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9. MINNESOTA

American Indian tribes with a rich cultural history lived in what is now the state of Minnesota for centuries before the 1800s. The territory of Minnesota became the 32nd state in 1858. Minnesota's Northwest Angle is the only part of the contiguous United States that lies above the 49th parallel, and is therefore the northernmost point of the contiguous U.S. This anomaly was caused by a surveying error in the map used to establish the 1783 Treaty of Paris, which caused American and British diplomats to agree on a U.S.-Canadian border that was geographically impossible (State of Minnesota, 2015) (Minnesota Historical Society, 2015a). Minnesota is bordered by Canada to the north, Wisconsin and Lake Superior to the east, North and South Dakota to the west, and Iowa to the south. This chapter provides details about the existing environment of Minnesota as it relates to the Proposed Action.

General facts about Minnesota are provided below:

- **State Nickname**: Land of 10,000 Lakes
- **Area:** 79,627 square miles; **U.S. Rank**: 12 (U.S. Census Bureau, 2010)
- **Capital:** St. Paul
- **Counties:** 87 (U.S. Census Bureau, 2015w)
- **2014 Estimated Population:** Over 5.4 million people; **U.S. Rank:** 21 (U.S. Census Bureau, 2015a)
- **Most Populated Cites:** Minneapolis, St. Paul, and Rochester (U.S. Census Bureau, 2015b)
- **Main Rivers:** Minnesota River and Mississippi River
- **Bordering Waterbodies:** Mississippi River, St. Croix River, Lake Superior, Lake of the Woods, Rainy River, Red River of the North, and Rainy Lake
- **Mountain Ranges:** Mesabi Range and Misquah Hills
- **Highest Point:** Eagle Mountain (2,301 ft) (USGS, 2016a)

9.1. AFFECTED ENVIRONMENT

9.1.1. Infrastructure

9.1.1.1. Definition of the Resource

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

Section 9.1.1.3 provides an overview of the traffic and transportation infrastructure in Minnesota, including road and rail networks and airport facilities. Minnesota 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 Minnesota are presented in more detail in Section 9.1.1.4. Section 9.1.1.5 describes specific public safety communications infrastructure and commercial telecommunications infrastructure in Minnesota. An overview of utilities in Minnesota, such as power, water, and sewer, are presented in Section 9.1.1.6.

9.1.1.2. Specific Regulatory Considerations

Multiple Minnesota laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 9.1.1-1 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 9.1.1-1: Relevant Minnesota Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Minnesota Statues (MS): Chapter 12 Emergency Management	Minnesota Department of Public Safety	Coordinates state agency preparedness for and emergency response to all types of natural and other emergencies and disasters, including discharges of oil and hazardous substances.
MS: Chapters 216-217 Utilities	Public Utilities Commission	Regulates gas and electric companies within the state, as well as some municipal utilities.
MS: Chapters 160-174A Transportation	Minnesota Department of Transportation (MnDOT)	Provides and oversees an integrated transportation system of aeronautics, highways, motor carriers, ports, public transit, railroads, and pipelines for the state.

9.1.1.3. Transportation

This section describes the traffic and transportation infrastructure in Minnesota, including specific information related to the road networks, airport facilities, rail networks, harbors, and ports (this PEIS defines “harbor” as a body of water deep enough to allow anchorage of a ship or boat). The movement of vehicles is commonly referred to as traffic, as well as the circulation along roads. Roadways in the state can range from multilane road networks with asphalt surfaces, to unpaved gravel or private roads. The information regarding existing transportation systems in Minnesota are based on a review of maps, aerial photography, and federal and state data sources.

The Minnesota Department of Transportation (MnDOT) 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 MnDOT is to “plan, build, operate, and maintain a safe, accessible, efficient and reliable multimodal transportation system that connects people to destinations and markets throughout the state, regionally and around the world” (MnDOT, 2015a).

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

- 138,767 miles of public roads (USDOT FHWA, 2014) and 12,961 bridges (USDOT FHWA, 2015a);
- 4,444 miles of rail network that includes passenger rail and freight (MnDOT, 2014);
- 464 aviation facilities, including airstrips and heliports (FAA, 2016);
- 12 harbors (MDNR, 2015a);
- 4 ports (MnDOT, 2016c); and
- 5 river ports (MnDOT, 2016c).

Road Networks

As identified in Figure 9.1.1-1, the major urban centers of the state from north to south are Duluth, Minneapolis-St. Paul, and Rochester (U.S. Census Bureau, 2013a). Minnesota has three 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 9.1.1-2 lists the interstates and their start/end points in Minnesota. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (USDOT FHWA, 2015b).

Table 9.1.1-2: Minnesota Interstates

Interstate	Southern or Western Terminus in MN	Northern or Eastern Terminus in MN
I-35	IA line near Emmons	MN-61 in Duluth
I-90	SD line near Manley	WI line in Dakota
I-94	ND line in Moorhead	WI line in Lakeland

In addition to the Interstate System, Minnesota 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 (USDOT FHWA, 2013). Figure 9.1.1-1 illustrates the major transportation networks, including roadways, in Minnesota. Section 9.1.8, Visual Resources, describes the National and State Scenic Byways found in Minnesota from an aesthetic perspective.

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

- Edge of the Wilderness: 47 miles in north-central Minnesota;
- Grand Rounds Scenic Byway: 52 miles around downtown Minneapolis;
- Great River Road: 2,069 miles in Arkansas, Illinois, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Tennessee, and Wisconsin;
- Gunflint Trail Scenic Byway: 57 miles in northeast Minnesota;
- Historic Bluff Country Scenic Byway: 88 miles in southeast Minnesota;
- Minnesota River Valley Scenic Byway: 287 miles across southern Minnesota;
- North Shore Scenic Drive: 154 miles in northeast Minnesota; and
- Paul Bunyan Scenic Byway: 54 miles in the center of Minnesota.

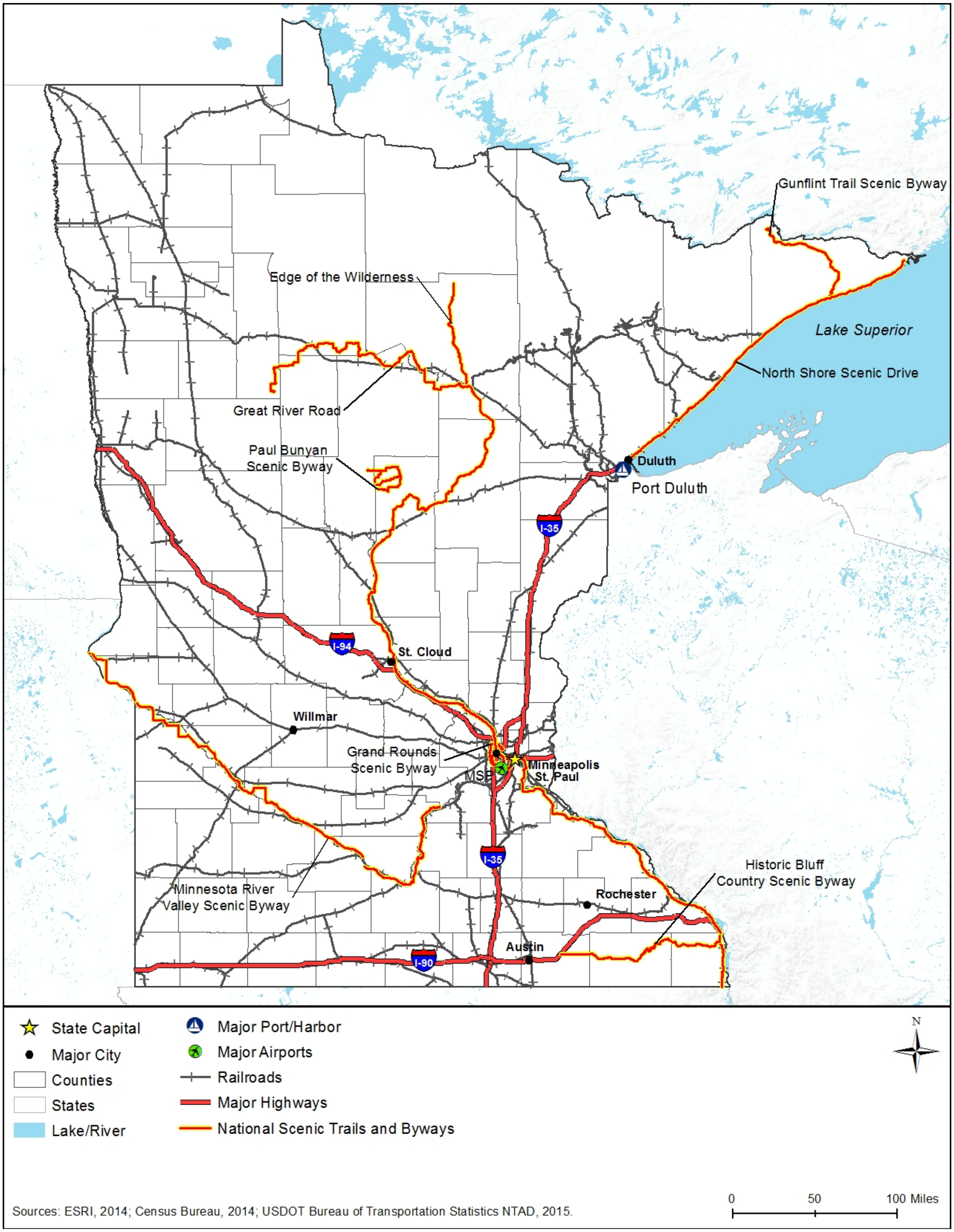

Figure 9.1.1-1: Minnesota Transportation Networks

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by MnDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Minnesota has 13 State Scenic Byways that crisscross the entire state (MnDOT, 2015b):[2]

- Apple Blossom Drive
- Avenue of Pines
- Glacial Ridge Trail
- Historic Highway 75 "King of Trails"
- Lady Slipper Scenic Byway
- Lake Country Scenic Byway
- Otter Trail Scenic Byway
- Saint Croix Scenic Byway
- Shooting Star Scenic Byway
- Skyline Parkway
- Superior National Forest Scenic Byway
- Veterans Evergreen Memorial Drive
- Waters of the Dancing Sky Scenic Byway

Airports

Air service to the state is provided by the Minneapolis-St. Paul International Airport (MSP), which is operated by the Metropolitan Airports Commission (MSP, 2015a). In 2015, MSP served 36,582,854 passengers and facilitated 404,612 aircraft operations (MSP, 2015b). In 2014, MSP moved 972,664,080 pounds of cargo (FAA, 2015b). MSP is the 16th busiest airport in the nation, in terms of the number of passengers served (MSP, 2015b). Figure 9.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 9.1.7, Airspace, provides greater detail on airports and airspace in Minnesota.

Rail Networks

Minnesota is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 9.1.1-1 illustrates the major transportation networks, including rail lines, in Minnesota.

Amtrak runs one line through Minnesota: the Empire Builder. The Empire Builder runs every day between Chicago and Portland or Seattle, making six stops in Minnesota. "Although Amtrak's presence in Minnesota is limited to the one daily train each way, both the Empire Builder and its patronage by Minnesota riders are standouts in Amtrak performance. The Twin Cities boasts the highest boardings and alightings of any station in the U.S. served by a single frequency" (MnDOT, 2010). Table 9.1.1-3 provides a complete list of Amtrak lines that run through Minnesota.

Table 9.1.1-3: Amtrak Train Routes Serving Minnesota

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Minnesota
Empire Builder	Chicago, IL	Portland, OR; Seattle, WA	46 hours	Winona, Red Wing, St. Paul, St. Cloud, Staples, Detroit Lakes

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

Metro Transit operates two commuter rail lines for the Twin Cities of Minneapolis and St. Paul: the Northstar Commuter and the METRO light-rail service. The Northstar commuter rail line provides service between downtown Minneapolis and its northwest suburbs (Metro Transit, 2015a). Northstar operates on 40 miles of track from Big Lake to Minneapolis, which takes about 49 minutes to complete the entire route with stops at seven stations (Metro Transit, 2015b). The METRO Blue Line is a light-rail service from downtown Minneapolis through MSP, and ending at the Mall of America to the southeast; it stops at 19 stations (Metro Transit, 2015c). It shares five stations with METRO's Green Line, which provides light-rail service between downtown Minneapolis and downtown St. Paul; it stops at 23 stations (Metro Transit, 2015d).

Four Class I freight railroad companies own and operate on 3,623 miles of track in Minnesota: BNSF Railway, Canadian National, Canadian Pacific, and Union Pacific (MnDOT, 2014). In addition, 1 Class II railroad owns and operates on 43 miles of track in the state, 14 Class III railroads on 727 miles of track, and 2 private railroads on 51 miles of track (MnDOT, 2014). In 2007, 38 percent of freight by volume moving through Minnesota traveled via freight rail (MnDOT, 2010).

Harbors and Ports

While most of Minnesota borders the states of Wisconsin, Iowa, South Dakota, North Dakota, and the province of Ontario, it does have some coastline along Lake Superior. In Minnesota, four ports (Lake Superior are Taconite Harbor, Silver Bay, Two Harbors, and Duluth/Superior) are situated on Lake Superior with numerous small boating and fishing marinas also found along its coastline. In addition, there are 5 river ports along the 222 miles of the Mississippi River (MnDOT, 2016a). The Port of Duluth/Superior is highest volume port on the Great Lakes, with facilities between the Superior Bay and the Saint Louis Bay, at the western end of St. Lawrence Seaway (Figure 9.1.1-1) (DuluthPort, 2015a). It is home to "20 privately owned and operated docks along 49 miles of waterfront" as well as "one general cargo terminal, a fueling depot, tug/barge services, and a shipyard with two dry docks" (DuluthPort, 2015b). The port is served by four class one railroads: Canadian National, Union Pacific, Canadian Pacific, and BNSF Railway (DuluthPort, 2015b). Its cargo includes cement, coal, iron ore, grain, coal, limestone, steel coil, and turbine components (DuluthPort, 2015c). In 2013, the Port of Duluth was responsible for the import of $53.7 million worth of cargo weighing 737,336 tons, and for the export of $439.7 million worth of cargo weighing 31,967,028 tons (U.S. Census Bureau, 2015x). There are 16 locks on the Great Lakes/St. Lawrence Seaway; the U.S. Corps of Engineers (USACE) manages 3 locks, including a 29-foot deep channel, and the Canadian government operates 13 locks (MnDOT, 2016b). The major ports in Minnesota along the Mississippi River are located in Minneapolis, St. Paul, Savage, Red Wing, and Winona. Over 4.4 million tons of grain were transported down the Mississippi River in 2012. The main commodities transported along this river system include agricultural products (e.g., corn, soybean, wheat); dry products (e.g., fertilizer, cement, sand/gravel, scrap metals); and liquid products (e.g., vegetable oils, petroleum) (MnDOT, 2016b).

9.1.1.4. Public Safety Services

Minnesota public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 9.1.1-4 presents Minnesota'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 9.1.9, Socioeconomics.

Table 9.1.1-4: Key Minnesota Indicators

Minnesota Indicators	
Estimated Population (2014)	5,457,173
Land Area (square miles) (2010)	79,626.74
Population Density (persons per sq. mile) (2010)	66.6
Municipal Governments (2013)	854

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

Table 9.1.1-5 presents Minnesota's public safety infrastructure, including fire and police stations. Table 9.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 9.1.1-5: Public Safety Infrastructure in Minnesota by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	917
Law Enforcement Agencies [b]	448
Fire Departments [c]	726

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

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

Table 9.1.1-6: First Responder Personnel in Minnesota by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	1,380
Fire and Rescue Personnel [b]	15,683
Law Enforcement Personnel [c]	15,458
Emergency Medical Technicians and Paramedics [d e]	4,380

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

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

9.1.1.4.1. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Minnesota; therefore, the following information and data are combined from a variety of sources, as referenced.

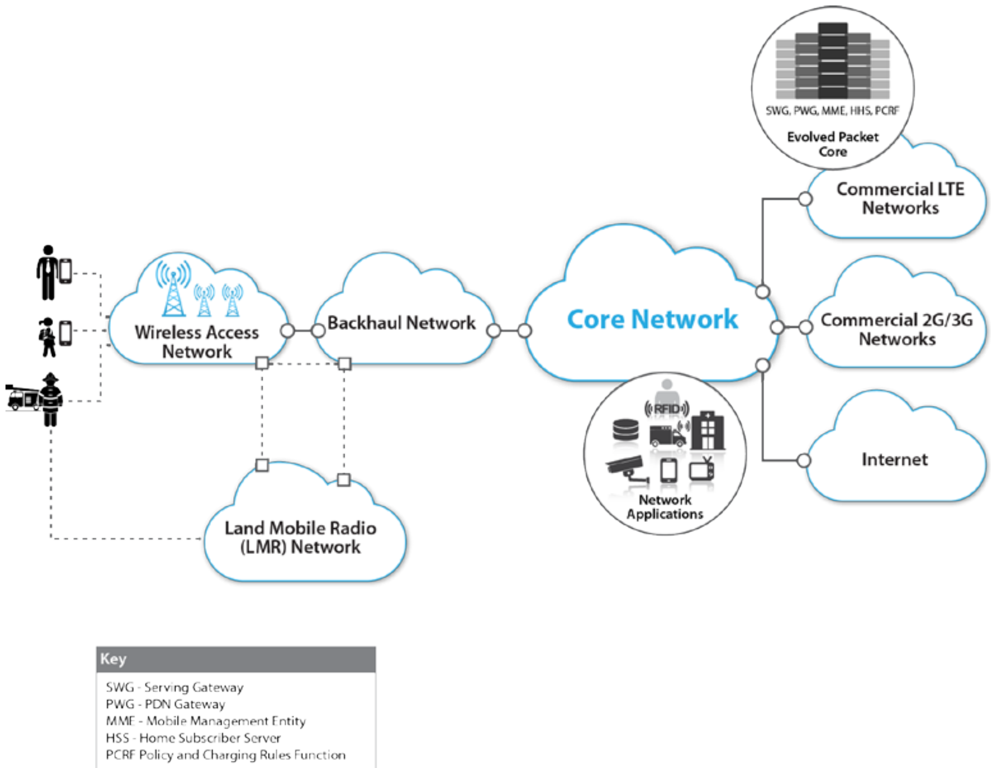

Figure 9.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

Communications throughout the state are based on a variety of publicly- and commercially-owned technologies, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems providing voice, data, and video services.

Figure 9.1.1-2 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 LTE evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications.

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would 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 scale, which is national (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 Minnesota.

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 Program (PSCR) – Boulder Laboratories, in 2015, prepared a locations-based services (LBS) research and development “roadmap” to examine the current state of location-based technologies. The program also forecasts the evolution of LBS capabilities and gaps, and identify potential research and development opportunities that would improve the public safety community’s use of LBS within operational settings. This is the first of several technology roadmaps that PSCR plans to develop over the next few years (PSCR, 2015).

Minnesota initiated its statewide public safety network project, Allied Radio Matrix Emergency Response (ARMER), system in 2004 to create an interoperable 800 MHz digital P25 network across the state. Like most states, Minnesota’s public safety legacy systems were composed of a variety of frequencies, system vendors, and technologies which inhibited public safety interoperability (DPS, 2015). Today, 96 percent of its counties participate in the ARMER network and Minnesota enjoys broad adoption by counties for the state ARMER networks (DPS, 2015). In addition to public safety agency adoption of the system, all state agencies, tribal governments, and non-governmental public safety use the 800 MHz system (RadioReference.com, 2015a).

Administration of the AMER system is coordinated across the state’s Department of Public Safety (DPS) and the Statewide Emergency Management Communications Board (SECB) with MnDOT owning the backbone network (DPS, 2015).

Statewide/Multi-County Public Safety Networks

ARMER provides statewide LMR coverage in Minnesota, and covers 85 of the state's 88 counties, with the other five counties transitioning to the ARMER network (as of October 2015). Figure 9.1.1-3 depicts the network as of October 2015 (DPS, 2015). This 96 percent adoption rate across counties reflects Minnesota's desire to provide near-universal 800 MHz interoperability within the state. The Minnesota State Patrol (MSP) was reliant on using legacy analog Very High Frequency (VHF)[3] and Ultra High Frequency (UHF)[4] systems for its communications needs has now transitioned to the digital P25 ARMER system (RadioReference.com, 2015b). Minnesota's hospital and EMS communications continue to operate on a VHF channels for EMS medical and air transport and for hospital paging/dispatch (RadioReference.com, 2015a). There are 9 VHF channels dedicated to providing an overlay network on the state's ARMER network in order to support interoperability in the state on 109 tower sites (RadioReference.com, 2015c).

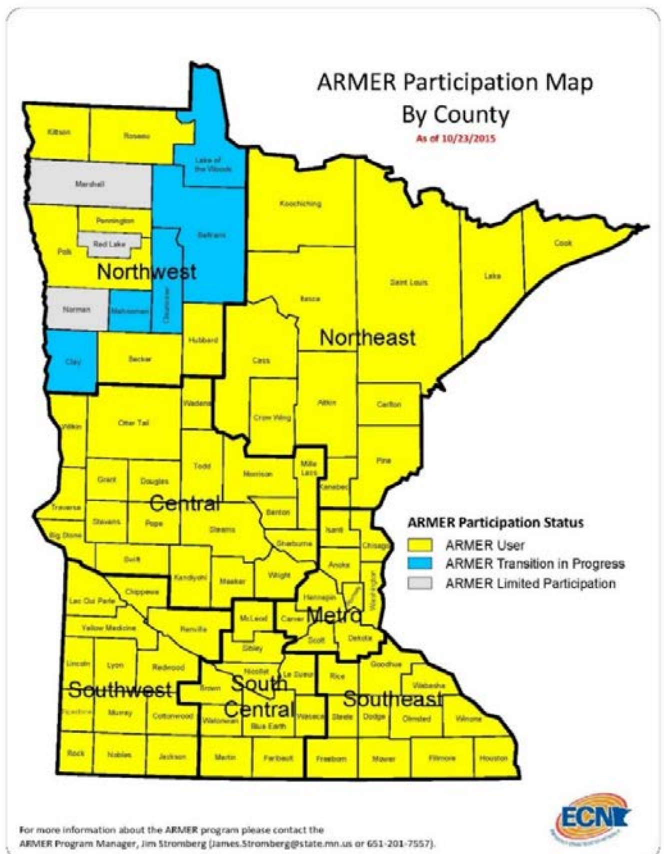

Figure 9.1.1-3: AMER County Participation Map

Source: (DPS, 2015)

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

County/City Public Safety Networks

Although the state has standardized on digital P25 technology in Minnesota, the city and county LMR system landscape at the local level remains diverse due to the ongoing use of VHF and UHF by many counties and cities. These systems are used to create backup channel capacity and to meet specific local needs such as police or fire local dispatch (RadioReference.com, 2015d). However, the clear trend is for counties and cities to reduce their dependency on older analog VHF and UHF systems and move toward digital P25 and 800 MHz.

Minnesota's ARMER digital P25 network has seen very high penetration across public safety county departments, with 800 MHz becoming the state standard system. Because of the broad adoption of the state's digital P25 800 MHz system by counties, there are not a large number of public safety standalone P25 systems in Minnesota. The city of Eden Prairie City Services network is the only additional public safety P25 system in the state currently (in addition to the ARMER system) (Project 25.org, 2015).

The Eden Prairie City Services network is a standalone digital network operating at 800 MHz, the same LMR frequency used by the ARMER network as Table 9.1.1-7 indicates (Project 25.org, 2015). The Eden Prairie system serves public safety and municipal services departments in the City of Eden Prairie, which is located at the edge of southwest Minneapolis in Hennepin County. This system supports all of the city public safety talk groups (police, fire, and interoperability), the municipal public works talkgroups, citywide talkgroups, and city public schools communications (RadioReference.com, 2015e).

Table 9.1.1-7: Minnesota Public Safety P25 Networks

Minnesota P25 Public Safety Systems	Frequency Band
Allied Radio Matrix Emergency Response (ARMER)	800 MHz
Eden Prairie City Services	800 MHz

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

In Hennepin County the preponderance of public safety (police, fire, and EMS, communications and dispatch) occurs on the AMER network; this includes the city of Minneapolis. However in the county, Hennepin Common (HENCOMMON) exists. This network leverages a collection of LMR repeaters which can interoperate with the ARMER digital system and also provides secondary and backup communications (RadioReference.com, 2015f). In addition to the Hennepin county public safety agencies mentioned above, the network also supports the city public safety communications on VHF for the cities of: Bloomington (fire pagers/dispatch), Eden Prairie (fire paging/dispatch), Eden Prairie (fire/EMS dispatch), city of Minnetonka (fire paging/dispatch), Plymouth (police), and of St. Louis Park (police) (RadioReference.com, 2015f).

In Ramsey County, the second largest county in the state after Hennepin County, an increasing number of public safety users have migrated to the state's ARMER system, although VHF and UHF systems in the county continue to be used by police, fire, and EMS departments (RadioReference.com, 2015f).

In Dakota County, the third largest county in the state, county public safety departments have migrated to the state's P25 800 MHz AMER system (RadioReference.com, 2015g). VHF channels remain available for fire paging/dispatch in the county, and cities in the county continue to use UHF channels for municipal services (RadioReference.com, 2015g).

Public Safety Answering Points (PSAP)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 135 PSAPs serving Minnesota's 87 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Minnesota'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 Minnesota'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

Minnesota'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 9.1.1-8 presents the number of providers of switched access[5] lines, Internet access,[6] and mobile wireless services including coverage.

Table 9.1.1-8: Telecommunications Access Providers and Coverage in Minnesota as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines	180	98.1% of households
Internet access	105	57% of households
Mobile Wireless	7	97% of population

[a] Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of service providers was reported by the FCC as of December 31, 2013 in Table 17 in "Local Telephone Competition: Status as of December 31, 2013" as the total of ILEC and non-ILEC providers (FCC, 2014b).
[b] Internet access providers are presented in Table 21 in "Internet Access Services: Status as of December 31, 2013" by technology provided; number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers (FCC, 2014a).
[c] Mobile wireless provider data is provided by the FCC in the sources identified. However, NTIA's National Broadband Map provides newer data, so FirstNet is using NTIA's GIS-based data from the National Broadband Map instead of the data reported by the FCC. The process for retrieving the National Broadband Map data is explained in detail in a subsequent footnote in Section 9.1.1.5, Last Mile Fiber Assets.

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

Table 9.1.1-9 shows the wireless providers in Minnesota along with their geographic coverage. The following four maps: Figure 9.1.1-4 to Figure 9.1.1-7 show the combined coverage for the top two providers; Sprint and T-Mobile's coverage; MVTV Wireless's coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.[7]

[5] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services." (FCC, 2013)
[6] Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.
[7] 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 "[State Name] Other Fiber Providers." All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "[State Name] Other Wireless Providers." Providers under 5% were denoted in their respective tables.

Table 9.1.1-9: Wireless Telecommunications Coverage by Providers in Minnesota

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	96.20%
Verizon Wireless	83.96%
Sprint	46.59%
MVTV Wireless	13.39%
T-Mobile	12.53%

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

Other: Provider with less than 5 percent coverage area. Providers include: Radio Link Internet; Xtratyme Technologies, Inc.; Arvig Communication Systems; Info Link Wireless, Inc.; Broadband Corp; Blue Sky Broadband; Wikstrom Telephone Company; Access Broadband; CitEscape High Speed Internet; InvisiMax, Inc.; Genesis Wireless; JAB Broadband; Starnet; Wisper Wireless; Cloudnet Inc.; Nextera Wireless; Federated Telephone Cooperative; RRCNet; RRT Ag Wireless; Duet Wireless; Mille Lacs Energy Cooperative; HBC; Sioux Valley Wireless; Bradco-Wisp, Inc.; NU-Telecom; Cooperative Light & Power; Minnesota Wifi; Moose-Tec; Northfield Wifi; HTC; NetPoint; SynKro Southwest; Jaguar Communications; Palmer Wireless; Nates Net; Benton Cooperative Telephone Company; AirLink Broadband; 702 Communications; LTD Broadband LLC; Gardonville Telephone; Albany Telephone; A Better Wireless; Enterpoint Wireless; Harmony Telephone Company; Fallsnet; AcenTek; airFiber; Christensen Communications Company; Farmers Mutual Telephone Company; RC Technologies; IGL TeleConnect; Sheehan Gas; CTC Skywave; USI Wireless; Otter Tail Telecom; Chaska.net.

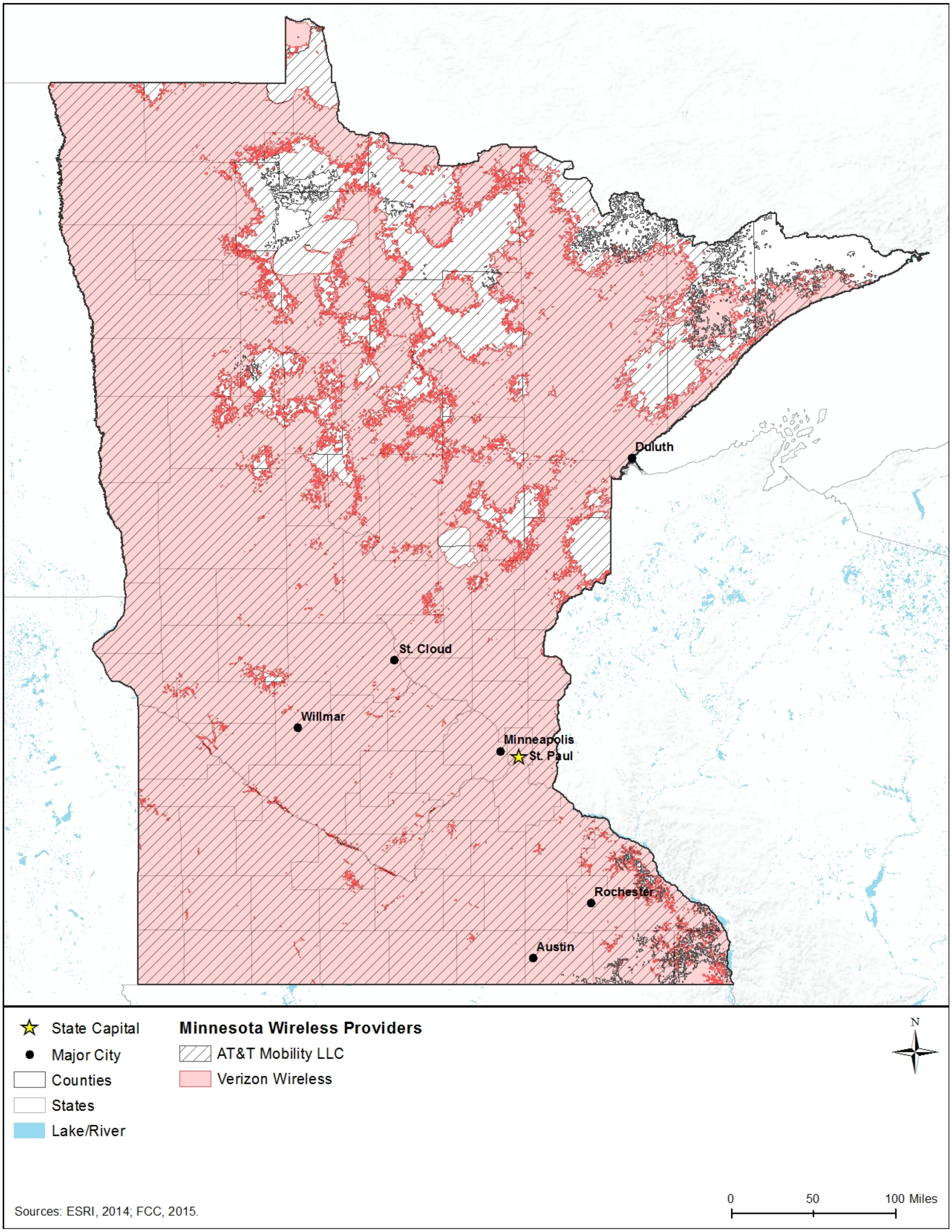

Figure 9.1.1-4: Top Wireless Providers Availability in Minnesota

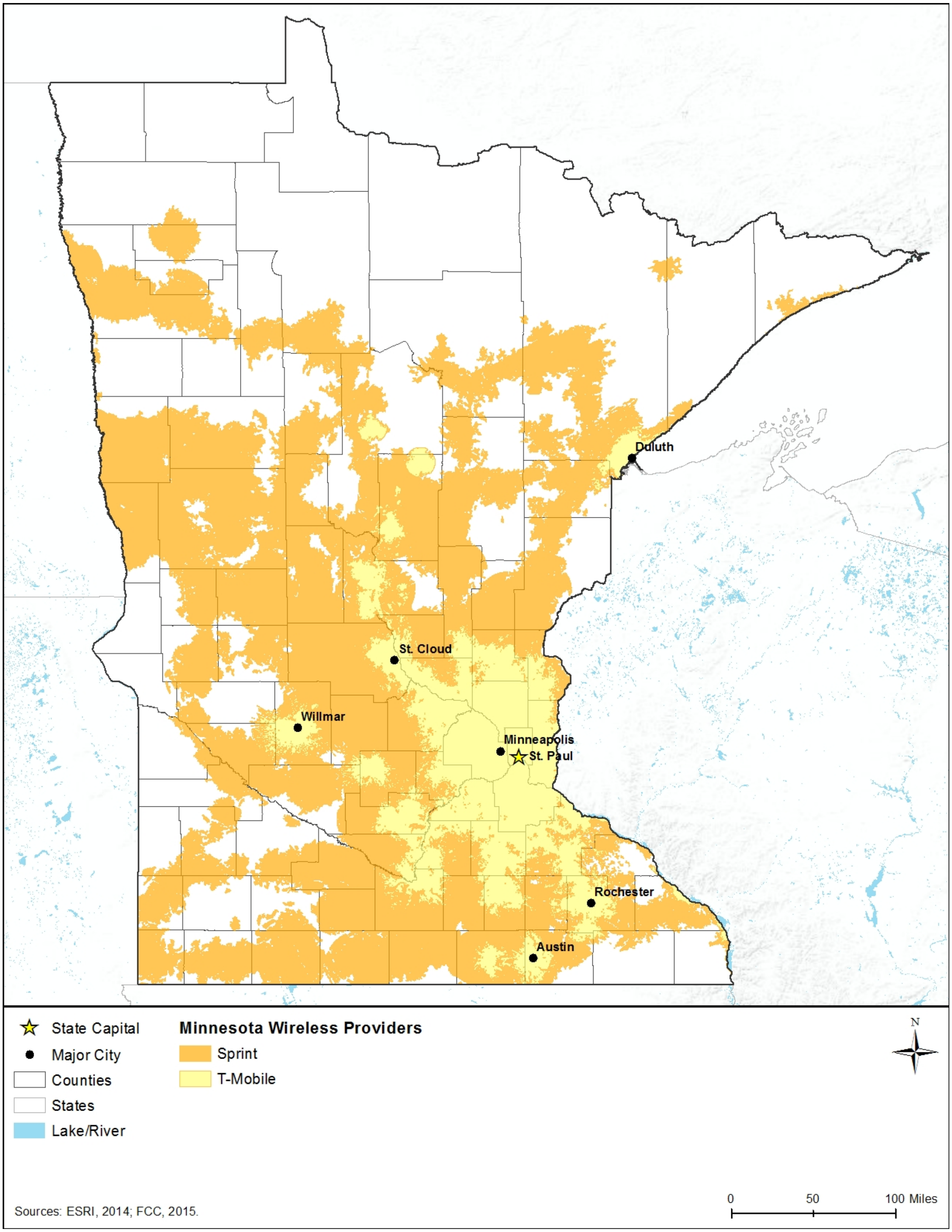

Figure 9.1.1-5: Sprint and T-Mobile Wireless Availability in Minnesota

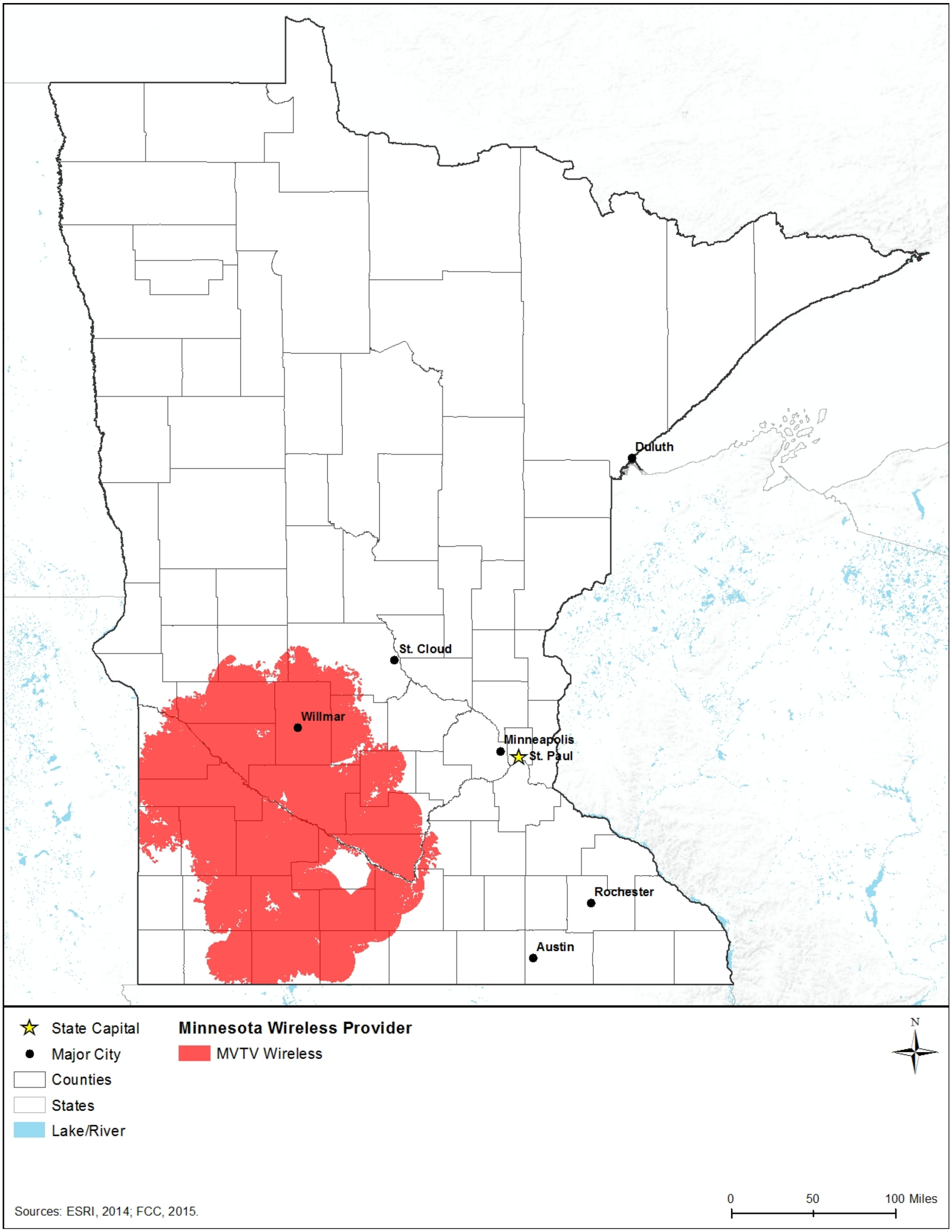

Figure 9.1.1-6: MVTV Wireless Availability in Minnesota

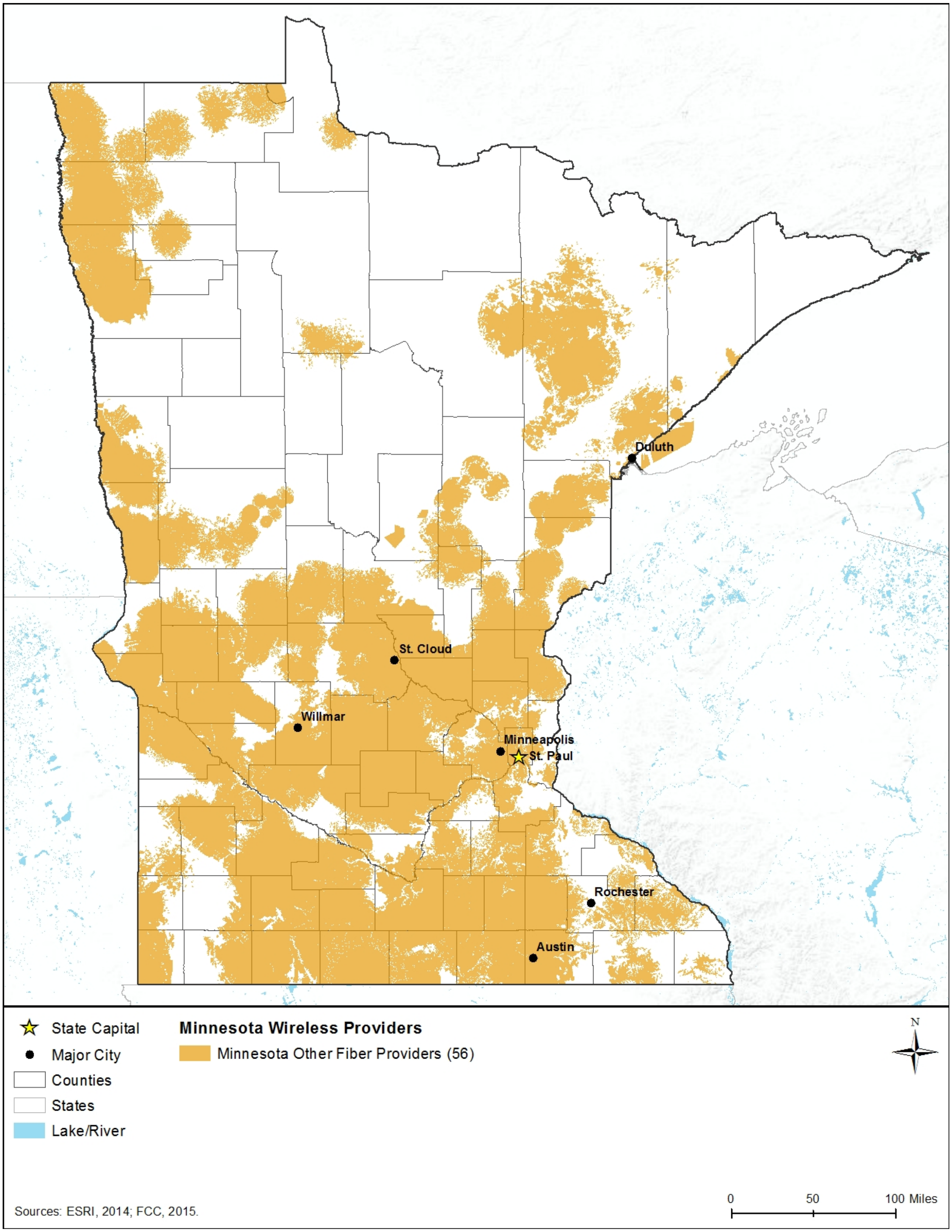

Figure 9.1.1-7: Other Provider Wireless Availability in Minnesota

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. Figure 9.1.1-8 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 9.1.1-8: Types of Towers

Telecommunications tower infrastructure can be found throughout Minnesota, although tower infrastructure is concentrated in the higher and more densely populated areas of Minnesota: Minneapolis/St. Paul, Duluth, St. Cloud, and Rochester. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016a).[8] Table 9.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in

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

Minnesota by tower type, and Figure 9.1.1-9 presents the location of those structures, as of June 2016.

Table 9.1.1-10: Number of Commercial Towers in Minnesota by Type

Constructed[a] Towers[b]		**Constructed Monopole Towers**	
100ft and over	586	100ft and over	2
75ft – 100ft	631	75ft – 100ft	1
50ft – 75ft	339	50ft – 75ft	18
25ft – 50ft	195	25ft – 50ft	42
25ft and below	84	25ft and below	20
Subtotal	**1,835**	**Subtotal**	**83**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	90	100ft and over	3
75ft – 100ft	81	75ft – 100ft	0
50ft – 75ft	26	50ft – 75ft	1
25ft – 50ft	3	25ft – 50ft	7
25ft and below	0	25ft and below	1
Subtotal	**200**	**Subtotal**	**12**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	27	100ft and over	3
75ft – 100ft	55	75ft – 100ft	2
50ft – 75ft	28	50ft – 75ft	0
25ft – 50ft	13	25ft – 50ft	0
25ft and below	17	25ft and below	0
Subtotal	**140**	**Subtotal**	**5**
Constructed Tanks[d]			
Tanks	24		
Subtotal	**24**		
Total All Tower Structures		**2,299**	

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).

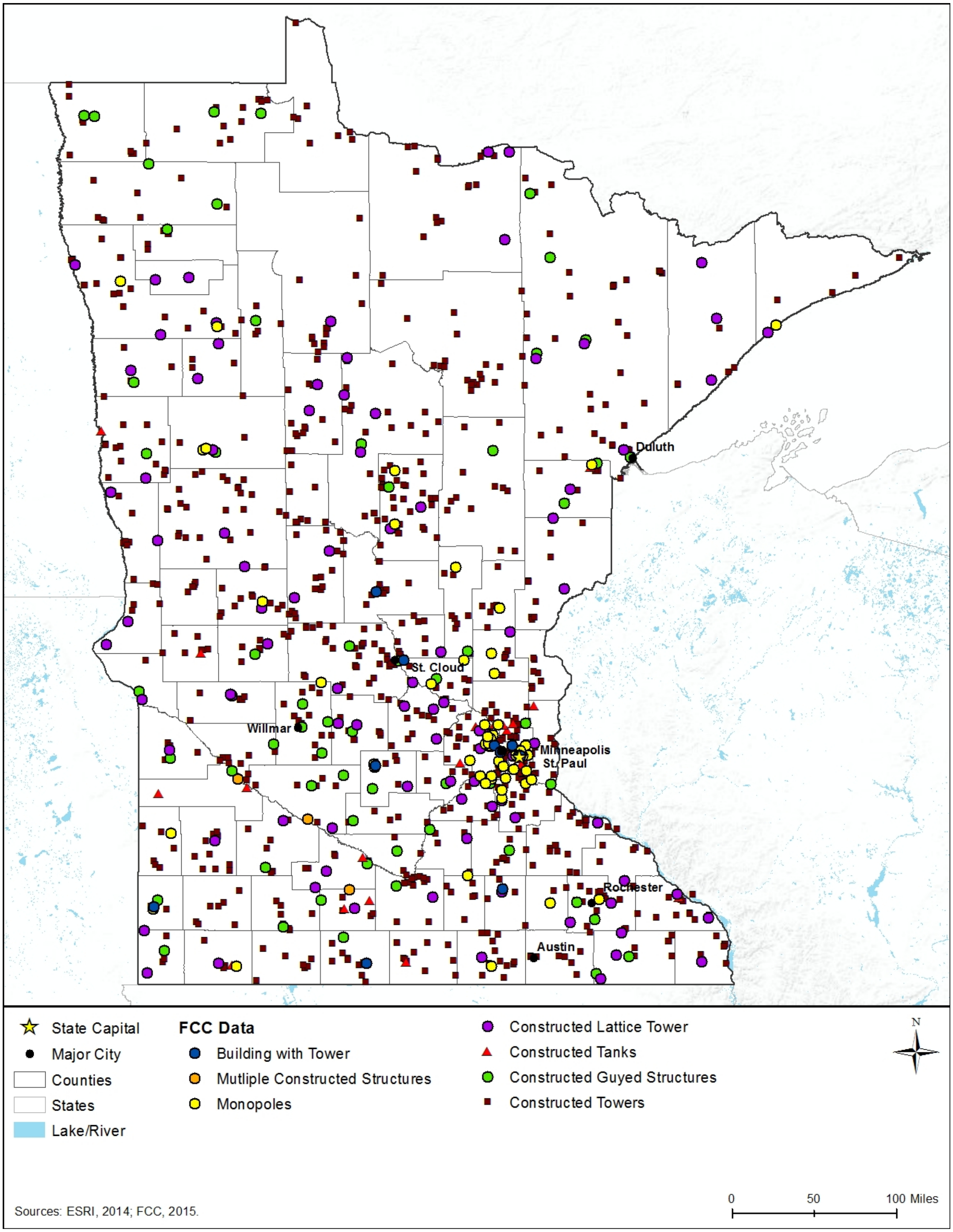

Figure 9.1.1-9: FCC Tower Structure Locations in Minnesota

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way (ROWs). A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 9.1.1-10. 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)

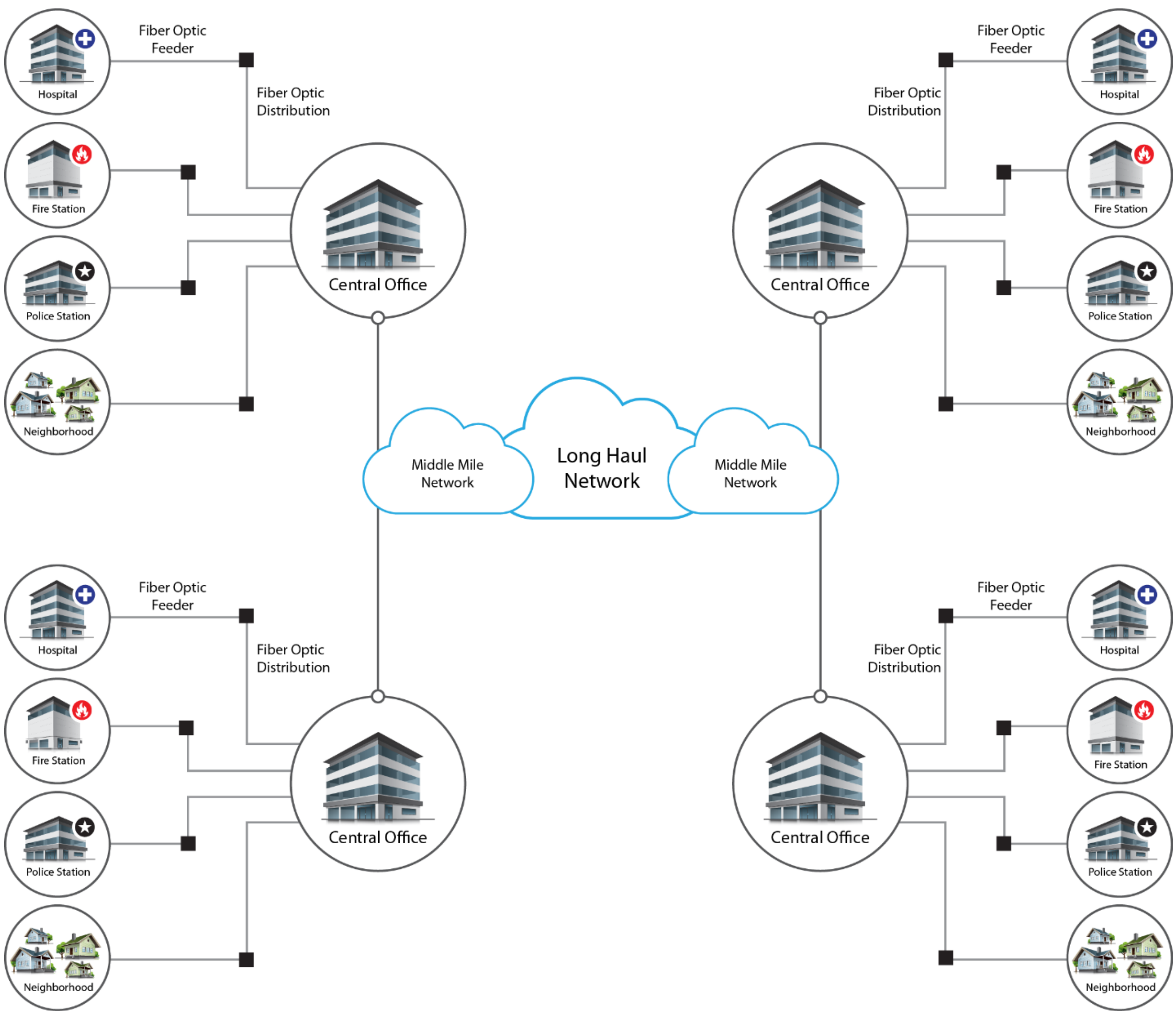

Figure 9.1.1-10: Typical Fiber Optic Network in Minnesota

Source: (ITU-T, 2012)

Prepared by: Booz Allen Hamilton

Last Mile Fiber Assets

In Minnesota, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Minnesota there are 79 fiber providers that offer service in the state, as listed in Table 9.1.1-11. Figure 9.1.1-11 shows coverage for Frontier Communications of Minnesota, CenturyLink, and Arvig Communication Systems, and Figure 9.1.1-12 shows coverage for other providers with less than 5 percent coverage area, respectively.

Table 9.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
Frontier Communications of Minnesota	10.20%
CenturyLink	9.07%
Arvig Communication Systems	5.27%
Other[a]	29.89%

Source: (NTIA, 2014)

[a]Other: Provider with less than 5 percent coverage area. Providers include: Garden Valley Telephone Company; Paul Bunyan Telephone; Charter Communications, Inc.; Wikstrom Telephone Company; Midcontinent Communications; NU-Telecom; EVCOMM; Comcast; TDS Telecom; Mediacom; MegaPath Corporation; Federated Telephone Cooperative; Runestone Telephone Association; Jaguar Communications; Farmers Mutual Telephone Company; CTC Telecom; Windstream Lakedale, Inc.; AcenTek; Hanson Communications; West Central Telephone Association; Hickory Tech Corporation; Red River Rural Telephone Association; Southern Cablevision; Park Region Mutual Telephone Company; HTC; Benton Cooperative Telephone Company; Woodstock Telephone Company; Interstate Telecommunications Cooperative, Inc.; Gardonville Telephone; Minnesota Valley Telephone Company; KM Telecom; SCI Broadband; Sjoberg's Inc.; Johnson Telephone Co.; Rothsay Telephone Company Inc.; Southwest Minnesota Broadband Services; Albany Mutual Telephone Association; Winnebago Cooperative Telecom Association; Integra Telecom; Christensen Communications Company; ACS Communications; Lake Connections; HBC; Alliance Communications Cooperative, Inc.; Sytek Communications; Lonsdale Telephone Company, Inc.; Lismore Cooperative Telephone Company; Winthrop Telephone; Manchester-Hartland Telephone Company; Emily Cooperative Telephone Company; Level 3 Communications, LLC; WOW!; Wolverton Telephone Company; Spring Grove Communications; Arrowhead Electric Cooperative, Inc.; Polar Communications Mutual Aid Corporation; Harmony Telephone Company; Mabel Cooperative Telephone Company; Benton Cablevision, Inc.; Valley Telephone Company; Crosslake Communications; TW Telecom of Minnesota LLC; Cable ONE; Otter Tail Telecom; 702 Communications; IdeaOne Telecom; St. Olaf College; FiberNet Monticello; Windomnet; Bagley Public Utilities; FTTH Communications; Barnesville Municipal Telephone; MVTV Wireless; Milaca Local Link; US Internet; Cogent Communications, Inc.

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.

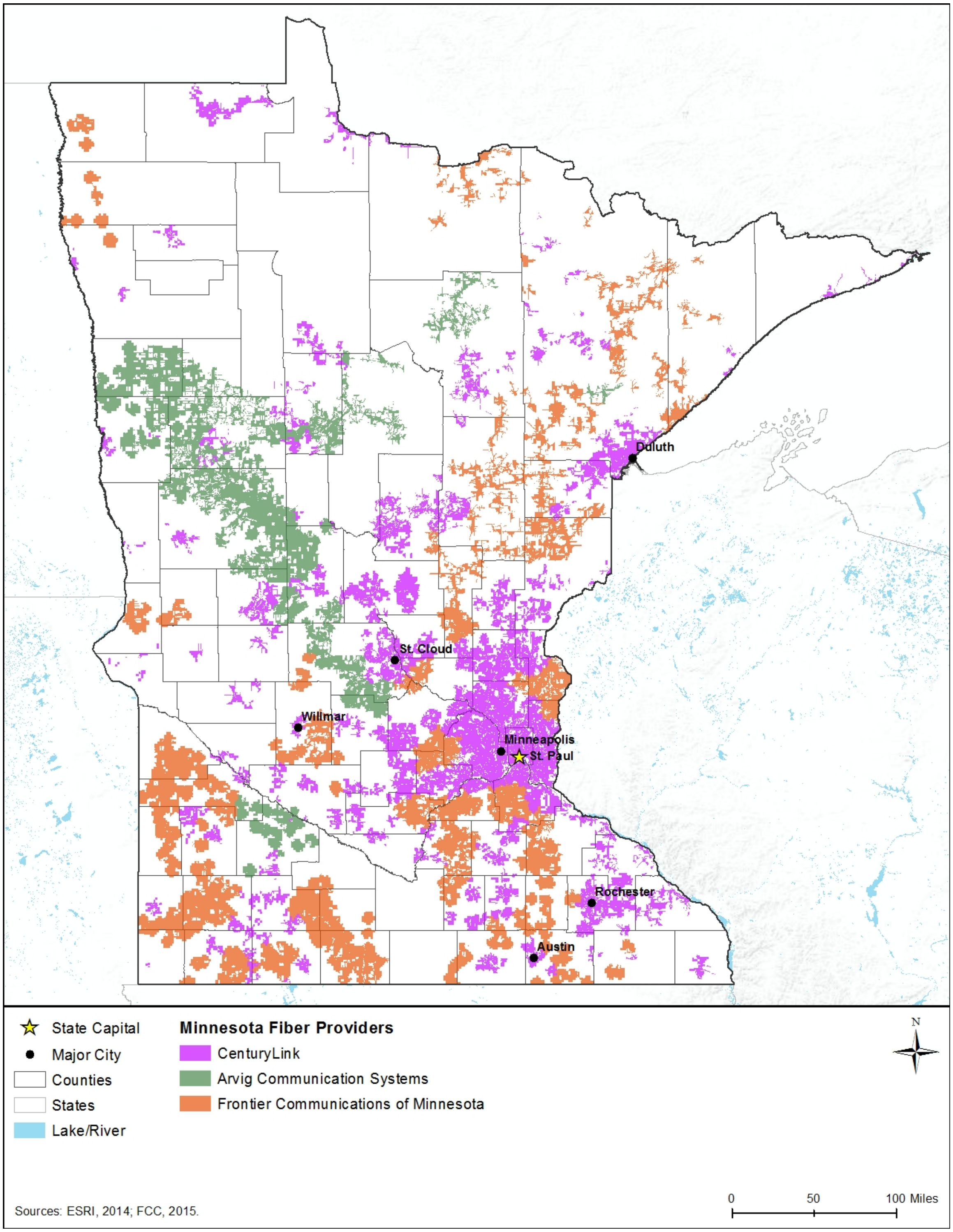

Figure 9.1.1-11: Fiber Availability in Minnesota for CenturyLink, Arvig Communications Systems, and Frontier Communications of Minnesota

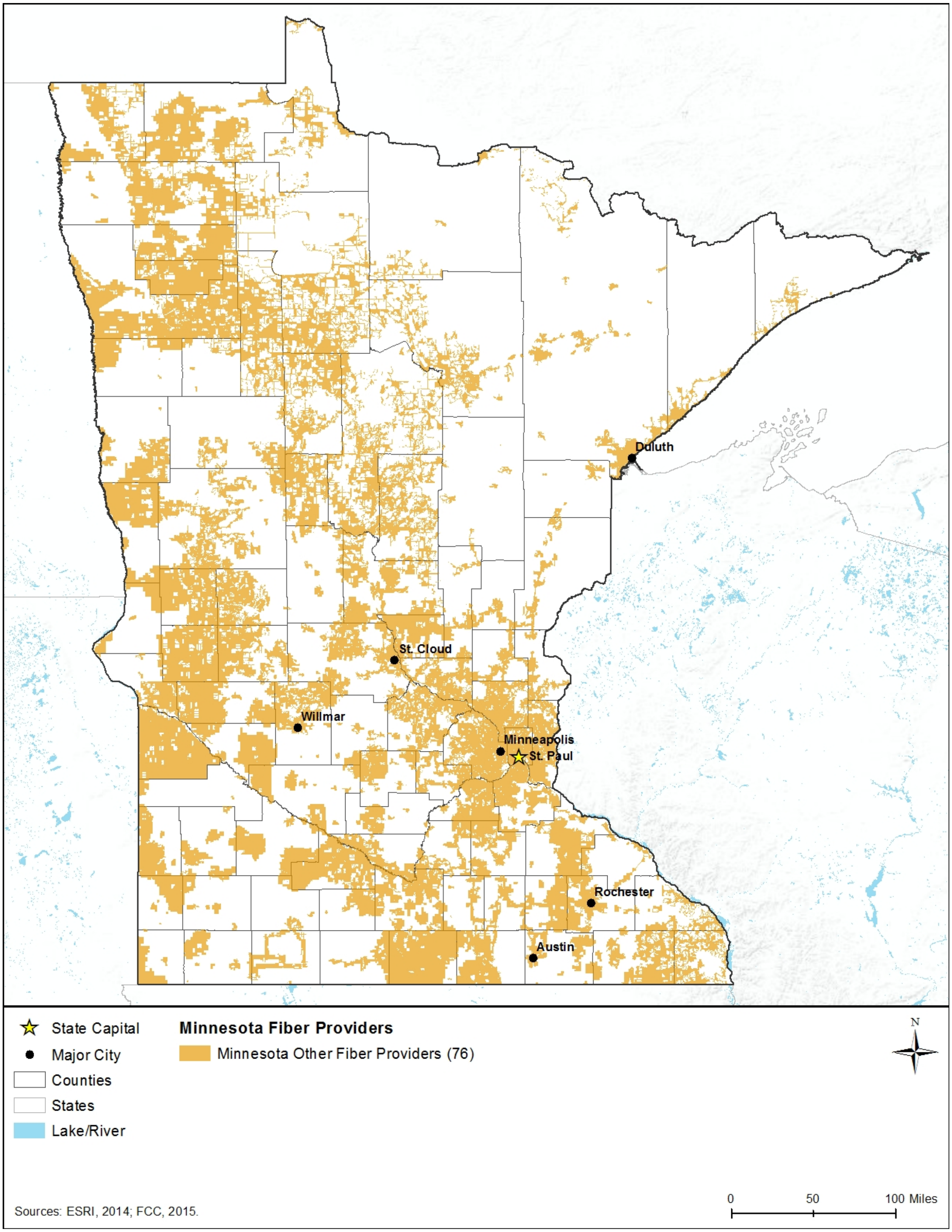

Figure 9.1.1-12: Other Provider's Fiber Availability in Minnesota

9.1.1.5. 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 9.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Minnesota's investor owned electric utilities have some aspects of their service regulated by the Minnesota Public Utilities Commission (PUC), including the rates that are charged to utility customers and the quality of the service that is provided to them. The PUC also approves the development and new energy providing facilities (PUC, 2015a). There are four utilities within their jurisdiction: Minnesota Power, Northwestern Wisconsin Electric, Otter Tail Power Company and Xcel Energy. Electric cooperatives are regulated by member-elected directors, while municipal electric utilities are governed by their city council or regulatory body. There are 45 electric cooperatives and 125 municipal electric providers in the state (PUC, 2015b).

Most of Minnesota's electricity comes from facilities using one of two sources for generation; coal or nuclear power (EIA, 2015a). In 2014, coal fueled electric generation facilities produced 27,956,679 megawatthours[9] of electricity. This accounted for 49 percent of the total 56,998,330 megawatthours generated in Minnesota that year. Nuclear power facilities generated 12,707,166 megawatthours (22 percent), while wind power facilities generated 9,961,019 megawatthours (17 percent) of electricity in 2014. "Minnesota ranked seventh in the nation in net electricity generation from wind energy in 2013" (EIA, 2016). Additional significant sources of electricity included natural gas (about 7 percent) and biomass (3 percent) (EIA, 2015b). Regarding the consumption of this electricity, the largest portion of it went to Minnesota's industrial sector. In 2013, the industrial sector used 34.2 percent of its power, compared to the 24.1 percent used by the transportation sector, the 22.4 percent used by the residential sector, and the 22.4 percent used by the commercial sector (EIA, 2016).

Water

Ensuring the quality and safety of Minnesota's drinking water quality is the responsibility of the state's Drinking Water Protection Program, which is run by the Minnesota Department of Health (MDH) (MDH, 2015h). Under the provisions of the Safe Water Drinking Act (SDWA), the MDH regulates all of the approximately 6,900 public water in the state. About 960 of these are considered community water systems, while the other 6,000 are non-community systems (MDH, 2015b). "Community public water supplies serve at least 25 persons or 15 service connections year-round, which includes municipalities, manufactured mobile home parks, etc" (MDH, 2015c). Non-community water supplies are either transient or non-transient. Transient non-community water supplies "serve at least 25 people at least 60 days of the year, but do not serve the same 25 people over six months of the year," and include restaurants or campgrounds (MDH,

[9] One megawatthour is defined as one thousand kilowatt-hours or 1million watt-hours'; where one watthour is "the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour." (EIA, 2015d)

2015d). Non-transient non-community water supplies "serve at least 25 of the same people over six months of the year," and include schools and offices (MDH, 2015e).

Amendments to the SWDA made in 1996 mandated that states "produce source water assessments for all their public water systems and to make the results of those assessments available to the public." These source water assessments describe the water's source and "how susceptible that source may be to contamination" (MDH, 2015f). Water suppliers are also required to send Consumer Confidence Reports (CCRs) to their customers each year, outlining much of the information included in source water assessments; namely the source of water and a list of any contaminants found in it (MDH, 2015g). *The Annual Drinking Water Report for 2014* reported relatively few failures in compliance with contaminant regulations; of the approximately 6,900 water supplies in the state, there were 210 violations of the bacterial contamination rule, 14 violations of the nitrate/nitrite rule, 5 violations of the arsenic rule, 10 violations of the radioactive elements rule, 2 violations of the disinfection by-products rule and 36 violations of the lead and copper rules. These were spread between community and non-community water supplies. There were no systems that exceed the contamination limits set for pesticides, industrial contaminants, or inorganic chemicals (MDH, 2015b).

Wastewater

The control, treatment, and disposal of Minnesota's wastewater is the responsibility of the Minnesota Pollution Control Agency (MPCA), in addition to also handling the certification of wastewater facility operators and offer training programs to educate them (MPCA, 2015a). Additionally, MPCA issues National Pollutant Discharge Elimination System (NPDES) permits that "regulate wastewater discharges to lakes, streams, wetlands and other surface waters" (MPCA, 2015b). These permits often include requirements for monitoring and facility management, as well as limiting the amounts of a given pollutant being discharged. MPCA also issues State Disposal System (SDS) permits to regulate the "construction and operation of wastewater disposal systems, including land treatment systems." These permits are usually bundled together when used by industrial facilities as combined NPDES/SDS permits as a means of consolidation. Non-industrial facilities can still receive their permits separately (MPCA, 2015b). MPCA offers individual permits to regulate singular discharger with specific needs, as well as general permits to cover operations at multiple similar facilities (MPCA, 2015b) (MPCA, 2015c). As stated, MPCA certifies wastewater treatment facility operators to ensure their competence. An operator are defined as "a person who has 'direct responsibility' for the operation of, or operates, a wastewater treatment facility." These certifications must be renewed every three years (MPCA, 2015d).

Solid Waste Management

Minnesota's solid waste is also managed by the MPCA, through the enacting of state policy and county level planning "developed for solid waste reduction, recycling, and the management of yard wastes, problem materials, and construction and demolition wastes" (MPCA, 2015e). According to the 2011 Solid Waste Policy Report, Minnesota generated 5,630,339 tons of mixed municipal wastes in 2010; more than half (57 percent) of this came from seven counties in

Minnesota's more metropolitan areas surrounding Minneapolis, while the remaining 43 percent was generated in the rest of the state (MPCA, 2015f). 1,958,703 tons of the 5,630,339 tons generated (35 percent) were sent to one of the state's 21 mixed municipal landfills (MPCA, 2015f). A further 1,036,342 tons (18 percent) was sent to waste-to-energy facilities, while the rest was handled through composting or on-site disposal. About two percent of the total mixed municipal waste was considered a problem material that cannot be recycled; these items include "vehicle batteries, tires, major appliances, motor oil, and oil filters" In 2010, 2,430,048 tons (43 percent) of mixed municipal waste was recycled. "When credits for yard waste and waste reduction efforts are included, the recycling rate increases to 50.3 percent" (MPCA, 2015f). An unfinished draft version of the 2015 Solid Waste Policy Report lists that in 2013, a total of 5,789,647 tons of mixed municipal waste was collected; with 28 percent landfilled, 21 percent sent to waste-to-energy facilities, and 41 percent recycled (MPCA, 2015g).

9.1.2. Soils

9.1.2.1. 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.

9.1.2.2. 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 Relevant Federal Laws and Executive Orders. A list of applicable state laws and regulations is included in Table 9.1.2-1 below.

Table 9.1.2-1: Relevant Minnesota Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
National Pollutant Discharge Elimination System (NPDES)[a]	MPCA	Erosion and sediment control best management practices (BMPs) are required as part of the Construction Stormwater General Permit under the NPDES program.

9.1.2.3. Environmental Setting

Minnesota is composed of three Land Resource Region (LRR),[10] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Central Feed Grains and Livestock Region,
- Northern Great Plains Spring Wheat Region, and
- Northern Lake States Forest and Forage Region.

Within and among Minnesota's three LRRs are 15 Major Land Resource Areas (MLRA),[11] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Minnesota's MLRAs are presented in Figure 9.1.2-1 and Table 9.1.2-2.

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[12] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[13] 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[14] (discussed further in the subsections below).

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[10] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[11] 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).
[12] The flora and fauna of a region.
[13] 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).
[14] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009).

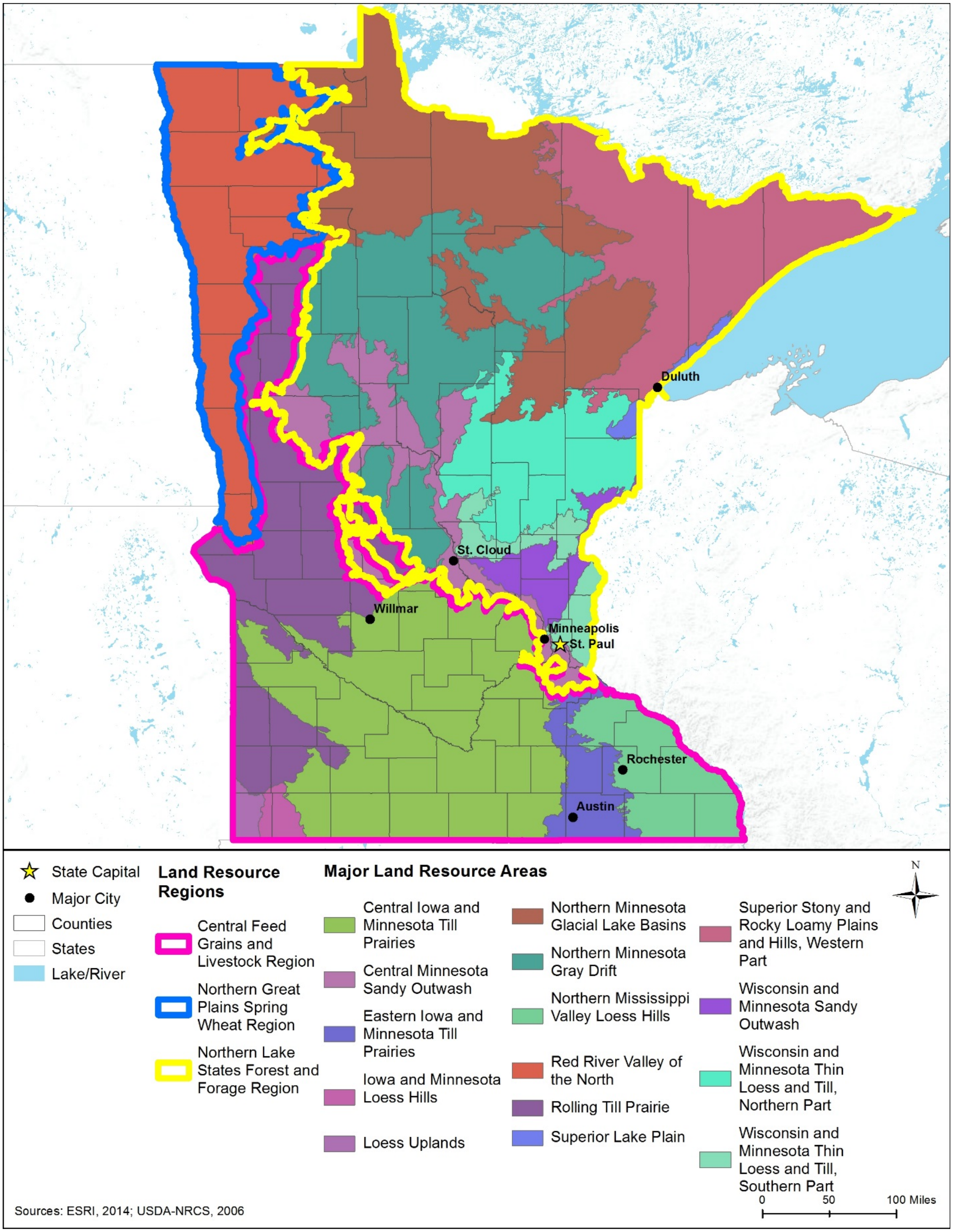

Figure 9.1.2-1: Locations of Major Land Resource Areas in Minnesota

Table 9.1.2-2: Characteristics of Major Land Resource Areas in Minnesota

MLRA Name	Region of State	Soil Characteristics
Central Iowa and Minnesota Till Prairies	Southern Minnesota	Mollisols[a] are the dominant soil order, with Alfisols[b] and Inceptisols[c] less so. These soils range from very poorly drained to well drained, and are typically very deep and loamy[d].
Central Minnesota Sandy Outwash	Central Minnesota	Histosols[e] and Mollisols are the dominant soil orders. These soils range from very poorly drained to excessively drained.
Eastern Iowa and Minnesota Till Prairies	Southeastern Minnesota	Alfisols and Mollisols are the dominant soil orders. These loamy and typically very deep soils range from very poorly drained to well drained.
Iowa and Minnesota Loess Hills	Southwestern Minnesota	Mollisols is the dominant soil order.
Loess Uplands	Southwestern Minnesota	Mollisols is the dominant soil order. These clayey or loamy soils are moderately well drained to somewhat excessively drained and range from very deep to shallow.
Northern Minnesota Glacial Lake Basins	Northeastern Minnesota	Alfisols, Entisols,[f] and Histosols are the dominant soil orders. These sandy to clayey soils are very deep, and are typically somewhat poorly drained to very poorly drained.
Northern Minnesota Gray Drift	North-central Minnesota	Alfisols, Entisols, and Histosols are the dominant soil orders. These sandy to loamy soils are very deep.
Northern Mississippi Valley Loess Hills	Southeastern Minnesota	Alfisols and Entisols are the dominant soil orders, with Mollisols less so. These loamy soils are typically well drained or moderately well drained, and are moderately deep to very deep.
Red River Valley of the North	Northwestern Minnesota	Mollisols and Vertisols[g] are the dominant soil orders. These soils are clayey or loamy, and are very deep. They are somewhat poorly drained to very poorly drained.
Rolling Till Prairie	Western Minnesota	Mollisols is the dominant soil order. These loamy soils range from very poorly drained to well drained, and are very deep.
Superior Lake Plain	Northeastern Minnesota	Alfisols, Entisols, Inceptisols,[h] and Spodosols[i] are the dominant soil orders. These clayey, sandy, silty, or loamy soils are very deep.
Superior Stony and Rocky Loamy Plains and Hills, Western Part	Northeastern Minnesota	Entisols, Histosols, and Inceptisols are the dominant soil orders. These loamy, coarse, or silty soils range from very poorly drained to excessively drained, and range from shallow to very deep.
Wisconsin and Minnesota Sandy Outwash	Eastern Minnesota	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These mucky or sandy soils range from very poorly drained to excessively drained, and are very deep.
Wisconsin and Minnesota Thin Loess and Till, Northern Part	Northeastern Minnesota	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These soils are silty, sandy, or loamy.
Wisconsin and Minnesota Thin Loess and Till, Southern Part	Eastern Minnesota	Alfisols, Entisols, Histosols, Inceptisols, and Spodosols are the dominant soil orders These loamy to sandy soils range from very poorly drained to well drained. They are typically moderately deep to very deep.

[a] 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)

[b] 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)
[c] Inceptisols: “Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17% of the world's ice-free land surface.” (NRCS, 2015d)
[d] Loamy Soil: “[A soil] that combines [sand, silt, and clay] in relatively equal amounts.” (Purdue University Consumer Horticulture, 2006)
[e] 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)
[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] Vertisols: “Vertisols have a high content of expanding clay minerals. They undergo pronounced changes in volume with changes in moisture, and have cracks that open and close periodically, and that show evidence of soil movement. Vertisols transmit water very slowly, have undergone little leaching, and tend to be high in natural fertility. They make up about 2% of the world's ice-free land surface.” (NRCS, 2015d)
[h] 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)
[i] 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)
Source: (NRCS, 2006)

9.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy[15]; there are 12 soil orders in the world and they are characterized by both observed and inferred[16] 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[17] soil database identifies 17 different soil suborders in Minnesota (NRCS, 2015a). Figure 9.1.2-2 depicts the distribution of the soil suborders, and Table 9.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[15] Science of naming and classifying organisms or specimens.
[16] “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, 2015g).
[17] 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.

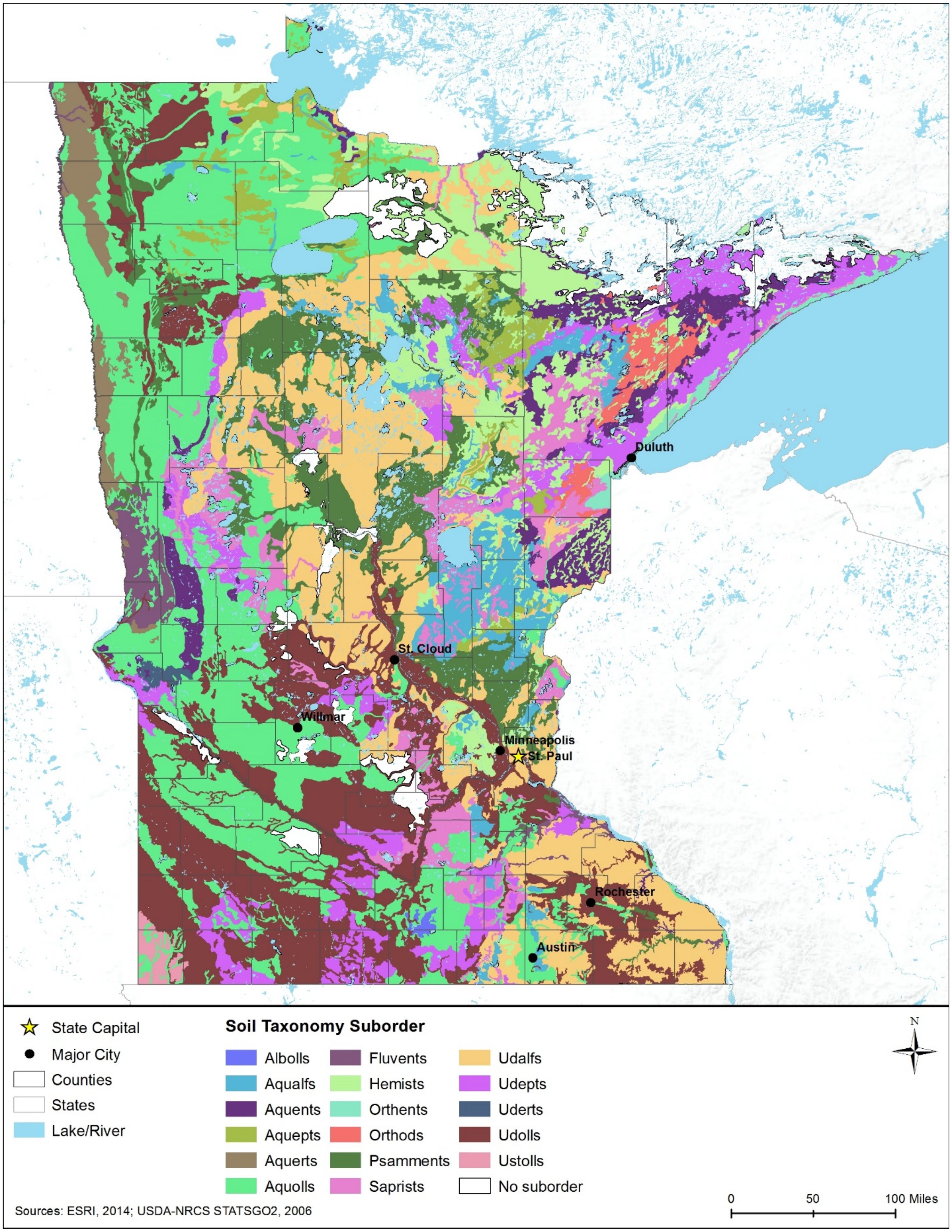

Figure 9.1.2-2: Minnesota Soil Taxonomy Suborders

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Table 9.1.2-3: Major Characteristics of Soil Suborders[18] Found in Minnesota, as Depicted in Figure 9.1.2-2

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
Mollisols	Albolls	Albolls have a fluctuating groundwater table, with gentle slopes. They supported grasses and shrubs, and are typically used as cropland.	Silt loam	0-1	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
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.	Clay, Loam, Loamy sand, Sandy loam, Silt loam, Silty clay loam, Very fine sandy loam	0-6	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
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Loam, Mucky silt loam, Sand, Silt loam, Stratified loamy very fine sand to silt loam, Very fine sandy loam	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
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, Loamy fine sand, Loamy sand, Muck, Very fine sand	0-3	Very poorly drained to somewhat poorly drained	No, Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Vertisols	Aquerts	Aquerts are wet soils, with prolonged moisture at or near the soil surface. Their natural vegetation includes savanna, grass, and forest. They are used as forest, rangeland, and cropland, although drainage for cropland can be difficult due to poor drainage.	Clay, Silty clay	0-2	Poorly drained	Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Clay, Clay loam, Coarse sand, Fine sand, Fine sandy loam, Loam, Loamy fine sand, Loamy sand, Sand, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stratified gravelly sand to clay loam, Stratified loam to silty clay loam, Stratified silt loam to clay, Unweathered bedrock, Very fine sandy loam	0-3	Very poorly drained to somewhat poorly drained	No, 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

[18] 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
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently-deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Loamy fine sand, Silt loam, Silty clay, Silty clay loam	0-25	Somewhat poorly drained to moderately well drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low
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.	Muck, Mucky peat, Sandy loam	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
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Gravelly silt loam, Variable	25-70	Well drained to somewhat excessively drained	No	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	Low
Spodosols	Orthods	Orthods have a moderate accumulation of organic carbon, and are relatively freely drained. Most of these soils are either used as forest or have been cleared and are used as cropland or pasture. Although they are naturally infertile, they can be highly responsive to good management.	Loamy fine sand, Stratified gravelly coarse sand to sand	2-12	Well drained to somewhat excessively drained	No	A, B	Low, Medium	High, Moderate	Low to Medium, depending on slope	Low
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Coarse sand, Fine sand, Loamy sand, Sand, Weathered bedrock	0-25	Somewhat poorly drained to excessively drained	No	A, B	Low, Medium	High, Moderate	Low to Medium, depending on slope	Low
Histosols	Saprists	Saprists have organic materials are well decomposed, and many support natural vegetation and are used as woodland, rangeland, or wildlife habitat. Some Saprists, particularly those with a mesic or warmer temperature regime, have been cleared, drained, and used as cropland.	Muck, Stratified sand to fine sandy loam	0-12	Very poorly drained	Yes	A, D	Low, High	High, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Clay, Clay loam, Fine sand, Gravelly sandy loam, Loam, Loamy fine sand, Loamy sand, Sandy loam, Silt loam, Silty clay loam, Stratified gravelly coarse sand to loamy fine sand, Stratified sand to silt loam, Very fine sandy loam	0-50	Poorly drained to somewhat excessively drained	No, 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

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
Inceptisols	Udepts	Udepts have a udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the Northwest and mixed or hardwood forest in the East. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Fine sandy loam, Gravelly loam, Gravelly loamy coarse sand, Gravelly sandy loam, Loam, Sandy loam, Silt loam, Stratified sandy loam to silt loam	2-35	Moderately well drained to somewhat excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low
Vertisols	Uderts	Uderts are found in humid areas, and primarily used as cropland, forest, or pasture. They have low permeability, and water usually must be drained from the surface of cropland.	Silty clay	4-10	Moderately well drained	No	C	Medium	Low	Medium	Low
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay loam, Coarse sand, Fine sandy loam, Flaggy sandy loam, Gravelly coarse sand, Loam, Loamy fine sand, Loamy sand, Sand, Sandy clay loam, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stratified loam to sandy clay loam, Unweathered bedrock	0-80	Somewhat poorly drained to excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low
Mollisols	Ustolls	Ustolls typically supported grass and forest vegetation, and are now primarily used as cropland or rangeland. They are generally freely drained, and found in subhumid to semiarid climates. Areas with drought are common, and blowing soil can be an issue.	Loam, Silt loam, Silty clay loam	0-25	Moderately well drained to well drained	No	B	Medium	Moderate	Medium	Low

[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 types are hydric while others are not.
[b] Based on Runoff Potential, described in Section 9.1.2.5.
Source: (NRCS, 2015a) (NRCS, 1999)

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9.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[19] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 9.1.2-3 provides a summary of the runoff potential for each soil suborder in Minnesota.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[20] even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission" (Purdue University, 2015). Aquents, Aquolls, Fluvents, Hemists, Orthods, Psamments, Saprists, Udalfs, Udepts, and Udolls fall into this category in Minnesota.

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. Aqualfs, Aquents, Aquepts, Aquolls, Fluvents, Hemists, Orthents, Orthods, Psamments, Udalfs, Udepts, Udolls, and Ustolls fall into this category in Minnesota.

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, Aquerts, Aquolls, Fluvents, Udalfs, Udepts, Uderts, and Udolls fall into this category in Minnesota.

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

9.1.2.6. 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

[19] Classifying soils is highly generalized and it is challenging to differentiate orders as soil properties can change with distance or physical properties. The soil suborders are at a high level, therefore soil groups may be found in multiple hydrologic groups within a state, as composition, topography, etc. varies in different areas.

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

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 9.1.2-3 provides a summary of the erosion potential for each soil suborder in Minnesota. Soils with medium to high erosion potential in Minnesota include those in the Albolls, Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Fluvents, Hemists, Orthents, Orthods, Psamments, Saprists, Udalfs, Udepts, Uderts, Udolls, and Ustolls suborders, which are found throughout the state (Figure 9.1.2-2).

9.1.2.7. Soil Compaction and Rutting

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

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 9.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Minnesota. Soils with the highest potential for compaction and rutting in Minnesota include those in the Albolls, Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Hemists, Saprists, and Udalfs suborders, which are found throughout the state (Figure 9.1.2-2).

9.1.3. Geology

9.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and groundwater availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 9.1.4), Human Health and Safety (Section 9.1.15), and Climate Change (Section 9.1.14).

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

- Section 9.1.3.3, Environmental Setting: Physiographic Regions[21] and Provinces[22]
- Section 9.1.3.4, Surface Geology
- Section 9.1.3.5, Bedrock Geology[23]
- Section 9.1.3.6, Paleontological Resources[24]
- Section 9.1.3.7, Fossil Fuel and Mineral Resources
- Section 9.1.3.8, Geologic Hazards[25]

9.1.3.2. 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 9.1.3-1.

Table 9.1.3-1: Relevant Minnesota Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Minnesota Department of Natural Resources Parks and Trails Division, Application for Research Permits and Renewals	Minnesota Department of Natural Resources (MDNR)	No fossils may be removed from state parks, and a Research Application is required for paleontological research in state parks (MDNR, 2015b).
Minnesota State Building Code	Minnesota Department of Labor and Industry	Provides seismic design guidelines (MNDOLI, 2015a).

9.1.3.3. 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).

Minnesota has two major physiographic regions: Laurentian Upland (Superior Upland Province) and Interior Plains (Central Lowland Province) (USGS, 2003b). The locations of these regions

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

and their respective provinces are shown in Figure 9.1.3-1 and their general characteristics summarized in the following subsections.

Laurentian Upland Region

The Laurentian Upland Region extends from northwestern Michigan, through northern Wisconsin, and into northeastern Minnesota. The metamorphic[26] 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, 2014a)

<u>Superior Upland Province</u> – The Superior Upland Province is comprised of the northeastern portion of the Laurentian Upland Region within Minnesota. "The rocks of the Superior Upland are mostly Precambrian [older than 542 MYA] metamorphic rocks and overlying Paleozoic rocks (Cambrian [542 to 488 MYA])."[27] 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 (NPS, 2014b). Within Minnesota, the Superior Upland Province is "characterized by glacially scoured bedrock terrain with thin and discontinuous deposits of coarse loamy till[28] and numerous lakes. The section has high relief, reflecting the rugged topography of the underlying bedrock" (MDNR, 2015c).

[26] Metamorphic Rocks: "A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids." (USGS, 2015e)
[27] 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.
[28] 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, 2013d).

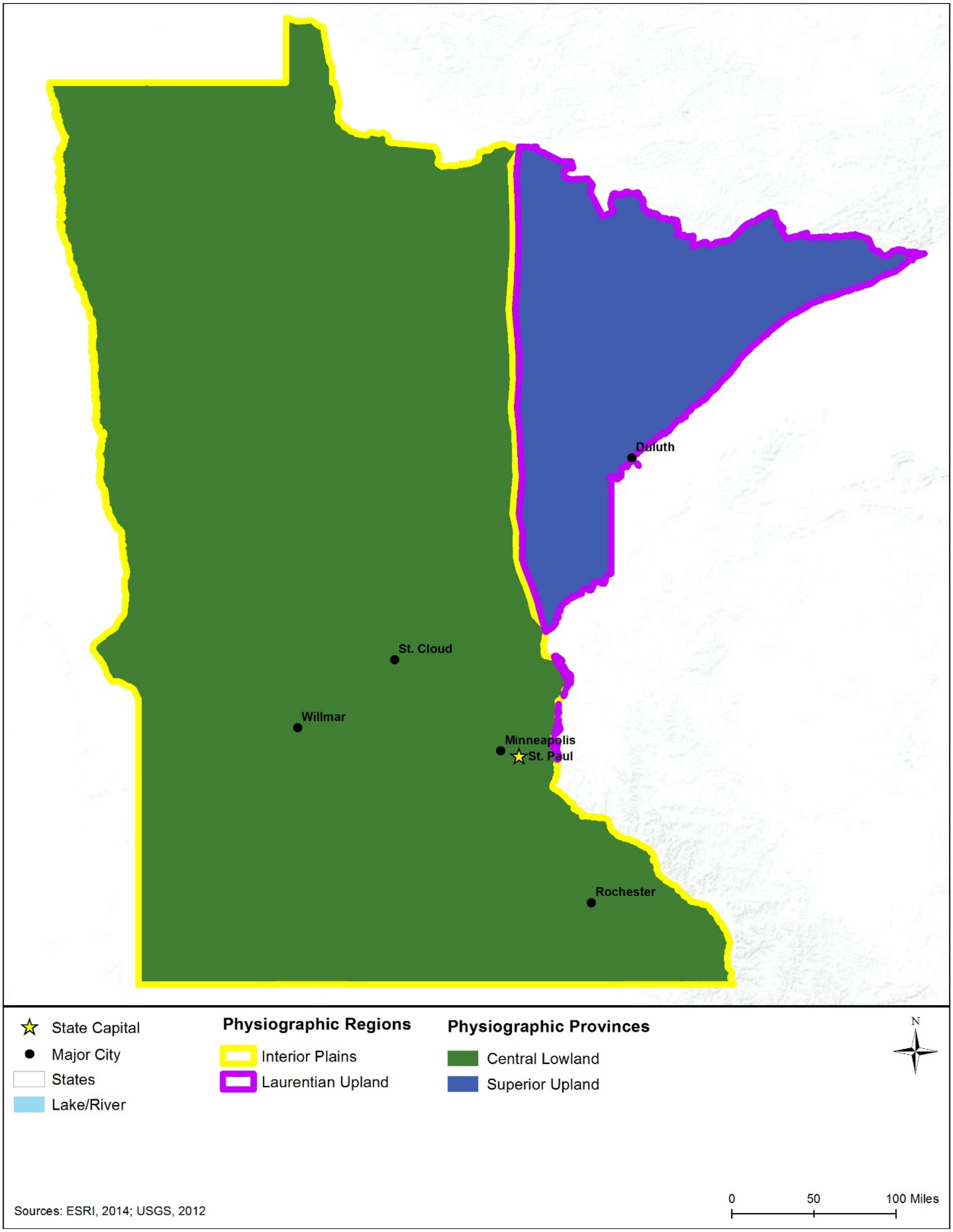

Figure 9.1.3-1: Physiographic Regions and Provinces of Minnesota

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

As reported above, the Interior Plains Region within Minnesota is composed of one physiographic province: the Central Lowland (USGS, 2003b).

<u>Central Lowland Province</u> – 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. Much of the region is flat lying and is at about 2,000 feet above sea level (ASL) (NPS, 2014a). Within Minnesota, the Central Lowland includes much of the southern portion of the state. The province “is characterized by flat-lying to rolling ground moraines and outwash plains” (USGS, 1996), and is underlain by carbonate[33] glacial deposits (USGS, 2013a), which are discussed further in Section 9.1.3.4.

9.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till, 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,[34] subsidence,[35] and erosion (Thompson, 2015).

Much of Minnesota's surface geology is attributable to the Wisconsinan glaciation which occurred between 85,000 and 10,000 years ago. At this time, the Laurentian Ice Sheet covered most of the state, with four lobes advancing and retreating across the state from different directions at different times. This glaciation produced river valleys, gently rolling hills, and

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[29] Igneous Rock: "Rocks that solidified from molten or partly molten material, such as magma." (USGS, 2005)
[30] Sedimentary Rock: "Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding." (USGS, 2014d)
[31] Sandstone: "Sedimentary rock made mostly of sand-sized grains." (USGS, 2015e)
[32] Mudstone: "A very fine-grained sedimentary rock formed from mud." (USGS, 2015e)
[33] Carbonate: "A sedimentary rock made mainly of calcium carbonate ($CaCO_3$). Limestone and dolomite are common carbonate sedimentary rocks." (USGS, 2015e)
[34] 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)
[35] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." (USGS, 2000)

thousands of lakes throughout the state. Glaciers began to retreat from the state approximately 11,000 years ago, although meltwater from the north continued to flood the state and form large glacial lakes. Glaciation did not greatly affect southeastern and southwestern portions of Minnesota, and thus, bedrock exposures are more prevalent in these areas. (MDNR, 2015d) (Minnesota Geological Survey, 1997)

Figure 9.1.3-2 depicts the main surficial composition of Minnesota.

9.1.3.5. Bedrock Geology

Bedrock geology analysis, and "[the study of] distribution, position, shape, and internal structure of rocks" (USGS, 2015a) reveals important information about a region's surface and subsurface characteristics (i.e., three dimensional geometry), including dip (slope of the formation),[36] rock composition, and regional tectonism.[37] These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (New Hampshire Department of Environmental Services, 2014).

The oldest rocks in Minnesota are from the early Precambrian Era (approximately 3,800 to 2,500 million years ago). These rocks that underlie the northern half of Minnesota are collectively referred to as the Canadian Shield, which include alternating bands of volcanic and sedimentary rocks, interspersed with granite.[38] Within the Minnesota River Valley are outcrops of gneiss[39] that date back approximately 3.6 million years (MDNR, 2015d). Precambrian rocks are also covered in some areas by Paleozoic (542 to 251 MYA) and Mesozoic (251 to 66 MYA) marine sedimentary rocks, along with extensive Quaternary (2.6 MYA to present) glacial deposits (Jirsa & Southwick, 2015).

Figure 9.1.3-3 displays the generalized bedrock geology for Minnesota.

[36] 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)
[37] Tectonism: "Structure forces affecting the deformation, uplift, and movement of the earth's crust." (USGS, 2015e)
[38] Granite: "A coarse-grained intrusive igneous rock with at least 65% silica. Quartz, plagioclase feldspar, and potassium feldspar make up most of the rock and give it a fairly light color." (USGS, 2015e)
[39] Gneiss: "A coarse-grained, foliated metamorphic rock that commonly has alternating bands of light and dark-colored minerals." (USGS, 2015e)

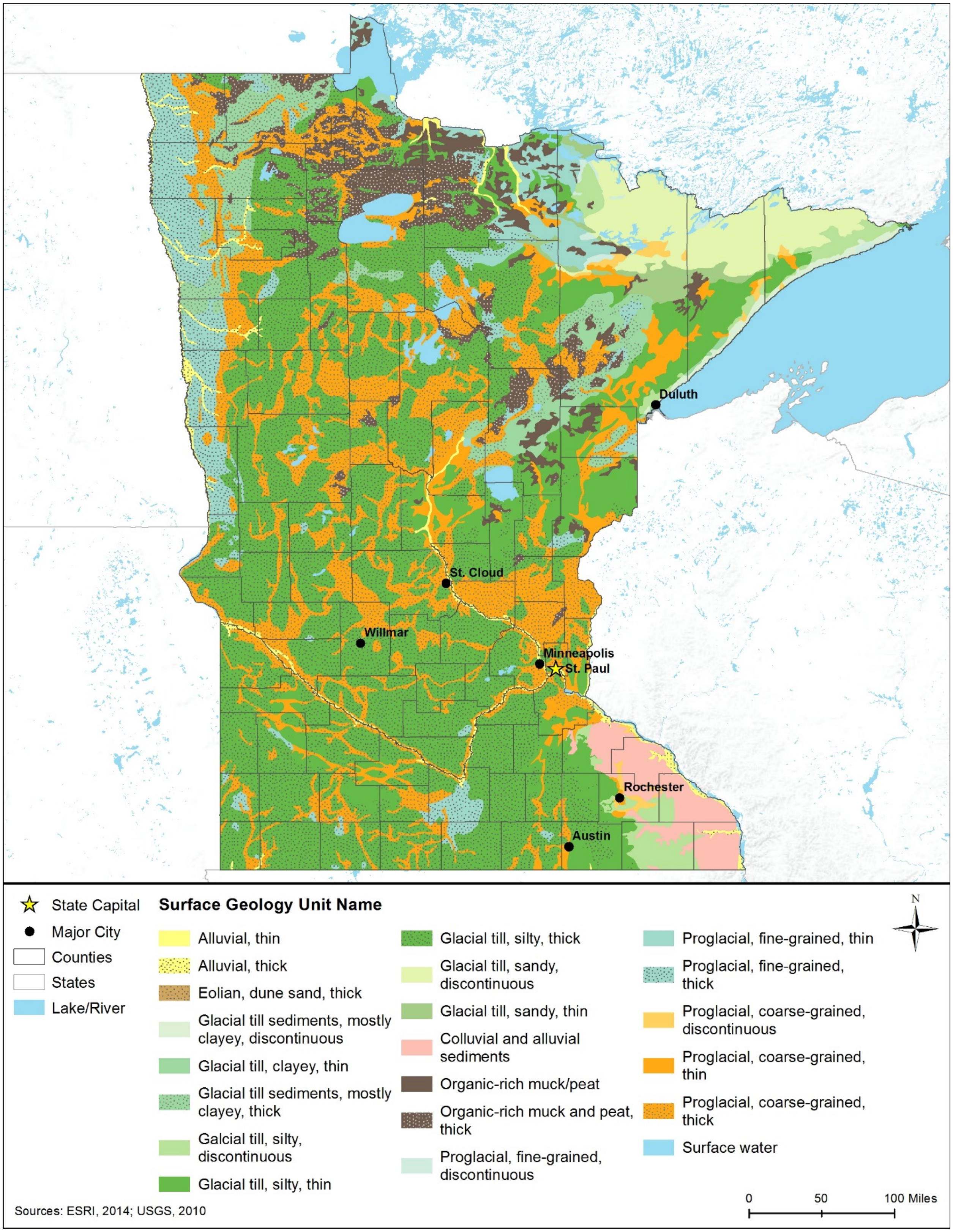

Figure 9.1.3-2: Generalized Surface Geology for Minnesota

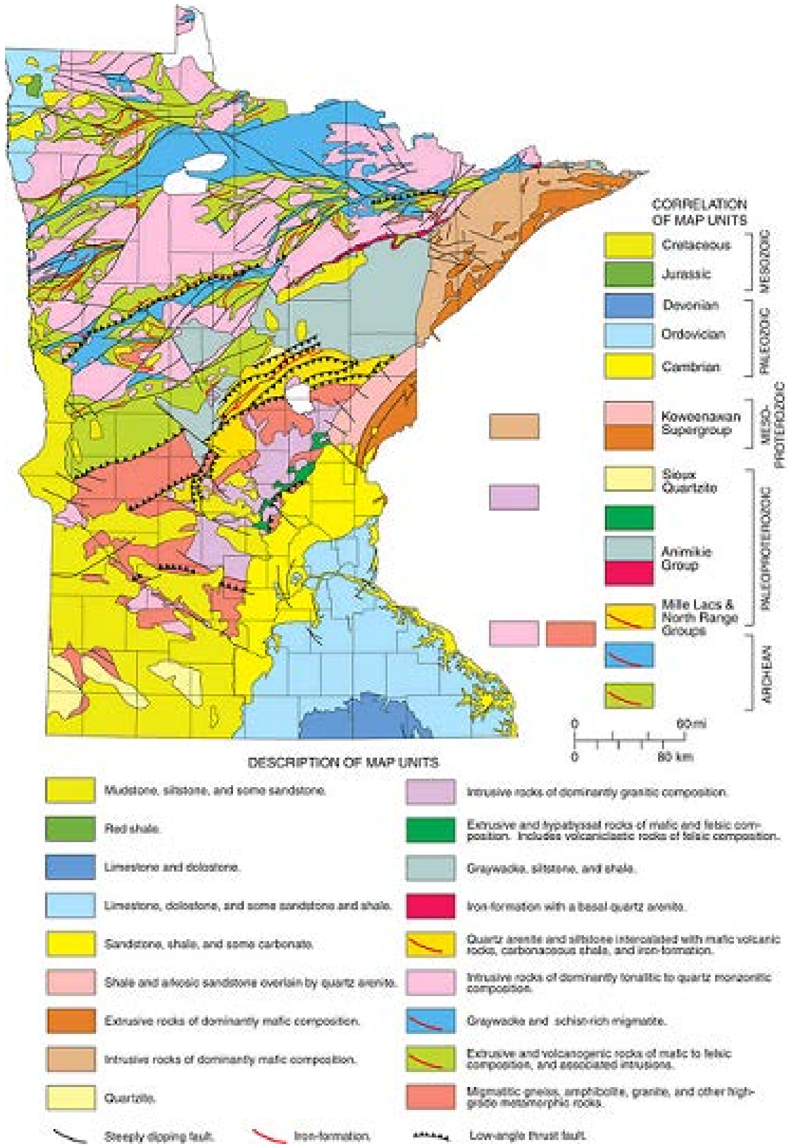

Figure 9.1.3-3: Generalized Bedrock Geology for Minnesota

Source: (Minnesota Geological Survey, 2003)

9.1.3.6. Paleontological Resources

Minnesota Trilobite Fossil

Source: (North Dakota State University, 2003)

Minnesota possesses abundant Paleozoic (542 to 251 MYA) fossils, particularly in marine deposits recorded from the Cambrian (542 to 488 MYA) and Ordovician (488 to 444 MYA) Periods. Those fossils include marine invertebrates such as brachiopods,[40] trilobites,[41] crinoids,[42] and mollusks. Shallow seas covered southern Minnesota during the Devonian Period (416 to 359 MYA), and corals, brachiopods, cephalopods.[43] and trilobites have been recorded form this time. Mesozoic (251 to 66 MYA) fossils in Minnesota are from the Cretaceous Period (146 to 66 MYA), and include clams, oysters, and fish. Quaternary Period (2.6 MYA to present) deposits yield the only fossils from the Cenozoic Era (66 MYA to present), and include mammoths, mastodons, and musk ox (Paleontology Portal, 2015). There is no state fossil for Minnesota (NPS, 2010).

9.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

Minnesota does not produce fossil fuels but "plays an important role in moving fossil fuels to markets across the Midwest and beyond." Cargo transported on the Mississippi River travels through the state, including coal and petroleum. Although Minnesota has two crude oil refineries, the state does not produce any crude oil. Minnesota also does not produce and natural gas nor does it have any "natural gas market centers" even with natural gas pipelines crossing into the state. (EIA, 2016)

Minerals

In 2015, Minnesota's total nonfuel mineral production was valued at $959M. This level of production ranked 4th nationwide (in terms of dollar value), and accounted for nearly 1.23 percent of the country's total production value. In 2015, Minnesota's leading nonfuel minerals were iron ore, construction sand and gravel, crushed stone, industrial sand and gravel, and

[40] 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)

[41] 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)

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

[43] 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.[44] Minnesota and Michigan led the country in iron-ore production for 2015 (USGS, 2016b). Other minerals produced in the state are common clay and shale, peat, perlite, sulfur, lime, and steel (USGS, 2013b).

9.1.3.8. Geologic Hazards

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

Earthquakes

Though the potential for significant earthquakes is minimal throughout Minnesota, areas of greatest seismicity in Minnesota are concentrated in the western portions of the state (Figure 9.1.3-4). Between 1973 and March 2012, there were four earthquakes of a magnitude 4.5 (on the Richter scale[45]) or less in Minnesota (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, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale. Subduction zone earthquakes occur where Earth's tectonic plates collide. “When 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, 2014i). 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).

“Minnesota has one of the lowest occurrence levels of earthquakes in the United States… Minnesota earthquakes, like those elsewhere in the Midwest, are attributed to minor reactivation of ancient (Precambrian) faults in response to modern stresses.” It is estimated that the recurrence interval for magnitude 4.0

Spotlight: Minnesota's Largest Earthquake

The largest earthquake ever recorded in Minnesota was a magnitude 5.0 quake that occurred in Stevens County (in the western portion of the state) in 1975. The earthquake was also felt in parts of Iowa, South Dakota, and North Dakota over an area that exceeded 120,000 square miles. (USGS, 2014g)

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

earthquakes may be once every 10 years, and perhaps every 266 years for a magnitude 5.5 earthquake. (University of Minnesota, 2014).

Figure 9.1.3-4 depicts the seismic risk throughout Minnesota; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10% g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g. (USGS, 2010).

Landslides

Landslide hazards are minimal throughout much of Minnesota, with the exception of a few areas (Figure 9.1.3-5). "The term 'landslide' describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures" (USGS, 2003a). Geologists use the term "mass movement" to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale (USGS, 2003a).

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

Minnesota is particularly susceptible to landslides along the Red River and in specific geographic areas such as around Duluth. According to the 2011 Minnesota All Hazard Mitigation Plan, landslides are "a naturally reoccurring process related to river erosion and the presence of slump-prone clay deposits. These conditions are present throughout the Red River Valley from Lake Winnipeg to south of Fargo… Clays are present in northwestern Minnesota because the Red River Valley is the floor of ancient glacial Lake Agassiz, a large lake that formed at the edge of a retreating ice-age glacier. Multiple landslides occurred in this area in 2007 following a series of heavy rainfall events (MN HSEM, 2011). Likewise, heavy rainfall in southeastern Minnesota in August 2007 resulted in landslides throughout the region (Rochester-Olmsted Planning Department, 2009). Figure 9.1.3-5[46] shows landslide incidence and susceptibility throughout Minnesota.

[46] Areas susceptible to landslides in northwestern Minnesota are highly localized and, thus, not shown on Figure 9.1.3-5. (MN HSEM, 2011)

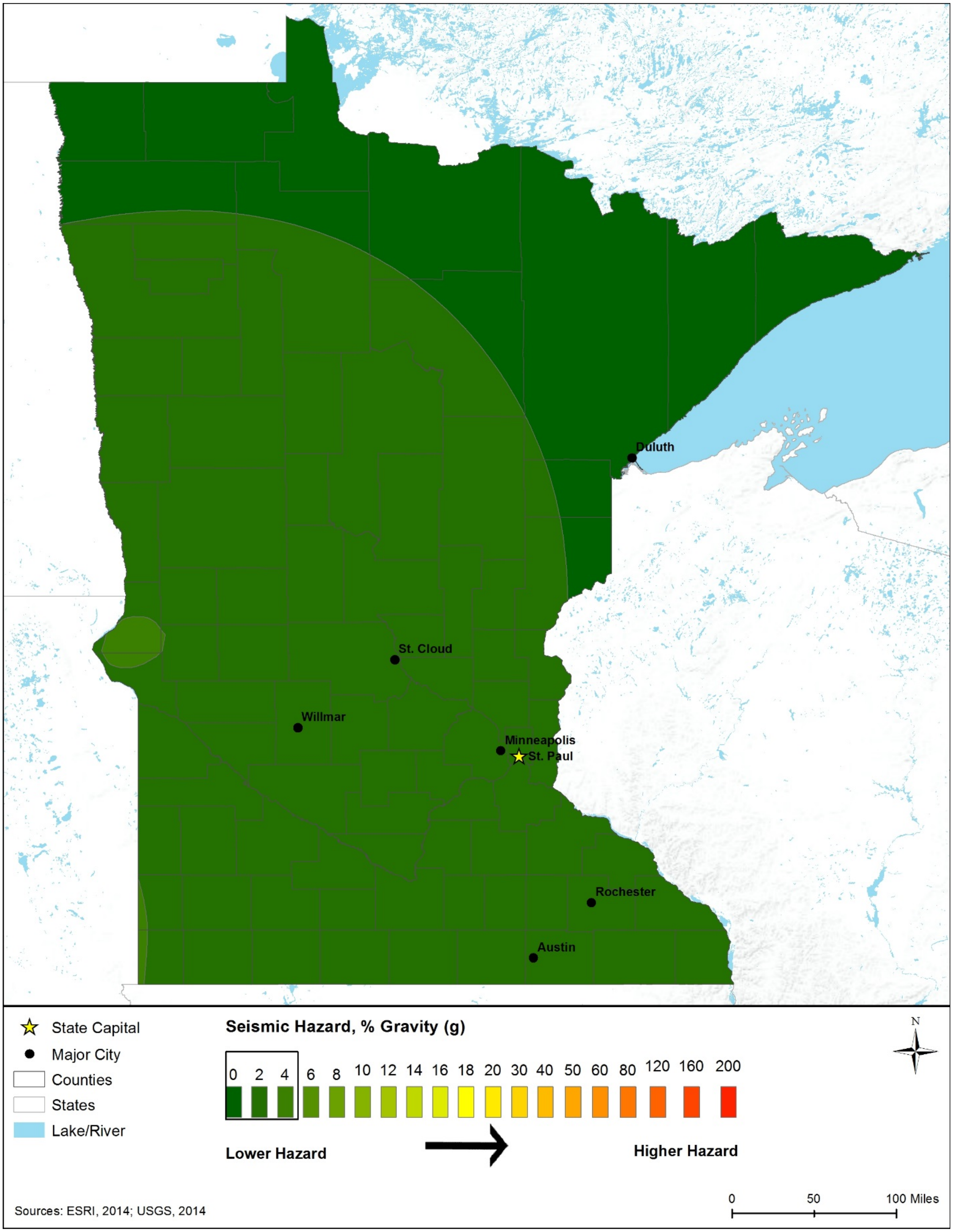

Figure 9.1.3-4: Minnesota 2014 Seismic Hazard Map

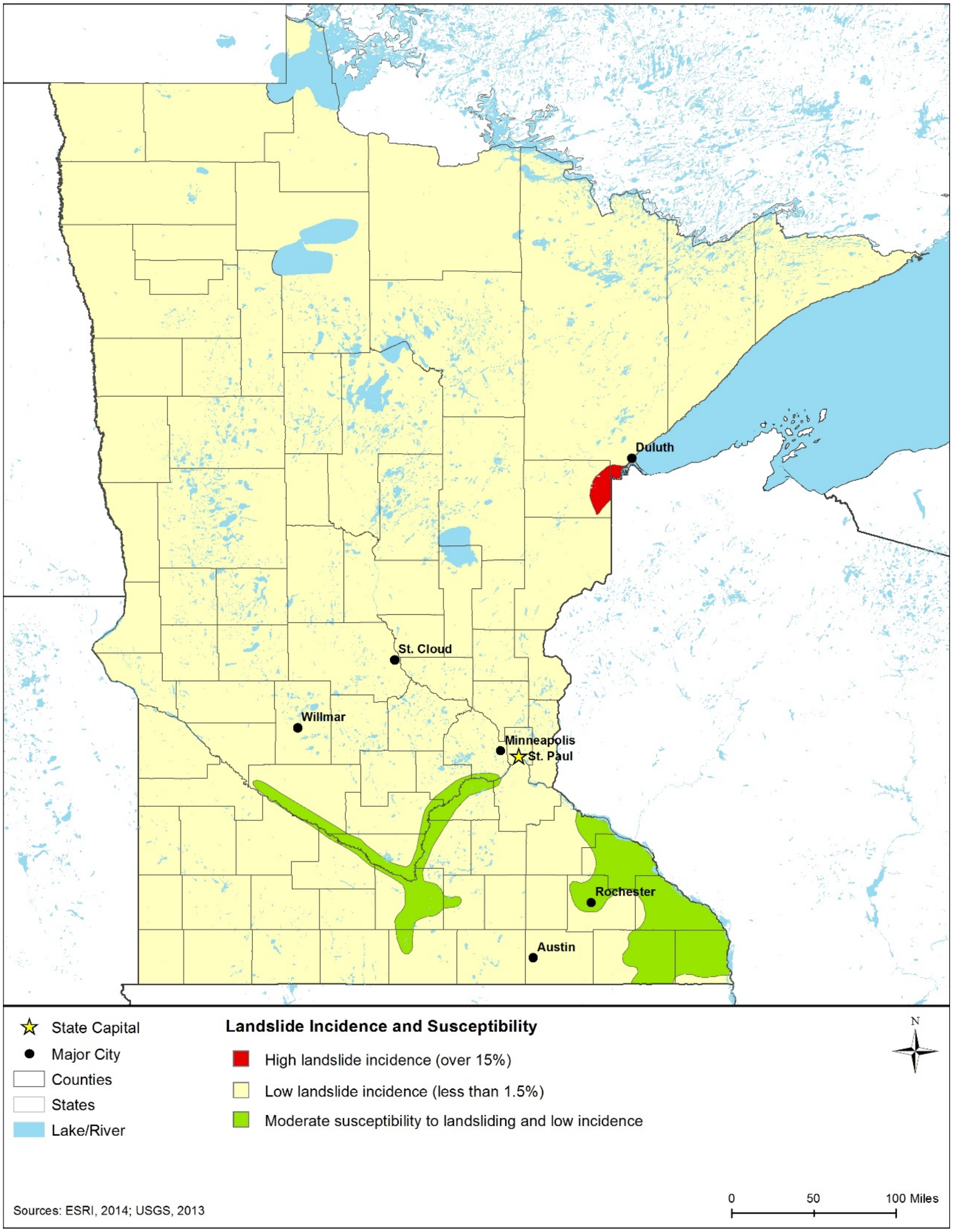

Figure 9.1.3-5: Minnesota Landslide Incidence and Susceptibility Hazard Map[47]

[47] Susceptibility hazards not indicated in Figure 9.1.3-5 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, 2014f)

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). In Minnesota, a significant cause of land subsidence is the formation of caves and sinkholes associated with karst topography (MN HSEM, 2011). 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 U.S. 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, 2013c).

In Minnesota, areas susceptible to land subsidence due to karst topography are prevalent in areas underlain by carbonate rocks such as limestone[48] or dolostone.[49] These areas are most common in southeastern portions of the state near Minneapolis-St. Paul; there are also very small, localized areas of karst in other parts of Minnesota. "Fillmore County, [in the southeastern corner of the state], has more caves, sinkholes, and disappearing streams than all other Minnesota counties combined." Sinkholes have also been observed in northeastern Minnesota near the town of Askov's sewage treatment plant (MN HSEM, 2011). Other landforms associated with karst topography in Minnesota include:

- Subsurface drainage (i.e., absence of surface water);
- Blind valleys;[50]
- Caves;
- Disappearing streams; and,
- Springs (MPCA, 2015h).

Figure 9.1.3-6 shows the location of areas in Minnesota that are susceptible to land subsidence due to karst topography.

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[48] Limestone: "A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation." (USGS, 2015e)
[49] Dolostone: "A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral ($CaMgCO_3$)." (USGS, 2015e)
[50] Blind Valley: "A valley that terminates abruptly at a point where its stream sinks, or once sank, underground. Blind valleys are completely enclosed valleys that water cannot flow out of on the surface." (MPCA, 2015h)

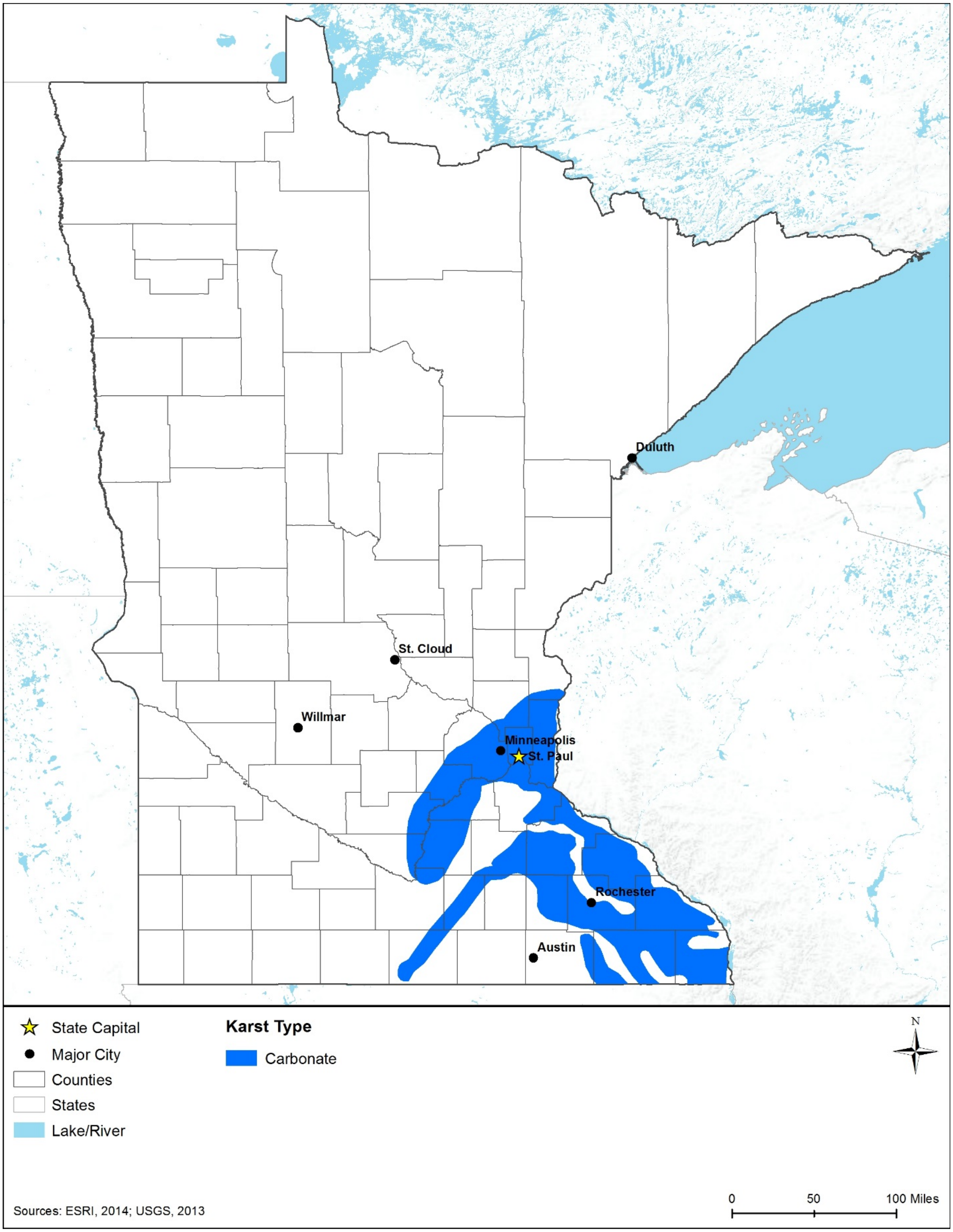

Figure 9.1.3-6: Areas Susceptible to Subsidence Due to Karst Topography in Minnesota

9.1.4. Water Resources

9.1.4.1. 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 9.1.5). 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, 2014j)

9.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations. Table 9.1.4-1 summarizes the major Minnesota laws and permitting requirements relevant to the state's water resources.

Table 9.1.4-1: Relevant Minnesota Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Minnesota Statute 103G.265	MDNR	Defines Minnesota water permit requirements.
Minnesota National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS)	MPCA	Required for any construction activity that disturbs one acre or more of soil, or if activity is part of a larger common development disturbing one acre of soil or greater, or if MPCA determines activity poses risk to water resources.
Clean Water Act (CWA) Section 401	MPCA	Certification is required for any activity that may result in a discharge of a pollutant into waters of the United States, to ensure that the discharge complies the applicable water quality standards.

9.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams. Minnesota has approximately 12,000 lakes, along with over 104,000 miles of rivers and streams (MPCA, 2015i). Minnesota also has nearly 200 miles of coastline along Lake Superior (MDNR, 2015e).

Watersheds

Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains streams and rainfall to a common outlet (e.g., reservoir, bay). Minnesota's waters (lakes, rivers, and streams) are divided into 10 major watersheds, or drainage basins (Figure 9.1.4-1).

The Lake Superior Basin in northeastern Minnesota encompasses approximately 6,200 square miles, and is the only basin on the coast of a Great Lake (MPCA, 2015j). The Minnesota River basin, located in southern Minnesota, drains approximately 16,770 square miles across 37 counties (MPCA, 2015k). The Red River of the North Basin, in northwest Minnesota, covers approximately 37,100 square miles (MPCA, 2014a). The headwaters of the Mississippi River are located within the Upper Mississippi Basin. This basin encompasses about 20,100 square miles, stretching from the headwaters of the Mississippi River at Lake Itasca, down to the Lock and Dam Number 2 close to the town of Hastings (MPCA, 2014b). Visit http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/basins/basins-and-watersheds-in-minnesota.html for additional information and maps about each MPCA watershed's location, size, and water quality.

Freshwater

Nearly 12,000 lakes are at least 10 acres in size, and over 6,500 rivers are in the state. As shown in Figure 9.1.4-1, major rivers in Minnesota include the Mississippi, Minnesota, St. Croix, Bigfork, North Fork Crow, Otter Tail, Rainy, Red Lake, Red of the North, St. Louis, and Wild Rice rivers. The Mississippi River flows for 680 miles through Minnesota, and the Minnesota River flows for 370 miles through the state. Major lakes in the state include the Lake of the Woods, Red Lake (Upper and Lower), Mille Lacs Lake, and Lake Superior. Surface water in Minnesota drains south to the Gulf of Mexico, east to the Atlantic Ocean, or north to the Hudson Bay, in Canada (MDNR, 2015f).

The Great Lakes form the largest surface freshwater system on the planet spanning more than 94,000 square miles of surface area (NOAA, 2015a). Of the five Great Lakes, Lake Superior borders Minnesota. Lake Superior borders the north shore of Minnesota. As the largest freshwater body in the world based on surface area, Lake Superior is approximately 1,300 feet deep and has a shoreline that stretches over 2,700 miles long. Lake Superior water quality issues include contaminated sediments in Duluth-Superior harbor, toxic contaminants in the lake's food chain, decreasing water clarity in its western arm, and algal blooms in its bays (MPCA, 2013a).

MPCA works with local, federal, and international agencies to protect and restore the Great Lakes. In 1987, the governments of the United States and Canada committed to develop and implement the Lakewide Action and Management Plans (LAMPs) for the Great Lakes, including Lake Superior. The LAMPs focus on the entire lake ecosystem to protect each lake and restore degraded areas (USEPA, 2015a).

Figure 9.1.4-1: Major Minnesota Watersheds and Surface Waterbodies

9.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

A 226-mile segment of the St. Croix River (Figure 9.1.4-1) has been federally designated as a National Wild and Scenic River in Minnesota (National Wild and Scenic Rivers System, 2015b). The St. Croix River, along with its major tributary, the Namekagon River, flows between Minnesota and Wisconsin, and provides clear water, scenic views, and recreational opportunities (National Wild and Scenic Rivers System, 2015a).

In addition to federally designated Wild and Scenic Rivers, Minnesota's Wild and Scenic Rivers program was established in 1973 "to protect rivers which have outstanding natural, scenic, geographic, historic, cultural, and recreational values" (MDNR, 2015g). There are six rivers designated under this program: Mississippi (from St. Cloud to Anoka); Kettle (Pine County); Rum (Mille Lacs, Sherburne, Isanti, and Anoka Counties); North Fork – Crow (Meeker County); Minnesota (from Lac Qui Parle dam to Franklin); and Cannon (from Faribault to the Mississippi River). For more information on Minnesota's rivers, visit the MDNR's website at http://www.dnr.state.mn.us/waters/watermgmt_section/wild_scenic/wsrivers/rivers.html (MDNR, 2015g).

9.1.4.5. 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 Clean Water Act, states are required to assess water quality and report a listing of impaired waters,[51] the causes of impairment, and probable sources. Table 9.1.4-2 summarizes the water quality of Minnesota's assessed major waterbodies by category, percent impaired, designated use,[52] cause, and probable sources. Figure 9.1.4 2 shows the Section 303(d) waters in Minnesota as of 2014.

Table 9.1.4-2 shows that various sources affect Minnesota's waterbodies, causing impairments. Of the 17 percent of Minnesota's rivers and streams assessed, nearly 80 percent are impaired, and nearly all of the state's assessed lakes, reservoirs, and ponds are impaired. Designated uses of rivers and streams in Minnesota include drinking water, aquatic life, and recreation. Designated uses of lakes, ponds, and reservoirs include aquatic life, recreation, and warm water aquatic consumption. Section 403(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. (USEPA, 2012a)

Nearly 90 percent of pollution in Minnesota's surface water can be attributed to nonpoint sources. Pollutants including phosphorus, nitrates, bacteria, and sediments come from runoff

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[51] 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, 2015i)

[52] 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, 2015i)

from paved surfaces, construction sites, lawns, and feedlots, as well as storm sewers and failing septic systems. (MPCA, 2013b)

Table 9.1.4-2: Section 303(d) Impaired Waters of Minnesota, 2012

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	17%	79%	drinking water, aquatic life, and recreation	turbidity, mercury, organic enrichment, polychlorinated biphenyls (PCBs), and pathogens[c]	atmospheric deposition,[d] municipal point source discharge/sewage, agriculture, wildlife, and urban runoff/storm sewers
Lakes, Reservoirs, and Ponds	84%	95%	aquatic life, recreation, and warm water aquatic consumption	mercury, PCBs, and nutrients	atmospheric deposition, wildlife, and municipal point source discharge/sewage

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

Source: (USEPA, 2012a)

9.1.4.6. 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 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 filtered by floodplain vegetation and soils, improving water quality. 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, 2014b).

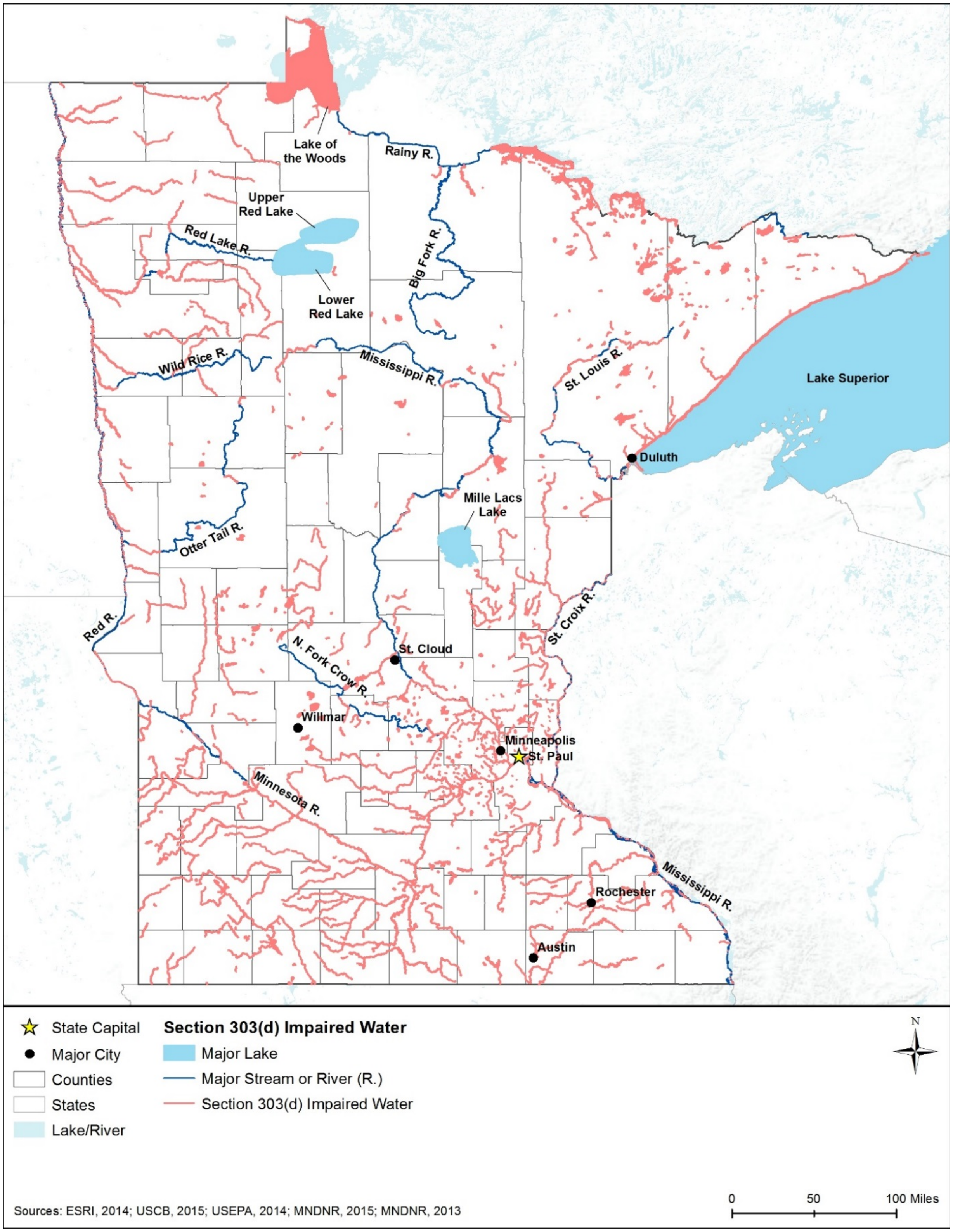


Figure 9.1.4-2: Section 303(d) Impaired Waters of Minnesota, 2012

The primary types of floodplains in Minnesota are riverine and lake floodplains. Riverine and lake floodplains occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. Relatively flat floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water (FEMA, 2014a).

2012 Northeast Minnesota Flooding

After one of the wettest Mays on record in 2012, locally heavy rainfall (as much as 10 inches in some areas) occurred across northeast Minnesota June 19-20. The rainfall set a new two day record in Duluth, which received 7.25 inches of rain. The Mississippi, St. Croix, and Lake Superior basins were inundated with rain, and widespread river and flash flooding occurred. Nine counties in northeastern Minnesota were declared Federal Disaster Areas. (Czuba, Fallon, & Kessler, 2012)

Source: (USGS, 2012d)

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 Minnesota, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include flash flooding, riverine flooding (including overbank flooding), ice jams, fluctuation of lake levels, coastal flooding along the North Shore of Lake Superior, and debris flow (DPS, 2014).

Between 1957 and 2013, 42 Presidential Disaster Declarations have been issued for flooding in Minnesota. Based on these numbers, there is an approximate 55 percent chance of major flooding occurring annually somewhere in Minnesota. Every region of Minnesota is subject to flooding; however, some areas are more susceptible. For example, the Red River of the North has flooded consistently about every other or every three years. This is due to the river flowing north, with water backing up as it enters areas that have not yet thawed, along with the flat terrain surrounding the river, which allows flooding to continue for miles. Some of the counties most susceptible to flooding, based on estimated economic loss, include Anoka, Hennepin, St. Louis, Washington, Olmsted, Winona, Dakota, and Polk counties. (DPS, 2014)

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 600 communities in Minnesota through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015a). 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, Minnesota had 9 communities participating in the CRS (FEMA, 2014d).[53]

9.1.4.7. Groundwater

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

Minnesota's principal aquifers consist of carbonate-rock[54] and sandstone aquifers.[55] Approximately 75 percent of the state's drinking water supply comes from groundwater, and nearly all of the water utilized for agricultural irrigation comes from groundwater. Most of Minnesota's groundwater is of good quality, but pollutants such as nitrates, chlorides, and volatile organic compounds threaten groundwater quality. Although chlorides are naturally occurring from weathering of rock, excess chlorides can enter groundwater from road salt use (MPCA, 2013c). Table 9.1.4-3 provides details on aquifer characteristics in the state; Figure 9.1.4-3 shows Minnesota's principal and sole source aquifers.

Sole Source Aquifers

The U.S. Environmental Protection Agency (USEPA) defines sole source aquifers (SSAs) as "an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer" and are areas with no other drinking water sources (USEPA, 2015c). Minnesota has one designated SSA within the state, the Mille Lacs Aquifer (as shown in Figure 9.1.4-3). Designating a groundwater resource as an SSA helps to protect the drinking water supply in that area and requires reviews for all federally funded proposed projects to ensure that the water source is not jeopardized (USEPA, 2015c).

[53] A list of the 9 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).

[54] 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, 1992).

[55] 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, 1995).

Table 9.1.4-3: Description of Minnesota's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin These aquifers consist mainly of sand and gravel	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 agricultural. Other uses include domestic and commercial; industrial; mining; and thermoelectric-power.
Cambrian-Ordovician aquifer system Composed mainly of sandstone	Southeast part of the state stretching up along the border to south central	Water is suitable for most purposes though rarely used for water supply as larger yields of water can be obtained from the other aquifers. Water has a median dissolved-solids concentration. In southwestern part of the aquifer, the mineralized water is of limited use for public and industrial supply.
Lower Cretaceous aquifers Consists of shale and sandstone	Primarily found in the western and southwestern part of the state	Generally not used as a water supply source. Harder water and more mineralized compared to other aquifer in the state. Dissolved solids concentrations vary throughout the aquifer.
Upper carbonate aquifer Composed of limestone and dolomite	Southeast corner of the state, around Austin	Suitable for most uses. Water has a median dissolved-solids concentration and is of a mixed ion type. Thinness of aquifer susceptible to contamination from the surface. Primary uses are for public, industrial, and domestic supply.

Source: (Moody, Carr, Chase, & Paulson, 1986) (Olcott, 1992)

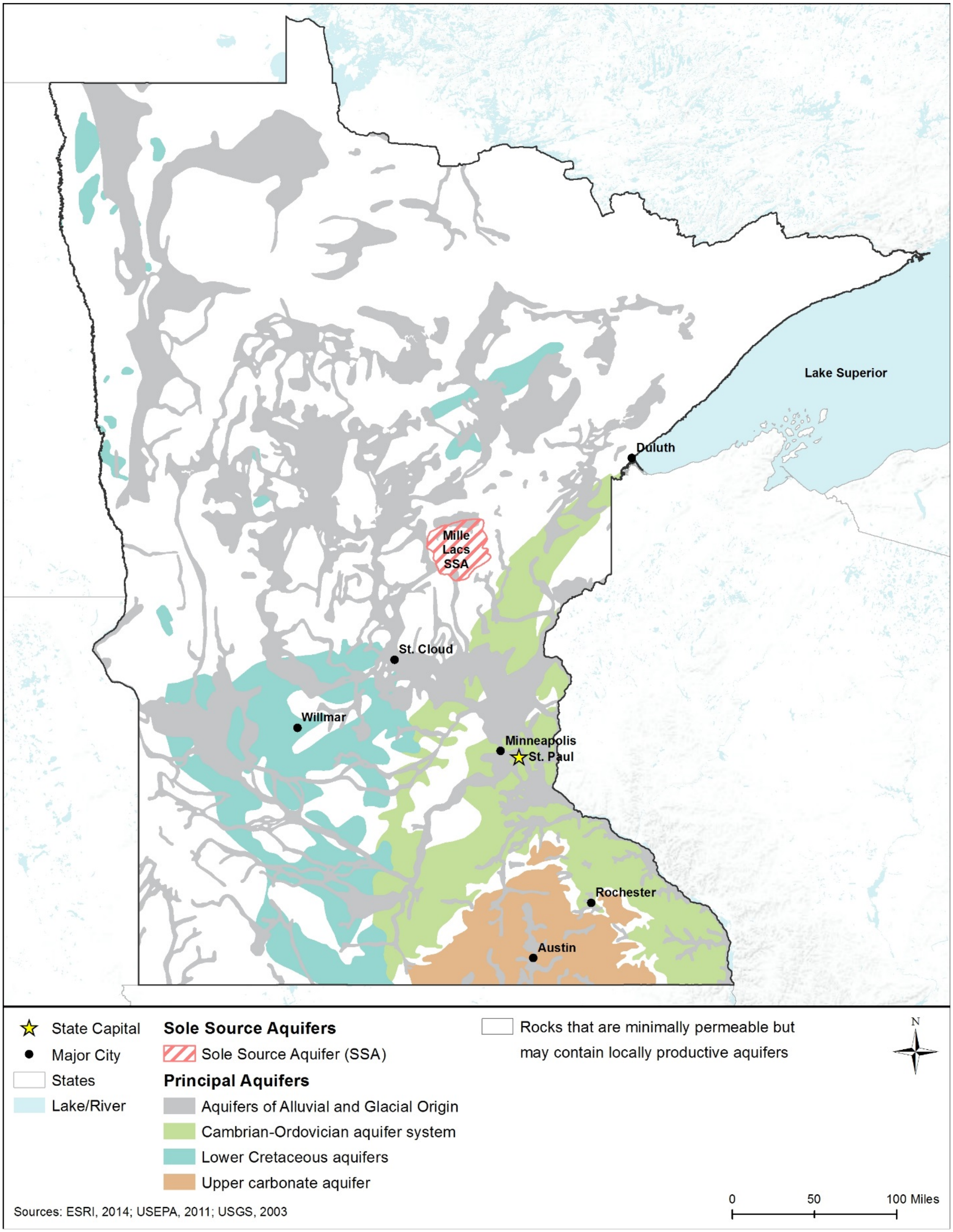


Figure 9.1.4-3: Principal and Sole Source Aquifers of Minnesota

9.1.5. Wetlands

9.1.5.1. Definition of the Resource

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

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

9.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 9.1.5-1 summarizes the major Minnesota state laws and permitting requirements relevant to the state's wetlands.

Table 9.1.5-1: Relevant Minnesota Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
CWA Section 404 permit, Minnesota regional requirements	U.S. Army Corps of Engineers (USACE), St. Paul District	In lieu of nationwide general permits, the USACE St. Paul District has Regional General Permits (RGP) to authorize discharge of dredged or fill material into waters of the United States (USACE, 2015). Any activity in a calcareous fen, or adjacent to and within 300 feet of a state designated calcareous fen, is excluded from the regional permit.
Wetland Conservation Act	MDNR	"Requires anyone proposing to drain, fill, or excavate a wetland first to try to avoid disturbing the wetland; second, to try to minimize any impact on the wetland; and, finally, to replace any lost wetland acres, functions, and values." (Minnesota Bureau of Water and Soil Resources, 2015a)
Public Waters Permit Program (Minnesota R. ch. 6115)	MDNR	Permit is required for development activities in Public Waters Wetlands, including filling, excavation, shore protection, bridges and culverts, structures, docks, marinas, water level controls, dredging, and dams (as defined in Minnesota Statute 103G.005, Subdivision 15a).
CWA Section 401	MPCA	The MPCA certifies that federal permits comply with state water quality standards, found in Minnesota R. ch. 7050.
National Pollutant Discharge Elimination System	MPCA	NPDES storm water permits are required for construction activities larger than one acre.

9.1.5.3. 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 that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 9.1.5-2:). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats (USFWS, 2015a).

- The Marine System consists of open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 30 percent salty) water chemistry; minimal influence from rivers or estuaries. Where wave energy is low, mangroves, or mudflats may be present.
- "The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and the ocean water is at least occasionally diluted by freshwater runoff from the land."
- "Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt."
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent." The System is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, et al. 1979)

In Minnesota, the main type of wetland is palustrine (freshwater) wetlands found on river and lake floodplains across the state. Riverine and lacustrine wetlands, as defined in Table 9.1.5-2, comprise less than three percent of the wetlands in the state and are not discussed in this PEIS. Table 9.1.5-2 uses 2014 NWI data to characterize and map Minnesota wetlands on a broad-scale.[56] The data is not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be conducted, as appropriate, at the site-specific level once those locations are known. As shown in Figure 9.1.5-1, wetlands are found throughout the state, although more concentrated in the northern half of Minnesota. The map codes and colorings in Table 9.1.5-2 correspond to the wetland types in the figures.

Table 9.1.5-2: Minnesota Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests and hardwood swamps are examples of PFO wetlands.	Throughout the state, heavily concentrated in northern Minnesota	7,193,339
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,[57] prairie potholes, and sloughs.[58]	Throughout the state	2,930,276
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	219,184
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		

[56] The wetland acreage data was obtained from the 2014 NWI 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. 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.

[57] Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water. (Edinger, et al., 2014)

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

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep,[59] and other miscellaneous wetlands are included in this group.	Throughout the state	461
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	8,676
Lacustrine wetland	L2	Lacustrine systems are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are generally less than 8.2 feet deep.	Throughout the state	275,485
			TOTAL	**10,627,421**

Source: (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).
[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 Minnesota, palustrine wetlands include the majority of vegetated freshwater wetlands. Common palustrine wetlands typically found in Minnesota include seasonally flooded flats or basins, wet meadows, shallow and deep marshes, shallow open water, shrub and wooded swamps, and bogs.

Seasonally flooded flats or basins are found throughout the state, including in upland depressions, and floodplain forests. They only contain water seasonally and are typically well drained through most of the growing season. Wet meadows are typically found near marshes, streams, and lakes. They are characterized by low-lying grassy areas, and include sedge meadows, low prairies, and rare calcareous fens.[60] Shallow and deep marshes are common, and found throughout Minnesota. Shallow marshes are typically covered with six inches or more of water, while deep marshes are flooded in depths up to three feet during the growing season. Shallow marshes are characterized by grasses, bulrush (*Typha sp.*), and spikerush (*Eleocharis palustris*), while deeper marshes may also have vegetation such as pondweed (*Potamogeton sp.),* and duckweed (*Lemna minor*). These marshes are found in shallow lake basins or sloughs, or

[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)
[60] See Section 9.1.5.4 for a detailed description of calcareous fens.

bordering deeper water. In western and southern parts of Minnesota, these wetlands are called Prairie Potholes, which are wetlands formed in shallow depressions that were made by retreating glaciers. Shallow ponds and reservoirs are similar to marshes, are typically inundated with water less than 10 feet deep, and with emergent vegetation similar to shallow and deep marshes. Shrubs and wooded swamps are found around the edge of streams, rivers, and lakes, and are characterized by shrubs and forests. Common wooded swamps in Minnesota include black spruce *(Picea mariana*) and black ash (*Fraxinus nigra*) forests. Bogs, also known as peatlands, are found extensively in north-central Minnesota. These wetlands have soils made of peat, with the water table at or near the surface. They are found along slow streams, on flat terrain, and on shallow glacial lakes depressions. (MDNR, 2015h)

Based on the USFWS NWI 2014 analysis, PFO/PSS is the dominant wetland type (68 percent), followed by PEM (28 percent), PUB/PAB (2 percent), and other palustrine wetlands (less than 1 percent). There are currently about 10.3 million acres of palustrine (freshwater) wetlands in the state (USFWS, 2014e). Over 50 percent of Minnesota's wetlands have been lost to agricultural conversion and development. Despite this, Minnesota has more wetland acreage than any other state in the country except Alaska (MDNR, 2015i) (MDNR, 1997).

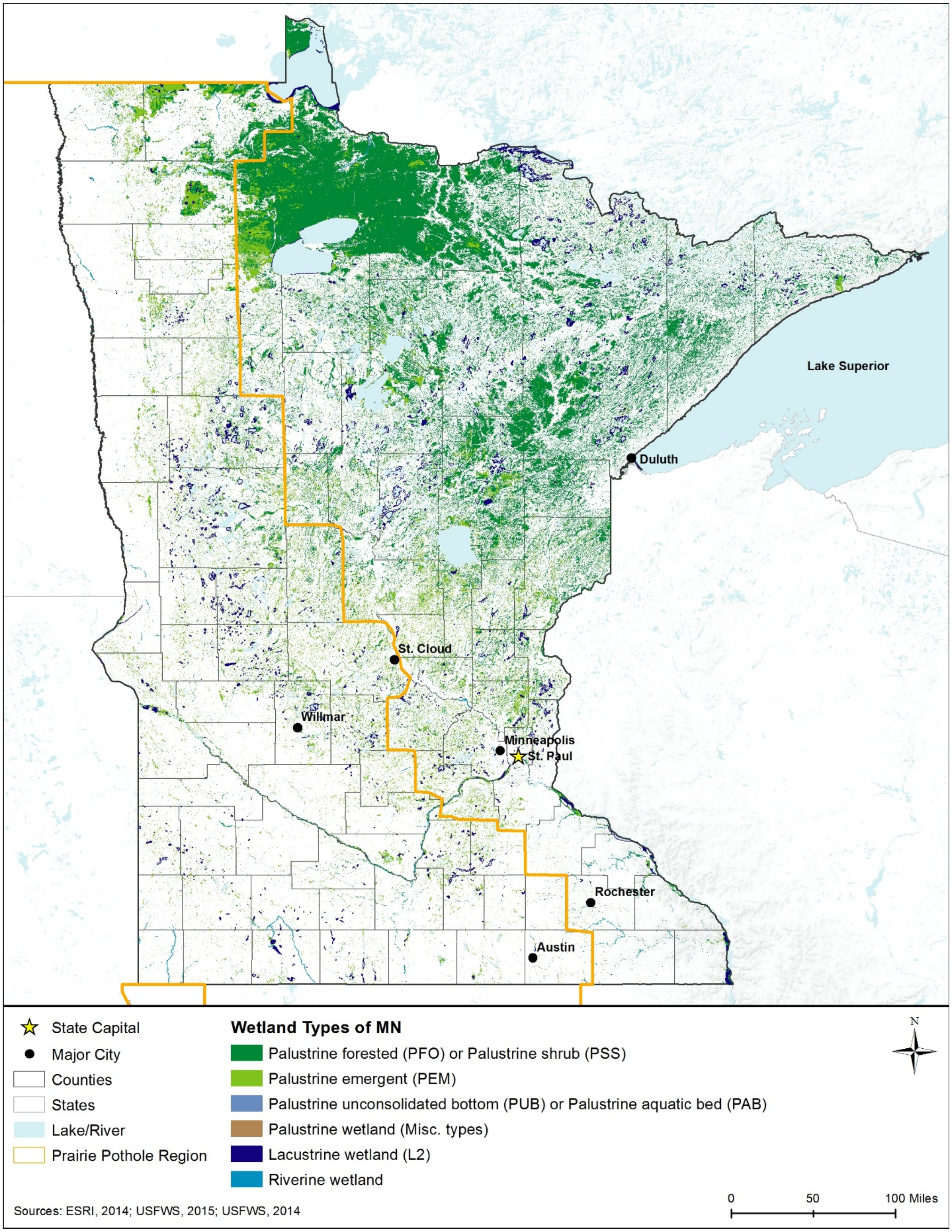


Figure 9.1.5-1: Wetlands by Type, in Minnesota, 2014

9.1.5.4. Wetlands of Special Concern or Value in Minnesota

Calcareous Fens

In Minnesota, calcareous fens are protected under the Wetlands Conservation Act. These fens are one of the rarest natural communities in the country. There are approximately 200 calcareous fens in Minnesota, with the majority being only a couple acres in size. These communities have a non-acidic peat substrate, and depend on a continuous supply of cold, oxygen-poor groundwater that is abundant in calcium and magnesium bicarbonate. Because this water produces such a calcium-rich environment, the plant communities requiring these nutrients thrive in these types of wetlands.

Calcareous fens are usually located in areas that have a slight sloping, where surface water input is minimal and groundwater that reaches the surface can drain away quickly. Therefore, the soils is nearly always saturated at the surface, but actual flooding is brief and rare. Calcareous fens are found on valley slopes and the sides of moraine hills in west-central and southern Minnesota, in southeast Minnesota at the base of terrace cliffs in river valleys, and on downslope sides of beach ridges within the ancient glacial Lake Agassiz basin, located in northwest Minnesota. Northern Minnesota also has some calcareous fens, in areas where groundwater reaches the surface within the larger peatlands. Calcareous fens support many rare plant species in Minnesota, including four species that occur nearly exclusively in these wetlands: Sterile sedge (*Carex sterilis*), Twig-rush (*Cladium mariscoides*), Fen beak (*Rhynchospora capillacea*), and Hairy fimbristylis (*Fimbristylis puberula*) (MDNR, 2015j).

Important Wetland Sites in Minnesota

- The Minnesota DNR manages over 1,440 wildlife management areas that contain nearly 1.3 million acres of wildlife habitat, some of which include wetlands (MDNR, 2015k). To learn more about state Wildlife Management Areas, visit http://www.dnr.state.mn.us/wmas/index.html.
- National Natural Landmarks (NNL) range in size from 640 acres to over 5,400 acres, and are owned by USFWS, U.S. Forest Service (USFS), University of Minnesota, Minnesota DNR, The Nature Conservancy, and private individuals (NPS, 2015a). Section 9.1.8, Visual Resources, describes Minnesota's NNLs.
- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state. These include NRCS, USFWS, Minnesota Board of Soil and Water Resources, MDNR, the State of Minnesota, and natural resource conservation groups such as state land trusts, The Nature Conservancy, and Ducks Unlimited. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), NRCS holds more than 119,000 acres in conservation easements in Minnesota (NCED, 2015).
- For more information on Minnesota's WMAs, NNLs, and conservation programs, see Section 9.1.8, Visual Resources, and Section 9.1.7, Land Use, Recreation, and Airspace.

9.1.6. Biological Resources

9.1.6.1. Definition of the Resource

This section describes the biological resources of Minnesota. 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. Because of the topographic variation within the state, Minnesota supports a wide diversity[65] of biological resources ranging from prairie settings across the western part of the state, vast wetlands concentrated to the north, and forested lands present in the northern half of the state.

9.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Minnesota are summarized in detail in Appendix C, Environmental Laws and Regulations. Table 9.1.6-1 summarizes major state laws relevant to Minnesota's biological resources.

Table 9.1.6-1: Major Minnesota Laws Relevant to Biological Resources

Law/Regulation	Regulatory Agency	Summary
Minnesota Noxious Weed Law (MS 18.75 through 18.91)	Minnesota Department of Agriculture (MDA)	This law regulates the spread of state-listed noxious weeds and their effects to "public health, the environment, public roads, crops, livestock, and other property." The law also contains information about "procedures for controlling and eradicating noxious weeds on all lands within the state." Noxious weeds are given priority ranks of eradicate, control, restricted, and specially regulated.
Invasive Species (MS 84D.01 through 84D. 15)	MDNR and MDA	Regulates the establishment of a state-wide program to control invasive aquatic plants and wild animals[66]. Divides invasive species into four classes, including prohibited, regulated, unlisted, and unregulated nonnative species.
Protection of Threatened and Endangered Species (MS 84.0895)	Minnesota Division of Fish and Wildlife (MDFW)	States that, "a person may not take, import, transport, or sell any portion of an endangered species of wild animal or plant, or sell or possess with intent to sell an article made with any part of the skin, hide, or parts of an endangered species of wild animal or plant." Establishes the list of protected species and any exceptions to the law.

[61] Terrestrial: "Pertaining to land." (USEPA, 2015q)
[62] Aquatic: "Pertaining to water." (USEPA, 2015q)
[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, 2015q)
[66] Invasive species: "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." (EPA 2015d)

9.1.6.3. Terrestrial Vegetation

The distribution of flora[67] within Minnesota is a function of the characteristic geology,[68] soils, climate,[69] and water of a given geographic area and correlates to distinct areas identified as ecoregions.[70] Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed; they depict but a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015) (World Wildlife Fund, 2015).

Ecoregion boundaries often coincide with physiographic[71] regions of an area. 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 (USEPA, 2016a). This Section provides an overview of the terrestrial vegetation resources for Minnesota at USEPA Level III. (USEPA, 2016a)

As shown in Figure 9.1.6-1, the USEPA divides Minnesota into seven Level III ecoregions. The seven ecoregions support a wide range of plant communities with varying types of prairies and grasslands, agriculture, wetlands, and forests. To the west, glaciers previously existed on many of the plains making the soils extremely fertile and allowing for pothole and seasonally flooded wetlands. Vast forested communities exist within Minnesota and are primarily concentrated in the north and central part of the state. Wetlands make up a large part of the state, and are primarily concentrated in the north part of the state, but lakes and other waters are scattered throughout all of Minnesota (USEPA, 2015s). Table 9.1.6-2 provides a summary of the general abiotic[72] characteristics, vegetative communities, and the typical vegetation found within each of the seven Minnesota ecoregions.

[67] Flora: The plants of a particular region, habitat, or geological period.
[68] Geology: "The study of the planet earth - the materials it is made of, the processes that act on those materials, the products formed, and the history of the planet and its life forms since its origin." (USEPA, 2015q)
[69] 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, 2015q)
[70] Ecoregion: "A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables." (USEPA, 2015q)
[71] Physiographic: "The natural, physical form of the landscape." (USEPA, 2015d)
[72] 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, 2016f)

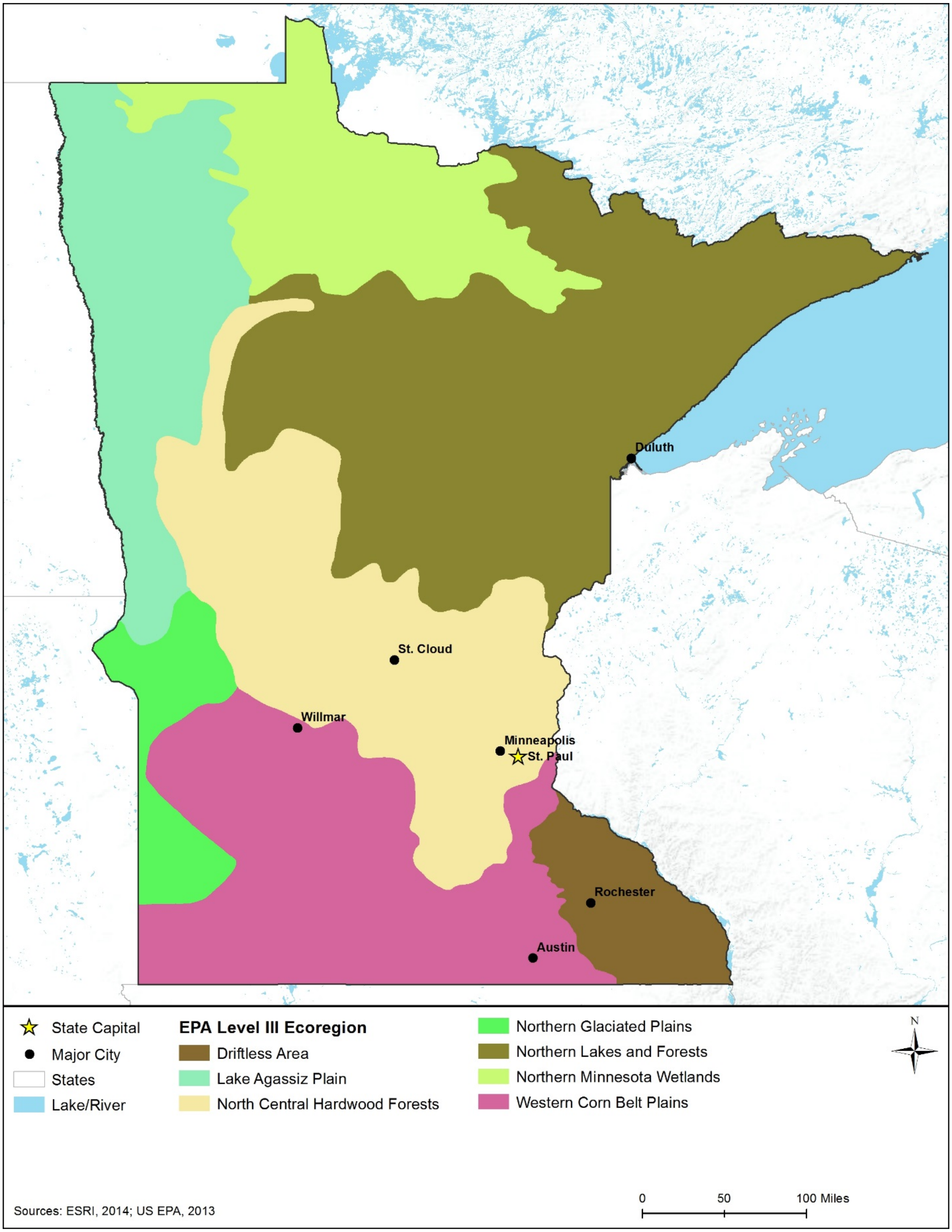


Figure 9.1.6-1. USEPA Level III Ecoregions of Minnesota

Table 9.1.6-2: USEPA Level III Ecoregions of Minnesota

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Southern Plains and Driftless Area				
46	Northern Glaciated Plains	A flat and gently rolling landscape with tall and short grass prairies and seasonal wetlands. Some agriculture is present, but very dependent on climatic conditions.	Seasonal emergent wetlands, rolling plains, flat plains	• **Deciduous Trees** – bur oak (*Quercus macrocarpa*), paper birch (*Betula papyrifera*), aspen (*Populus* sp.), and boxelder (*Acer negundo*). • **Shrubs –** red osier dogwood (*Cornus sericea*), serviceberry (*Amelanchier* spp.), and snowberry (*Symphoricarpos* sp.). • **Herbaceous –** green needlegrass (*Nassella viridula*), needle and thread grass (*Hesperostipa comata*), blue grama (*Bouteloua gracilis*), little bluestem (*Schizachyrium scoparium*), western wheatgrass (*Pascopyrum smithii*).
47	Western Corn Belt Plains	A flat and gently rolling plain region with fertile soil, temperate climate, and regular precipitation. Agricultural productivity is high in the region.	Deciduous riparian woodlands, tallgrass prairie	• **Deciduous Trees -** cottonwood (*Populus* sp.), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), boxelder. • **Herbaceous –** big bluestem (*Andropogon gerardii*), little bluestem, Indiangrass (*Sorghastrum nutans*), green needlegrass, needle and thread grass, prairie dropseed (*Sporobolus heterolepis*).
48	Lake Agassiz Plain	Lake Agassiz was a proglacial lake that previously filled the area and left behind thick lacustrine sediments. An extremely flat area that once was tallgrass prairie is now primarily used as agriculture.	Glacial lake plains, deciduous riparian woodlands	• **Deciduous Trees –** cottonwood, American elm, green ash, and willow (*Salix* spp.). • **Herbaceous –** wheatgrass spp. (*Pascopyrum* spp.), big bluestem, little bluestem, Indiangrass, switchgrass (*Panicum virgatum*), and saltgrass (*Distichlis spicata*).

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
52	Driftless Area	A hilly upland area distinguished from surrounding areas by a loess-capped plateau that is dissected by many streams. There is evidence of glacial drift in this region, as glacial deposits have had little effect on the landscape compared to glacial effects in adjacent regions. Major agricultural land uses consist of livestock and dairy farming.	Mixed Woodland, Oak Forests, Savannas, Large Prairie Grasslands, Sugar-Maple/Basswood Oak Forests	• **Hardwood Trees –** red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), Hill's oak (*Quercus ellipsoidalis*), bur oak (*Quercus macrocarpa*), red oak (*Quercus borealis*), basswood (*Tilia Americana*), black ash (*Fraxinus nigra*), black oak (*Quercus velutina*), American beech (*Fagus grandifolia*).
Geographic Region: Northern Forests, Wetlands, and Lakes				
49	Northern Minnesota Wetlands	A transitional flat region mostly covered by standing water in marshes and other wetlands, forests, and river channels.	Forested lake plains, peatlands	• **Deciduous Trees –**black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), mountain maple (*Acer spicatum*), glossy buckthorn (*Rhamnus frangula*). • **Coniferous Trees –** black spruce (*Picea mariana*), northern white-cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), tamarack (*Larix laricina*).
50	Northern Lakes 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 thick and lack arability.	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 pine (*Pinus banksiana*), red pine (*Pinus resinosa*), white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*). • **Hardwood Trees –** yellow birch (*Betula alleghaniensis*), paper birch, sugar-maple (*Acer saccharum*), basswood (*Tilia Americana*), Hill's oak (*Quercus ellipsoidalis*), bur oak, red oak (*Quercus borealis*).

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
51	North Central Hardwoods	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, paper birch, red maple, sugar maple, Hill's oak, bur oak, red oak, basswood, black ash, black oak (*Quercus velutina*), beech (*Fagus grandifolia*).

Source: (USEPA, 2007) (Fenneman, 1916) (Omernik & Gallant, 2010)

Communities of Concern

Minnesota 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[73] that could result from implementation of an action.

The MDNR manages a list of all types of natural communities known to occur, or that have historically occurred, in the state. Minnesota has its own ranking system. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. The U.S. National Vegetation Classification (USNVC) ranking system assesses rarity using a state rank (S1, S2, S3, S4, and S5) that indicates its rarity within Minnesota. Communities ranked as an S1 by the USNVC 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.

Twelve vegetative communities are ranked as S1 communities[74] in Minnesota. A description of the communities of conservation concern in Minnesota along with their state rank, distribution, abundance, and the associated USEPA Level III ecoregions, can be found in Minnesota Appendix A. These communities represent the rarest terrestrial habitat in the state. The communities can be found scattered throughout the state, with some being concentrated in rarest areas.

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive plants. Direct impacts to nuisance and invasive plants may be viewed as beneficial to the environment, but such impacts often result in the inadvertent and unintended spread and dispersal of these species. Construction sites in particular provide colonizing opportunities for nuisance and invasive species, and long-term maintenance activities can perpetuate a disturbance regime that facilitates a continued dispersal mechanism for the spread of these species. Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently (Government Printing Office, 2011); however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas 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

[73] 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, 2015q)

[74] S1 – Communities at high risk because of extremely limited and/or rapidly declining population numbers, range, and/or habitat, making it highly vulnerable to global extinction or extirpation in the state. (MDNR, 2011)

2014, 112 federally recognized noxious weed species have been catalogued in the U.S. (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2014), of which 29 are known to occur in Minnesota.

Noxious weeds are a threat to Minnesota's rangeland,[75] cropland, pastureland,[76] forests, wetlands, and wildlands. The Minnesota Noxious Weed Control Act (MS 18.75 through 18.91) purpose is to protect the public from the "injurious effects" of listed noxious weeds, and provides information regarding "procedures for controlling and eradicating noxious weeds on all lands within the state." A total of 29 state-listed noxious weeds/complexes are regulated in Minnesota as set forth in the Minnesota Noxious Weed Law (MS 18.75 through 18.91). One of these species occur on the Federal Noxious Weed List (USDA, 2014). Of these species/complexes, 27 of them are terrestrial and two are aquatic species (MDA, 2015). The following species by vegetation type are regulated in Minnesota.

- **Aquatic –** Purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis ssp. australis*)
- **Shrubs –** Common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Frangula alnus*)
- **Terrestrial Forbs and Grasses –** black swallow-wort (*Cynanchum louiseae*), brown knapweed (*Centaurea jacea*), Canada thistle (*Cirsium arvense*), common tansy (*Tanacetum vulgare*), common teasel (*Dipsacus fullonum*), cut-leaved teasel (*Dipsacus laciniatus*), Dalmatian toadflax (*Linaria dalmatica*), garlic mustard (*Alliaria petiolata*), giant hogweed (*Heracleum mantegazzianum*), giant knotweed (*Polygonum sachalinense*), Grecian foxglove (*Digitalis lanata*), Japanese barberry (*Berberis thunbergii*), Japanese hops (*Humulus japonicus*), Japanese knotweed (*Polygonum cuspidatum*), leafy spurge (*Euphorbia esula*), meadow knapweed (*Centaurea x moncktonii*), multiflora rose (*Rosa multiflora*), narrowleaf bittercress (*Cardamine impatiens*), oriental bittersweet (*Celastrus orbiculatus*), palmer amaranth (*Amaranthus palmeri*), plumeless thistle (*Carduus acanthoides*), poison ivy (*Toxicodendron radicans*), spotted knapweed (*Centaurea stoebe ssp. micranthos*), wild parsnip (*Pastinaca sativa*), yellow star thistle (*Centaurea solstitialis*)

In addition to the regulation of noxious weeds, the state of Minnesota also has a Plant Pest Control Act (MS 18G.01 through 18G.16) that regulates other plant pests not characterized as noxious weeds. The Act specifically authorizes the commissioner "to abate, suppress, eradicate, prevent, or otherwise regulate the introduction or establishment of plant pests that threaten Minnesota's agriculture, forest, or horticultural interests or the general ecological quality of the state."

[75] Rangeland: "A Land cover/use category on which the climax or potential plant cover is composed principally of native grasses, grasslike plants, forbs or shrubs suitable for grazing and browsing, and introduced forage species that are managed like rangeland." (USEPA, 2015q)

[76] Pastureland: "Land used primarily for the production of domesticated forage plants for livestock." (USEPA, 2015q)

9.1.6.4. Terrestrial Wildlife

This section discusses terrestrial wildlife species in Minnesota, divided among mammals,[77] birds,[78] reptiles and amphibians,[79] and invertebrates.[80] Terrestrial wildlife consist of those species, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals, furbearers, nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Minnesota. 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 65 mammal species (MDNR, 2015l), 34 reptile species, 19 amphibian species (MDNR, 2015m), and over 440 bird species (MOU, 2015).

Mammals

Common and widespread mammalian species in Minnesota include beaver (*Castor canadensis*), badger (*Taxidea taxus*), and white-tailed deer (*Odocoileus virginianus*). Most mammals are widely distributed in the state; however, there are some species, such as the bison (*Bison bison*), which are found on a few protected lands throughout the state, and Canada lynx (*Lynx canadensis*), which are primarily found on the extreme northern part of the state (MDNR, 2015l). A number of threatened and endangered mammals are located in Minnesota. *S*ection 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

In Minnesota white-tailed deer, black bear (*Ursus americanus*), elk (*Cervus canadensis*), and moose (*Alces alces*) are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), and upland and migratory game birds. The following 11 species of furbearers may be legally hunted or trapped in Minnesota: badger (*Taxidea taxus*), beaver, bobcat (*Lynx rufus*), coyote (*Canis latrans*), fisher (*Martes pennanti*), pine marten (*Martes americana*), red fox (*Vulpes vulpes*), mink (*Neovison vison*), opossum (*Didelphis virginiana*), otter (*Lontra canadensis*), and raccoon (*Procyon lotor*). (MDNR, 2015l)

Minnesota has identified 22 mammals as Species of Greatest Conservation Need (SGCN). The SGCN list consists of at-risk species that are rare or declining, and can provide funding from State Wildlife Grants for efforts to reduce their potential to be listed as endangered. Although these species have been targeted for conservation, they are not currently under legal protection. (Minnesota Legislative Reference Library, 2007)

[77] 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, 2015q)
[78] Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves.” (USEPA, 2015q)
[79] 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, 2015q)
[80] Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015q)

Birds

The number of native bird species documented in Minnesota varies according to the timing of the data collection effort, changes in bird taxonomy,[81] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., wetlands, large rivers and lakes, plains, forests, etc.) found in Minnesota support a large variety of bird species. As of 2015, over roughly 440 species of resident and migratory birds have been documented in Minnesota (MOU, 2015), with 266 of them documented as breeding in the state (MDNR, 2016e). Among the 440 plus extant[82] species in Minnesota, 97 SGCN have been identified (Minnesota Legislative Reference Library, 2007).

Minnesota is located within the Mississippi Flyway, which spans the Great Lakes watershed, Mississippi River valley, and the Gulf Coast. The Mississippi Flyway generally follows the Mississippi River valley and Mississippi River delta in the United States (Audubon Society, 2015a). Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations" (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in the entire state all year, and Minnesota has the third largest breeding population in the nation. The majority of bald eagles are found in the northern half of the state, near the St. Croix and Mississippi Rivers, but they are starting to expand their range into the southern half of the state (MDNR, 2015ae). Golden eagles are found in a variety of habitats within their range, but they generally nest on mountains and cliffs. Golden eagles are uncommon in Minnesota, but occasional reports of the species have been made in the spring, fall, and winter (MDNR, 2015af).

A number of Important Bird Areas (IBAs) have also been identified in Minnesota, as can be seen in Figure 9.1.6-2. 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

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

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

According to the Audubon Society, a total of 54 IBAs, providing over 11 million acres of land, have been identified in Minnesota, including breeding,[83] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, grasslands, sage brush, and wetland/riparian[84] areas. These IBAs are widely distributed throughout the state, although the largest concentration of IBAs are located in the northern half of the state, within the Northern Lakes and Forests and the Northern Minnesota Wetlands ecoregions. IBAs in Minnesota vary greatly in habitat types, and include wetlands, forests, and prairies among many other landscapes that are key habitats for many migrating birds. The Big Bog IBA is considered one of the most unique areas to the state and provides woodlands, lakes, and wetlands which provide habitat for over 289 species in the state of Minnesota. Other IBAs such as the Superior National Forest provides a diverse, contiguous, forest and also contains the Boundary Waters Wilderness Area. (MDNR, 2016d)

A number of threatened and endangered birds are located in Minnesota. Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[83] Breeding range: "The area utilized by an organism during the reproductive phase of its life cycle and during the time that young are reared." (USEPA, 2015q)
[84] 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, 2015q)

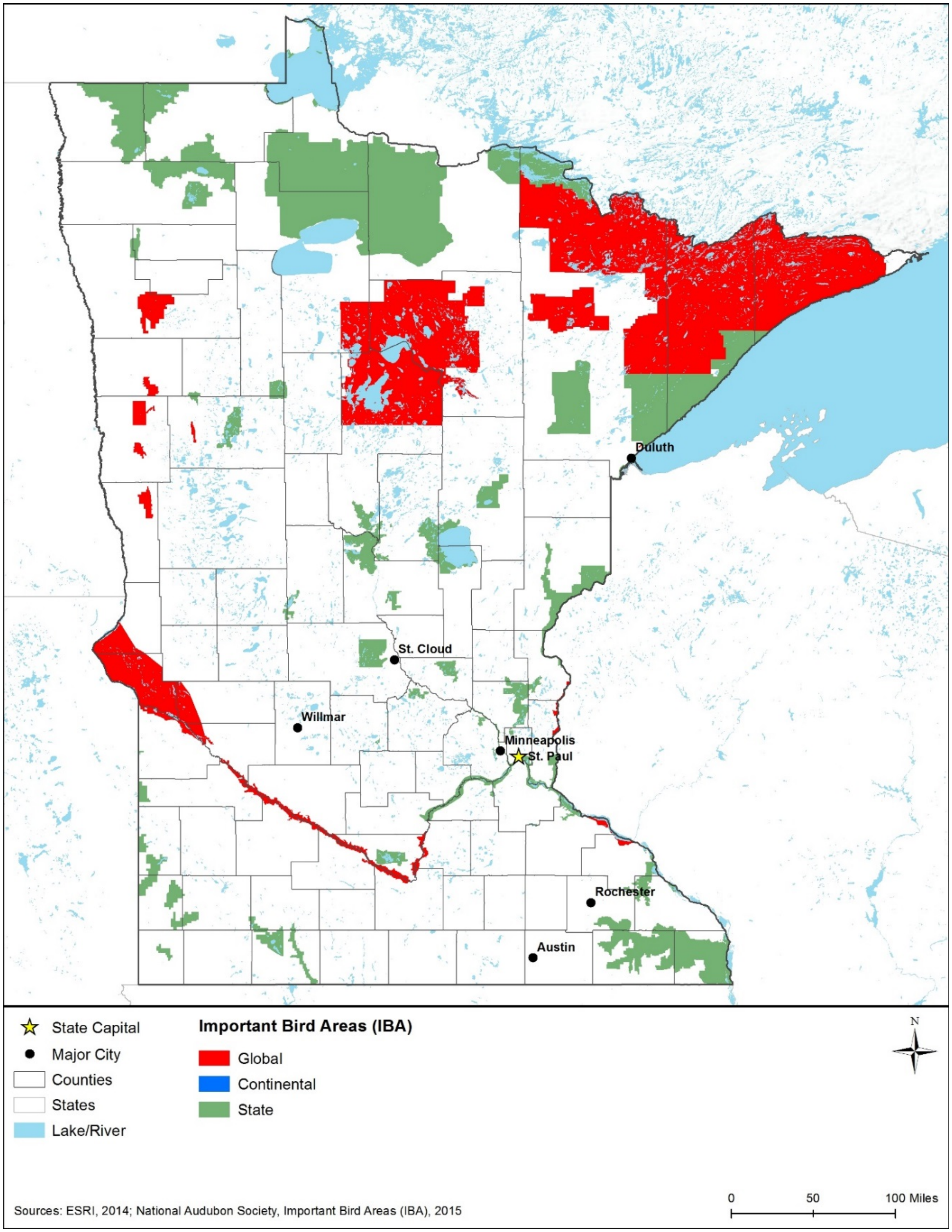


Figure 9.1.6-2: Important Bird Areas (IBAs) of Minnesota

Reptiles and Amphibians

A total of 53 reptile and amphibian species occur in the state of Minnesota, including 6 salamanders, 13 frogs and toads, 9 turtles, 3 lizards, and 22 snakes (Minnesota Legislative Reference Library, 2007) (USFWS, 2015c). Minnesota has a wide variety of herptile diversity, with species living in forest, prairie, wetland, and riparian communities around the state. Of the 53 reptile and amphibian species, 23 SGCN have been identified (Minnesota Legislative Reference Library, 2007).

Minnesota's turtle, toad, and frog species are classified as nongame species. Several rules are established to regulate the possession and sale of any species. Live frogs are not permitted to be imported into the state without a specialized permit unless they are to be used as bait (Minnesota Administrative Rule [MAR] 6256.0300). Additionally, any individual desiring to sell frogs and toads must first obtain a permit (MS 97C.601). Native turtles may be imported into the state if they were originally caught in a legal manner and the importer obtains a Minnesota permit (MS 17.4985). All turtles, except for common snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), and spiny softshell turtle (*Apalone spinifera*), may not be kept or sold as pets in Minnesota, and a permit is required to sell the three allowable species (MAR 6256.0500). There are no regulations regarding lizard, snakes, and salamanders unless the species is protected as a state or federal threatened or endangered species (MDNR, 2015m).

Invertebrates

Minnesota is home to numerous species of invertebrates, including a wide variety of flies, moths, wasps, bees, ants, and beetles. A total of 64 insect species are considered SGCN. This lists includes eight different jumping spiders, 13 caddisflies, and nine tiger beetles among many other species. There are also two federally-listed species on the SGCN list, including the candidate species Dakota skipper (*Hesperia dacotae*) and the endangered Karner blue (*Lycaeides melissa samuelis*) (Minnesota Legislative Reference Library, 2007). The Dakota skipper requires native prairie habitat in the western part of the state. It has significantly reduced populations due to habitat conversion to agriculture. It is currently present in 11 counties in the western part of the state (USFWS, 2015q). The Karner blue has a naturally patchy distribution because it requires specialized habitat containing a larval host plant, wild blue lupine (*Lupinus perennis*). In Minnesota, limited habitat is available for the species due to wild blue lupine reaching its western-most range in the middle of the state and due to development and succession of appropriate habitat. The Karner blue is currently present in only two locations in the state (MDNR, 2016h).

Invasive Wildlife Species

Minnesota maintains a list of prohibited invasive species (MS 84D.05), which includes some terrestrial mammals such as Asian raccoon dog (*Nyctereutes procyonoides*), European rabbit (*Oryctolagus cuniculus*), and European wild boar (*Sus scrofa scrofa*) (MDNR, 2015ag). In Minnesota, it is "unlawful to possess, import, purchase, transport, or introduce" listed prohibited species unless a specialized permit is obtained. The state also maintains a list of regulated invasive species (MS 84D.07), which includes terrestrial wildlife species such as Egyptian goose

(*Alopochen aegyptiacus*), mute swan (*Cygnus olor*), and Sichuan pheasant (*Phasianus colchicus strachi*) (MDNR, 2015ag). In Minnesota, mute swans could impact native waterfowl and wetland birds causing nest abandonment or impacts to rearing young due to their aggressive behavior. Further, this invasive bird could lead to declines in submerged aquatic vegetation that support native fish and other wildlife (MDNR, 2015n).

Invasive insects could pose a threat to Minnesota's forest and agricultural resources. Species such as the gypsy moth (*Lymantria dispar*), emerald ash borer (*Agrilus planipennis*), and Asian longhorn beetle (*Anoplophora glabripennis*) are known to cause irreversible damage to native forests.

In Minnesota, it is "legal to possess, sell, buy, and transport regulated invasive species, but they may not be introduced into a free-living state" (MS 84D.07).

9.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Minnesota, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in the state of Minnesota. However, critical habitat for threatened and endangered fish species, as defined by the ESA, does exist within Minnesota and is discussed in Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern. Also, there are special conservation areas throughout the states, including cold water trout streams, which are preferred for spawning in such areas.

Freshwater Fish

Minnesota is home to populations of more than 80 species of freshwater fish, ranging in size from small darters and minnows to larger species such as salmon and sturgeon (MDNR, 2015ah). Of the 80 plus species, 47 species are listed as SGCN. This list may not contain a complete list of all Minnesota fish species, as limited information was available on general wildlife species, but extensive information was available regarding species status fish species. These species are grouped into 19 families; a brief description of those families that contain common species, notable sport fish species, or species of concern is listed below (Minnesota Legislative Reference Library, 2007) (MDNR, 2015ah).

One species of basal ray-finned fish, the bowfin (*Amia calva*), occurs in Minnesota. This species can be found in slow-moving streams and clear lakes (MDNR, 2015ah). Bowfin typically are found in deeper waters in daytime and shallower waters at night. Adult bowfin are piscivorous[85], but also may eat crayfish and frogs. Bowfin spawn in spring and eggs typically hatch in eight to ten days (Texas Division of Parks and Wildlife, 2015).

The bullheads/catfishes family includes six species, which include the channel catfish (*Ictalurus punctatus*), yellow bullhead (*Ameiurus natalis*), black bullhead (*Ameiurus melas*), brown bullhead (*Ameiurus nebulosus*), flathead catfish (*Pylodictis olivaris*), and slender madtom

[85] Piscivorous: A fish-eating animal (USEPA, 2015q).

(*Noturus exilis*). Catfish prefer large rivers and lowland lakes and can be found in the Red of the North, Minnesota, Mississippi, and St. Croix rivers (MDNR, 2015ah). The slender madtom is considered an SGCN and is very rare in the state, with the last records of it occurring being in 2008. The slender madtom prefers spring-fed perennial creeks with limestone, rubble, or gravel substrates intermixed with sand (MDNR, 2015ai).

The codfish family includes one species, burbot (*Lota lota*), which is native to Minnesota. Burbot may be caught and eaten by anglers. They are voracious predators and therefore are able to be caught with many lures. Burbot are most commonly found in colder waters in Minnesota (MDNR, 2015ah).

The drum family includes one species, freshwater drum (*Aplodinotus grunniens*). Freshwater drum are the only drum species that live entirely in freshwater. This species can be found in deep rivers and lakes, in calm, still water. (MDNR, 2015ah)

One species of eel, the American eel (*Anguilla rostrate*), is present within Minnesota and is considered an SGCN. This species can be found in warm and cool water rivers and tributaries. Very limited information is available about the distribution of this species within the state (MDNR, 2015ai).

The longnose gar (*Lepisosteus osseus*) is the only species of gar in Minnesota. It can be found in warm, still waters in southern and central Minnesota (MDNR, 2015ah).

One killifish species is present in Minnesota, the plains topminnow (*Fundulus sciadicus*), which is considered a SGCN. The plains topminnow is uncommon in the state and declining due to habitat siltation and drought. It prefers stillpools and backwaters with ample vegetation. This species is found in drainages only in the southwestern part of the state in the Rock River system (MDNR, 2015ai).

Three lamprey species, northern brook lamprey (*Ichthyomyzon fossor*), southern brook lamprey (*Ichthyomyzon gagei*), and American brook lamprey (*Lampetra appendix*), exist in Minnesota and all three are considered SGCN (Minnesota Legislative Reference Library, 2007). The northern brook lamprey was discovered in Minnesota in 1986 and was found in the northeastern and southeastern parts of the state. The southern brook lamprey is confined to a few counties in the eastern part of the state (MDNR, 2015ai). The American brook lamprey is found in the streams of the southeastern corner of the state (MDNR, 2008).

Many species of minnows occur in Minnesota, and 14 minnow species are considered SGCN. SGCN include several chub, shiner, minnow, and dace species. One species, the Topeka shiner, is a federally-endangered species (Minnesota Legislative Reference Library, 2007). Once common in Minnesota, this species now only inhabits 10 percent of its entire historic range. Topeka shiner prefer stream oxbows and pools with slow-moving water with sand or gravel substrates (MDNR, 2015ai). Another species, the largescale stoneroller is the only stoneroller in the group and can be found in the St. Croix and Mississippi drainages, but is rare in the Minnesota drainage (Minnesota Legislative Reference Library, 2007).

The paddlefish family in Minnesota is comprised of just one species, which is listed as a SGCN (Minnesota Legislative Reference Library, 2007). Paddlefish (*Polyodon spathula*) inhabit slow or quiet areas of large rivers or reservoirs and river oxbows, and is only found in the St. Croix and Mississippi Rivers and in Lake Pepin and Lake St. Croix in Minnesota (MDNR, 2015ai).

A total of 10 species of perches occur in Minnesota, including large members such as yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), and sauger (*Sander canadensis*). Pirate perch (*Aphredoderus sayanus*) are also present and are considered an SGCN in Minnesota. Darters are also included and are much smaller than the other species included, and rarely exceed 4 inches in length. Crystal darter (*Ammocrypta asprella*), western sand darter (*Ammocrypta clara*), mud darter (*Etheostoma asprigene*), bluntnose darter (*Etheostoma chlorosoma*), least darter (*Etheostoma microperca*), and gilt darter (*Percina evides*) are all considered Minnesota SGCN (MDNR, 2015ai).

Three species of pikes/pickerals occur in Minnesota's waters, the northern pike (*Esox lucius*), the tiger muskellunge (*Esox masquinongy* x *Esox lucius*), and pure muskellunge (*Esox masquinongy)*. Tiger muskellunge are a hybrid between northern pike and pure muskellunge and are stocked in many urban metro waters. Northern pike populations in Minnesota vary greatly in size but are present throughout much of the state. (MDNR, 2015ah)

Two species in the sculpin family, spoonhead sculpin (*Cottus ricei*) and the deepwater sculpin (*Myoxocephalus thompsoni*), are present in Minnesota and both are considered SGCN. Limited information is available regarding the distribution and habitat preference of these species in the state, but it is known that they only exist in Lake Superior and one inland lake (Minnesota Legislative Reference Library, 2007) (MDNR, 2015ai).

Two species are in the shad/herring family, bloater (*Coregonus hoyi*) and skipjack herring (*Alosa chrysochloris*), are present in Minnesota and are considered SGCN (MDNR, 2015ah). Skipjack herring was once abundant in Minnesota; however, dam construction has now limited their range and they were even considered extirpated from the state for some time. They now are present in Lake Pepin in deep, fast-flowing clear waters with sand or gravel substrates (MDNR, 2015ai).

The sturgeon family is comprised of two species in Minnesota, lake sturgeon (*Acipenser fulvescens*) and shovelnose sturgeon (*Scaphirhynchus platorynchus*), both of which are listed as SGCN. Lake sturgeon were once very common in the state, but pollution and overfishing have decreased their populations. They prefer large rivers and lakes with moderately clear waters and sand, gravel, or rubble substrates. They can be found in the Mississippi, St. Croix, Red, and Rainy rivers and Lake Superior, Lake of the Woods, and in waterbodies in the Boundary Waters Canoe Area (MDNR, 2015ah).

The sucker family includes six species in Minnesota (MDNR, 2015ah). The bigmouth buffalo (*Ictiobus cyprinellus*) is the largest member of the sucker family and can be found in lakes and rivers in Minnesota. Another species, the white sucker (*Catostomus commersonii*), is one of the most common fish in Minnesota and occurs in streams and lakes throughout the entire state. One species, blue sucker (*Cycleptus elongatus*), is listed as a SGCN (Minnesota Legislative Reference Library, 2007). It can be found in main channel areas of large- or medium-sized rivers with sand, gravel, or rubble substrates, including the Mississippi, Minnesota, and St. Croix rivers (MDNR, 2015ai). Three redhorse species are also present, river redhorse (*Moxostoma* *carinatum*), black redhorse (*Moxostoma duquesnei*), and greater redhorse (*Moxostoma valenciennesi*), and are all three SGCN (Minnesota Legislative Reference Library, 2007).

The sunfish family includes 12 species, many of which are highly popular with sport fishermen. Two species, largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*), are found throughout the state and often sought after by anglers. One of the most commonly encountered species is bluegill (*Lepomis macrochirus*). White crappie (*Pomoxis annularis*) and black crappie (*Pomoxis nigromaculatus*) are also present and black crappie are much more widely distributed in the state (MDNR, 2015ah). Two species, warmouth (*Lepomis gulosus*) and longear sunfish (*Lepomis megalotis*), are rare in the state and are considered SGCN (Minnesota Legislative Reference Library, 2007).

White bass (*Morone chrysops*) and yellow bass (*Morone mississippiensis)* are the only two species in the temperate bass family present in Minnesota. Yellow bass can be found below Lake Pepin, in the backwaters of the Mississippi River and white bass can be found in the Minnesota, Mississippi, and the St. Croix rivers (MDNR, 2015ah). White bass are very common within the state, but yellow bass are rarer and are considered an SGCN (Minnesota Legislative Reference Library, 2007).

Minnesota has 12 species in the salmon/trout family (AGFD 2011; (MDNR, 2015ah). Two species, the brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) are non-native to the state and have been stocked in waters since the 1800s. Lake trout (*Salvelinus namaycush*) and brook trout (*Salvelinus fontinalis)* are both native to the state and can be found in numerous waters throughout the state (MDNR, 2015ah). Salmon species present include Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), and pink salmon (*Oncorhynchus gorbuscha*). All three were introduced into Lake Superior where they reside most of the time, until they swim upstream in Minnesota Rivers to spawn and die (MDNR, 2015ah). This family contains four SGCN, including shortjaw cisco (*Coregonus zenithicus*), kiyi (*Coregonus kiyi*), nipigon cisco (*Coregonus nipigon*), and pygmy whitefish (*Prosopium coulteri*) (Minnesota Legislative Reference Library, 2007).

Shellfish and Other Invertebrates

Limited information is available regarding freshwater invertebrate species in the state. Many species exist within the state, including various crayfish, mollusks, and aquatic insects. A total of six crayfish species are present in Minnesota (Helgen, 1990). Two species are non-native to the state and are regulated. Rusty crayfish (*Orconectes rusticus*) is a regulated species and red swamp crayfish (*Procambarus clarkii*) is a prohibited species in the state (MDNR, 2015ag). Minnesota provides habitat for 48 native mussel species (MDNR, 2015aj) and a total of 39 species are considered SGCN (Minnesota Legislative Reference Library, 2007). Mussels inhabit the many waters of Minnesota, including lakes, rivers, and streams. Mussels are indicator species of stream health and have declined rapidly due to poor water quality within the state and nation (MDNR, 2015aj).

Invasive Aquatic Species

Minnesota maintains a list of prohibited invasive species (MS 84D.05), which includes over 15 invasive aquatic plants, 23 invasive fish, and 6 invasive aquatic invertebrate species (MDNR, 2015ag). In Minnesota, it is "unlawful to possess, import, purchase, transport, or introduce" listed prohibited species unless a specialized permit is obtained. The state also maintains a list of regulated invasive species (MS 84D.07), which includes seven invasive aquatic plants, five invasive fish, and four invasive aquatic invertebrate species (MDNR, 2015ag). In Minnesota, it is "legal to possess, sell, buy, and transport regulated invasive species, but they may not be introduced into a free-living state" (MS 84D.07).

9.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

The USFWS is responsible for administering the ESA (16 U.S.C § 1531 *et seq*.); 10 endangered and 9 threatened species known to occur in Minnesota. Of these 19 federally listed species, 6 have designated critical habitat[86] (USFWS, 2016a). The 19 listed species include 3 mammals, 2 birds, 1 reptile, 1 fish, 8 invertebrates, and 4 plants (USFWS, 2016a) are discussed in detail under the following sections. Federal land management agencies maintain lists of species of concern for their landholdings; these lists are not discussed below as they are maintained independently from the ESA. For future site-specific analysis on those lands, consultation with the appropriate land management agency would be required.

Mammals

Three threatened mammal species are federally listed for Minnesota as summarized in Table 9.1.6-3. The Canada lynx *(Lynx Canadensis)* and gray wolf *(Canis lupus)* occur in northern Minnesota. The northern long-eared bat *(Myotis septentrionalis)* occurs throughout Minnesota. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Minnesota is provided below.

[86] 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))

Table 9.1.6-3: Federally Listed Mammal Species of Minnesota

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Minnesota	Habitat Description
Canada Lynx	*Lynx canadensis*	T	Yes; Cook, Koochiching, Lake, and St. Louis counties, northeastern Minnesota.	Boreal forests; found in 14 counties in northern Minnesota.
Gray Wolf	*Canis lupus*	T	Yes; areas of Beltrami, Cook, Itasca, Koochiching, Lake, Lake of the Woods, Roseau, and St. Louis counties, northern Minnesota.	Higher elevation forests adjacent to grasslands; found in 26 counties in Minnesota.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Trees and snags, caves, and abandoned mines; found in 87 counties in Minnesota.

[a] T = Threatened

Source: (USFWS, 2016a)

Canada Lynx. The Canada lynx is a 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 Canada lynx populations, occurring on public lands in the Rocky Mountains, and to the west of Lake Superior. In Minnesota, it can be found in 14 counties in the northern part of the state (USFWS, 2013b). Critical habitat was designated in 2014 (79 FR 54781 54846, September 12, 2014) *in* Cook, Koochiching, Lake, and St. Louis counties, northeastern Minnesota (USFWS, 2014a).

Canada Lynx Photo credit: USFWS

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 accidental injury or death of a lynx from hunting or trapping is possible, available data do not indicate this to be a cause for low species densities. (USFWS, 2013b) (USFWS, 2005a)

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 6 feet, weighs approximately 100 pounds, and typically lives up to five years (USFWS, 2015s). 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. In 2012, gray wolves were "completely removed from the federal Endangered Species List" (MDNR, 2016f). However, two years later, in 2014, federal ESA protections for gray wolves were reinstated and the gray wolf population in Minnesota was once again listed as threatened (MDNR, 2016f). 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. Within Minnesota, it is found in 26 counties in the northern half of the state (USFWS 2015). Critical habitat was designated in 1978 (43 FR 9607 9615, March 9, 1978) in areas of Beltrami, Cook, Itasca, Koochiching, Lake, Lake of the Woods, Roseau, and St. Louis counties, northern Minnesota (USFWS, 1978) (USFWS, 2010a).

Habitat for the gray wolf includes dense woodlands in mountainous regions where large ungulate species (hoofed mammals) are found, adjacent to grasslands. As a top predator and keystone species in 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)

Northern Long-eared Bat. The northern long-eared bat is a brown furred, insectivorous bat with long ears. This bat is medium-sized, relative to other members of the genus *Myotis*, reaching a total length of 3 to 3.7 inches in length (USFWS, 2015f). This species 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 Minnesota, it can be found throughout the entire state (USFWS, 2015g).

This species hibernates in caves and mines that exhibit constant temperatures, high humidity, and no air currents. In the summer, they roost singly or in colonies beneath bark, or in crevices or cracks of both live and dead trees. Although mating occurs in the fall, fertilization occurs following hibernation, from which pregnant females then migrate to summer areas where they roost in small colonies. (USFWS, 2015f)

White Nose Syndrome is the leading cause for the decline of this species. The numbers of northern long-eared bats in hibernacula has decreased by 99 percent in the northeast U.S. (USFWS 2015g). Other threats include temperature or air flow impacts to their hibernating habitat, forest management practices that are incompatible with this species' habitat needs, habitat fragmentation, and wind farm operations (USFWS, 2015f).

Birds

One endangered and one threatened bird species are federally listed for Minnesota as summarized in Table 9.1.6-4 the piping plover *(Charadrius melodus)* can be found in northern Minnesota. The red knot *(Calidris canutus rufa)* can be found throughout Minnesota. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Minnesota is provided below.

Table 9.1.6-4: Federally Listed Bird Species of Minnesota

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Minnesota	Habitat Description
Piping Plover	*Charadrius melodus*	E	Yes; Rocky Point, Pine and Curry Island, and Morris Point, in Lake of the Woods County, northern Minnesota.	Open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Found in Lake of the Woods County, northern Minnesota.
Red Knot	*Calidris canutus rufa*	T	No	Found around bays and shorelines throughout Minnesota.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2016a)

Piping Plover Photo credit: USFWS

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, and the Virgin Islands (50 FR 50726 50734, Dec 11, 1985). In Minnesota, the bird can be found in Lake of the Woods County, in the northern part of the state (USFWS, 2015h). Critical habitat was designated in 2002 (67 FR 57638 57717, September 11, 2002) within Minnesota at Rocky Point, Pine and Curry Island, and Morris Point (Lake of the Woods County) (USFWS, 2001).

Piping plover are found on open, sandy beaches and on mudflats and sandflats (USFWS, 2001). 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 wetlands in the Northern Great Plains. 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, flooding from coastal storms, and environmental contaminants (USFWS, 2015j) (USFWS, 2015i).

Red Knot. The red knot is approximately nine inches in length with a wing-span 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, 2005b) (USFWS, 2014b). In Minnesota, the red knot can be found throughout the state (USFWS, 2015k).

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).

Reptiles

One reptile species is federally listed for Minnesota (Table 9.1.6-5). The eastern massasauga *(Sistrurus catenatus)* occurs in southeastern Minnesota. Information on the habitat, distribution, and threats to the survival and recovery of this species in Minnesota is provided below.

Table 9.1.6-5: Federally Listed Reptile Species of Minnesota

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Minnesota	Habitat Description
Eastern Massasauga	*Sistrurus catenatus*	T	No	Wet areas such as wet prairies, river bottomlands, floodplains, and marshes in western Pennsylvania/Lake Erie region. Found in Houston, Wabasha, and Winona counties in the southeastern corner of Minnesota.

T = Threatened

Source: (USFWS, 2016a)

Eastern Massasauga. The eastern massasauga is a small thick-bodied rattlesnake, averaging a length of about 2 feet. It is grey or light brown with large chocolate brown blotches on its back and sides (USFWS, 2015m). Regionally this species is known to occur in isolated populations from western New York to southern Iowa (USFWS, 2013c). In Minnesota, it can be found in Houston, Wabasha, and Winona counties in the southeastern corner of the state. The eastern massasauga has been a candidate species for listing under the ESA since 1999 (64 FR 57535 57547, December 25, 1999), but was recently reclassified proposed for listing in 2015 (USFWS, 2015m) (USFWS, 2016b).

The preferred habitat for this species are wet areas such as river bottomlands, floodplains, wet prairies, and marshes. However, relatively drier habitats are often used in summers. They feed primarily on small rodents, but may also consume frogs, other snakes, and nesting birds. Breeding generally occurs during summer or early fall, although it can occur anytime in the spring. Additionally, this species is different from other rattlesnakes as it hibernates alone in wet areas, often in crayfish burrows and usually under logs or tree roots. (USFWS, 2013c)

Current threats include habitat alteration, human fragmentation, and mortality. Natural resource extraction and land development are also threats to habitat loss for this species. (Pennsylvania Fish and Boat Commission, 2011)

Fish

One endangered fish species is federally listed for Minnesota (Table 9.1.6-6). The Topeka shiner *(Notropis topeka)* occurs in southwestern Minnesota. Information on the habitat, distribution, and threats to the survival and recovery of this species in Minnesota is provided below.

Table 9.1.6-6: Federally Listed Fish Species of Minnesota

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Minnesota	Habitat Description
Topeka Shiner	*Notropis topeka*	E	Yes; in Lincoln, Murray, Nobles, Pipestone, and Rock counties, southwestern Minnesota.	Small prairie streams in pools containing clear, clean water, clean gravel, rock, or sand bottoms. Found in Lincoln, Murray, Nobles, Pipestone, and Rock counties, in the southwestern corner of Minnesota.

[a] E = Endangered

Source: (USFWS, 2016a)

Topeka Shiner. The Topeka shiner is a silvery minnow with a dark stripe on its side growing to approximately 3 inches in length (KDWPT, 2015). The species was federally listed as endangered in 1998 (63 FR 69008 69021, December 15, 1998) and had critical habitat designated in 2004 (69 FR 44736 44770, July 27, 2004) in Lincoln, Murray, Nobles, Pipestone, and Rock counties, southwestern Minnesota, where it is found. The Topeka shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska (USFWS, 2015n).

The Topeka shiner occurs primarily along small prairie streams in pools containing clear, clean water, clean gravel, rock, or sand bottoms. Threats to the species include alterations to stream quality such as increases in sedimentation or nutrients from fertilizers, changes in stream flow volume or temperatures, and restricted access for species river movement and isolation of populations. (USFWS, 2010b)

Invertebrates

Seven endangered and one threatened invertebrate species are federally listed for Minnesota as summarized in Table 9.1.6-7. The Dakota Skipper (*Hesperia dacotae*) occurs in western Minnesota. The sheepnose mussel (*Plethobasus cyphyus*), snuffbox mussel (*Epioblasma triquetra*), spectaclecase mussel (*Cumberlandia monodonta),* and the winged mapleleaf (*Quadrula fragosa*) occur in eastern Minnesota. The Higgins eye pearlymussel (*Lampsilis higginsii*) and the Karner blue butterfly (*Lycaeides melissa samuelis*) occur in southeastern Minnesota. The Poweshiek skipperling (*Oarisma poweshiek*) occurs throughout Minnesota. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Minnesota is provided below.

Table 9.1.6-7: Federally Listed Invertebrate Species of Minnesota

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Minnesota	Habitat Description
Dakota Skipper	*Hesperia dacotae*	T	Yes; in Chippewa, Clay, Kittson, Lincoln, Murray, Norman, Pipestone, Polk, Pope, and Swift counties, western Minnesota.	Two types of prairies; moist bluestem prairie and upland prairie that is somewhat dry and usually found on ridges and hillsides. Found in 10 counties in western Minnesota.
Higgins Eye Pearlymussel	*Lampsilis higginsii*	E	No	Deep, moderately flowing rivers with firm, loose riverbeds. Found in 9 counties in southeastern Minnesota.
Karner Blue Butterfly	*Lycaeides melissa samuelis*	E	No	Early successional communities; found in Winona County in the southeastern corner of Minnesota.
Poweshiek Skipperling	*Oarisma poweshiek*	E	Yes; in Chippewa, Clay, Cottonwood, Douglas, Kittson, Lac Qui Parle, Lincoln, Lyon, Mahnomen, Murray, Norman, Pipestone, Polk, Pope, Swift, and Wilkin counties, Minnesota.	Prairie fens and tallgrass; found in 23 counties throughout Minnesota.
Sheepnose Mussel	*Plethobasus cyphyus*	E	No	Large rivers and streams with moderate to swift currents and shallow shoal habitats. Found in Wabasha, Washington, and Winona counties, eastern Minnesota.
Snuffbox Mussel	*Epioblasma triquetra*	E	No	Small to medium sized creeks, lakes, and rivers with shoal habitats and swift current. Found in Chisago, Hennepin, Ramsey, and Washington counties, in eastern Minnesota.
Spectaclecase Mussel	*Cumberlandia monodonta*	E	No	Sheltered areas in large rivers; found in Chisago, Pine, and Washington counties, in eastern Minnesota.
Winged Mapleleaf	*Quadrula fragosa*	E	No	Large freshwater streams with muddy-gravel bottoms. Found in Chisago, Ramsey, and Washington counties, eastern Minnesota.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2016a)

Dakota Skipper. The Dakota skipper is a small butterfly with a wingspan of 1 inch. It has a thick body and flies faster and more powerfully than most butterflies. Males have tawny-orange to brown colored upper wings with a mark on the forewing, and a dusty yellow-orange lower surface. Females have darker brown colored upper wings with tawny-orange spots and some white spots on the edge of the forewing, and a gray-brown colored lower surface with a faint white spot across the middle (USFWS, 2015o). The Dakota skipper was federally listed as threatened in 2014 (79 FR 63671 63748, October 24, 2014).

Regionally, this species is known or believed to occur in Iowa, Minnesota, North Dakota, and South Dakota. In Minnesota, it can be found in 9 counties in the western part of the state: Clay, Douglas, Kittson, Lincoln, Murray, Norman, Pipestone, Polk, and Pope (USFWS, 2015q). Critical habitat was designated in 2015 (80 FR 59247 59384, October 1, 2015) in Chippewa, Clay, Kittson, Lincoln, Murray, Norman, Pipestone, Polk, Pope, and Swift counties, western Minnesota (USFWS, 2015o). It inhabits two types of prairies; moist bluestem prairie and upland prairie that is somewhat dry and usually found on ridges and hillsides. The biggest threat to the Dakota skipper is habitat loss and degradation due to overgrazing and land conversion (USFWS, 2015p).

Higgins' Eye Pearlymussel. The Higgins' eye pearlymussel is a larger river mussel species which was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976) (USFWS, 2004). The species' range is primarily limited to the northeastern third of the Mississippi River and tributaries adjacent to Wisconsin. Within Minnesota, it can be found in nine counties in the southeastern part of the state (USFWS, 2004).

The species is usually found in mussel beds with at least 15 other types of mussels, in portions of rivers with firm, loose bottoms such as sand and gravel, and not packed clay, organic material, or artificial substrates (e.g., concrete). The river environment should be deep with a moderate flow. The primary limiting factor to the Higgins' eye pearlymussel is the threat of invasive species such as the Zebra mussel (*Dreissena polymorpha*), which has intensively impacted mussel communities in various locations throughout the species' range. (USFWS, 2004)

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, December 14, 1992) (USFWS 2015s). Their range extends across 12 states from Minnesota to Maine (USFWS, 2008). In Minnesota, it can be found in Winona County in the southeastern corner of the state (MDNR, 2016h).

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, 2008)

Poweshiek Skipperling. The Poweshiek skipperling is a small, dark brown and orange butterfly with streaked, white veins on the underside of its wings (USFWS, 2015r). The species was listed as endangered in 2014 (79 FR 63671 63748, October 24, 2014). The range for the Poweshiek skipperling has historically extended from Canada to Iowa, however has been reduced to the eastern regions of North and South Dakota to the eastern edge of Michigan. Further, 2014 surveys have only found single populations within Michigan, Wisconsin, and central Canada (USFWS, 2015r). In Minnesota, it can be found in 23 counties throughout the state (USFWS, 2015z).

Critical habitat was designated in 2015 (80 FR 59247 59384, October 1, 2015) in Chippewa, Clay, Cottonwood, Douglas, Kittson, Lac Qui Parle, Lincoln, Lyon, Mahnomen, Murray, Norman, Pipestone, Polk, Pope, Swift, and Wilkin counties, Minnesota (USFWS, 2015z). 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, 2015r).

Sheepnose Mussel. The endangered sheepnose mussel is a medium sized freshwater mussel that usually grows about 5 inches. The sheepnose shell is a light yellow to dull yellowish brown color with darker ridges (USFWS, 2012a). After multiple status reviews since 2004, the USFWS listed the sheepnose mussel as endangered in 2012 (77 FR 14914 14949, March 13, 2012). This species historically occurred mostly along the Mississippi River, and populations can now be found in Alabama, Illinois, Indiana, Iowa, Kentucky, Minnesota, Missouri, Ohio, Pennsylvania, Virginia, West Virginia, and Wisconsin (USFWS, 2015t) (USFWS, 2012a). In Minnesota, it can be found in Wabasha, Washington, and Winona counties, in the eastern portion of the state (USFWS, 2015t).

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

Snuffbox Mussel. The snuffbox mussel is a freshwater mussel that usually grows from 1.8 to 2.8 inches in length. The snuffbox has a yellow, green, or brown triangular shell with green rays (USFWS, 2012d). This species was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012) (USFWS, 2015w). The snuffbox total population has been 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, 2012d). It still occurs in 14 states and in Canada. In Minnesota, it can be found in Chisago, Hennepin, Ramsey, and Washington counties, in the eastern portion of the state (USFWS, 2015w).

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

Spectaclecase Mussel. The spectaclecase mussel is a large (up to 9 inches long) freshwater mussel. As its name suggest, its brownish to black shell is large with a somewhat curved appearance and moderate inflation (USFWS, 2012b). This species was first listed as federally endangered in 2012 (*77 FR 14914 14949, April 12, 2012*). Today the spectaclecase mussel has suffered a 55 percent decrease in distribution and only occurs in 20 of the 44 streams it once inhabited. Most populations are now fragmented and limited to short reaches of streams in the 12 states it occurs: Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky, Minnesota, Missouri, Tennessee, Virginia, West Virginia, and Wisconsin (USFWS, 2012b). In Minnesota, it can be found in Chisago, Pine, and Washington counties, in the eastern part of the state (USFWS, 2015x).

Suitable habitat for the spectaclecase mussel includes sheltered areas in large rivers. This species seeks out areas that are sheltered from the force of the river current such as beneath rock slabs, firm mud banks, and in-between tree roots. Spectaclecase mussels spend their entire lives partially or completely buried in river bottom substrate, and some specimens have been recorded up to 70 years old. This species of mussels have a complex reproduction cycle. They have a parasitic life stage and are dependent on a host fish for successful rearing and relocation of larvae young. The current major threat to the survival of this species are dams. Dams alter the natural flow and temperature regime of rivers, blocking fish passage which are necessary to prevent fragmentation and connect populations. Sedimentation of rivers, pollution, channelization, and invasive zebra mussels also pose threats to this species (USFWS, 2012b).

Winged Mapleleaf. The winged mapleleaf is a generally round, reddish-brown, green-accented mussel which grows up to approximately 4 inches in length and may have two rows of bumps which lead from the rear hinge to the shell opening. The species was listed as endangered in 1991 (*56 FR 28345 28349, June 20, 1991*). The species' range extends from Minnesota south to Arkansas and Missouri, though only the population within the St. Croix River is markedly reproducing (USFWS, 2015l). Within Minnesota, the species is known or believed to occur in Chisago, Ramsey, and Washington counties, in the eastern part of the state (USFWS, 2015y) (USFWS, 2015l).

Habitat for the winged mapleleaf consists of large freshwater streams on mud, muddy-gravel, or gravel bottoms, and may be found in fast flowing, shallow areas with clear and high-quality water. Threats and cause of decline for the winged mapleleaf consist of reduced reproduction rates in most populations other than within the St. Croix River, opportunistic predation, competitors from species such as zebra mussels and habitat loss due to reduced water quality and hydrological alterations (Vaughan, 1997).

Plants

One endangered and three threatened plant species are federally listed for Minnesota as summarized in Table 9.1.6-8. The western prairie fringed orchid (*Platanthera praeclara*) grows occurs along the western border of Minnesota. The prairie bush-clover (*Lespedeza leptostachya*) occurs in southern Minnesota. The Leedy's roseroot (*Rhodiola integrifolia ssp. leedyi*) and the Minnesota dwarf trout lily (*Erythronium propullans*) occur in southeastern Minnesota. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Minnesota is provided below.

Table 9.1.6-8: Federally Listed Plant Species of Minnesota

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Minnesota	Habitat Description
Leedy's Roseroot	*Rhodiola integrifolia ssp. Leedyi*	T	No	Moist wooded cliffs. Found in Fillmore and Olmsted counties, southeastern Minnesota.
Minnesota Dwarf Trout Lily	*Erythronium propullans*	E	No	Rich, black, well-aerated soil on the lower parts of wooded slopes that are north facing, and on nearby floodplains near streams or abandoned stream channels. Found in Dodge, Goodhue, Rice, and Steele counties, southeastern Minnesota.
Prairie Bush-clover	*Lespedeza leptostachya*	T	No	Tallgrass prairie regions with moderately moist soil. Found in 15 counties in southern Minnesota.
Western Prairie Fringed Orchid	*Platanthera praeclara*	T	No	Prairies and meadows. Found in 11 counties along the western border of Minnesota.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2016a)

Leedy's Roseroot. Leedy's roseroot is a cliffside dwelling wildflower with a long, leafy stem and small, 4- to 5-petaled flowers in colors from dark red to yellow or orange. Leedy's roseroot was federally listed as threatened in 1992 (57 FR 14649 14653, April 22, 1992).

Regionally this species is known or believed to occur in Minnesota, South Dakota, and New York. In Minnesota, it can be found in Fillmore and Olmsted counties, in the southeastern portion of the state (USFWS, 2015aa). It inhabits very specialized cliffside habitats; in Minnesota, it grows on cliffs that are cooled by air leaving underground passages in karst[87] terrain. Threats to the Leedy's roseroot include habitat disturbances, groundwater contamination, and its low numbers (USFWS, 1998).

Minnesota Dwarf Trout Lily. The Minnesota dwarf trout lily is a forest wildflower with small, pale pink flowers about the size of a dime or less. The Minnesota dwarf trout lily was federally listed as endangered in 1986 (51 FR 10521 10523, March 26, 1986). This species is only known or believed to occur in Dodge, Goodhue, Rice, and Steele counties, in southeastern Minnesota. (USFWS, 2015v)

[87] Landscape underlain by limestone that has been eroded by dissolution, producing ridges, towers, fissures, sinkholes, and other characteristic landforms.

It inhabits rich, black, well-aerated soil on the lower parts of wooded slopes that are north facing, and on nearby floodplains. It grows in areas near streams or abandoned stream channels. Threats to the Minnesota dwarf trout lily include habitat destruction and modification due to construction, urban and agricultural development, recreational uses, changes in water management, and collection. (USFWS, 1987)

Prairie Bush-clover. The prairie bush-clover is a perennial member of the pea family, with pinkish-cream flowers, clover-like leaves, and a silvery gloss which was listed as threatened in 1987 (52 FR 781 785, January 9, 1987) (USFWS, 2015e). The species' range primarily extends from Iowa to the shores of Lake Michigan, reaching north to the Twin Cities and south to central Illinois. Within Minnesota, the species is known or believed to occur in 15 counties in the southern portion of the state (USFWS, 2015u).

Habitat for the prairie bush-clover consists of tallgrass prairie regions, with moderately moist soils that are typically utilized for cropland, though the species has continued to thrive on slopes and rocky areas with similar soils. Threats include conversion of prairie tallgrass areas to cropland, "overgrazing, agricultural expansion, herbicide application, urban expansion, rock quarrying, and transportation right-of-way maintenance and rerouting; and hybridization with the more common round-headed bush clover" (USFWS, 2015u).

Western Prairie Fringed Orchid. The western prairie fringed orchid stalks up to 4 feet tall with 24 white flowers. The species was federally listed as threatened in 1989 (*54 FR 39857 39863, September 28, 1989*) and can be found along the edge of the plains from Minnesota south to Oklahoma. In Minnesota, the western prairie fringed orchid can be found in 11 counties along the western border of the state. (USFWS, 2015d)

The orchid is found in prairies and meadows and utilizes support from mycorrhizal fungi during seed germination and before plants are capable of photosynthesis. The western prairie fringed orchid requires measured periodic disturbance (i.e., fire, mowing, or grazing) and consistent soil moisture. Threats to the species include land conversion, impacts to the few species of sphinx moths which pollinate the orchid, and lowering of groundwater levels (USFWS, 1996).

9.1.7. Land Use, Recreation, and Airspace

9.1.7.1. Definition of the Resource

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

Land Use and Recreation

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

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

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

Airspace

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

9.1.7.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, summarizes numerous federal environmental laws and regulations that, to one degree or another, may affect land use in Minnesota. However, most site-specific land use controls and requirements are governed by local county, city, and village laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities.

Because the Nation's airspace is governed by federal laws, there are no specific Minnesota state laws that would alter the existing conditions relating to airspace for this PEIS. Minnesota Statutes, Chapter 360, Airports and Aeronautics, addresses aviation for the state (Minnesota Legislature, 2015d).

9.1.7.3. Land Use and Ownership

For the purposes of this analysis, Minnesota is classified into primary land use groups based on coverage type as agricultural; forest and woodlands; developed land; and Public Land, Surface Water, and Other Land Covers. Land ownership within Minnesota has been classified into four main categories: private, federal, state, and tribal.

Land Use

Table 9.1.7-1 Table 9.1.7-1 identifies the major land uses by coverage type in Minnesota. Agriculture comprises the largest portion of land use with 45 percent of Minnesota's total land area occupied by this category. Forest and woodland is the second largest area of land use with 45 percent of the total land area. Developed areas account for approximately five percent of the total land area. The remaining percentage of land includes public land, surface water, and other land covers, shown in Figure 9.1.7-1, that are not associated with specific land uses (USGS, 2012c).

Table 9.1.7-1: Major Land Use in Minnesota by Coverage Type

Land Use	Square Miles*	Percent of Land
Agricultural Land	35,979	45%
Forest and Woodland	35,128	45%
Developed Land	4,277	5%
Public Land, Surface Water, and Other Land Covers	4,243	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, 2012c)

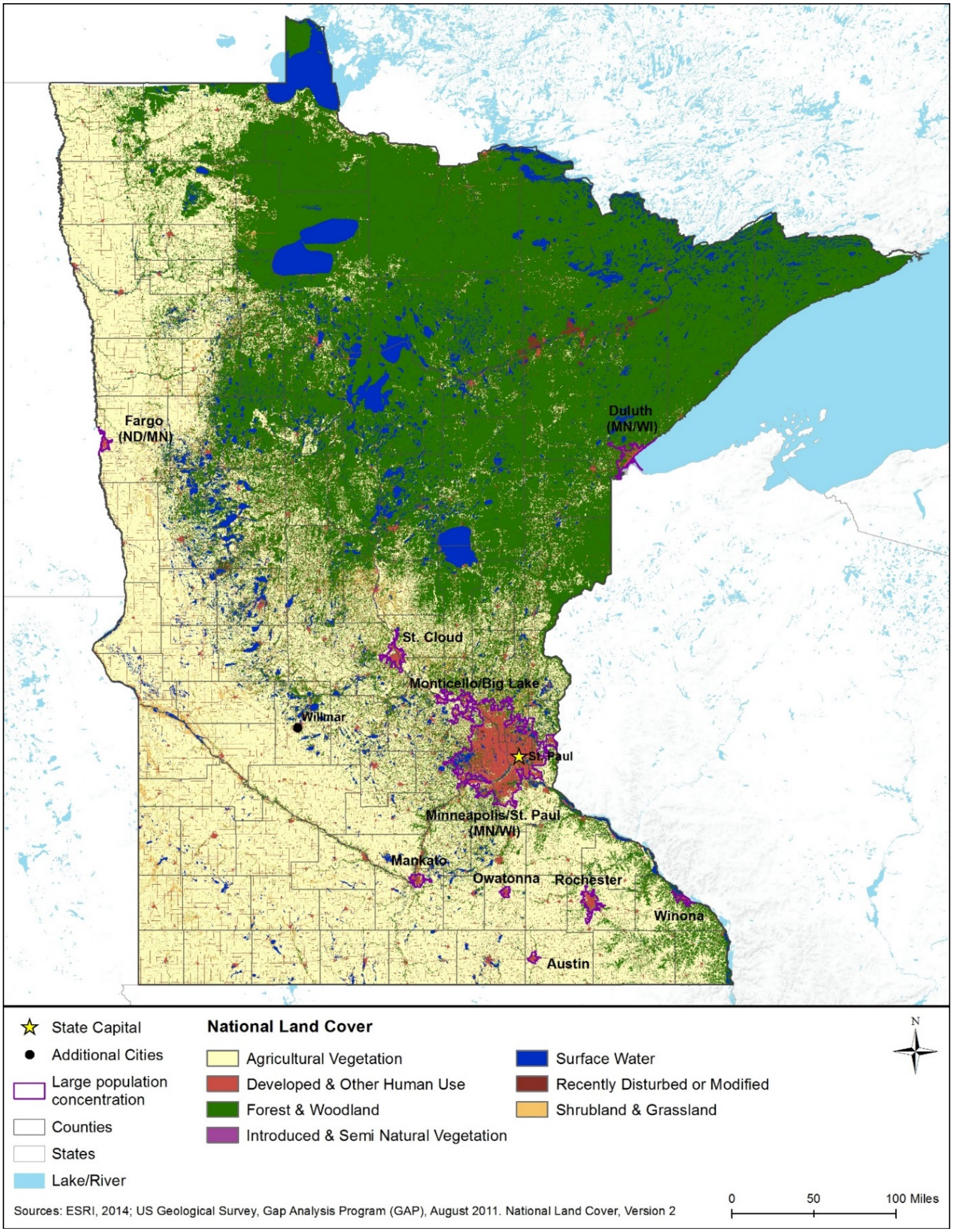


Figure 9.1.7-1: Major Land Use Distribution by Coverage Type

Agricultural land exists in every region of the state, with the largest concentrations in the western and southern portions of the state. Almost one-half of Minnesota's total land area is classified as agricultural land (approximately 45 percent). In 2012, there were 74,542 farms in Minnesota and most were owned and operated by small, family businesses, with most farms being less than 100 acres (USDA, 2012). Some of the state's largest agricultural uses include corn, soybeans, hay, sugar beets, and wheat. Other agricultural uses include dairy, turkeys, hogs, bison, and elk. For more information by county, access the USDA Census of Agriculture website: http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Minnesota/.

Forest and Woodland

Forest and woodland areas are primarily located in the northern and eastern portions of the state. Most forest and woodland areas throughout Minnesota are privately owned; however, most evergreen forest is owned by state and federal land agencies. Section 9.1.6 presents additional information about terrestrial vegetation.

State Forests

State Forests account for 4,843.75 square miles of state land within 58 forest units. State forests are managed by the Division of Forestry within the MDNR and "were established to produce timber and other forest crops, provide outdoor recreation, protect watersheds, and perpetuate rare and distinctive species of native flora and fauna" (MDNR, 2016g).

Private Forest and Woodland

Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, jobs, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, state forests, and national forests. For additional information regarding forest and woodland areas, see Section 9.1.6, Biological Resources, and Section 9.1.8, Visual Resources.

Developed Land

Developed land in Minnesota tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Table 9.1.7-2). Although only five percent of Minnesota land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 9.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates and Figure 9.1.7-2 shows where these areas are located within the developed land use category.

Table 9.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Minneapolis/St. Paul (MN/WI)	2,650,614
St. Cloud	110,621
Rochester	107,677
Duluth (MN/WI)	93,333
Mankato	57,584
Total Estimated Population of Metropolitan Areas	**3,019,829**
Total State Estimated Population	**5,457,173**

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

Land Ownership

Land ownership within Minnesota has been classified into four main categories: private, federal, state, and tribal.

Private Land

The majority of land in Minnesota is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed. Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.[88]

Federal Land

The federal government manages 6,411 square miles (eight percent) of Minnesota land with a variety of land types and uses, including national parks, monuments, historic sites, military bases, and national forests (Table 9.1.7-3). Four federal agencies manage the majority of federal lands throughout the state (Table 9.1.7-3 and Figure 9.1.7-2).[89] There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.

Table 9.1.7-3: Federal Land in Minnesota

Agency	Square Miles	Representative Type
Department of Defense	429	Military Bases
USFWS	705	National Wildlife Refuges
USFS	4,940	Wilderness and Forest Areas
NPS	337	Parks, Monuments, Historic Sites
Total	**6,411**	

Sources: (USGS, 2012e) (USGS, 2014h) (BLM, 2011) (Recreation.gov, 2015)

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

[89] 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.

- The Department of Defense owns and manages 429 square miles used for air force stations, national guard bases, military camps, and armories;
- The USFWS owns and manages 705 square miles consisting of 20 National Wildlife Refuges (NWRs) in Minnesota;
- The USFS owns and manages 4,940 square miles set aside as the Superior and Chippewa National Forests; and
- The National Park Service (NPS) manages 337 square miles consisting of the Grand Portage and Pipestone National Monuments, the Mississippi National River and Recreation Area, and the Voyageurs National Park (NPS, 2016a).

State Land[90]

The Minnesota state government owns approximately 14,233 square miles of land comprised of state parks, state forests, historic sites, wildlife management areas, state offices, trust lands, schools, and recreation areas. The MDNR manages 9,167 square miles of state land under its various divisions.

Table 9.1.7-4: State Land in Minnesota[a]

Agency	Square Miles	Type
Division of State Parks	417.18	State Parks, Trails, and Recreation Areas
Division of Forestry	4,843.75	State Forests
School Trust Lands	3,906.25	State Trust Lands
Division of Fish and Wildlife	2,015,62	State Wildlife Management Areas
Other	1,831.58	Historic Sites, Landmarks, Universities, Schools, Offices

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

The Division of State Parks manages 67 state parks, eight state waysides, and 24 state trails, totaling 417.18 square miles; the Division of Forestry manages 58 state forests totaling 4,843.75 square miles; School Trust Lands account for 3,906.25 square miles and are located throughout the state; and there are 1,440 state wildlife management areas totaling 2,015.62 square miles located throughout the state. (MDNR, 2013) (MDNR, 2016a) (MDNR, 2016b) (MDNR, 2016c)

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

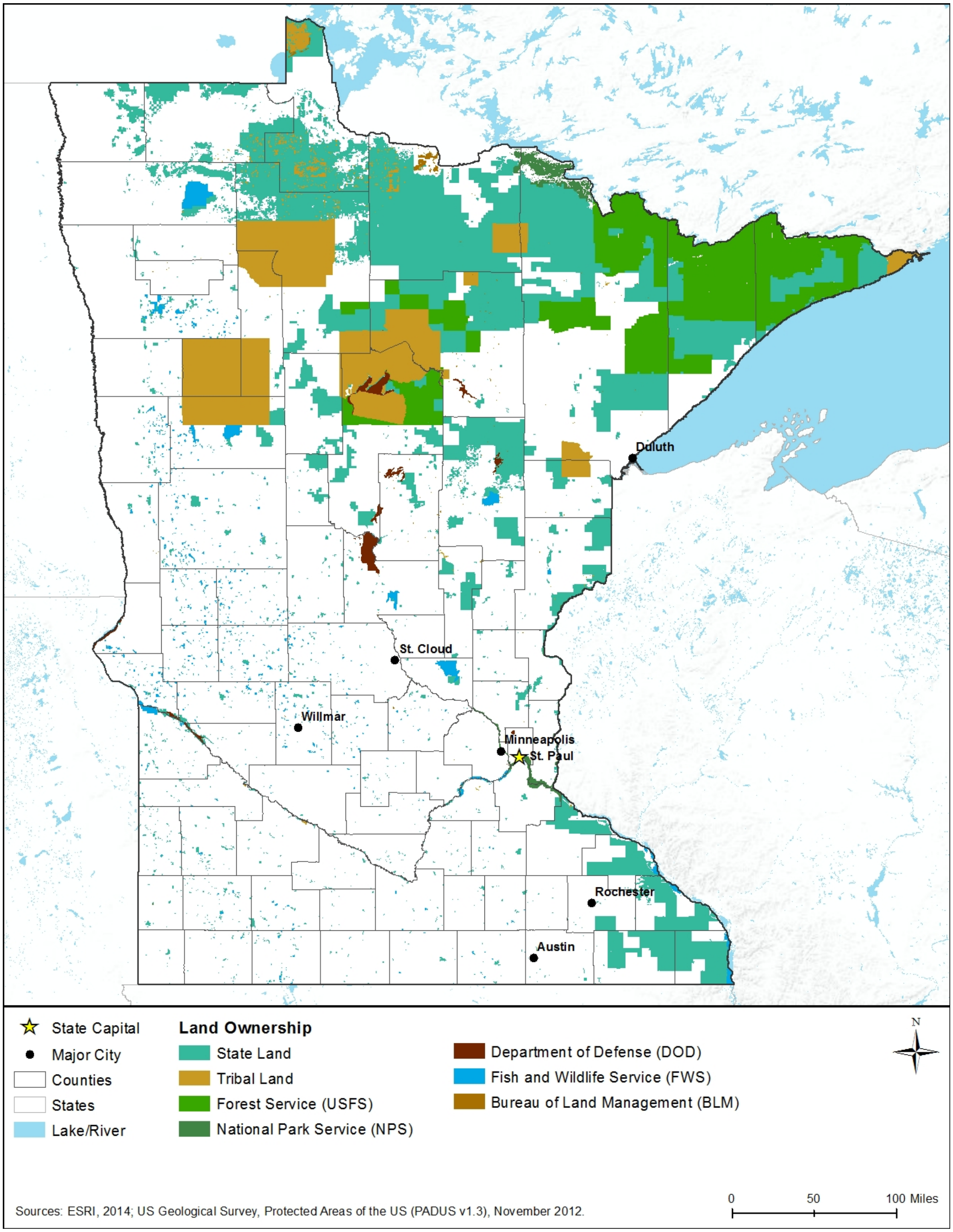


Figure 9.1.7-2: Land Ownership Distribution in Minnesota

Tribal Land

The Bureau of Indian Affairs, along with individual tribes, manages 4,310 square miles, or 5.4 percent of the total land within Minnesota.[91] These lands are composed of 23 reservations and trust lands currently located in the state.

For additional information regarding tribal land currently located in the state, see Section 9.1.11, Cultural Resources.

Table 9.1.7-5: Indian Reservations and Other Land Holdings of Minnesota

Reservation Name	Square Miles
Bois Forte (Deer Creek) Reservation	79.21
Bois Forte (Nett Lake) Reservation	390.12
Bois Forte (Vermillion Lake) Reservation	3.58
Fond du Lac Reservation	335.05
Fond du Lac Trust Land	0.45
Grand Portage Reservation	165.85
Grand Portage Trust Land	0.13
Lake Traverse (Sisseton) Reservation	0.12
Leech Lake Reservation	2,792.13
Leech Lake Trust Land	0.65
Lower Sioux Reservation	5.56
Mille Lacs Reservation	10.32
Mille Lacs Trust Land	3.72
Minnesota (Chippewa) Homestead Trust Lands	0.15
Prairie Island Community	1.57
Prairie Island Community Trust Land	0.21
Red Lake Ceded Lands	538.36
Red Lake Reservation	2,258.95
Red Lake Trust Land	207.67
Shakopee Community	0.78
Shakopee Community Trust Land	0.55
Upper Sioux Community	2.43
White Earth Reservation	2,827.20
Total (adjusted to eliminate overlap)	**4,310.23**

Source: (USGS, 2012e)

9.1.7.4. Recreation

Minnesota varies widely in its population density, affluence, and cultural interests. On the community level, cities and towns provide an assortment of indoor and outdoor recreational facilities including: community and recreation centers, theaters, museums, athletic fields and courts, golf courses, multi-use trails, playgrounds, picnicking areas, theme/amusement parks, alpine (downhill) ski resorts and Nordic (cross country skiing) centers, and boat launches and marinas. Availability of community-level facilities is typically commensurate to the population's distribution and interests, and the natural resources prominent in the vicinity. There are 67 state parks, 9 recreation areas, 8 waysides, 62 state forest campgrounds, and 24 state trails (MDNR,

[91] Although the Bureau of Indian Affairs “manages” Native American lands, the Bureau of Indian Affairs is different than other land management agencies as the lands are held in trust and are sovereign nations.

2013) (MDNR, 2015o). In addition to the Lake Superior and Lake of the Woods shorelines, and 680 miles of the Mississippi River, Minnesota has approximately 11,842 inland lakes larger than 10 acres and 69,200 miles of streams and rivers (Explore Minnesota, 2015a). Availability of these resources makes water-based recreation very popular with residents and visitors. Minnesota also has a network of over 22,000 miles of groomed trails for snowmobiles (MDNR, 2015p) and 54 state motorized trails for off-highway vehicle (OHV) riders (MDNR, 2015q). The North Country National Scenic Trail passes through northern Minnesota for 775 miles. This trail will eventually be the longest National Scenic Trail in the U.S., passing through seven states for 4,600 miles (NPS, 2015c). The Minnesota segment of the Mississippi River Trail Bikeway has just been completed in 2015, and stretches almost 800 miles from Itasca State Park to the Iowa border (MnDOT, 2015c).

Federally, the NPS, USFS, USFWS, and the USACE manage areas in Minnesota with substantial recreational attributes.

This section discusses key recreational opportunities and activities representative of various regions of Minnesota. For the sake of grouping recreational aspects in Minnesota, the state can be categorized by five distinct recreational regions, each of which are presented in the following sub-sections.[92] For information on visual resources such as National Scenic Byways and state-designated Byways, see Section 9.1.8, Visual Resources; and for information on culturally/historically significant resources (e.g., National Historic Sites, National Historic Landmarks, sites on the National Register of Historic Places, and Natural Heritage Areas), see Section 9.1.11, Cultural Resources.

Northwest Region

The Northwest Region is bordered by Ontario, Canada to the north, North Dakota and the Red River to the west, the Northeast Region to the east, and the Central Region to the south. Two of the largest lakes in the state, Upper and Lower Red Lake are located in this region, as is the Lake of the Woods on the northern border (Figure 9.1.7-3). Streams, rivers, lakes, and state and national forests are plentiful in the eastern half of this region. This region is largely rural with small towns and villages, and lakeside resorts and cabins. The town of Bemidji is the largest town amid this concentration of state forests, and the Mississippi River headwaters originate in this area. Outdoor enthusiasts flock to this region for its impressive variety of water and boating sports, fishing, and to the woods for hunting, camping, hiking, skiing, bicycle, horse, ATV, and snowmobile riding. Several downhill skiing areas and resorts are located in this region. The state's largest Wildlife Management Area (Red Lake WMA) is also located here.

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

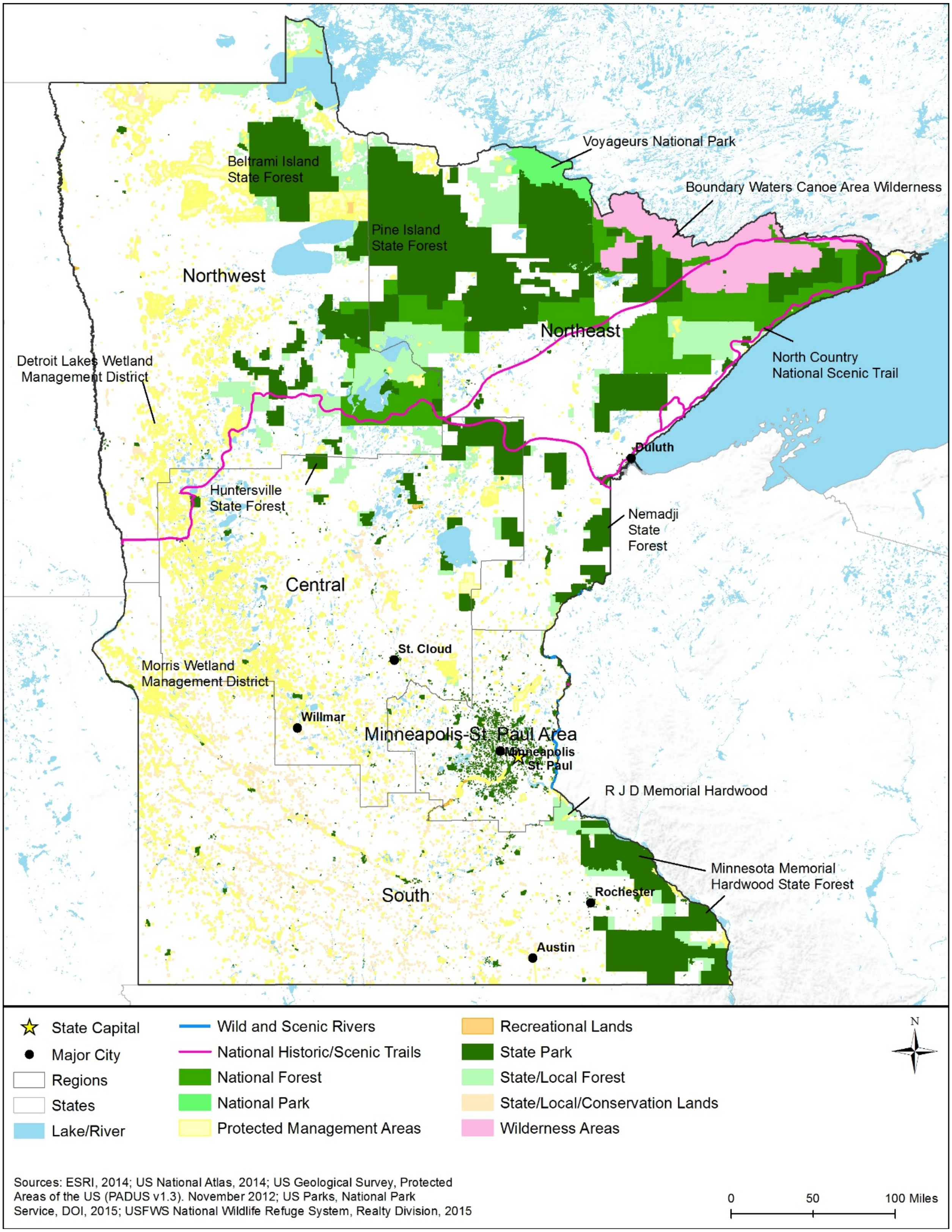


Figure 9.1.7-3: Minnesota Recreation Resources

Chippewa National Forest's diverse ecosystem of prairie, coniferous and hardwood woodlands, wetlands, rivers, and lakes make this forest a favored location for outdoor recreation, especially wildlife viewing, hunting, and fishing. Chippewa National Forest has the highest population of breeding Bald Eagles (in the lower 48 states). Camping, swimming, and canoeing are easy to access at the 21 campgrounds that have been developed along the major lakes in this forest. There are also approximately 300 miles of both motorized and non-motorized trails available (USFS, 2015a). Fifty miles of the Heartland State Trail, (one of the country's first "rails-to-trails" projects) traverses through this region. Big Bog State Recreation Area features the largest peat bog in the U.S. lower 48 states (MDNR, 2015r) and Buffalo River State Park highlights one of the state's largest remnant prairies (MDNR, 2015s). Itasca State Park is the oldest park in the system and one of the top five in use by visitors (MDNR, 2015t).

Northeast Region

The Northeast Region is bounded by Ontario, Canada to the north, the Minneapolis-St. Paul ("Twin Cities") metropolis to the south, Lake Superior and Wisconsin to the east, and Central and Northeast regions to the west (Figure 9.1.7-3). Voyageurs National Park is surrounded by Kabetogama Lake on the Minnesota side and Rainy Lake on the Canadian border. It is a popular destination for those wanting to utilize the 270-lakeside campsites that are only accessible by boat; as well as opportunities for boating, hiking, fishing, snowshoeing, cross-country skiing, and snowmobiling (NPS, 2015d). The over 1 million-acre Boundary Waters Canoe Area Wilderness (BWCAW), extends from the eastern edge of Voyageurs National Park 150 miles along the Canadian border all the way to Lake Superior. With more than 1,000 lakes, 1,500 miles of canoe routes, and 2,200 campsites the BWCAW offers a unique opportunity for recreationists seeking a wilderness canoeing experience (USFS, 2015b).

Superior National Forest is dominant in this region, with 41 campgrounds, 277 backcountry camping sites, over 2,000 miles of designated use trails, 77 lake accesses, and 10 beaches available to visitors (USFS, 2015c). Additionally, this region has large parcels of state forest (Koochiching, Kabetogama, Burntside, Bear Island, Finland, Cloquet Valley, Fond du Lac, Nemadji, and St. Croix), many with associated or nearby state parks. The Lake Vermilion-Soudan Underground Mine and Hill Annex Mine State Parks (iron ore mines), and Iron Range Off-Highway Vehicle State Recreation Area are popular destinations in this region. Duluth is the largest city in this region, and is located on the shore of Lake Superior. This seaport city provides plenty of opportunities for arts and cultural activities for residents and visitors, and serves as the gateway for those headed to the northern coast recreation sites. There are 8 state parks, 4 byways, and the 146-mile C.J. Ramstad-North Shore State Trail located along the coast, in addition to the numerous national and state forest facilities. Several downhill skiing resorts are also present in this region. St. Croix National Scenic Waterway provides extensive opportunities for boating (motor and paddling), camping, fishing, and hiking within a short drive of the Minneapolis-St. Paul metropolitan area (NPS, 2015e).

Central Region

The Central Region is bordered by the northern and southern regions, with North and South Dakota to the west and the Minneapolis-St. Paul metropolitan area to the east (Figure 9.1.7-3). This region has many small communities, towns, and its largest city, St. Cloud, offers the most opportunities for arts and cultural activities. The Paul Bunyan Land amusement park in Brainerd is a popular tourist attraction. Water sports (particularly boating, waterskiing, and fishing) are favored in this region, due to the prevalence of lakes and rivers. Bikers, hikers, cross country skiers, and snowmobilers enjoy the many trail systems, including the Paul Bunyan State Trail. There are more than 70 golf courses present in this area.

Minneapolis-St. Paul Region

The “Twin Cities” metropolitan area is the state's hub for museums, art galleries, and performing arts, music, and sports venues. The nation's largest shopping destination (with an indoor theme park) is the “Mall of America,” in Bloomington (Explore Minnesota, 2015b) and the area also hosts one of the nation's largest state fairs. Outdoor recreation opportunities also abound within the Twin Cities with the presence of Ft. Snelling State Park, the 72-mile Mississippi National River and Recreation Area (NPS, 2015f), Pike Island, Snelling Lake, and the extensive multiuse trails that link the Minnesota Valley National Wildlife Refuge with Minnehaha Park. Interstate State Park, on the St. Croix River, is heavily visited by locals and visitors. It has many recreational opportunities including canoeing, kayaking, fishing, rock climbing, hiking, and notable geology sites to explore (MDNR, 2015u).

Southern Region

The Southern Region is bordered by the Mississippi River and Wisconsin to the east, Iowa to the south, South Dakota to the west, and the Central and Minneapolis-St. Paul regions to the north. The terrain is grasslands, prairies, and farmlands, with valleys and bluffs along the many streams and major rivers such as the Minnesota and Mississippi (Figure 9.1.7-3). The Richard J. Dorer Memorial Hardwood State Forest is dominant along the entire eastern border of this region, and provides excellent opportunities for birdwatching, biking, OHV, and horseback riding. There are also 5 state water trails, 6 recreation areas, and 7 campgrounds within this forest (MDNR, 2015v). Of the 22 state parks in this region Flandrau, Nerstrand Big Woods, Forestville/Mystery Cave, and Great River Bluffs State Parks stand out. They offer unique geologic and natural features, as well as traditional opportunities for hiking, biking, horseback riding, cross-country skiing, snowmobiling, fishing, and wildlife viewing. Many communities in this region host ethnic festivals and several have renowned performing arts venues such as the Commonwealth Theater Company, Fairmont Opera House, and the Pipestone Performing Arts Center (Explore Minnesota, 2015c).

9.1.7.5. 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 9.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[93] service is based on the airspace classification (FAA, 2008).

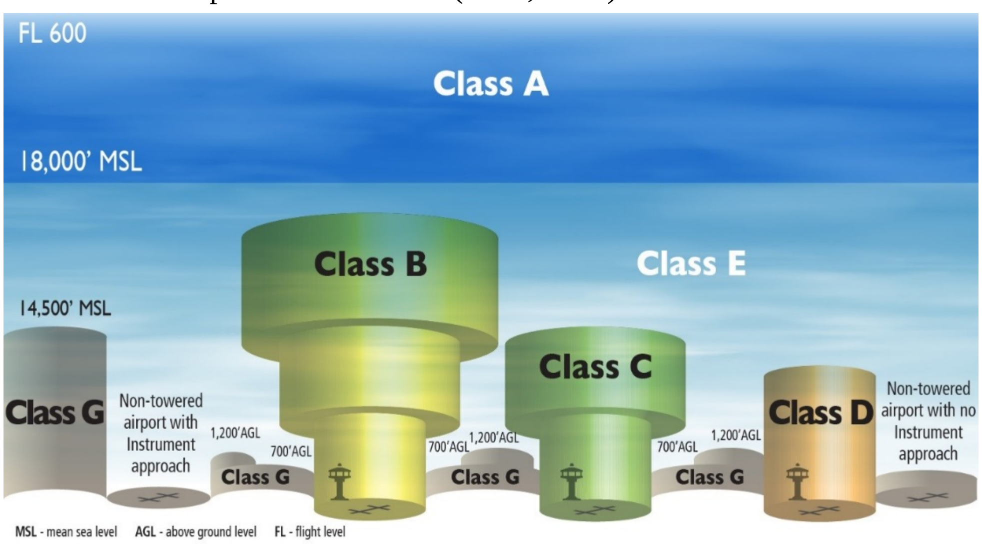


Figure 9.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL).[94] 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).[95]

[93] ATC – Approved authority service to provide safe, orderly and expeditious flow of air traffic operations. (FAA, 2015a)
[94] 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, 2015a)
[95] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015a).

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

Uncontrolled Airspace

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

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (Table 9.1.7-6).

Table 9.1.7-6: 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."

SUA Type	Definition
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 9.1.7-7, 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 9.1.7-7: 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. • 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.

Type	Definition
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)

9.1.7.6. 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.

9.1.7.7. 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 and alteration of a facility that may impinge upon the NAS. Per 14 CFR Part 77.9, the FAA is to be notified about construction or alterations when:

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

9.1.7.8. Minnesota Airspace

The MnDOT Office of Aeronautics and Aviation is responsible administration of development, maintenance, and operational funds, regulation of airport operations, registration of aircraft, aviation planning (state airport system and community), regulatory enforcement, provisioning of equipment, aviation and safety training/dissemination of related information, and providing air transportation services for state officials (MnDOT, 2015d). There are several sections within the Office of Aeronautics and Aviation that execute the responsibilities of this office. Sections responsible with assuring aviation safety include the following:

- The Aviation Planning Section oversees airport zoning and statewide/regional aviation system planning.
- The Airport Development Section provides technical assistance (e.g., planning, zoning, airspace issues) for continued development and maintenance of the state's existing airports.
- The Aviation Operations Section addresses safety, aircraft registration, and licensing of airports. (MnDOT, 2015d)

There is one FAA FSDO for Minnesota located in Minneapolis-St. Paul (FAA, 2015d).

Minnesota airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the state's airport system, as well as addressing key associated with their airports (NASAO, 2015). Figure 9.1.7-5 presents the different aviation airports/facilities residing in Minnesota, while Figure 9.1.7-6 and Figure 9.1.7-7 present the breakout by public and private airports/facilities. There are approximately 454 airports within Minnesota as presented in Table 9.1.7-8 and Figures 9.1.7-5 through Figure 9.1.7-7 (USDOT, 2015).

Table 9.1.7-8: Type and Number of Minnesota Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	142	187
Heliport	0	65
Seaplane	11	48
Ultralight	0	1
Balloonport	0	0
Gliderport	0	0
Total	**153**	**301**

Source: (USDOT, 2015)

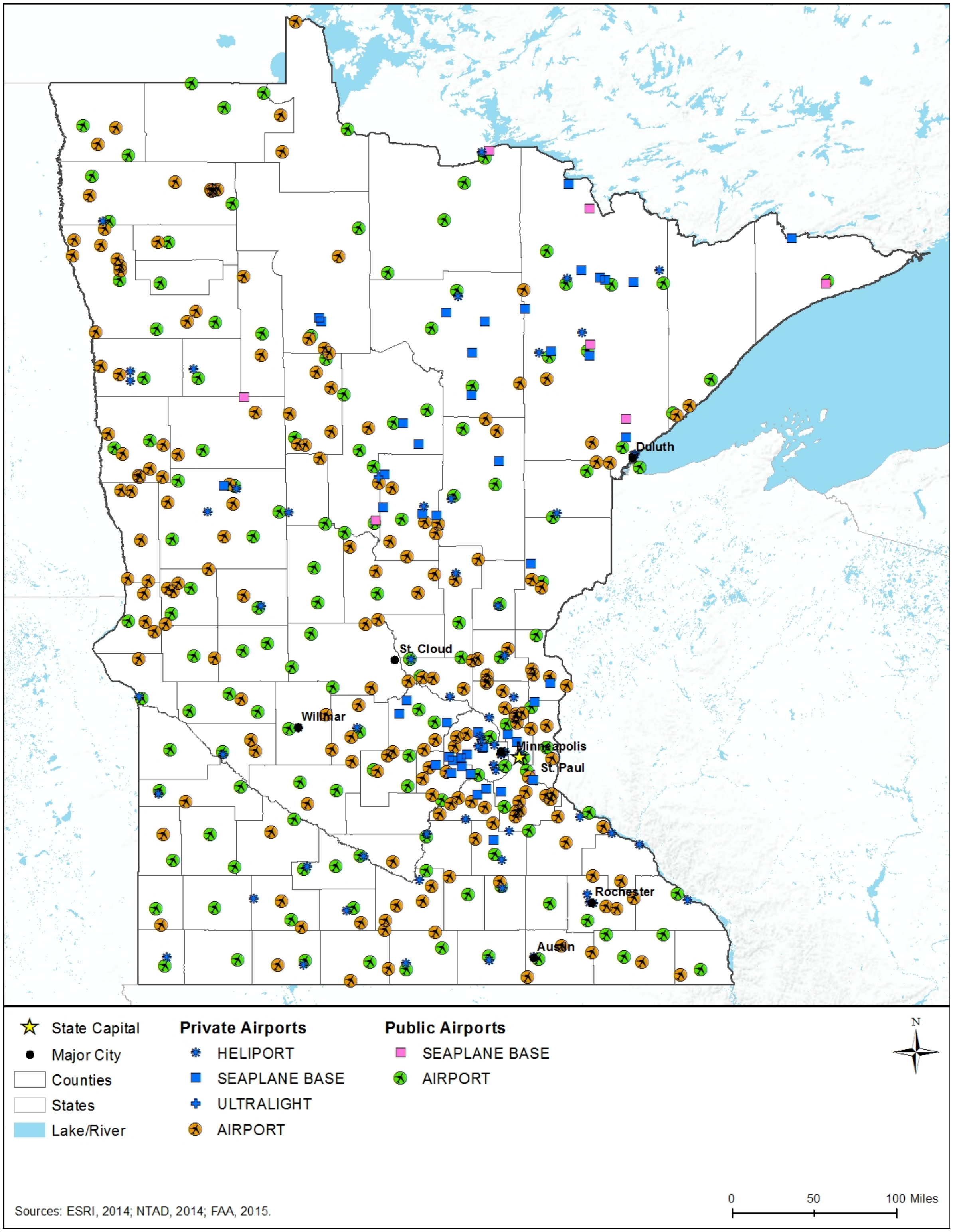


Figure 9.1.7-5: Composite of Minnesota Airports/Facilities

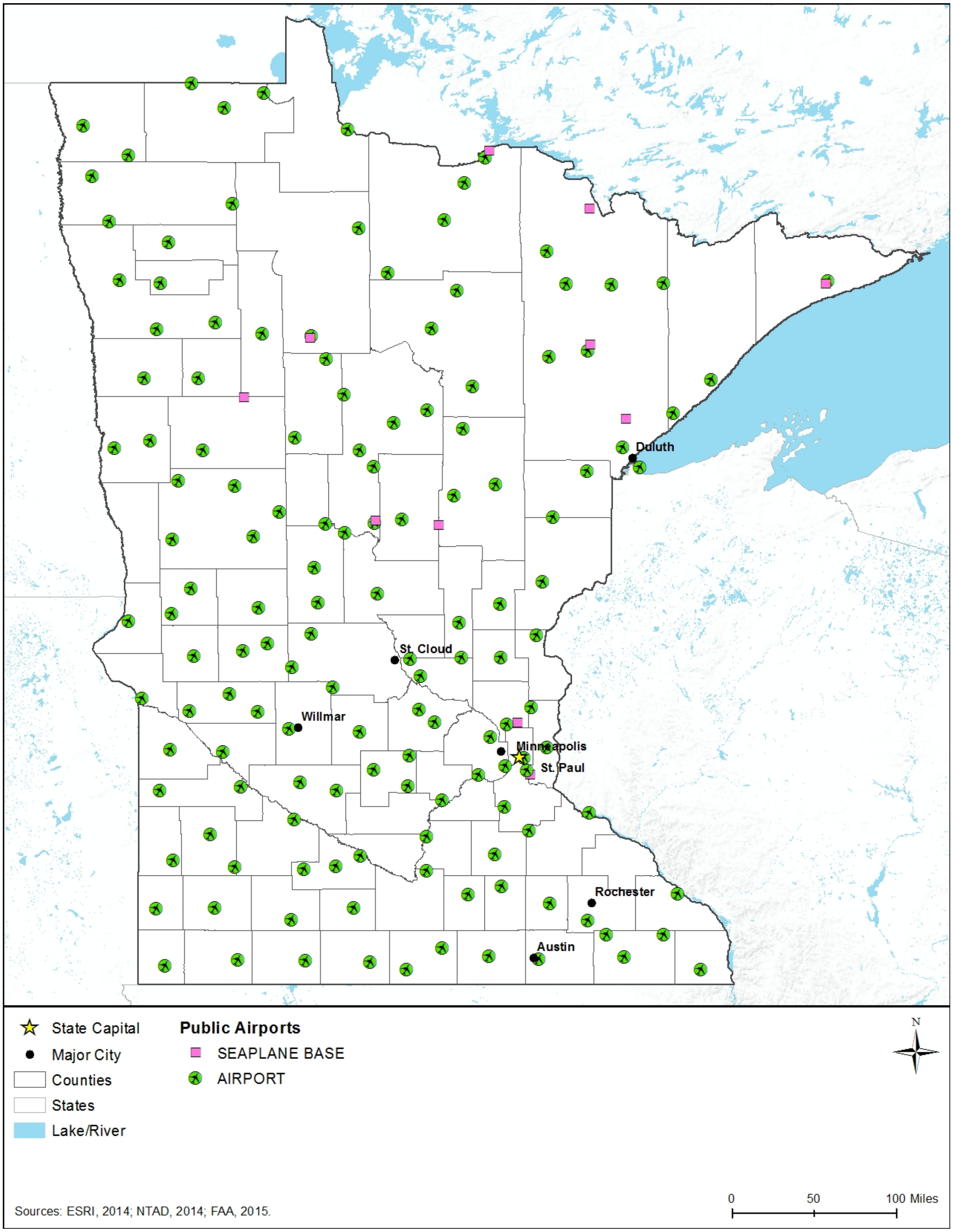


Figure 9.1.7-6: Public Minnesota Airports/Facilities

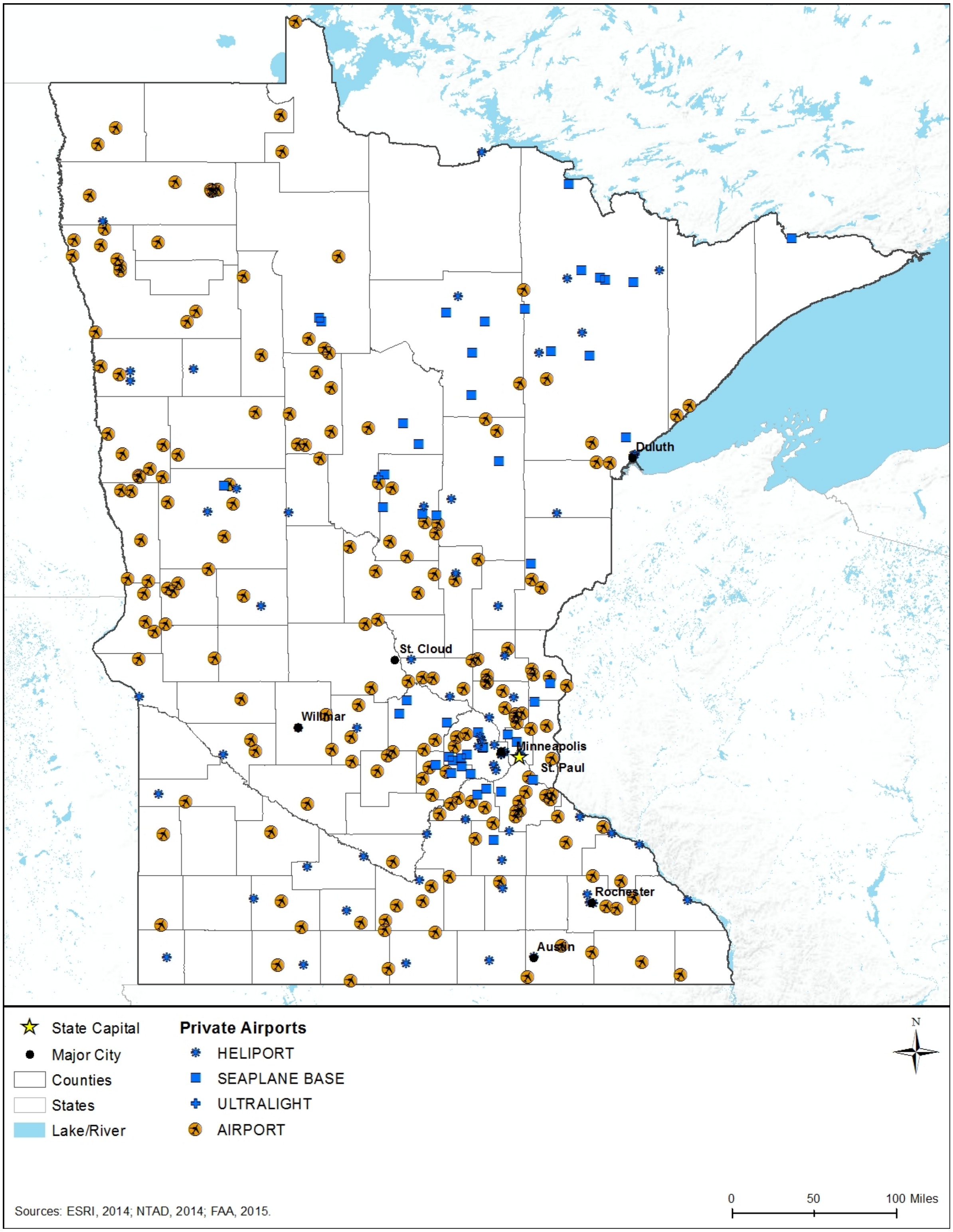


Figure 9.1.7-7: Private Minnesota Airports/Facilities

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

- One Class B –
  - Minneapolis-St. Paul International (Wold-Chamberlain), Minneapolis
- Nine Class D
  - Ray S. Miller Army Airfield, Camp Ripley
  - Duluth International
  - Anoka County-Blaine, Minneapolis
  - Crystal, Minneapolis
  - Flying Cloud, Minneapolis
  - Rochester International
  - St. Cloud Regional
  - St. Paul Downtown Airport/Holman Field, St. Paul
  - South St. Paul Municipal Airport-Richard E. Fleming Field (FAA, 2015f)

SUAs (i.e., three prohibited, one restricted area, and two MOAs) located in Minnesota are as follows:

- Lake Superior National Forest
  - P-204 – Surface to 4,000 feet MSL
  - P-205 – Surface to 4,000 feet MSL
  - P-206 – Surface to 4,000 feet MSL (FAA, 2015h)
- Camp Ripley (Restricted)
  - R-4301 – Surface to 27,000 feet MSL (FAA, 2015g)

The two MOAs for Minnesota are as follows:

- Beaver – 300 feet AGL up to, but not including, 18,000 feet MSL; Excluding the airspace below 1,500 AGL within three NM of the following public use airports: Big Falls, Bigfork, Bowstring, Northhome, and Waskish
- Snoopy –
  - West – 6,000 feet MSL to, but not including, FL 180 (FAA, 2015g)

The SUAs for Minnesota are presented in Figure 9.1.7-8. There are no TFRs (See Figure 9.1.7-8). MTRs in Minnesota, presented in Figure 9.1.7-9, consist of three Visual Routes, two Instrument Routes, and three Slow Routes.

UAS Considerations

For UAS operators that use a drone with a FAA-Issues N-Number registration are required by the MnDOT, pursuant to state statutes, to register and obtain a state license (MnDOT, 2015f). The NPS signed a policy memorandum on June 24, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service" (NPS, 2014d). There are five National Parks in Minnesota that must comply with this agency directive (NPS, 2015g).

Obstructions to Airspace Considerations

Several references in the Minnesota legislature address airspace hazards. As defined in the Section 360.013 of Chapter 360 Airports and Aeronautics, an airport hazard is “any structure, object of natural growth, or use of land, which obstructs the air space required for the flight of aircraft in landing or taking off at any airport or restricted landing area or is otherwise hazardous to such landing or taking off” (Minnesota Legislature, 2015a). Regulation of tall structures is addressed in Sections 360.81 through 360.91 of Chapter 360. Section 360.81 states “The safety, welfare, and protection of persons and property in the air and on the ground and of the maintenance of electronic communications within this state require that the navigable air space overlying the state and the approaches to and the air traffic pattern area of any public airport in this state be maintained in a reasonably unobstructed condition for the safe flight of aircraft. To that end, the location, height, and identification of structures and the use of land thereto related, are regulated. (Minnesota Legislature, 2015b)” Section 360.84, Height Limitations; Exceptions, addresses the requirements for which a permit is required with regard to new or modified tall structures. A permit may be “to erect or add to a structure which will extend to a height of more than 1,000 feet above the highest point of land within a one mile radius from the location of the structure proposed to be erected or added to if such proposed structure will not be higher than 50 feet above the height of the highest structure in existence on the effective date of Laws 1959, chapter 387, which is within a distance of one mile from the location of the structure proposed to be erected or added to” (Minnesota Legislature, 2015c).

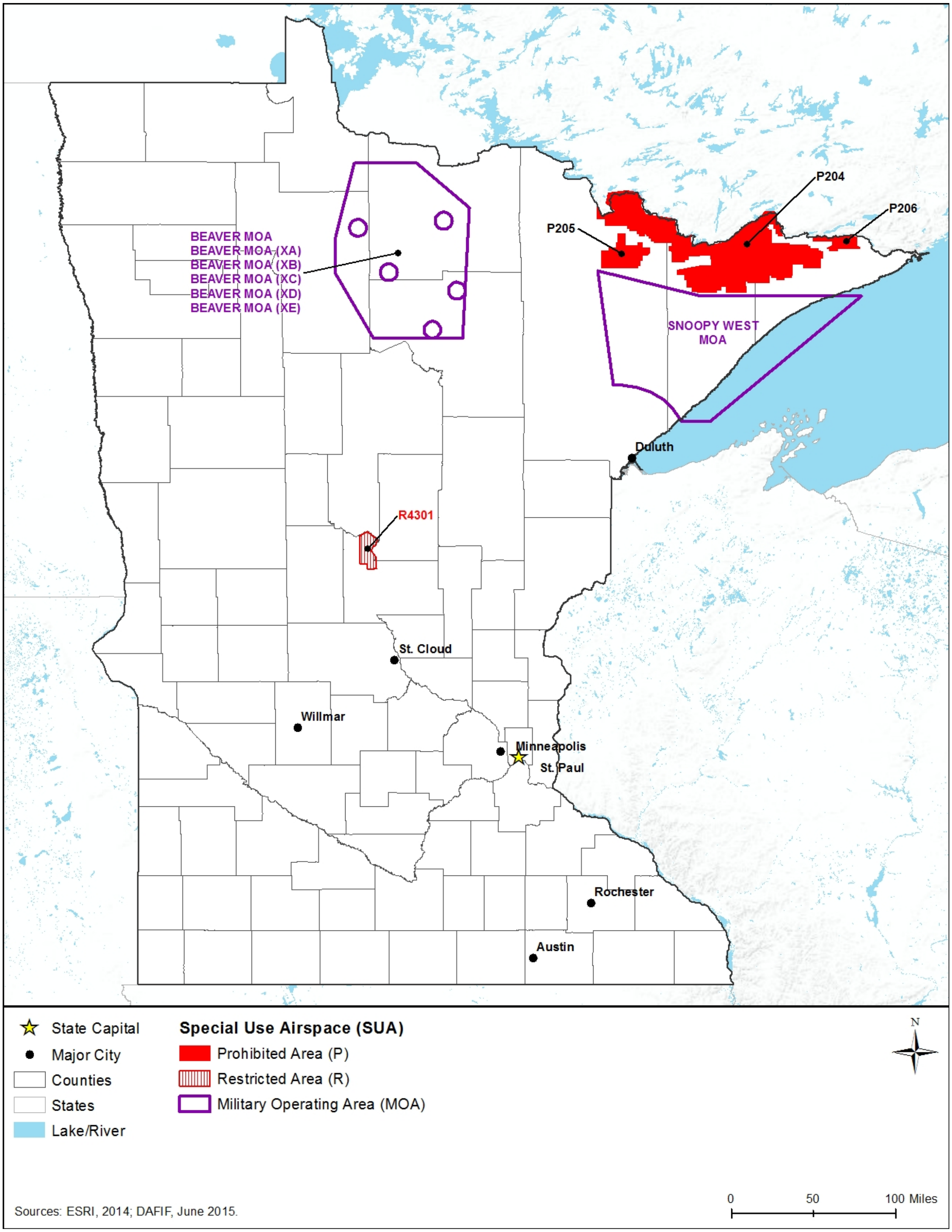


Figure 9.1.7-8: SUAs in Minnesota

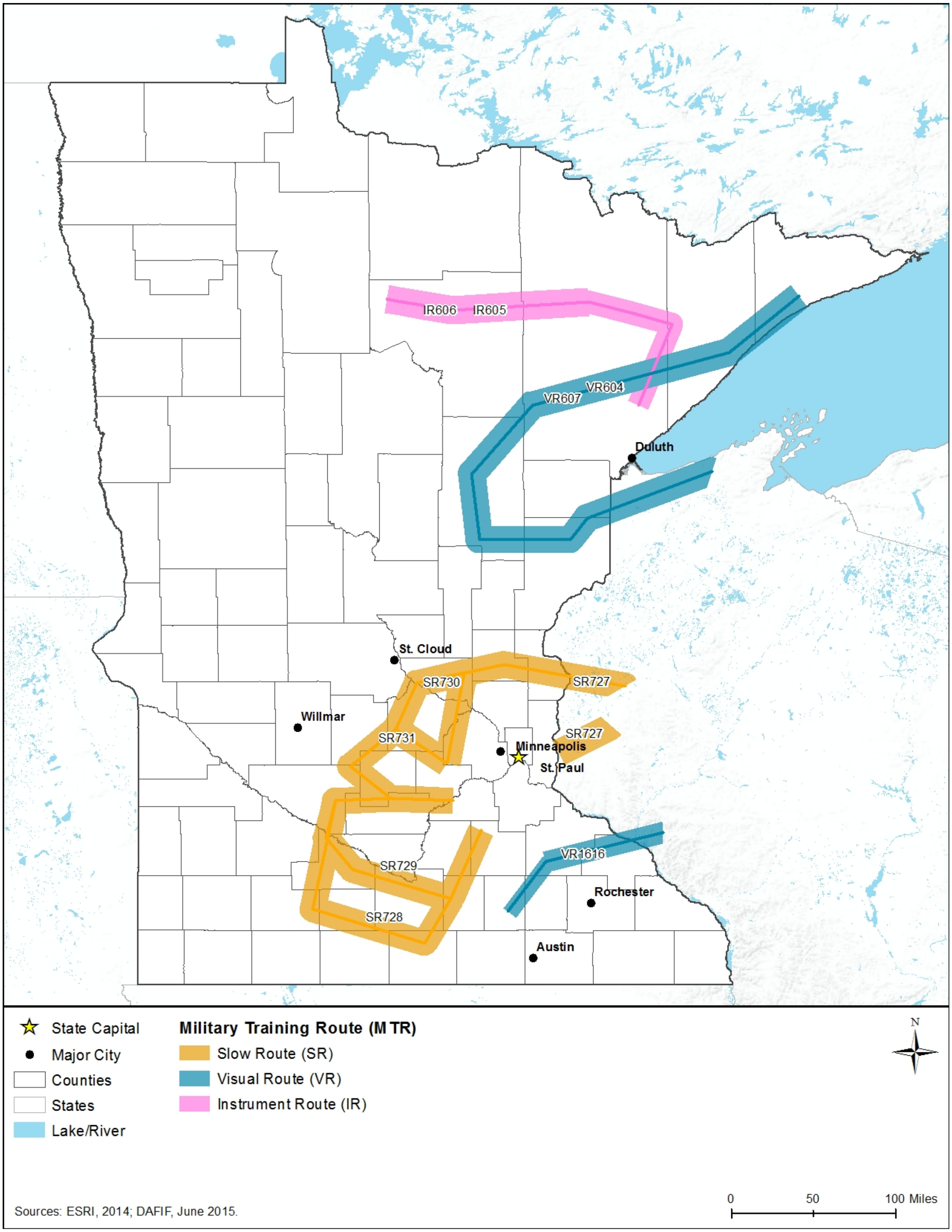


Figure 9.1.7-9: MTRs in Minnesota

9.1.8. Visual Resources

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

9.1.8.2. Specific Regulatory Considerations

Table 9.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 9.1.8-1: Relevant Minnesota Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Minnesota Statutes, Natural Resources, Chapter 84, Section 84.035: Peatland Protection	MDNR	Protection of certain Minnesota peatlands with "unique scientific, aesthetic, vegetative, hydrologic, geologic, wildlife, wilderness, and educational values."
Minnesota Statutes, Recreation, Chapter 86A, Section 86A.05: State Park	Parks and Recreation	Establishes parks for "aesthetic, cultural, and educational purposes" for a variety of recreational uses and to "complement the natural features and the values being preserved."
Minnesota Statutes, State History, Chapter 138, Section 138.663: State Register of Historic Places	SHPO	Establishes the state register of historic places to "preserve the historical values of the state, outstanding properties possessing historical, architectural, archaeological, and aesthetic values are of paramount importance in the development of the state."
Minnesota Statutes, Telecommunications, Chapter 238, Section 238.24: Conditions for Access	Public Utilities	Establishes that the installation of cable communications facilities "must conform to reasonable conditions necessary to protect the safety, functioning, and aesthetic appearance of the premises, and the convenience and well-being of the property owner and residents."

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

Where counties, cities, towns, or villages have planning documents that address scenery, character, or visual resources, the placement of towers or temporary transmission structures would be required to comply with the management or provide mitigation measures to meet compliance.

9.1.8.3. Character and Visual Quality of the Existing Landscape

Minnesota has a wide range of visual resources from pristine forests to open prairie and urban cities. The vast majority of the state is characterized as forested, agricultural, or undeveloped (Figure 9.1.7-1) in Section 9.1.7, Land Use, Recreation, and Airspace). Forested and agricultural lands are the most dominant landscapes in the state, occupying 45 percent each of the land in Minnesota. Lakes, rivers, wetlands, and waterfront lands in Minnesota vary from vegetated riparian areas (areas located on the bank of a watercourse, lake, or tidewater) to wide, open prairie vistas. The consistency, continuity, and lack of view obstructions from major constructed features characterizes the visual attributes of these areas.

Forested areas are the second most prevalent visual resource within the state, occupying 45 percent of the total land area. Visual resources within forested areas are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape.

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

9.1.8.4. 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 9.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Minnesota, there are 1,675 NRHP listed sites, which include 25 National Historic Landmarks and 2 National Monuments. Some State Historic Sites, State Heritage Areas, and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time.

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

National 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. There are no NHAs in Minnesota.

National Historic Landmarks

NHLs are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015h). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 2016b). Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. In Minnesota, there are 25 NHLs, including sites such as Frank B. Kellogg House, Mayo Clinic, and Split Rock Light Station (Figure 9.1.8-1) (NPS, 2015i). By comparison, there are over 2,500 NHLs in the United States (NPS, 2015b). Figure 9.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National and State Historic Sites

The Minnesota Historical Society manages 26 historic sites throughout the state (Figure 9.1.8-1). These sites are likely to contain scenic or aesthetic components that may be considered visual resources or visually sensitive. Examples of heritage sites include the Comstock House, Jeffers Petroglyphs, and the Minnesota State Capitol. For additional information regarding these properties and resources, see Section 9.1.11, Cultural Resources.

9.1.8.5. Parks and Recreation Areas

Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 9.1.7-3 in Section 9.1.7, Land Use, Recreation, and Airspace identifies parks and recreational resources that may be visually sensitive in Minnesota. For additional information about recreation areas, including national and state parks, see Section 9.1.7, Land Use, Recreation, and Airspace.

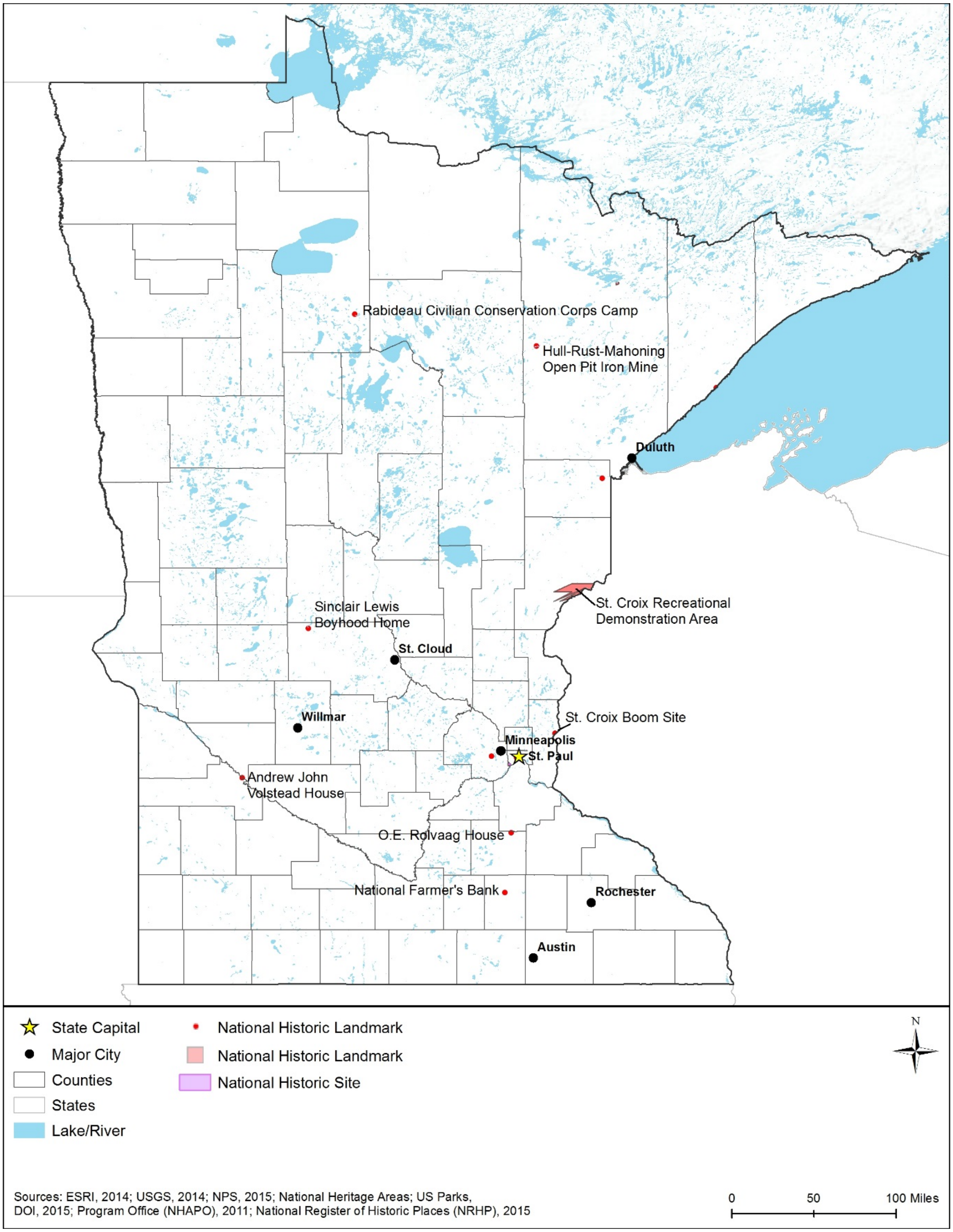


Figure 9.1.8-1: Representative Sample of Some Historic and Cultural Areas that May be Visually Sensitive

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Minnesota residents and visitors. There are 67 state parks throughout Minnesota (Figure 9.1.8-2 and Figure 9.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (MDNR, 2015w).[96] Table 9.1.8-2 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks and their attributes, visit the MDNR website http://www.dnr.state.mn.us/state_forests/management.html.

Table 9.1.8-2: Examples of Minnesota State Parks and Associated Visual Attributes

State Park	Visual Attributes
Scenic State Park	Pristine lakes, beaches, forest and woodland views
Wild River State Park	River, forest, and wildlife views
Glacial Lakes State Park	Vast open prairie views, lake views, forested areas, and wildlife
Fort Ridgely State Park	Historic sites, forested areas, valleys, streams, and wildlife

Source: (MDNR, 2015w)

Figure 9.1.8-2: Garden Island State Park

Source: (MDNR, 2016i)

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

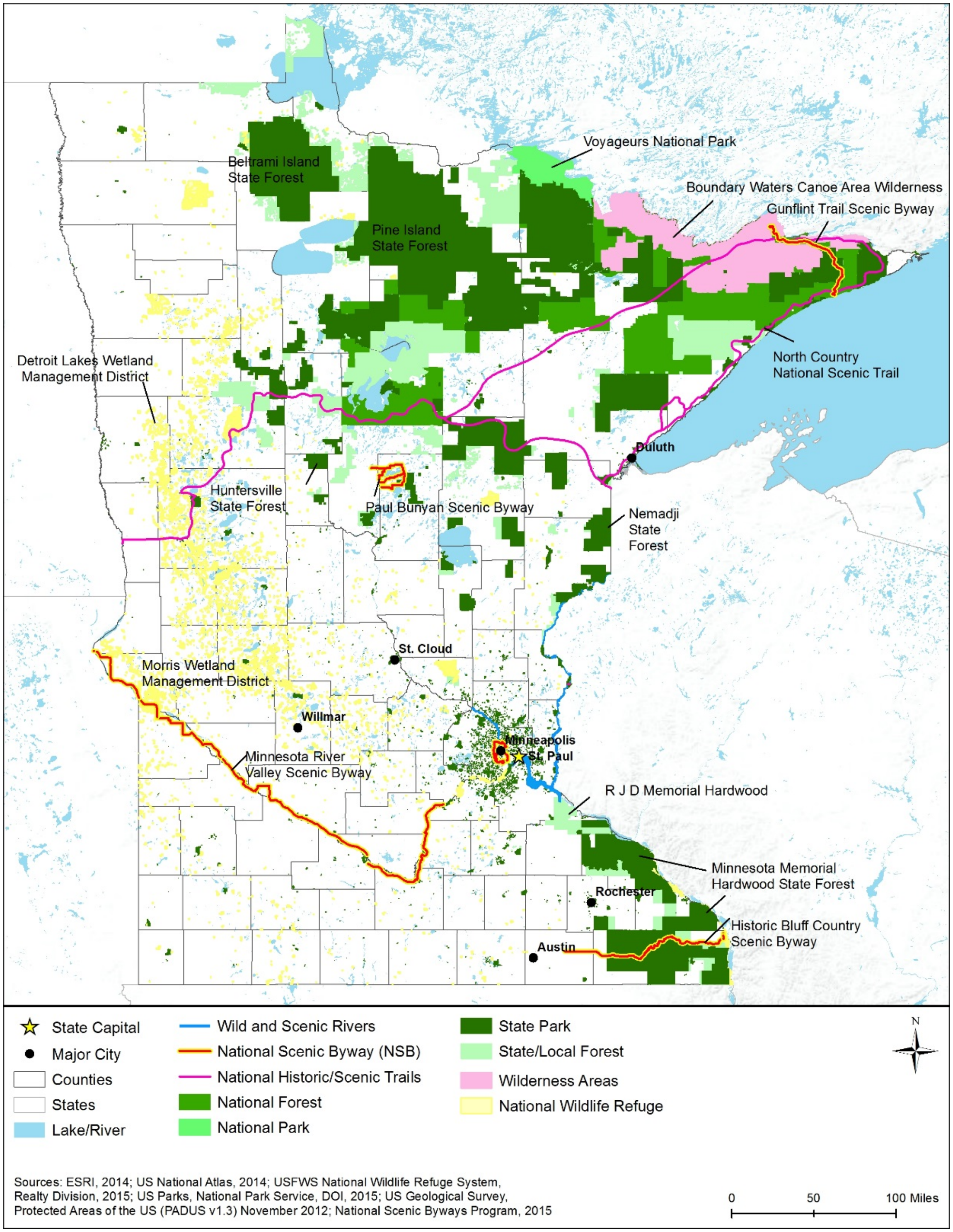


Figure 9.1.8-3: Natural Areas that May be Visually Sensitive

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 Minnesota there are five[97] officially designated National Parks, in addition to other NPS affiliated areas (such as National Heritage Areas). There are two National Monuments (Pipestone National Monument and Grand Portage National Monument), one National River and Recreation Area (Mississippi National River and Recreation Area), one National Scenic Trail, and one National Park (Voyageurs National Park) (Figure 9.1.8-4). For additional information regarding parks and recreation areas, see Section 9.1.7, Land Use, Recreation, and Airspace.

Figure 9.1.8-4: Mississippi National River and Recreational Area

Source: (NPS, 2015j)

State and Federal Trails

Minnesota has designated 24 trails covering 1,346 miles. These trails contain visual resources such as historic views, forest and woodland views, and scenic vistas of valleys and gorges (MDNR, 2015x).

Designated under Section 5 of the National Trails System Act (16 USC 1241-1251, as amended), National Scenic Trails (NSTs) are defined as extended trails that "provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas though which they pass" (NPS, 2012a). There is one National Scenic Trail within Minnesota: the North Country NST administered by the NPS. The North Country NST is a 3,200-mile-long trail extending from eastern Minnesota to North Dakota (NPS, 2014e).

The National Trails System Act authorized the designation of National Recreational Trails near urban areas (American Trails, 2015). There are over 1,100 National Recreation Trails across the

[97] This count is based on the NPS website "by the numbers" current as of 9/30/2014 (NPS, 2016a) Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

nation administered by the U.S. Forest Service, U.S. Army Corps of Engineers, USFWS, local or state governments, and non-profit organizations (National Recreation Trails, 2015).

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value." Over 106 million acres of federal public lands have been designated as wilderness areas. 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, 2015k)

Minnesota is home to three federally managed Wilderness Areas including Agassiz Wilderness (4,000 acres), Boundary Waters Canoe Area Wilderness (814,441 acres), and Tamarac Wilderness (2,180 acres) (Figure 9.1.8-3) (NPS, 2015k).

State Forests

State Forests account for 4,843.75 square miles of state land within 58 forest units. State forests are managed by the Division of Forestry within the Minnesota Department of Natural Resources and "were established to produce timber and other forest crops, provide outdoor recreation, protect watersheds, and perpetuate rare and distinctive species of native flora and fauna" (MDNR, 2016g).

National Forests

USDA National Forests maintain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. There are two National Forests in Minnesota: Chippewa and Superior National Forests (USFS, 2016).

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 USC 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. A portion (226 miles) of the St. Croix River has been designated a National Wild and Scenic River in Minnesota (Figure 9.1.8-3) (National Wild and Scenic Rivers System, 2015a).

Figure 9.1.8-5: National Wild and Scenic River System

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

National Wildlife Refuges 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, 2016c). There are 20 NWRs in Minnesota (Table 9.1.8-3). Visual resources within the NWRs include views and sites of the forested areas, beaches, wildlife, lakes, rivers, streams, valleys, prairies, and naturally vegetated areas.

Table 9.1.8-3: Minnesota National Wildlife Refuges

Agassiz National Wildlife Refuge	Minnesota Valley National Wildlife Refuge
Big Stone National Wildlife Refuge	Minnesota Valley Wetland Management District
Big Stone Wetland Management District[98]	Morris Wetland Management District
Crane Meadows National Wildlife Refuge	Northern Tallgrass Prairie National Wildlife Refuge
Detroit Lakes Wetland Management District	Rice Lake National Wildlife Refuge
Fergus Falls Wetland Management District	Rydell National Wildlife Refuge
Glacial Ridge National Wildlife Refuge	Sherburne National Wildlife Refuge
Hamden Slough National Wildlife Refuge	Tamarac National Wildlife Refuge
Litchfield Wetland Management District	Upper Mississippi River National Wildlife and Fish Refuge
Mille Lacs National Wildlife Refuge	Windom Wetland Management District

Source: (USFWS, 2016c)

State Wildlife Management Areas (WMAs) are "part of Minnesota's outdoor recreation system and are established to protect those lands and waters that have a high potential for wildlife production, public hunting, trapping, fishing, and other compatible recreational uses" (MDNR, 2015y). WMAs are managed by MDNR. There are 1,500 WMAs covering over 1.3 million

[98] A Wetland Management District is an administrative organization that manages all the waterfowl production areas in a multi-county area (USFWS 2012).

acres scattered throughout the state (MDNR, 2015y). For additional information on wildlife refuges and management areas, see Section 9.1.6.4, Wildlife.

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, 2014f). These landmarks may be considered visual resources or visually sensitive. In Minnesota, eight NNLs exist entirely or partially within the state (Table 9.1.8-4). Some of the natural features located within these areas include "an ice age river channel, an internationally known research site at the juncture of three major biomes, northern boreal and eastern deciduous forests, tall grass prairie, and extensive peatland illustrating various geologic formations and plant communities" (NPS, 2012b). Another example, Keeley Creek NNL, contains "undisturbed mixed pine and black spruce forest with rare mature jack pine stands and significant upland bogs" (Figure 9.1.8-6) (NPS, 2012d).

Figure 9.1.8-6: Keeley Creek NNL

Source: (NPS, 2012d)

Table 9.1.8-4: Minnesota National Natural Landmarks

NNL Name	
Ancient River Warren Channel NNL	Itasca Natural Area NNL
Cedar Creek Natural History Area-Allison Savanna NNL	Keeley Creek Natural Area NNL
Lac La Croix Research Natural Area NNL	Lake Agassiz Peatlands Natural Area NNL
Pine Point Research Natural Area NNL	Upper Red Lake Peatland NNL

Source: (NPS, 2012c)

9.1.8.6. 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. Minnesota has eight designated National Scenic Byways:

- Edge of the Wilderness,
- Grand Rounds,
- Great River Road,
- Gunflint Trail,
- Historic Bluff Country,
- Minnesota River Valley,
- North Shore, and
- Paul Bunyan.

9.1.9. Socioeconomics

9.1.9.1. 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 9.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: Land Use, Recreation, and Airspace (Section 9.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 9.1.1, Infrastructure), and aesthetic considerations (Section 9.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau (Census Bureau)[99] and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS are the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which based on surveys (population samples) are 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).

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

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.

9.1.9.2. 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.

9.1.9.3. Communities and Populations

This section discusses the population and major communities of Minnesota (MN) 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 9.1.9-1 presents the 2014 estimated population and population density of Minnesota in comparison to the Central region[100] and the nation. The estimated population of Minnesota in 2014 was 5,457,173. The population density was 69 persons per square mile (sq. mi.), which was slightly higher than the population density of the region (66 persons/sq. mi.) and lower than the population density of the nation (90 persons/sq. mi.). In 2014, Minnesota was the 21st largest state by estimated population among the 50 states and the District of Columbia, 14th largest by land area, and had the 31st greatest population density (U.S. Census Bureau, 2015ab; U.S. Census Bureau, 2015aa).

Table 9.1.9-1: Land Area, Estimated Population, and Population Density of Minnesota

Geography	Land Area (sq. mi.)	Population 2014 (estimated)	Population Density 2014 (persons/sq. mi.)
Minnesota	79,627	5,457,173	69
Central Region	1,178,973	77,651,608	66
United States	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2015ab; U.S. Census Bureau, 2015aa)

Estimated population growth is an important subject for this PEIS given FirstNet's mission. Table 9.1.9-2 presents the population growth trends of Minnesota from 2000 to 2014 in comparison to the Central region and the nation. The state's annual growth rate decreased slightly in the 2010 to 2014 period compared to 2000 to 2010, from 0.76 percent to 0.71 percent.

[100] The Central region is comprised of the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Nebraska, North Dakota, Ohio, Minnesota, 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.

The growth rate of Minnesota in the 2010 to 2014 period was higher than the growth rate of the region, at 0.45 percent, and was slightly lower than the nation's growth rate of 0.81 percent.

Table 9.1.9-2: Recent Population Growth of Minnesota

Geography	Population			Numerical Estimated Population Change		Rate of Estimated Population Change (AARC)[a]	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Minnesota	4,919,479	5,303,925	5,457,173	384,446	153,248	0.76%	0.71%
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, 2015ab)
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 9.1.9-3 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 (ProximityOne, 2015) (University of Virginia Weldon Cooper Center, 2015). The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates Minnesota's estimated population will increase by approximately 651,000 people, or 11.9 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.71 percent, which matches the historical growth rate from 2010 to 2014. The projected growth rate of the state is slightly higher than that of the region (0.60 percent) and slightly lower when compared to the rate of the nation (0.80 percent).

Table 9.1.9-3: Projected Estimated Population Growth of Minnesota

Geography	Population 2014 (estimated)	Projected 2030 Estimated Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) 2014 to 2030
Minnesota	5,457,173	6,079,331	6,136,486	6,107,909	650,736	11.9%	0.71%
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 9.1.9-1 presents the distribution and relative density of the estimated population of Minnesota. 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. The map shows that the northernmost portion of the state is very sparsely populated.

Table 9.1.9-4 provides the populations of the 10 largest population concentrations in Minnesota, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[101] In 2010, the largest population concentration by far was the Minnesota portion of the Minneapolis/St. Paul area, which had approximately 2.7 million people. The state had no other population concentrations over a million. The second largest population concentration was the St. Cloud area, with a population of 110,621. The smallest of these 10 population concentrations was the Austin area, with a 2010 population of 25,103. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Monticello/Big Lake area, with an annual growth rate of 5.34 percent. This area had a large increase in its area definition that may have taken in some existing populations; thus, the growth rate may reflect this factor as well as organic growth (net in-migration and/or births exceeding deaths). The Mankato area had the second fastest annual growth rate (2.03 percent) during this period.

Table 9.1.9-4 also shows that the top 10 population concentrations in Minnesota accounted for 59.8 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 86.6 percent of the entire state's growth.

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

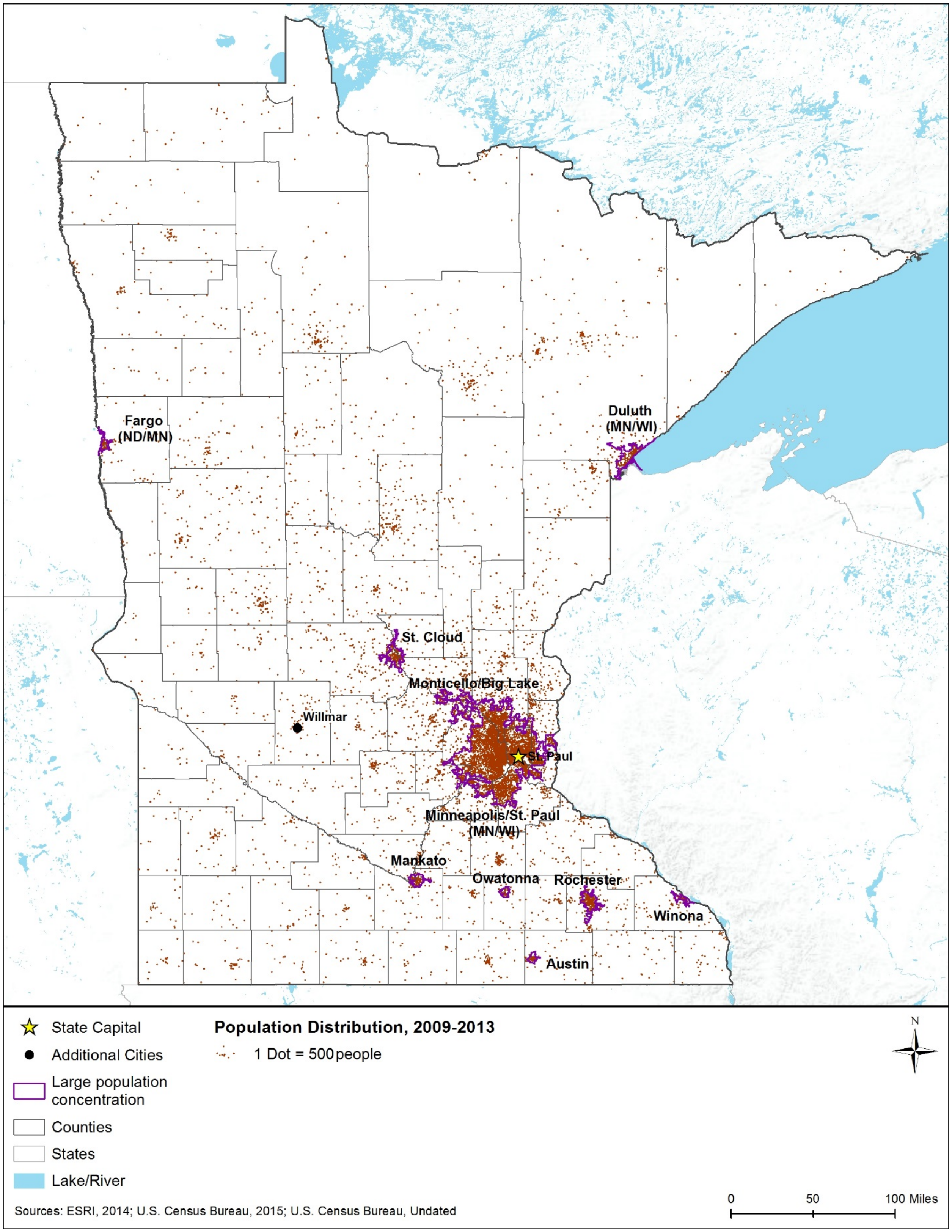


Figure 9.1.9-1: Estimated Population Distribution in Minnesota, 2009–2013

Table 9.1.9-4: Population of the 10 Largest Population Concentrations in Minnesota

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Austin	23,682	25,103	25,348	10	1,421	0.58%
Duluth (MN/WI) (MN Portion)	91,601	93,333	92,695	4	1,732	0.19%
Fargo (ND/MN) (MN Portion)	35,900	42,527	42,654	6	6,627	1.71%
Mankato	47,115	57,584	58,182	5	10,469	2.03%
Minneapolis/St. Paul (MN/WI) (MN Portion)	2,388,593	2,650,614	2,687,366	1	262,021	1.05%
Monticello/Big Lake*	15,179	25,536	26,731	8	10,357	5.34%
Owatonna	22,245	25,394	25,311	9	3,149	1.33%
Rochester	91,271	107,677	109,013	3	16,406	1.67%
St. Cloud	91,305	110,621	110,590	2	19,316	1.94%
Winona	29,440	30,712	30,551	7	1,272	0.42%
Total for Top 10 Population Concentrations	**2,836,331**	**3,169,101**	**3,208,441**	**NA**	**332,770**	**1.12%**
Minnesota (statewide)	**4,919,479**	**5,303,925**	**5,347,740**	**NA**	**384,446**	**0.76%**
Top 10 Total as Percentage of State	**57.7%**	**59.8%**	**60.0%**	**NA**	**86.6%**	**NA**

Sources: (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015g)
AARC = Average Annual Rate of Change (compound growth rate)
*The large population increase from 2000 to 2010 reflects a large change in the area definition for the Monticello/Big Lake urban cluster, from 10 sq. mi. in 2000 to 17 sq. mi. in 2010.

9.1.9.4. 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 9.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 9.1.9-5 compares several economic indicators for Minnesota to the Central region and the nation. The table presents two indicators of income[102] – per capita and median household – as income is a good measure of general economic health of a region.

Per capita income is total income divided by the total population. As a mathematical average, the very high incomes of a relatively small number of people tend to bias per capita income figures upwards. Nonetheless, per capita income is useful as an indicator of the relative income level across two or more areas. As shown in Table 9.1.9-5, the per capita income in Minnesota in 2013 ($31,358) was $3,830 higher than that of the region ($27,528), and $3,174 higher than that of the nation ($28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 9.1.9-5 shows that in 2013, the MHI in Minnesota ($60,664) was $8,619 higher than that of the region ($52,045), and $8,414 higher than that of the nation ($52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 9.1.9-5 compares the unemployment rate in Minnesota to the Central region and the nation. In 2014, Minnesota's statewide unemployment rate of 4.1 percent was considerably lower than both the rate for the region (5.7 percent) and the nation (6.2 percent).[103]

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

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

Table 9.1.9-5: Selected Economic Indicators for Minnesota

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Minnesota	$31,358	$60,664	4.1%
Central Region	$27,528	$52,045	5.7%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015b; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

Figure 9.1.9-2 and Figure 9.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015i) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 9.1.9-1 (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e). Following these two maps, Table 9.1.9-6 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 Minnesota.

Figure 9.1.9-2 shows that, in general, counties with a 2013 MHI above the national median were located in the southern portions of the state, surrounding the Minnesota portion of the Minneapolis/St. Paul area. Most of the remainder of the state had MHI levels below the national average, with a few exceptions. Table 9.1.9-6 is consistent with those observations. It shows that the 2009–2013 MHI in the Minneapolis/St. Paul (Minnesota portion), Monticello/Big Lake, and Rochester areas was above the state average. MHI in all other population concentrations was below the state average. MHI was lowest in the Austin area, which is the smallest population of the areas shown in the table.

Figure 9.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that the great majority of counties had unemployment rates below the national average (that is, better employment performance). Only a small number of counties, located outside of the 10 largest population concentrations, had unemployment rates above the national average. When comparing unemployment in the population concentrations to the state average (Table 9.1.9-6), half of the 10 areas (the Minnesota portion of the Fargo area, and the Mankato, Monticello/Big Lake, Owatonna, and Rochester areas) had a 2009–2013 unemployment rate that was lower than the state average.

Detailed employment data provide useful insights into the nature of a local, state, or national economy. Table 9.1.9-7 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 slightly higher in Minnesota than in the Central region and the nation. The percentage of government workers was lower in the state than in the region and nation. The percentage of self-employed workers in Minnesota was slightly higher than in the region and slightly lower than in the nation.

By industry, Minnesota has a mixed economic base and some notable figures in the table are as follows. Minnesota in 2013 had a considerably higher percentage (more than two percentage points difference) of workers in “manufacturing” than the nation did. The rest of the values for Minnesota were within two percentage points of the region and nation.

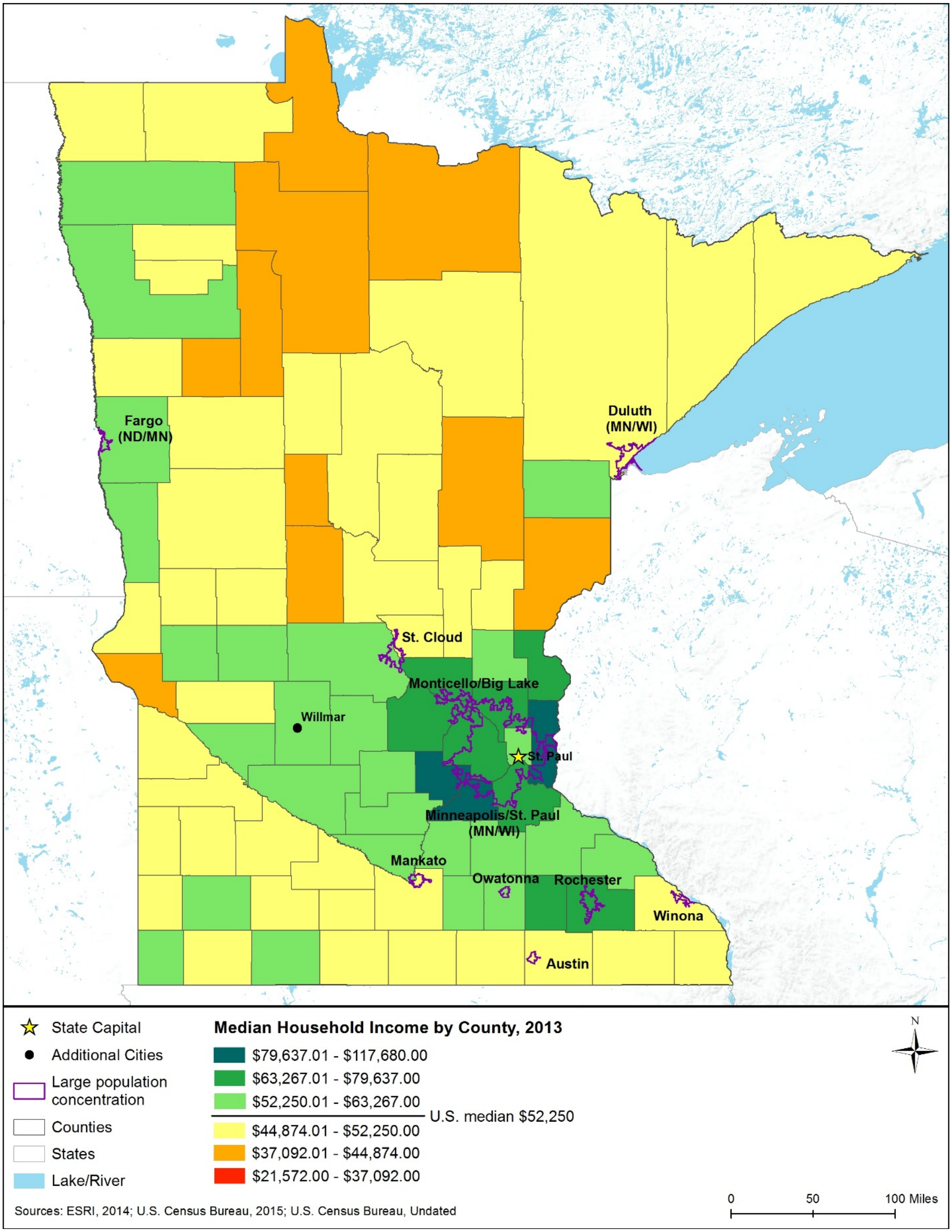


Figure 9.1.9-2: Median Household Income in Minnesota, by County, 2013

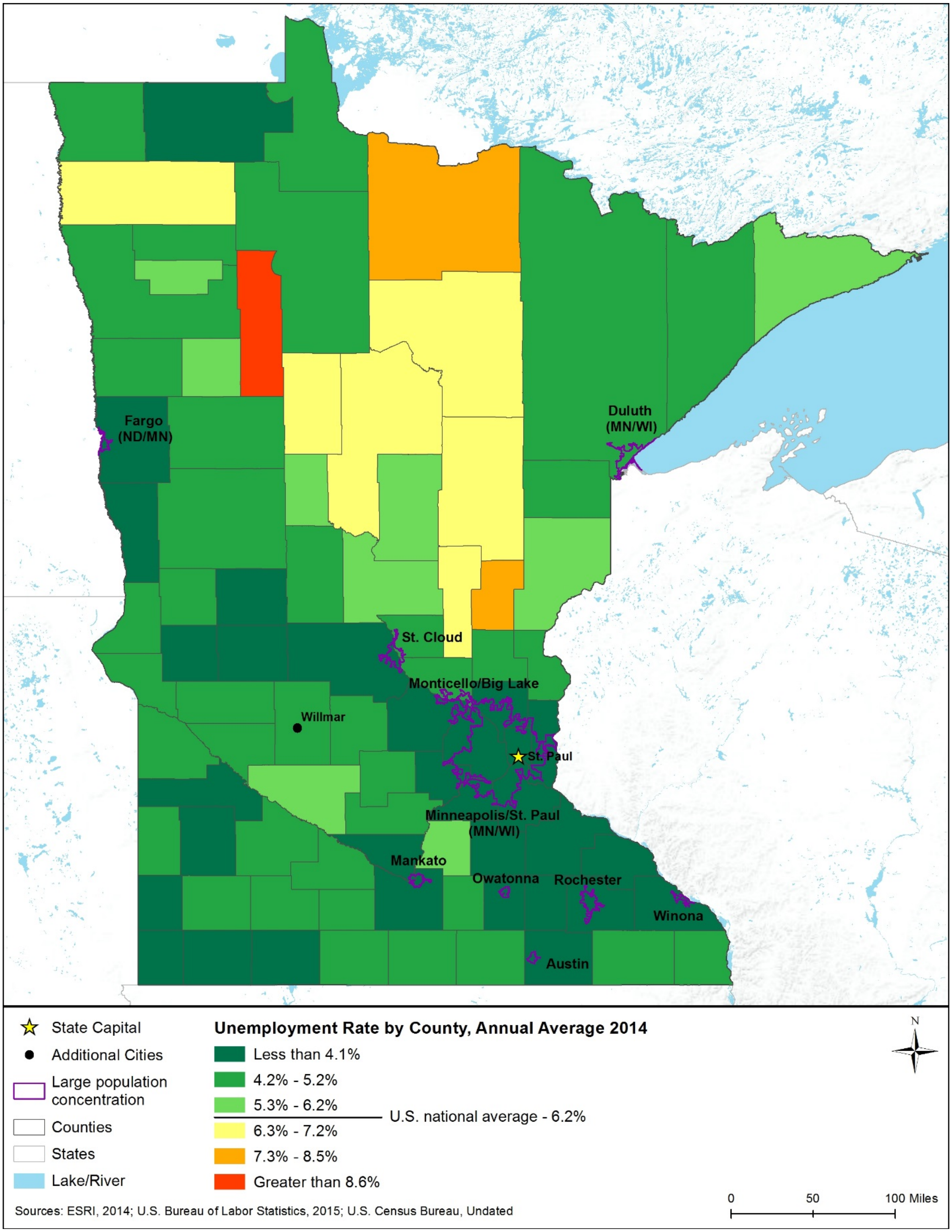


Figure 9.1.9-3: Unemployment Rates in Minnesota, by County, 2014

Table 9.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Minnesota, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Austin	$39,102	7.6%
Duluth (MN/WI) (MN Portion)	$43,762	8.2%
Fargo (ND/MN) (MN Portion)	$47,648	6.0%
Mankato	$47,767	6.6%
Minneapolis/St. Paul (MN/WI) (MN Portion)	$66,145	7.5%
Monticello/Big Lake	$73,065	6.2%
Owatonna	$53,282	7.0%
Rochester	$62,050	4.5%
St. Cloud	$47,559	8.5%
Winona	$39,886	9.7%
Minnesota (statewide)	$59,836	7.1%

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

Table 9.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Minnesota	Central Region	United States
Civilian Employed Population 16 Years and Over	2,828,280	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	82.5%	81.7%	79.7%
Government workers	11.8%	12.8%	14.1%
Self-employed in own not incorporated business workers	5.4%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	2.4%	2.2%	2.0%
Construction	5.3%	5.6%	6.2%
Manufacturing	13.4%	14.0%	10.5%
Wholesale trade	2.8%	2.7%	2.7%
Retail trade	11.4%	11.5%	11.6%
Transportation and warehousing, and utilities	4.6%	4.9%	4.9%
Information	1.9%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	7.2%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	10.1%	9.7%	11.1%
Educational services, and health care and social assistance	24.6%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.3%	9.1%	9.7%
Other services, except public administration	4.6%	4.6%	5.0%
Public administration	3.4%	3.9%	4.7%

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

Table 9.1.9-8 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 9.1.9-7 for 2013.

Table 9.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Minnesota, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Austin	4.4%	3.1%	2.1%	6.3%
Duluth (MN/WI) (MN Portion)	4.0%	4.9%	1.7%	6.6%
Fargo (ND/MN) (MN Portion)	6.8%	5.1%	1.3%	5.8%
Mankato	4.1%	3.3%	3.2%	6.0%
Minneapolis/St. Paul (MN/WI) (MN Portion)	3.9%	4.3%	2.3%	12.7%
Monticello/Big Lake	7.2%	4.8%	1.1%	9.4%
Owatonna	3.7%	2.7%	1.2%	6.3%
Rochester	3.6%	2.8%	2.1%	6.6%
St. Cloud	4.7%	4.8%	1.4%	5.8%
Winona	2.7%	2.5%	2.3%	6.0%
Minnesota (statewide)	5.5%	4.5%	1.9%	12.7%

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 9.1.9-9 compares Minnesota to the Central region and nation on several common housing indicators.

As shown in Table 9.1.9-9, in 2013, Minnesota had a higher percentage of housing units that were occupied (89.5 percent) than the region (88.4 percent) or nation (87.6 percent). Of the occupied units, Minnesota had a slightly higher percentage of owner-occupied units (71.6 percent) than the region (67.6 percent) or nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Minnesota in 2013 (67.4 percent) was slightly lower than the region (67.7 percent) and higher than the nation (61.5 percent). The homeowner vacancy rate in Minnesota (1.4 percent) was slightly lower than the rate for the region (1.8 percent) and the nation (1.9 percent). This rate reflects "vacant units that are 'for sale only'" (U.S. Census Bureau, 2015h). The vacancy rate among rental units was lower in Minnesota (3.9 percent) than in the region (6.0 percent) or nation (6.5 percent).

Table 9.1.9-9: Selected Housing Indicators for Minnesota, 2013

Geography	Total Housing Units	Housing Occupancy and Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Minnesota	2,368,754	89.5%	71.6%	1.4%	3.9%	67.4%
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 9.1.9-10 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 9.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Minnesota, 2009–2013

Area	Total Housing Units	Housing Occupancy and Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Austin	11,037	94.0%	64.7%	2.8%	3.5%	71.9%
Duluth (MN/WI) (MN Portion)	40,770	93.4%	59.8%	1.0%	4.2%	60.9%
Fargo (ND/MN) (MN Portion)	16,934	94.1%	63.1%	0.5%	6.6%	58.3%
Mankato	23,966	94.3%	61.3%	0.6%	5.0%	54.1%
Minneapolis/St. Paul (MN/WI) (MN Portion)	1,115,521	94.9%	68.0%	1.4%	4.3%	56.7%
Monticello/Big Lake	9,702	95.2%	78.4%	1.3%	3.4%	69.0%
Owatonna	10,726	94.7%	72.0%	2.2%	2.1%	70.7%
Rochester	46,435	93.9%	70.9%	1.3%	7.6%	63.3%
St. Cloud	45,545	93.4%	58.7%	1.8%	6.0%	58.3%
Winona	12,969	89.8%	63.5%	2.9%	11.3%	60.4%
Minnesota (statewide)	2,353,932	89.5%	72.5%	1.6%	4.9%	67.3%

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

Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 9.1.9-11 provides indicators of residential property values for Minnesota and compares these values to values for the Central region and nation. The figures on median value of owner-occupied units are from the Census Bureau's ACS, based on owner estimates of how much their property (housing unit and land) would sell for if it were for sale (U.S. Census Bureau, 2015h). Table 9.1.9-11 shows that the median value of owner-occupied units in Minnesota in 2013 ($180,100) was higher than the corresponding values for the Central region ($151,200) and the nation ($173,900).

Table 9.1.9-11: Residential Property Values in Minnesota, 2013

Geography	Median Value of Owner-Occupied Units
Minnesota	$180,100
Central Region	$151,200
United States	$173,900

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

Table 9.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. The median property value for these 10 communities ranged from $93,400 in the Austin area to $217,300 in the Minneapolis/St. Paul (Minnesota portion); the state value was $132,400. The lowest property values were in the two areas – Austin and Winona – that had the lowest median household incomes (Table 9.1.9-6).

Table 9.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Minnesota, 2009–2013

Area	Median Value of Owner-Occupied Units
Austin	$93,400
Duluth (MN/WI) (MN Portion)	$148,400
Fargo (ND/MN) (MN Portion)	$153,200
Mankato	$157,500
Minneapolis/St. Paul (MN/WI) (MN Portion)	$217,300
Monticello/Big Lake	$167,400
Owatonna	$152,200
Rochester	$163,700
St. Cloud	$155,700
Winona	$139,000
Minnesota (statewide)	$187,900

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 9.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure.

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

Table 9.1.9-13 shows that state and local governments in Minnesota received more total revenue in 2012 on a per capita basis than their counterpart governments in the region and nation. The state government in Minnesota had higher levels per capita of intergovernmental revenues than its counterpart governments in the region and nation. Additionally, Minnesota local governments had higher levels per capita of intergovernmental revenues[104] than their counterparts in the region and lower levels than their counterpart governments in the nation. The Minnesota state government obtained more revenue per capita from property taxes than its counterpart governments in the region and the nation. Local governments in Minnesota obtained higher levels of property taxes per capita than local governments in the region and slightly lower levels than local governments in the nation. General sales taxes on a per capita basis were higher for the Minnesota state government than for its counterparts in the region and nation, and were lower for Minnesota local governments than for their counterparts in the region and nation. Selective sales taxes on a per capita basis were higher for the Minnesota state government than for its counterparts in the region and nation. Selective sales taxes on a per capita basis for Minnesota local governments were slightly higher than for their counterparts in the region, and lower than for their counterparts in the nation. The state government in Minnesota reported no revenue from public utility taxes.[105] Local governments in Minnesota reported more revenue from public utility taxes than their counterpart governments in the region, and less revenue than counterpart governments in the nation. The state government in Minnesota reported more revenue from individual and corporate income taxes, on a per capita basis, than its counterpart

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

governments in the region and nation. Local governments in Minnesota reported no revenue from individual and corporate income taxes.

Table 9.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue		Minnesota		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	($M)	$38,554	$28,422	$463,192	$231,980	$1,907,027	$1,615,194
	Per capita	$7,167	$5,284	$6,020	$3,015	$6,075	$5,145
Intergovernmental from Federal	($M)	$9,608	$1,018	$125,394	$9,383	$514,139	$70,360
	Per capita	$1,786	$189	$1,630	$122	$1,638	$224
Intergovernmental from State	($M)	$0	$10,644	$0	$76,288	$0	$469,147
	Per capita	$0	$1,979	$0	$992	$0	$1,495
Intergovernmental from Local	($M)	$117	$0	$2,721	$0	$19,518	$0
	Per capita	$22	$0	$35	$0	$62	$0
Property Taxes	($M)	$808	$7,053	$3,626	$61,015	$13,111	$432,989
	Per capita	$150	$1,311	$47	$793	$42	$1,379
General Sales Taxes	($M)	$4,942	$120	$58,236	$6,920	$245,446	$69,350
	Per capita	$919	$22	$757	$90	$782	$221
Selective Sales Taxes	($M)	$4,197	$184	$33,313	$2,191	$133,098	$28,553
	Per capita	$780	$34	$433	$28	$424	$91
Public Utilities Taxes	($M)	$0	$106	$3,627	$1,153	$14,564	$14,105
	Per capita	$0	$20	$47	$15	$46	$45
Individual Income Taxes	($M)	$7,988	$0	$72,545	$5,148	$280,693	$26,642
	Per capita	$1,485	$0	$943	$67	$894	$85
Corporate Income Taxes	($M)	$1,066	$0	$9,649	$310	$41,821	$7,210
	Per capita	$198	$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.

9.1.10. Environmental Justice

9.1.10.1. 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 1.8.12, Executive Order 12898 – 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 the National Environmental Policy Act (NEPA)* to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, the USEPA Office of Environmental Justice (USEPA, 2015j) offers guidance on Environmental Justice issues and provides an "environmental justice screening and mapping tool," EJSCREEN (USEPA, 2015o).

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).

9.1.10.2. Specific Regulatory Considerations

The MPCA updated its environmental justice policy in 2012. MPCA seeks to ensure the "…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." This policy identifies principles and practices, and provides guidance to integrate these principles into state-administered programs. (MPCA, 2012)

The MPCA strives to ensure that pollution does not disproportionately impact any group or community. MPCA established a network of organizations and community groups involved in environmental equity. In addition, the state has a tribal liaison program, to improve relations with tribes and provide better communication on air and water permit notices and other issues. (MPCA, 2015l)

9.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 9.1.10-1 presents 2013 data on the composition of Minnesota's estimated population by race and by Hispanic origin. The state's estimated population has considerably lower percentages of individuals who identify as Black/African American (5.4 percent) or Some Other Race (1.6 percent) than the estimated populations of the Central region and the nation. (Those percentages are, for Black/African American, 9.3 percent for the Central region and 12.6 percent for the nation; and for Some Other Race, 2.4 percent and 4.7 percent respectively.) The state's estimated population has higher percentages of individuals who identify as Asian (4.3 percent) than the populations of the region (2.8 percent) and slightly lower percentages when compared to the populations of the nation (5.1 percent). The state's percentage of persons identifying as White (84.8 percent) is larger than that of the Central region (82.2 percent) or the nation (73.7 percent).

The percentage of the estimated population in Minnesota that identifies as Hispanic (4.9 percent) is considerably smaller than in the Central region (8.5 percent) and the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin.

The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Minnesota's All Minorities estimated population percentage (18.1 percent) is considerably lower than that of the Central region (23.3 percent) or the nation (37.6 percent).

Table 9.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Minnesota (11.2 percent) is considerably lower than that for the Central region (14.7 percent) and for the nation (15.8 percent).

Table 9.1.10-1: 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		
Minnesota	5,420,380	84.8%	5.4%	1.1%	4.3%	0.0%	1.6%	2.7%	4.9%	18.1%
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 9.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Minnesota	11.2%
Central Region	14.7%
United States	15.8%

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

9.1.10.4. 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 9.1.10-1 visually portrays the results of the environmental justice population screening analysis for Minnesota. 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 9.1.10-1 shows that Minnesota has a number of areas with high potential for environmental justice populations. However, compared to most other states, Minnesota has a relatively low proportion of its area in the high potential category. The high potential areas are distributed across the state, but are somewhat more prevalent in the northern half of the state. Areas with moderate potential for environmental justice are more prevalent than, but show a similar pattern of distribution as, high potential areas. High and moderate potential areas occur both within and outside of the 10 largest population concentrations.

It is important to understand how the data behind Figure 9.1.10-1 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 9.1.10-1 does not definitively identify environmental justice populations. It indicates *degrees of likelihood of the presence* of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under- or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier off the methodology of this PEIS.

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to NEPA criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997). The Environmental Consequences section (Section 9.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

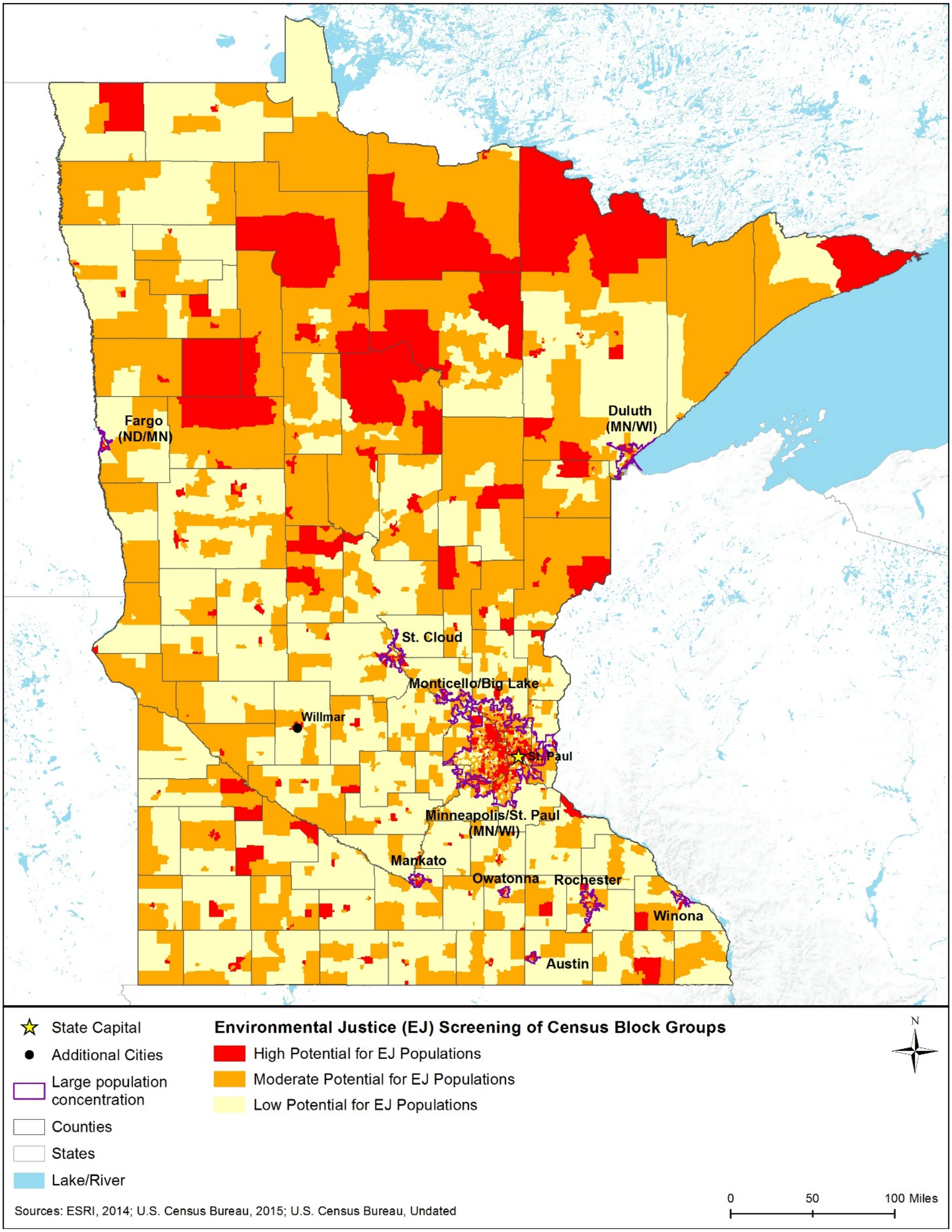


Figure 9.1.10-1: Potential for Environmental Justice Populations in Minnesota, 2009–2013

9.1.11. Cultural Resources

9.1.11.1. Definition of Resource

For the purposes of this Programmatic Environmental Impact Statement (PEIS), Cultural Resources are defined as:

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

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

- The statutory language and implementing regulations for Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), formerly 16 USC 470a(d)(6)(A) (now 54 USC 306131(b)) and 36 CFR 800.16(l)(1);
- The statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 USC 470cc(c) and 43 CFR 7.3(a);
- The statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 USC 3001(3)(D) and 43 CFR 10.2(d);
- The NPS program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2016c); and
- The Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to Indian tribes or Native Hawaiian organizations (ACHP, 2004).

9.1.11.2. Specific Regulatory Consideration

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 to Cultural Resources include the NHPA (detailed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Minnesota 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 9.1.11-1 presents state and local laws and regulations that relate to cultural resources.

Table 9.1.11-1: Relevant Minnesota Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Minnesota Statutes, State History, Chapter 138, Section 138.663: State Register of Historic Places	SHPO	Establishes the state register of historic places to "preserve the historical values of the state, outstanding properties possessing historical, architectural, archaeological, and aesthetic values are of paramount importance in the development of the state."

9.1.11.3. Cultural and Natural Setting

By around 11,000 years ago, the ice sheets that covered what is now Minnesota had retreated, allowing the growth of a landscape of grasslands and woodlands, which created habitat for mammoth, bison, and caribou. The first human inhabitants of Minnesota are believed to have been Paleoindians who entered the region in small numbers following their eastward movement from Asia via the Bering Land Bridge (Gibbon, 2002). This culture of hunters of large game used Clovis and Folsom stone projectile points for centuries until the megafauna they pursued became extinct through a combination of over-hunting and climatic change (Hirst, 2015).

The Archaic Period in Minnesota that followed was a mosaic of cultures that used different subsistence strategies, with some groups depending entirely on populations of prairie bison, some hunting in forests for a range of protein resources, and others living along the Mississippi River taking advantage of rich animal and plant resources, including waterfowl, fish, and mussels (Minnesota Office of the State Archaeolologist, 2016). In the subsequent Woodland and Late Prehistoric Periods, societies in the Minnesota region developed more specialized subsistence adaptations, such as maize agriculture and shellfish procurement and processing. This broad subsistence base contributed to increasing cultural complexity and social divisions, including elaborate burials in large earthen mounds and diverse pottery (Gibbon, 2002) (Anfinson, 1981).

Archaeologists typically divide the state into cultural regions with specific progressions of societal evolution, which are, in turn, associated with specific environmental settings and societies' environmental adaptations to them. For example, the Archaic Period is divided by the type of environmental adaption as follows: Prairie Archaic in the west, the Lake Forest Archaic in central and north-central Minnesota, the Shield Archaic in the far northeast, and the Riverine Archaic in the southeast (Minnesota Office of the State Archaeolologist, 2016). The sequences follow changes in the archaeological record through time, and to organize it into understandable periods, which are marked by particular technologies, subsistence strategies, and other cultural expressions.

Archaeological sites in Minnesota mostly are found from the surface to a depth of approximately two meters, with significant variability throughout the state. They are present in all physiographic regions (see Figure 9.1.3-1), in both rural and urban areas.

The following sections provide additional detail about Minnesota's prehistoric periods (approximately 11200 B.C. to A.D. 1650) and the historic period since European colonization in the 1600s. There is some overlap between the prehistoric period and the historic period, as

American Indians continued to carry on their traditional way of life in parts of Minnesota after European contact. Section 9.1.11.4 presents an overview of the initial human habitation in Minnesota and the cultural development that occurred before European contact. Section 9.1.11.5 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 9.1.11.6 provides a current list of significant archaeological sites in Minnesota and tools that the state has developed to ensure their preservation. Section 9.1.11.7 documents the historic context of the state since European contact, and Section 9.1.11.8 summarizes the architectural context of the state during the historic period.

Prehistoric Setting

The Paleoindian Period, Archaic Period, Woodland Period, and Late Prehistoric Period refer to prehistoric cultural sequences in Minnesota. Cultural traditions in Minnesota became more dynamic and complex over time, reflecting humans' more refined manipulation of their environment as it changed over millennia. As the climate, fauna, and flora of the state changed, the initial hunter-gather cultures changed to settlement-based cultures that used advances in environmental understanding and technology to cultivate land and establish trade with distant groups. This diversification and adaptation to specific environments gave rise to larger settlements, religious customs, and social stratification (Gibbon, 2002).

The prehistoric periods in Minnesota include the Paleoindian Period (11200 - 7000 B.C.), the Archaic Period (7000 - 500 B.C.), the Woodland Period (500 B.C. - A.D. 1000), and the Late Prehistoric Period (A.D. 1000 - 1650). The Protohistoric Period (A.D. 1650 - 1860) is marked by the introduction of Euro-American culture and technologies (Gibbon, 2002). The following sections explore these periods.

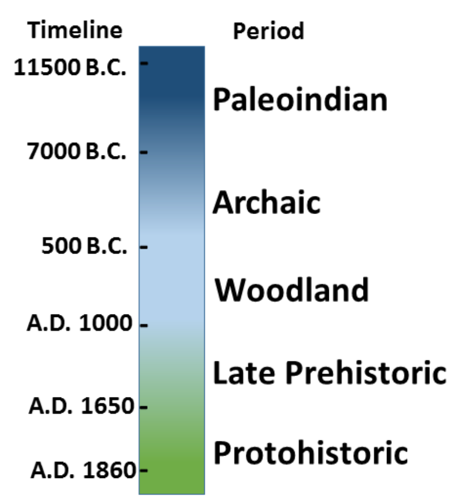


Figure 9.1.11-1: Timeline of Prehistoric Human Occupation

Source: (Institute of Maritime History, 2015)

Paleoindian Period (11500 - 7000 B.C.)

The Paleoindian Period in Minnesota is composed of Clovis, Folsom, and Plano cultures.[106] Paleoindian cultures are described in the archaeological record primarily through the characteristics of fluted points, which became slightly smaller between the Clovis and Folsom Periods, transitioning to even smaller, diversified, non-fluted projectile points in the Plano Period. Although Clovis and Folsom projectile points have been found on the surface during pedestrian surveys in central and southern Minnesota, no intact Clovis or Folsom period archaeological sites have been found in the state. (Minnesota Office of the State Archaeolologist, 2016).

The earliest archaeological sites found in Minnesota are from the Plano Period, with 200 sites across the state. One well-known example is the Browns Valley site, discovered in a gravel pit near Browns Valley, Traverse County, which included human remains and several spear points. The remains of the Browns Valley site, radiocarbon dated to 10000 B.C., are indicative of a bison hunter (Anfinson, Southwestern Minnesota Archaeology: 12,000 Years in the Prairie Lake Region, 1997). The Bradbury Brook site near Onamia, Mille Lacs County, contains a hearth dating to 10000 B.C. and is thought to have been a tool-making station associated with a nearby quarry (Minnesota Office of the State Archaeolologist, 2016).

Archaic Period (7000 - 500 B.C.)

The Archaic Period in Minnesota was between 7000 and 500 B.C., when drier conditions prevailed in the region, and prairie grasslands expanded in the eastern portion of the state. The prairie grassland displaced much of what was previously woodlands containing shallow lakes and marshlands. Bison thrived in the prairie grasslands and became the main protein source for human inhabitants there (the Prairie Archaic culture), while the Lake Forest Archaic in Central Minnesota, the Shield Archaic in far northeastern Minnesota, and the Riverine Archaic in the Mississippi River Valley hunted other local species (Minnesota Office of the State Archaeolologist, 2016). In spite of the expansion of grasslands during the Archaic Period, the region remained environmentally diverse and was home to several distinct hunter-gatherer cultures. Large lanceolate spears were replaced with smaller, nimbler darts that would have been projected by atlatls (Minnesota Office of the State Archaeolologist, 2016).

Prehistoric peoples in the Archaic Period in Minnesota are divided into the Prairie Archaic, the Lake Forest Archaic, and the Riverine Archaic cultures. These cultures are not based on periods, but rather on the ways that groups adapted to different environmental conditions within the state. Another culture, known as the Shield Archaic, is associated with the Canadian Shield volcanic area, which extended from the north of the state into Canada, where caribou hunting contributed to their economy. The limited artifacts and archaeological data associated with this environmental context make it more difficult to understand, and most of the data associated with the Shield Archaic culture has been found in Canada. (Minnesota Office of the State Archaeolologist, 2016)

[106] Clovis, 10,000-9000 B.C.; Folsom, 9000-8000 B.C.; Plano, 8000-7000 B.C.

The Prairie Archaic culture consisted of prairie grassland adaptations focused on community bison hunting and was associated with small refined dart points projected by atlatls. The Itasca Bison site near Lake Itasca, Clearwater County, has been dated to around 6000 B.C. It is a good example of the Prairie Archaic culture with remains of 16 now extinct bison and many small side-notched dart points (Minnesota Office of the State Archaeolologist, 2016).

The Lake Forest Archaic culture in Central Minnesota is less understood than the Prairie Archaic. It is defined by a broader adaptive subsistence strategy based mostly on forest animals, in addition to an early focus on bison. The Mississippi River flows through the center of the region, and the culture is also associated with the exploitation and trading of the various river resources (Minnesota Office of the State Archaeolologist, 2016).

The Riverine Archaic culture was along the valleys of the Mississippi River in southeastern Minnesota. Throughout the Riverine Archaic culture, the valleys and floodplains provided a rich and diverse source of animal and plant resources, including waterfowl, fish, shellfish, and wild plants, and readily supported horticultural, such as squash and other early crops. The hills of the Mississippi River Valley provided deer, elk, and occasional bison (Minnesota Office of the State Archaeolologist, 2016).

Woodland Period (500 B.C. - A.D. 1000)

While the Woodland Period[107] spanned about 1,500 years between 500 BC and A.D. 1000 in most of Minnesota, in the northern part of the state the period persisted until the French arrived during the 17th century. The period is characterized by the introduction of cereal (maize and wild rice) cultivation, burial mounds, ceramics, the bow, and arrow and finely worked, dart projectile points (Minnesota Office of the State Archaeolologist, 2016).

There are more than 12,000 Woodland Period burial mounds recorded in the state, even though many of these sites have been destroyed by industrial agricultural practices, modern land development, and other modern land adaptations. The Red Wing area, the Lake Minnetonka area, and the area around Mille Lacs Lake have the highest concentration of the earthen Woodland Period burial mounds. While burial mounds were excavated into the 1970s, none has been excavated since that time, as it is now against the law to intentionally excavate a mound without the consent of the Minnesota Indian Affairs Council, in accordance with the Native American Grave Protection and Repatriation Act (NAGPRA) (Minnesota Office of the State Archaeolologist, 2016).

Late Prehistoric (A.D. 1000—1650)

The Late Prehistoric Period is marked by the simultaneous existence of a set of complex cultural systems. These included the Cahokian culture, which emanated from across the Mississippi River near modern day St. Louis; the Oneota cultural complex in southern and central Minnesota; the mixed bison hunting and horticulture Plains Village complex; and the Psinomani

[107] This pattern of technological and religious innovation is called “Woodland” because it was first recognized in forested areas of the eastern United States.

complex, with its unique ceramic assemblage (Minnesota Office of the State Archaeolologist, 2016).

The most eminent of these cultural complexes existed in what is now St. Louis, which was a major prehistoric city with palisaded borders and intensive maize agricultural production. Cahokian ceramics and burial mounds covered a large area around Red Wing in Goodhue County. Globular Cahokian ceramics are tempered with crushed freshwater clam shells. Burial mounds found in Minnesota that are associated with Cahokia likely embodied a socio-religious complex that spread throughout the Upper Mississippi River Valley region (Minnesota Office of the State Archaeolologist, 2016).

The Oneota cultural complex was longer lived than the Cahokian complex and included intensive maize agriculture and shell tempered ceramics. The Siouan-speaking Oneota culture complex appears to have been more mobile and is not associated with burial mounds. This cultural complex existed from A.D. 1000 until the arrival of the French (Minnesota Office of the State Archaeolologist, 2016).

The Plains Village complex was a long-lasting culture that included intensive maize cultivation and bison hunting. Plains Village societies lived in communities that included large earthen fort lodges that were defended by wooden palisades. Plains Village cultures include the Cambria, Great Oasis, and Big Stone. These different cultures had similar socio-religious beliefs manifested in burial mounds, complex stone tool kits, and mixed hunting and farming subsistence practices (Minnesota Office of the State Archaeolologist, 2016).

The Psinomani people lived in eastern Minnesota and are thought to be the ancestors of the modern Dakota Indian tribe. Their cultural complex is very similar to the Oneota complex and includes shell-tempered ceramics (Minnesota Office of the State Archaeolologist, 2016).

Protohistoric (Contact) Period (A.D. 1650—1860)

The Protohistoric (Contact) Period, between 1650 and 1860, was a time of transformation, as foreign cultures and technologies began to have an impact on the regional economies of the American Indian cultures of the state. With a new preference for imported Euro-American goods, there was a marked reduction of ceramic and stone tools manufacture during this period. This period is also marked by the introduction of the fur trade economy, which came in waves as first the French, then the British, and finally the Americans entered Minnesota to engage in the lucrative trade.

This fur trade of Minnesota came to dominate the life of American Indians in the area, as they reoriented their economic activity to meet the demands of traders in exchange for goods. The introduction of goods and technologies, such as guns and horses, led to more efficient exploitation of bison, and thus increased specialization in other sectors of society. Beginning with the French and ending with the Americans into the 1850s, there were hundreds of fur trading posts in Minnesota. Of these, around 50 have been identified by archaeologists and only about 20 have been excavated. Sioux and Dakota tribal groups were living in Minnesota during the early Protohistoric period, with the Ojibwe groups migrating south from Canada to engage in the fur trade later (Minnesota Office of the State Archaeolologist, 2016).

9.1.11.4. Federally Recognized Tribes of Minnesota

According to the Bureau of Indian Affairs, Minnesota has 11 recognized tribes throughout the state:

- Bois Forte Band of Chippewa;
- Upper Sioux Community;
- Lower Sioux Indian Community;
- Shakopee Mdewakanton Sioux (Dakota Community);
- Prairie Island Indian Community;
- Fond Du Lac Reservation;
- Grand Portage Band of Chippewa Indians;
- Leech Lake Band of Ojibwe;
- Mille Lacs Band of Ojibwe;
- White Earth Reservation; and
- Red Lake Band of Chippewa Indians.

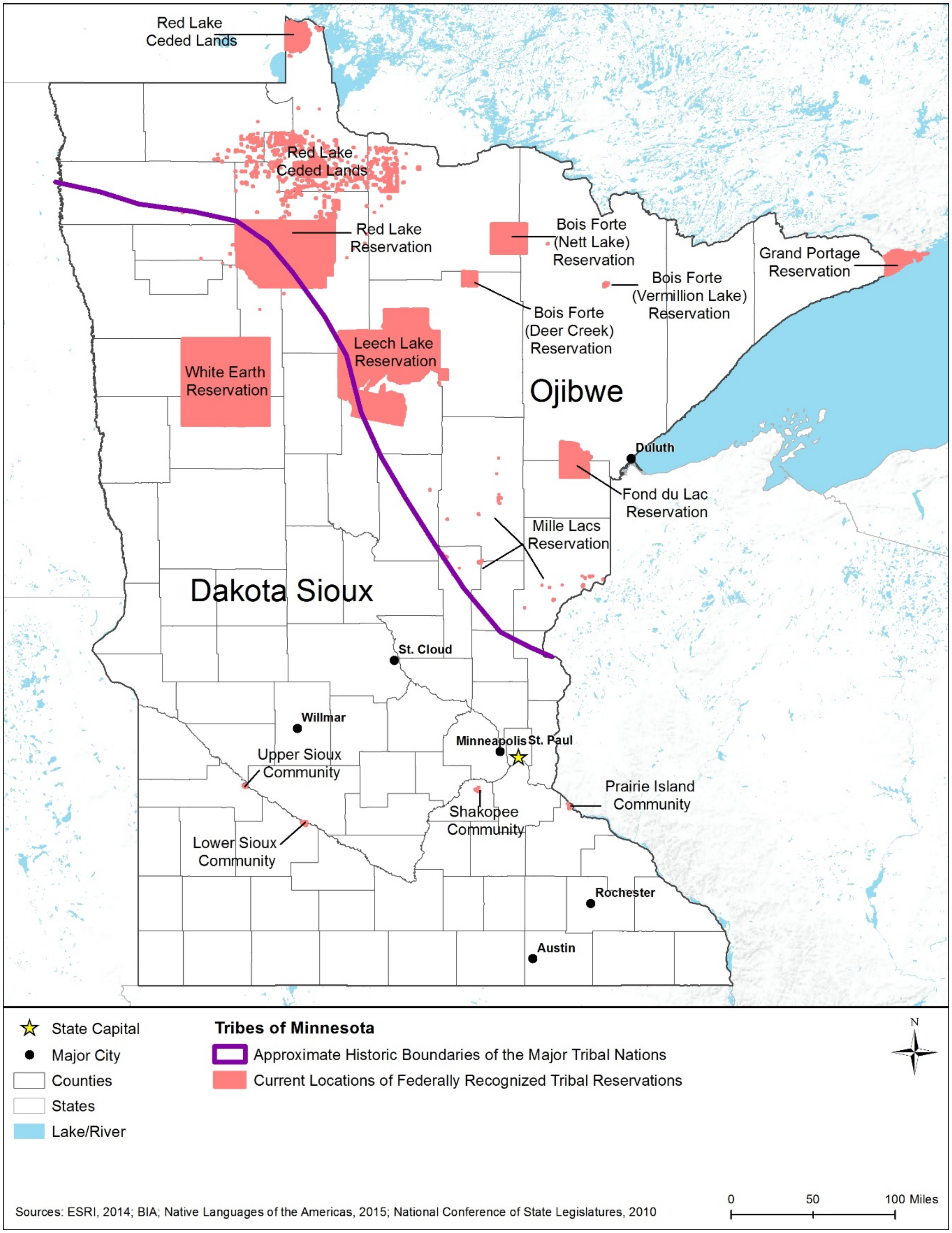


Figure 9.1.11-2: Approximate Historic Boundaries of Tribes in Minnesota

9.1.11.5. Significant Archaeological Sites of Minnesota

As mentioned in Section 9.1.11.3, there are 95 archaeological sites in Minnesota listed on the NRHP. Table 9.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are listed on the NPS NRHP website at http://www.nps.gov/nr/.

Minnesota State Cultural Resources Database and Tools

State Historic Preservation Office (SHPO)

The State Historic Preservation Office (SHPO) of Minnesota was established by the state to provide leadership in implementing the National Historic Preservation Act of 1966. The SHPO runs an ongoing statewide survey program that has recorded more than 50,000 historic structures and approximately 16,500 archaeological sites. The survey information is housed at the SHPO, other government agencies, county and local historical societies, educational institutions, research organizations, and private property owners. Additional information may be found through the following link: http://www.mnhs.org/shpo/survey/inventories.php (Minnesota State Historic Preservation Office, 2016).

Minnesota Office of State Archaeologist (OSA)

The Minnesota Office of the State Archaeologist is the primary public contact for archaeology in the State of Minnesota. The State Archaeologist maintains an archaeological site inventory and archaeological research and report files. Additional information may be found through the following link: http://mn.gov/admin/archaeologist/professional-archaeologists/index.jsp (Minnesota Office of the State Archaeologist, 2016).

Minnesota Archaeological Society

The Minnesota Archaeological Society was established in 1936 to preserve and study archaeological resources in Minnesota and the Upper Midwest Region. The society manages publications, conferences, and networks of professional archaeologists who do research in the state and act as consultants in cultural resource management (http://mnarchsociety.org/index.html).

Table 9.1.11-2: NRHP Listed Archaeological Sites in Minnesota

Closest City	Site Name	Type of Site
Unknown	Grand Mound	Prehistoric
Aitkin	ANDY GIBSON (shipwreck)	Shipwreck
Alexandria	Basswood Shores Site	Prehistoric
Angle Inlet	Fort St. Charles Archeological Site	Historic, Historic - Aboriginal, Prehistoric
Ashby	Fort Pomme de Terre Site	Historic
Backus	Old Backus	Prehistoric
Bagley	Lower Rice Lake Site	Prehistoric
Battle Lake	Morrison Mounds	Prehistoric
Beaver Bay	MADEIRA (Schooner--Barge) Shipwreck	Shipwreck
Cosmos	Pipe Lake Fort	Historic, Military
Cottage Grove	Schilling Archeological District	Prehistoric
Cross Lake	Gordon-Schaust Site	Prehistoric
Crosslake	Fort Flatmouth Mounds	Prehistoric
Duluth	THOMAS WILSON (Whaleback Freighter) Shipwreck	Shipwreck
Duluth	USS ESSEX Shipwreck Site	Shipwreck
Fergus Falls	Orwell Site	Prehistoric
Fort Ripley	Sebre Lake Site (21-CW-55)	Prehistoric
Grand Meadow	Grand Meadow Quarry Archeological District	Prehistoric
Granite Falls	Upper Sioux Agency	Historic - Aboriginal, Prehistoric
Hanska	Synsteby Site	Historic - Aboriginal, Prehistoric, Military
Hendrum	Canning Site (21NR9)	Prehistoric
Hovland	Fowl Lake Site	Prehistoric
International Falls	Laurel Mounds	Prehistoric
International Falls	McKinstry Mounds and Village Site	Prehistoric
International Falls	Archaeological Site No. 21SL82	Historic - Aboriginal, Prehistoric
International Falls	Archeological Site 21SL141	Historic - Aboriginal, Prehistoric
International Falls	Archeological Site 21SL35	Historic - Aboriginal, Prehistoric
International Falls	Archeological Site 21SL55	Historic - Aboriginal, Prehistoric
International Falls	Archeological Site No. 21SL73	Historic - Aboriginal, Prehistoric
Jackson	Robertson Park Site	Prehistoric
Jeffers	Jeffers Petroglyphs Site	Prehistoric
Jenkins	Upper Hay Lake Archeological District	Prehistoric
Kandiyohi	Kasota Lake Site	Prehistoric
Knife River	BENJAMIN NOBLE (Shipwreck)	Shipwreck
Knife River	NIAGARA Shipwreck Site	Shipwreck
Knife River	ONOKO (Bulk Freight Steamer) Shipwreck	Shipwreck
Lake Bronson	Lake Bronson Site	Prehistoric
Lake City	King Coulee Site	Prehistoric

Closest City	Site Name	Type of Site
Lester Park	MAY FLOWER (shipwreck)	Shipwreck
Little Falls	Ayer Mission Site	Historic - Aboriginal
Little Falls	Fort Duquesne (21-MO-20)	Historic, Prehistoric
Little Falls	Fort Ripley	Historic, Military
Little Falls	Pelkey Lake Site	Prehistoric
Little Falls	Pike's, Zebulon, 1805--1806 Wintering Quarters	Historic, Military
Little Falls	Rice Lake Prehistoric District	Prehistoric
Little Falls	Stanchfield Logging Camp	Historic
Little Falls	Swan River Village Site	Historic - Aboriginal, Prehistoric
Louisville Township	Inyan Ceyaka Otonwe	Historic - Aboriginal, Prehistoric
Luverne	Blue Mounds State Park WPA/Rustic Style Historic Resources	Historic
McGrath	Malmo Mounds and Village Site	Prehistoric
Menahga	Blueberry Lake Village Site	Prehistoric
Montevideo	Lac qui Parle Mission Archeological Historic District	Historic - Aboriginal
Mora	Knife Lake Prehistoric District	Prehistoric
Morse Township	Bull-of-the-Woods Logging Scow	Shipwreck
Morton	Lower Sioux Agency	Military
Mountain Lake	Mountain Lake Site	Prehistoric
Nisswa	St. Columba Mission Site	Historic
Onamia	Cooper Site	Historic - Aboriginal, Prehistoric
Onamia	Petaga Point	Prehistoric
Onamia	Saw Mill Site	Prehistoric
Orr	Nett Lake Petroglyphs Site	Prehistoric
Palmers	ROBERT WALLACE (bulk carrier) shipwreck site	Shipwreck
Park Rapids	Itasca Bison Site	Prehistoric
Park Rapids	Shell River Prehistoric Village and Mound District	Prehistoric
Pelican Rapids	Maplewood Site	Prehistoric
Pike Bay	South Pike Bay Site	Prehistoric
Pillager	Chippewa Agency Historic District	Historic, Historic - Aboriginal
Pillager	Gull Lake Mounds Site	Prehistoric
Pillager	Hole-in-the-Day House Site	Historic - Aboriginal
Pillager	Rice Lake Hut Rings	Historic - Aboriginal, Prehistoric, Military
Pine City	Stumne Mounds	Prehistoric
Puposky	Buena Vista Archeological Historic District	Historic
Red Wing	Bartron Site	Prehistoric
Red Wing	Fort Sweeney Site	Prehistoric
Red Wing	Spring Creek Petroglyphs	Prehistoric
Rice	Posch Site	Prehistoric
Savage	Maka Yusota	Historic - Aboriginal
Schroeder	AMBOY and GEORGE SPENCER Shipwreck Sites	Shipwreck

Closest City	Site Name	Type of Site
Sherburn	Fox Lake Site	Prehistoric
Shevlin	Upper Rice Lake Site	Prehistoric
Silver Bay	HESPER Shipwreck Site	Shipwreck
Squaw Lake	Turtle Oracle Mound	Prehistoric
St. Paul	Indian Mounds Park Mound Group	Prehistoric
Staples	Old Wadena Historic District	Historic
Stillwater	St. Croix River Access Site	Prehistoric
Taylors Falls	Archeological Site No. 21CH23	Prehistoric
Tenstrike	Three Island Park Site	Prehistoric
Tordenskjold	Fort Juelson	Military
Two Harbors	SAMUEL P. ELY Shipwreck	Shipwreck
Vineland	Vineland Bay Site	Historic - Aboriginal, Prehistoric
Vineland and vicinity	Kathio Site	Historic - Aboriginal, Prehistoric
Wadena	Reaume's Trading Post	Historic
Winnebago	Center Creek Archeological District	Prehistoric
Yucatan	Yucatan Fort Site	Prehistoric
Zemple	White Oak Point Site	Historic - Aboriginal, Prehistoric

Source: (NPS, 2016c)

9.1.11.6. Historic Context

French fur traders first entered present day Minnesota in the 1650s and established working relations with the native population. Europeans continued to explore the area during the second half of the 17th century, and fur trading grew to dominate the region. In 1695, the French began to establish forts and settlements in Minnesota in order to protect their fur trading interests; however, control transitioned to England following the French and Indian War (1754 to 1763). Following the American Revolution, much of Minnesota remained under British control, as it was outside of the territory ceded to the United States. Grand Portage, in the north on the banks of Lake Superior, served as the headquarters of the North West Company, which controlled much of the fur trading activity in the area (Office of the Minnesota Secretary of State, 2015). The historic North West Company headquarters have now been designated as a National Monument (NPS, 2015l).

In 1803, a large portion of what would become Minnesota was acquired by the United States through the Louisiana Purchase (U.S. Department of State, 2015b). The remainder of present day Minnesota was then acquired in 1818 from England. In 1849, the Minnesota Territory was organized, and on May 11, 1858, Minnesota joined the Union as the 32nd state. In 1862, the first railroad to operate in the state opened, connecting Minneapolis and St. Paul (Office of the Minnesota Secretary of State, 2015). During the Civil War, Minnesota supplied troops to the Union, and while these troops participated in many of the conflict’s critical battles, no fighting occurred in Minnesota (Minnesota Historical Society, 2015c). During the same time, the state dealt with the U.S.-Dakota War, though, which was a conflict between the U.S. government and the Dakota Indians resulting in the deaths of settlers and Dakota Indians.

Iron ore was discovered in Minnesota during the late 19th century, and was exported from locations such as the Vermillion Range and the Mesabi Range (Office of the Minnesota Secretary of State, 2015). Grain production, timber harvesting, and milling were also historically important, with settlements associated with the latter two located near waterways that could power equipment and facilitate the transportation of goods. Significant European immigration to Minnesota occurred during the late 19th century from countries such as Germany, Sweden, Norway, and Finland (Gebhard & Martinson, 1977).

During World War I (WWI), Minnesotans served the country both at home and abroad, with men serving in the armed forces and women occupying vacated factory jobs producing supplies for the war effort (Minnesota Historical Society, 2015b). During the Great Depression, Minnesota was the recipient of New Deal funds through programs such as the Civilian Conservation Corps and the Works Progress Administration, which resulted in the construction of lasting monuments and public facilities throughout the state (National Register of Historic Places, 1989).

Minnesota has 1,665 NRHP listed sites, as well as 25 National Historic Landmarks (NHL) (NPS, 2015a). Minnesota does not contain a National Heritage Area (NHA) (NPS, 2015m). Figure 9.1.11-3 shows the location of NRHP sites in the state.[108]

[108] See Section 9.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

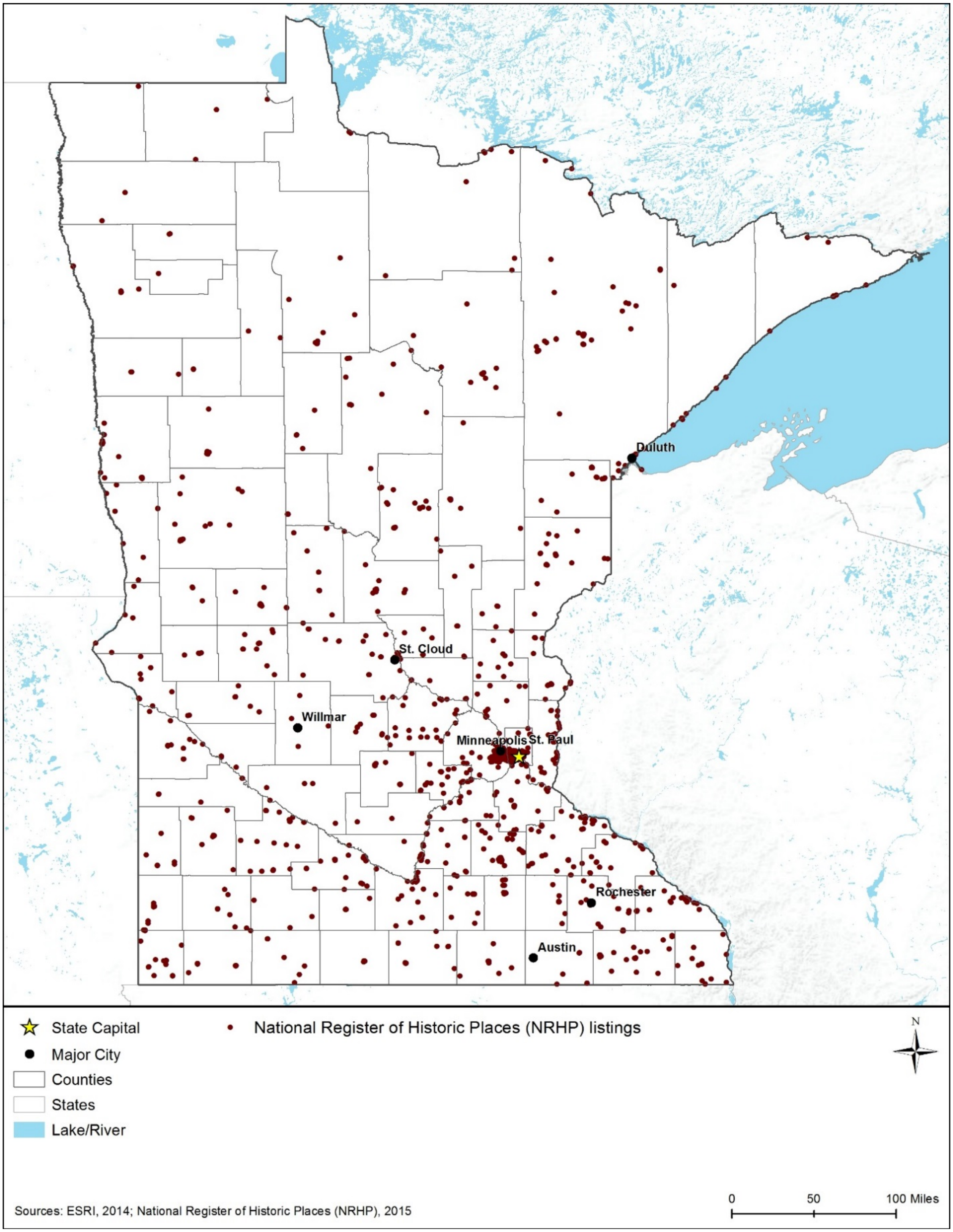


Figure 9.1.11-3: NRHP Sites in Minnesota

9.1.11.7. Architectural Context

While no remaining examples exist, indigenous architecture in Minnesota consisted of insulated conical wigwams in the winter months, with similar structures designed for warmer weather being used in the summer months; tepees were also common. Early Europeans structures were first built by French, English, and American fur trappers, and tended to follow these same traditions. Historic examples of these early impermanent non-native dwellings have not survived. The first surviving examples of European architecture took the form of large forts, such as Fort Snelling (1820 to 1824), logging settlements, farmsteads, and grain processing centers. Early settlement occurred around major waterways, which facilitated trade and transportation with the rest of the country (Gebhard & Martinson, 1977).

During the 19th century, Minnesota followed popular trends architecturally; however, styles arrived later and were often more vernacular in nature. Architectural styles include Federal buildings dating the early 19th century, with Greek Revival becoming popular during the second quarter of the 19th century. The Henry H. Sibley House (1835) in Mendota, MN, is an example that displays both of these styles, as it was built during this transitional period. Side-hall or central passageway house types were common well into the 19th century, and were adorned with the latest styles in ornamentation (Gebhard & Martinson, 1977).

Following the Civil War, Romanticism became popular, with Gothic Revival and Italianate houses being constructed. As with Federal and Greek Revival, there was a considerable blending of these styles, with many Gothic houses resembling Italianate houses in form, aside from their Gothic ornamentation. The LeDuc House (1856-1862) in Hastings, MN, is an example that survives today (Gebhard & Martinson, 1977). Many churches were built during the second half of the 19th century, and they reflected the preferences of the ethnic group ordering the construction. German immigrants, for example, constructed many Richardsonian Romanesque structures during the late 19th century, while English settlers favored Greek Revival and later Gothic Revival edifices. As settlements progressed, second generation churches surpassed the first generation in grandeur, with the third generation in turn surpassing the second generation (Lathrop, 2003).

During the latter part of the 19th century, Victorian styles became popular. Second Empire buildings were constructed, along with Queen Anne, Richardsonian Romanesque, and Eastlake in small numbers; the Shingle style did not gain popularity in Minnesota. During the early 20th century, revival styles grew in popularity. Colonial Revival was prominent, as was Beaux-Arts, particularly in the larger urban areas such as Minneapolis-St. Paul. It was also during this time that architect-designed buildings began to dominate the larger cities, leading to a greater distinction between urban and rural architecture (Gebhard & Martinson, 1977).

The manufacturing industry became more developed during the early 20th century, which resulted in the construction of large milling and industrial facilities in the larger cities. These structures took on styles that were popular throughout the country. In residential architecture, the Prairie style was popular during the early 20th century, but was soon surpassed by Craftsman style homes. Road construction increased following WWI, which, along with the streetcar, fostered suburban development (Gebhard & Martinson, 1977).

Minnesota contains a large collection of resorts dating to the early 20th century, associated with the state’s lake system and waterways. During the Great Depression, New Deal funding and work programs resulted in the construction of roads, bridges, and parks, as well was “new post offices, schools, and armories…in cities of all size” (Gebhard & Martinson, 1977). Following WWII, large-scale housing developments were undertaken and often featured speculative houses built as minimal traditional or ranch types in neighborhoods only accessible by automobile (Gebhard & Martinson, 1977).

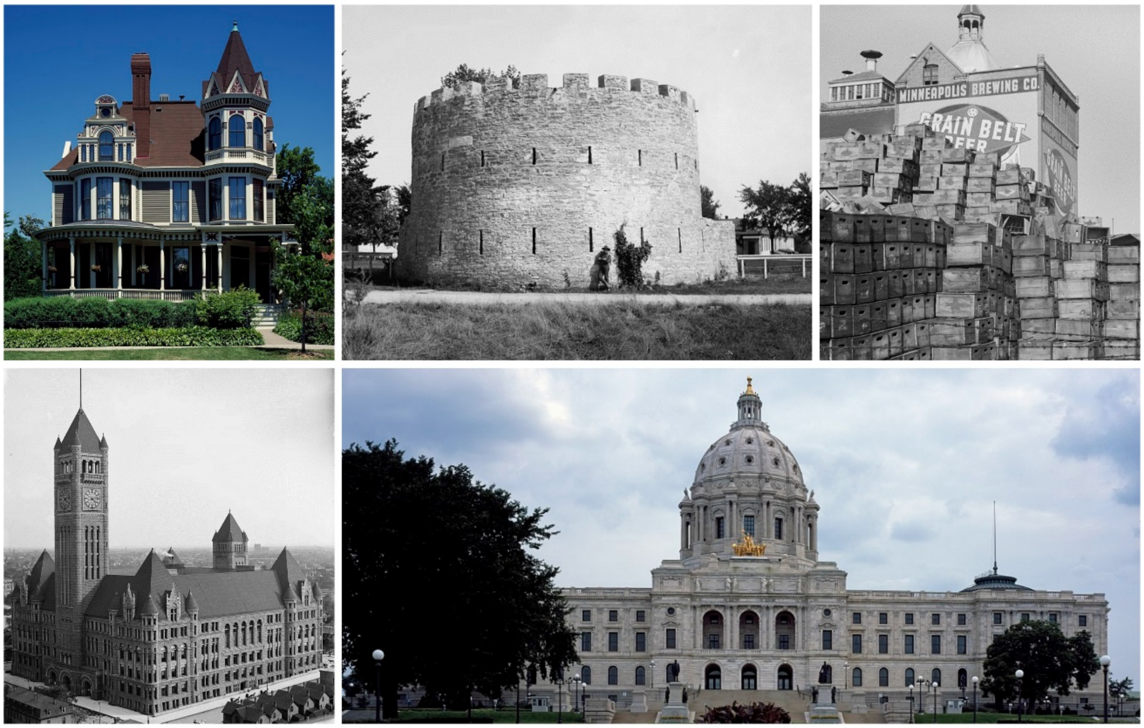


Figure 9.1.11-4: Representative Architectural Styles of Minnesota

Top Left – Historic House (Saint Paul, MN) – (Highsmith, Historic house, St. Paul, Minnesota, 1980a)
Top Middle – Fort Snelling Watch Tower (Fort Snelling, MN) – (Detroit Publishing Company, 1880)
Top Right – Brewery (Minneapolis, MN) – (Vachon, 1939)
Bottom Left – Minneapolis Courthouse and City Hall (Minneapolis, MN) – (Detroit Publishing Company, 1905)
Bottom Right – Minnesota State Capitol Building (Saint Paul, MN) – (Highsmith, Capitol building, St. Paul, Minnesota, 1980b)

9.1.12. Air Quality

9.1.12.1. 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[109] 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)[110] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[111] This section discusses the existing air quality in Minnesota. The USEPA designates areas within the United States as attainment,[112] nonattainment,[113] maintenance,[114] or unclassifiable[115] 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.

9.1.12.2. Specific Regulatory Considerations

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, oxides of nitrogen (NO_X), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_X). The NAAQS establish various standards, either primary[116] or secondary,[117] for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure. A description of the NAAQS is presented in Appendix E.

In addition to the NAAQS, there are standards for hazardous air pollutants (HAP), which are those typically associated with specific industrial processes such as chromium electroplating (hexavalent chromium), dry cleaning (perchloroethylene), and solvent degreasing (halogenated solvents) (USEPA, 2016c). HAPs can have severe adverse impacts on human health and the

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

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

[111] 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, 2015r)

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

[113] 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, 2015m)

[114] 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, 2015m)

[115] 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, 2015m)

[116] 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, 2014b)

[117] 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, 2014b)

environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs.

In conjunction with the federal NAAQS, Minnesota maintains its own air quality standards. Table 9.1.12-1 presents an overview of the Minnesota ambient air quality standards, as defined by the MPCA. (MPCA, 2000)

Table 9.1.12-1: Minnesota Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	
CO	8-hour	10,000	9	Same as Primary		Maximum concentration. Not to be exceeded more than once per year.
	1-hour	35,000	30	Same as Primary		Maximum concentration. Not to be exceeded more than once per year.
Lead	3-month	1.5	-	Same as Primary		Maximum arithmetic mean averaged over a calendar quarter.
NO_2	Annual	100	0.05	Same as Primary		Maximum arithmetic mean.
TSP	Annual	75	-	60	-	Maximum geometric mean.
	24-hour	260	-	150	-	Maximum concentration. Not to be exceeded more than once per year.
PM_{10}	Annual	50	-	Same as Primary		Arithmetic mean.
	24-hour	150	-	Same as Primary		Maximum concentration.
$PM_{2.5}$	Annual	15.0	-	Same as Primary		Arithmetic mean.
	24-hour	65	-	Same as Primary		Average concentration.
O_3	8-hour	235	0.08	Same as Primary		Daily maximum.
SO_2	Annual	80	0.03	60	0.02	Maximum arithmetic mean.
	24-hour	365	0.14	Same as Primary		Maximum concentration. Not to be exceeded more than once per year.
	3-hour	-	-	915	0.35	Maximum concentration. Not to be exceeded more than once per year in Air Quality Control Regions 127, 129, 130, and 132.
		-	-	1,300	0.5	Maximum concentration. Not to be exceeded more than once per year in Air Quality Control Regions 128, 131, and 133.
		1,300	0.5	-	-	Maximum concentration. Not to be exceeded more than once per year.
	1-hour	1,300	0.5	-	-	Maximum concentration. Not to be exceeded more than once per year.
H_2S	30-minutes	70.0	0.05	-	-	1/2 hour average not to be exceeded more than twice per year.
		42.0	0.03	-	-	½ hour average not to be exceeded more than two times in five consecutive days.

Source: (MPCA, 2000)

Title V Operating Permits/State Operating Permits

Minnesota 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, 2015t). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015t). Minnesota state air rules chapter 7007.0200, describes the applicability of Title V operating permits. Minnesota 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 9.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014a).

Table 9.1.12-2: Major Air Pollutant Source Thresholds

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

Source: (USEPA, 2014a)

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

Additionally, Minnesota state air rules chapter 7007.0250 describes the applicability of state operating permits. Major sources required to obtain a Title V operating permit are not required to also obtain a state operating permit. State operating permits are required for sources that do not meet the requirements of a Title V permit, but emit or have the potential to emit pollutants in excess of the thresholds listed in Table 9.1.12-3. If there are several similar stationary sources, all with the same or substantially similar regulatory requirements, and are required to obtain either a Title V or state operating permit, those sources can obtain a general operating permit, under Minnesota air rules chapter 7007.1100 (MPCA, 2013d).

Table 9.1.12-3: State Operating Permit Potential to Emit Threshold

Pollutant	TPY
Lead	0.5
SO_2	50.0
PM_{10}	25.0
VOCs	100.0

Source: (MPCA, 2013d)

Exempt Activities

The following are considered insignificant activities under, Minnesota state air rule 7007.1300, subpart 2 and 3. In accordance with Minnesota state air rules chapter 7007.0300, subpart 1.D these select activities are also exempt from obtaining operating permits when these are the only emission units at the stationary source:

- "…fuel burning equipment with a capacity less than 19,000 Btu per hour, but only if the combined total capacity of all fuel burning equipment at the stationary source with a capacity less than 19,000 Btu per hour is less than or equal to 420,000 Btu per hour…
- …brazing, soldering, or welding equipment…
- Individual emission units at a stationary source, each of which have a potential to emit the following pollutants in amounts less than:
  - 4,000 pounds per year of carbon monoxide;
  - 2,000 pounds per year each of nitrogen oxide, sulfur dioxide, particulate matter, particulate matter less than 10 microns, VOCs (including hazardous air pollutants-containing VOCs), and ozone; and
  - 1,000 tons per year of CO_2e[118]…" (MPCA, 2013d).

Temporary Emissions Sources Permits

The MPCA does not issue specific temporary operating permits. Temporary emission sources should apply under the state operating permit program, and contact the MPCA to confirm applicability of the source.

State Preconstruction Permits

Under Minnesota state air rules chapter 7007.0150, a construction permit is required prior to the construction, or reconstruction, of any major stationary source or major modification in a nonattainment area, or in a designated attainment/unclassifiable area, where emissions could cause or contribute to a violation of the NAAQS. (MPCA, 2013d)

General Conformity

Established under Section 176(c)(4) of the CAA, "the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality" outlined in the state implementation plan (SIP) (USEPA, 2013a). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), Federal actions "in response to emergencies which are typically commenced on the order of hours or days after the emergency" and actions "which are part of part of a continuing response to emergency or disaster" that are taken up to 6 months after beginning response activities, will be exempt from any conformity determinations (U.S. Government Publishing Office, 2010).

[118] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMTCO2e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_2e$ = (million metric tons of a gas) * (GWP of the gas)." (USEPA 2015)

The estimated pollutant emissions are compared to *de minimis* levels.[119] These values are the minimum thresholds for which a conformity determination must be performed (see Table 9.1.12-4). As a result, lower *de minimis* thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

Table 9.1.12-4: *De Minimis* Levels

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

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

If an action does not result in an emissions increase above the *de minimis* levels in, 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 9.1.12-4, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity[120], the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state's SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and

[119] 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, 2016g)
[120] Conformity: Compliance with the State Implementation Plan.

- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS (USEPA, 2010).

State Implementation Plan (SIP) Requirements

The Minnesota SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Minnesota's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Minnesota's SIP actions are codified under 40 CFR Part 52 Subpart Y. A list of all SIP actions for all six criteria pollutants can be found on the MPCA website (https://www.pca.state.mn.us/air/minnesota-state-implementation-plan-sip).

9.1.12.3. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas. Figure 9.1.12-1 and Table 9.1.12-5, below, present the nonattainment areas in Minnesota 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 9.1.12-5 contains a list of the counties and their respective current nonattainment status for each criteria pollutant. Unlike Table 9.1.12-5, Figure 9.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

Table 9.1.12-5: Minnesota Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Anoka	M									M	
Carver	M									M	
Dakota	M	M	X-6							M	
Hennepin	M									M	
Olmsted					M					M	
Ramsey	M				M					M	
Scott	M									M	
St Louis	M										
Washington	M									M	
Wright	M										

Source: (USEPA, 2015p)

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

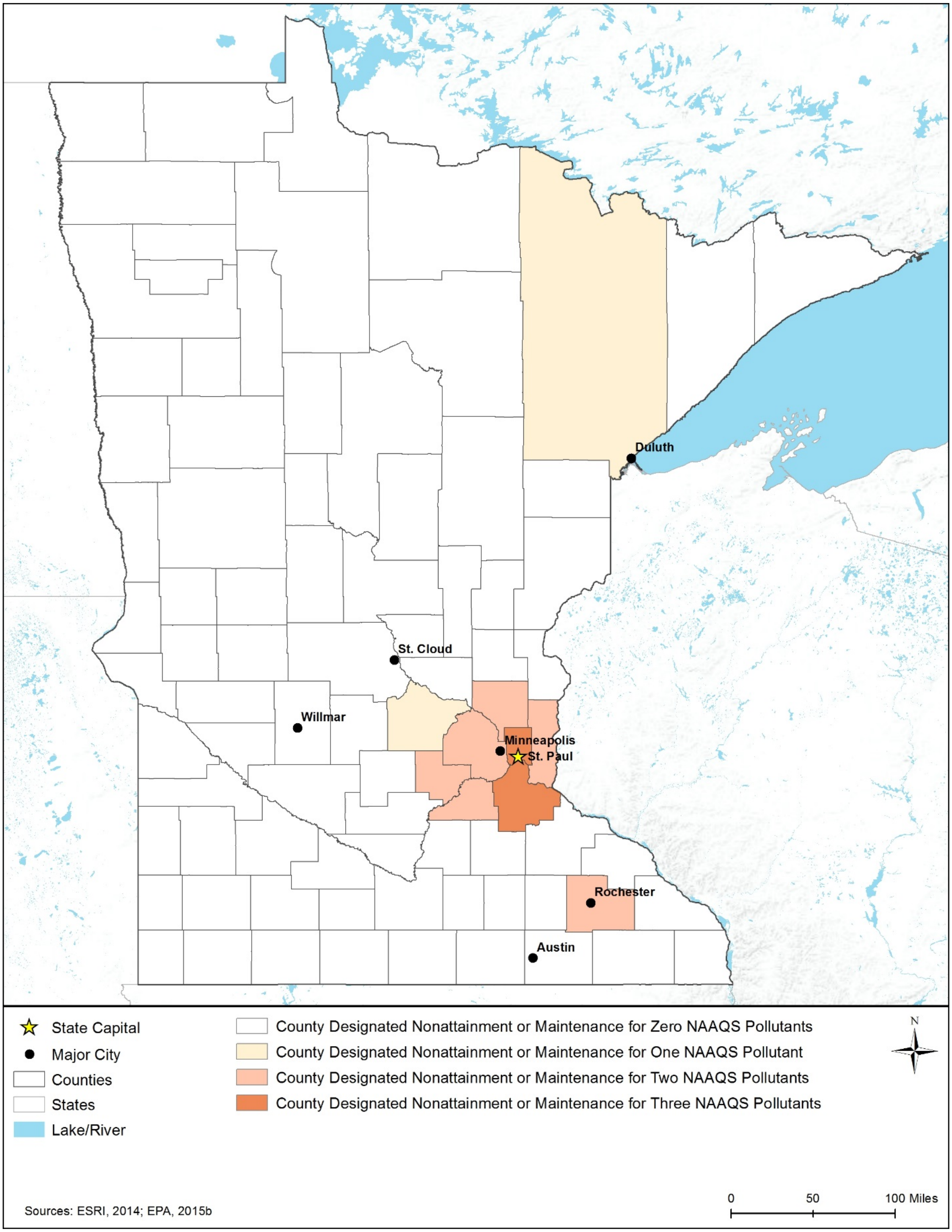


Figure 9.1.12-1: Nonattainment and Maintenance Counties in Minnesota

Air Quality Monitoring and Reporting

The MPCA measures air pollutants at 53 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (MPCA, 2015m). Annual Pollution Reports are prepared, containing pollutant emissions summarized by region. The MPCA also reports daily air quality conditions for $PM_{2.5}$ on their website (https://www.pca.state.mn.us/air/current-air-quality-index).

Throughout 2014, exceeded the secondary Minnesota ambient air quality standard for 24-hour total suspended particulate matter at two separate monitoring stations in Minneapolis. No other criteria pollutants or Minnesota state standards were exceeded in 2014. (MPCA, 2015m)

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[121] of a Class I area. "The EPA's policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers" (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.
- PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. "Historically, the EPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers[122] (the normal useful range of EPA-approved Gaussian plume models" (USEPA, 1992).
- Minnesota contain two Federal Class I areas; all other land within the state is classified as Class II (USEPA, 2012c). If a Proposed Action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts

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

to air quality within 100 kilometers from the source (USEPA, 1992). Wisconsin and Michigan also have a Class I area where the 100-kilometer buffer intersects a few Minnesota counties. Any PSD-applicable Proposed Action within these counties would require FLMs notification from the appropriate Regional Office. Figure 9.1.12-2 provides a map of Minnesota highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 9.1.12-2 correspond to the numbers and Class I areas listed in Table 9.1.12-6.

Table 9.1.12-6: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Voyageurs National Park	114,964	MN
2	Boundary Waters Canoe Area Wilderness Area	747,840	MN
3	Isle Royale National Park	542,428	MI
4	Rainbow Lake Wilderness Area	6,583	WI

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

[a] The numbers correspond to the shaded regions in Figure 9.1.12-2.

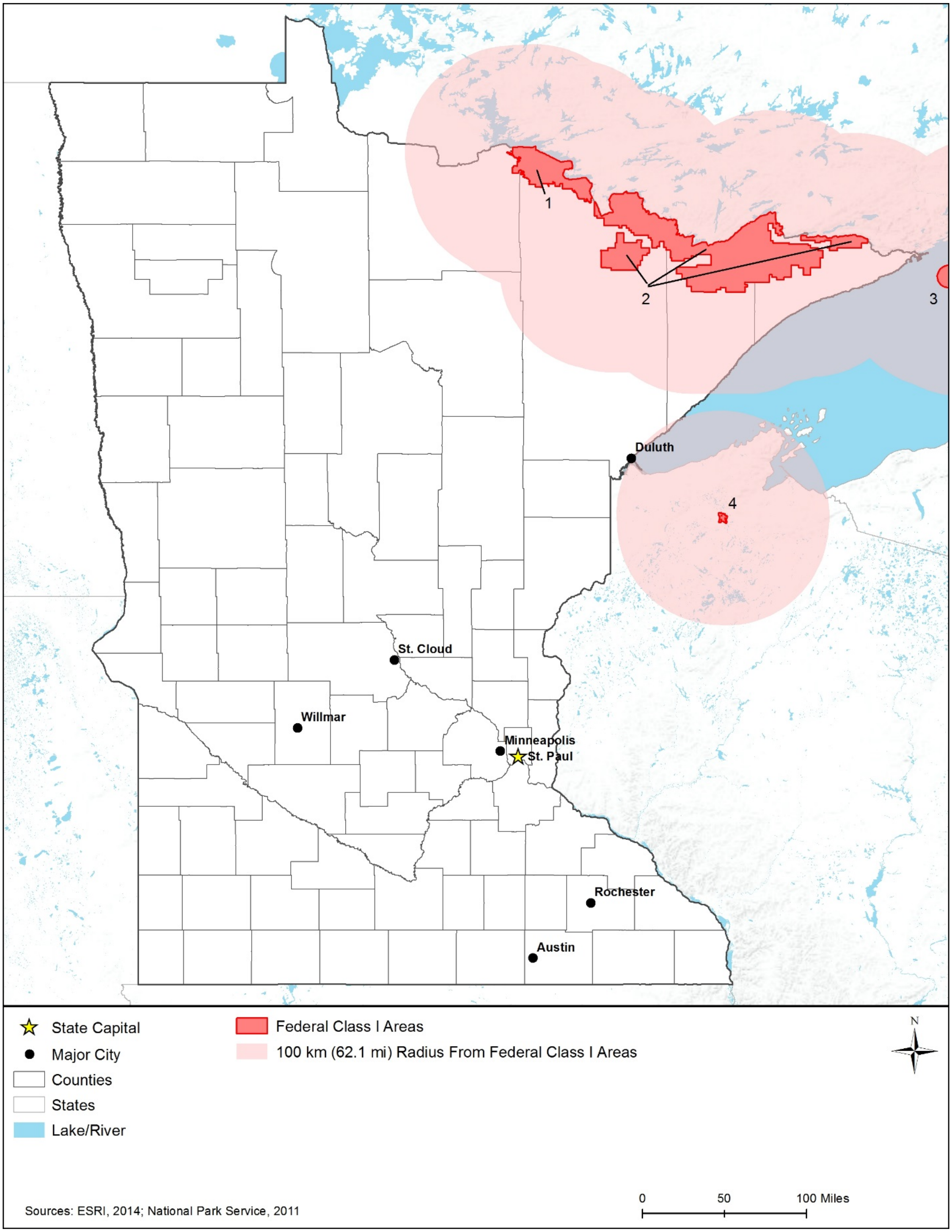


Figure 9.1.12-2: Federal Class I Areas with Implications for Minnesota

9.1.13. Noise

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

9.1.13.1. Definition of the Resource

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

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and,
- Physiological effects such as hearing loss and anxiety (USEPA, 2015k).

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB ("threshold of hearing") to about 140 dB ("threshold of pain") (OSHA 2016). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound. The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015c). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA 2016).

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

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

Figure 9.1.13-1 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.

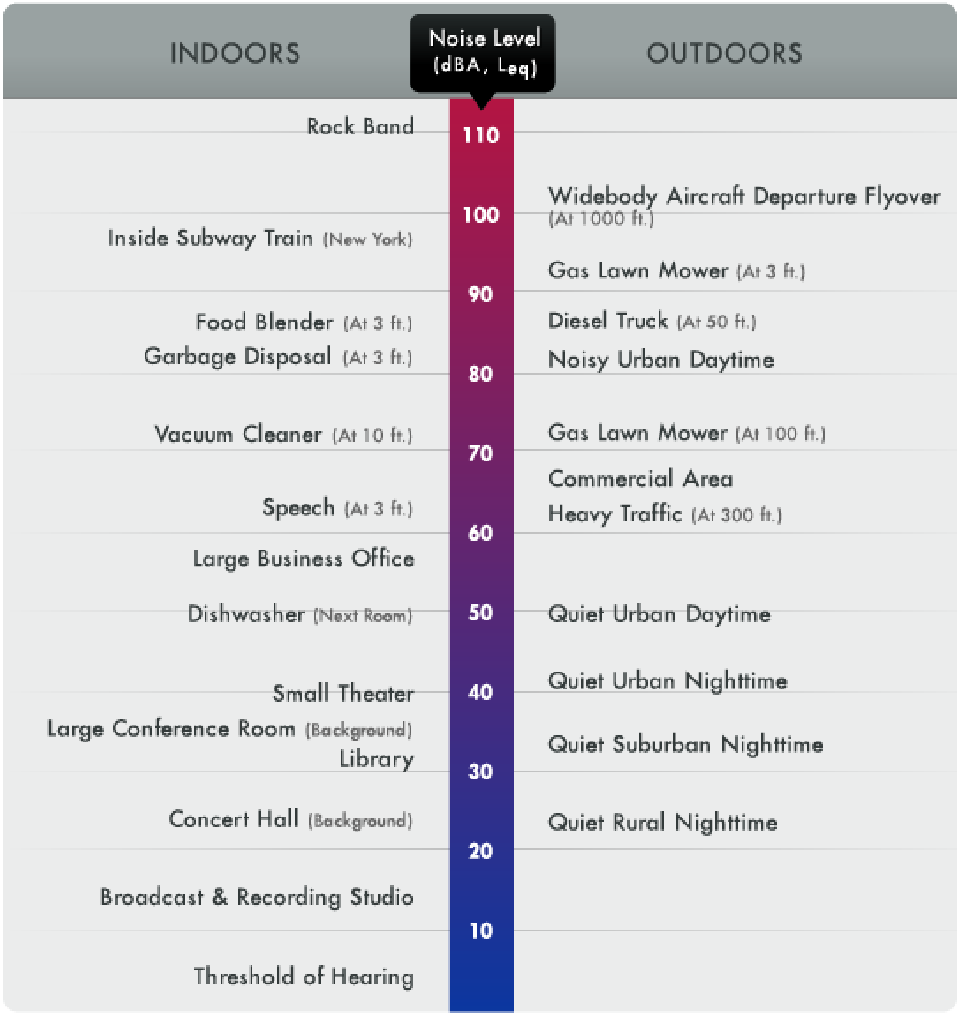


Figure 9.1.13-1: Sounds Levels of Typical Sounds

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

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

The changes in human response to changes in dB levels is categorized as follows (USDOT FTA, 2006):

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and
- A 10-dB change, which is generally considered a doubling of the sound level, almost certainly causes an adverse community response.

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

9.1.13.2. 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.

Minnesota has several statewide noise regulations written into the Minnesota Statutes and Minnesota Administrative Rules. They mainly apply to motor vehicle functions such as engine running and horns. Table 9.1.13-1 provides a brief summary of these regulations.

Table 9.1.13-1: Relevant Minnesota Laws and Regulations

State Law/ Regulation	Agency	Applicability
Statute 116.07	The Minnesota State Legislature	Empowers the Pollution Control Agency to regulate noise.
Statute 169.693	The Minnesota State Legislature	Obligates motor vehicle to adhere to noise limits established by the Pollution Control Agency.
Administrative Rule 7030.0040	The Minnesota State Legislature	Establishes general ambient noise standards.

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 Minneapolis, St. Paul, and Duluth are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (USDOT FHWA, 2011).

9.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Minnesota varies widely based on the area and environment of the area. The population of Minnesota can choose to live and interact in areas that are large cities, rural or suburban communities, small towns, and national and state parks. Figure 9.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Minnesota may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Minnesota. As such, this section describes the areas where the population of Minnesota can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of Interior, 2008). The urban areas that are likely to have the highest ambient noise levels in the state are Minneapolis, St. Paul, and Duluth.
- **Airports:** Areas surrounding airports tend to have higher noise levels due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012a). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports is in proximity to urban communities resulting in noise exposures from aircraft operations (arrivals/departures) to surrounding areas at higher levels and with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Minnesota, Minneapolis-St. Paul International Airport (MSP) and Duluth International Airport (DLH) have combined annual operations of more than 467,000 flights, with MSP accounting for more than 411,000 of those flights (FAA, 2015i). These operations result in increased ambient noise levels in the surrounding communities. See Section 9.1.7, Land Use, Recreation, and Airspace and Table 9.1.7-9 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 (USDOT FHWA, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (USDOT FHWA, 2015d). See Section 9.1.1, Infrastructure and Figure 9.1.1-1 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 (USDOT FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (USDOT FRA, 2015). Minnesota has one major passenger rail corridor with high levels of commercial and commuter rail traffic. The Minnesota section of the Empire Builder route runs between Winona and Detroit Lakes with stops at Red Wing, St. Paul/Minneapolis, St. Cloud, and Staples (MnDOT, 2015e). See Section 9.1.1, Infrastructure and Figure 9.1.1-1 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, 2014c). Minnesota has five national parks and eight National Natural Landmarks (NPS, 2016a). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 9.1.8, Visual Resources and Figure 9.1.8-2 for more information about national and state parks for Minnesota.

9.1.13.4. 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 Minnesota 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 Minnesota.

9.1.14. Climate Change

9.1.14.1. Definition of the Resource

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

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012e). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e), which equalizes for the different global warming potential of each type of GHG.[123] 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

[123] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMTCO$_2$e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMTCO$_2$E = (million metric tons of a gas) * (GWP of the gas)." (USEPA, 2016h)

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 Chapter Four, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation; 3) sea level; and 4) severe weather events (including tropical storms, tropical cyclones, and hurricanes).

9.1.14.2. 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. Minnesota has established goals and regulations to reduce GHG emissions to combat climate change. As shown in Table 9.1.14-1, three key state laws/regulations are the primary policy drivers on climate change preparedness and GHG emissions.

Table 9.1.14-1: Relevant Minnesota Climate Change Laws and Regulations

State Laws/Regulations	Regulatory Agency	Applicability
Next Generation Energy Initiative (December 12, 2006)	State of Minnesota	On December 12, 2006 Governor Pawlenty announced the state's "Next Generation Energy Initiative," including development of a comprehensive plan to reduce Minnesota's GHG emissions. Requested assistance from the Center for Climate Strategies (CCS) in the development of a Minnesota Climate Mitigation Action Plan (Action Plan) and formation of the Minnesota Climate Change Advisory Group (MCCAG), to develop a comprehensive set of state-level policy recommendations.
Generation Energy Act of 2007 (May 25, 2007)	State of Minnesota	On May 25, 2007, Governor Pawlenty signed the Next Generation Energy Act of 2007. The Next Generation Energy Act of 2007 includes requirements for Minnesotans to increase energy efficiency, expand community-based energy development, and establish a statewide goal to reduce GHG emissions. The act established goals to reduce statewide GHG emissions across all sectors to: • 15 percent below 2005 levels by 2015; • 30 percent below 2005 levels by 2025; and • 80 percent below 2005 levels by 2050.
Interagency Climate Adaptation Team (ICAT) (2009)	State of Minnesota	Since July 2009, Minnesota state agencies have been collaborating on climate adaptation efforts through ICAT. ICAT currently includes representatives from the following Minnesota state departments and agencies: Agriculture, Commerce (Division of Energy Resources), Health, Natural Resources, Pollution Control, Public Safety (Division of Homeland Security and Emergency Management), and Transportation, as well as the Board of Water and Soil Resources and the Metropolitan Council. ICAT prepared a preliminary report in 2010 and a follow-up report 2013.

9.1.14.3. Minnesota Greenhouse Gas Emissions

Estimates of Minnesota'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, 2015e). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015l). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

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

According to the EIA, Minnesota emitted a total of 88.6 million metric tons (MMT) of CO_2 in 2013. Petroleum products in the transportation sector were the largest source of emissions, followed by coal in the electric power sector (Table 9.1.14-2) (EIA 2015). Annual emissions between 1980 and 2013 are presented in Figure 9.1.14-1, Minnesota's CO_2 emissions increased from 1980 to a maximum of 101.0 MMT in 2005 before declining by almost 15 percent to their 2013 level. This decline was driven by the reduction in the use of coal by the electric power sector, and a small reduction in petroleum emissions by the transportation sector. Minnesota was ranked 24th in the U.S. for total CO_2 emissions in 2013, and 26th for per capita CO_2 emissions (EIA 2015b).

Table 9.1.14-2: Minnesota CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2013

Fuel Type (MMT)		Source (MMT)	
Coal	25.3	Residential	9.2
Petroleum Products	38.0	Commercial	6.7
Natural Gas	25.4	Industrial	18.3
		Transportation	28.7
		Electric Power	25.7
TOTAL	**88.6**	**TOTAL**	**88.6**

Source: (EIA, 2015f)

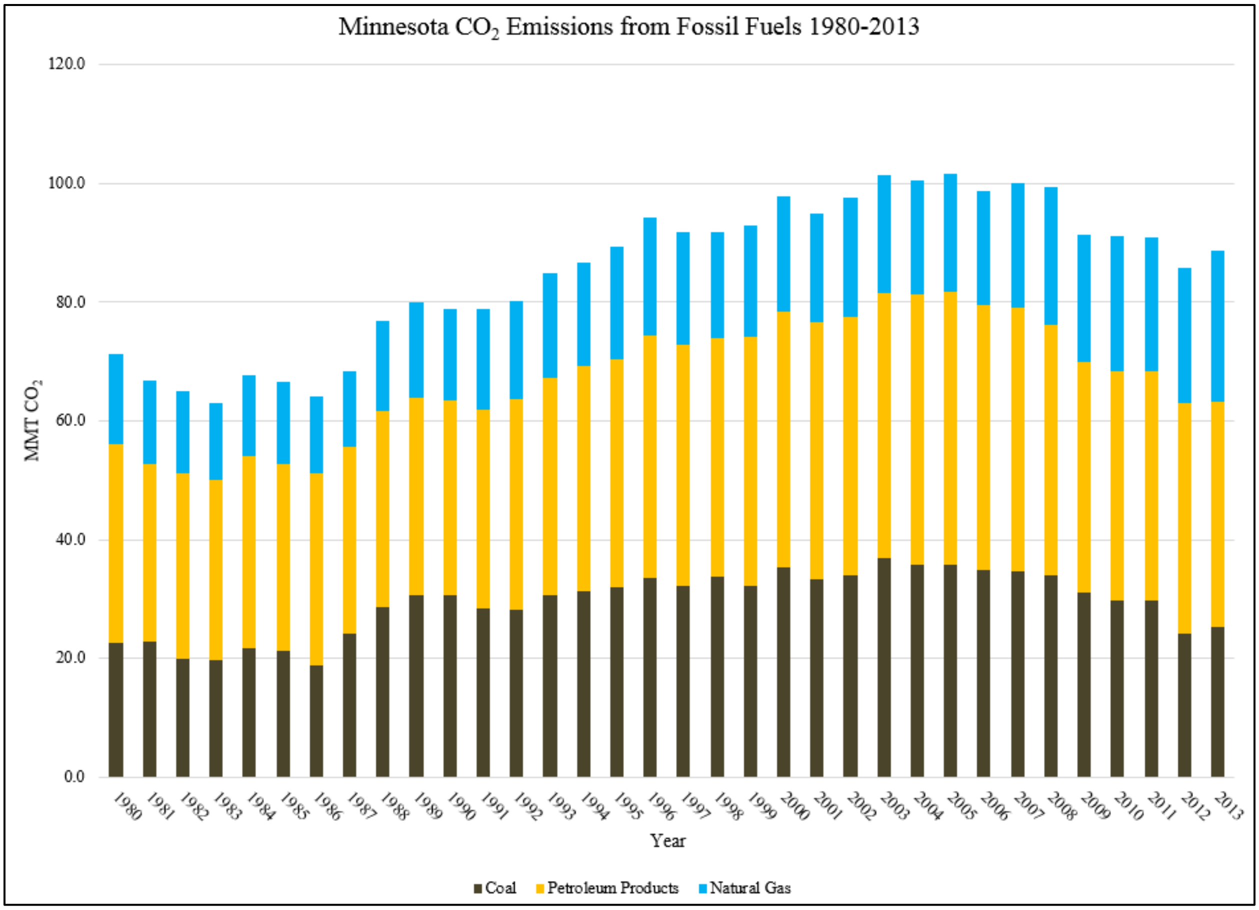


Figure 9.1.14-1: Minnesota CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015f)

The Minnesota Governor's Office, through the Minnesota Climate Change Advisory Group (MNCCAG), prepared in 2008 a 1990 to 2005 final GHG inventory and reference case projection (MNCCAG, 2008). Total GHG emissions in 1990 were estimated at 119 MMT CO_2e. Between 1990 and 2005, state emissions from all sectors grew by 32 percent and have continued to rise faster than the nation's average. Emissions in 2005 were calculated to be 157.1 MMT CO2e, with electricity usage and emissions from the transportation sector the largest contributors (MNCCAG, 2008). For comparison, total U.S. GHG emissions are estimated to have been 6,673 million metric tons (14.7 trillion pounds) in 2013 (USEPA, 2015n). Projections out to 2025 show GHG emissions increasing to 200.5 MMT CO2e, or by 68 percent over the 1990 baseline. Increases are projected to be driven mostly by the electricity generation sector, and by emissions from residential, commercial, and industrial fuel use (MNCCAG, 2008).

The industrial sector is also a large energy consumer because of the state's involvement in petroleum refining and food processing. Minnesota has two oil refineries that produce, "motor gasoline, diesel fuel, propane, butane, jet fuel for markets asphalt, heating fuels, and sulfur for fertilizer" (EIA, 2016). Industrial GHG emissions continue to grow because the use of "hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) as substitutes for ozone-depleting chlorofluorocarbons (CFCs)" (MNCCAG, 2008).

Minnesota does not produce natural gas, petroleum or coal, which keeps state emissions lower than they would be if they were produced in-state. These resources instead enter the state by rail or pipeline. Minnesota has two coal-fired power plants, which provides a majority of the state's electricity; the rest is generated by from wind farms, biomass, and hydropower (EIA, 2016). Although the state often experiences harsh summers and freezing winters, the residential sector's per capita energy consumption remains average. Agricultural activities in Minnesota also produce GHG emissions and account for 14 percent of the state's emissions which is much larger than the nation's average of 8 percent. (MNCCAG, 2008)

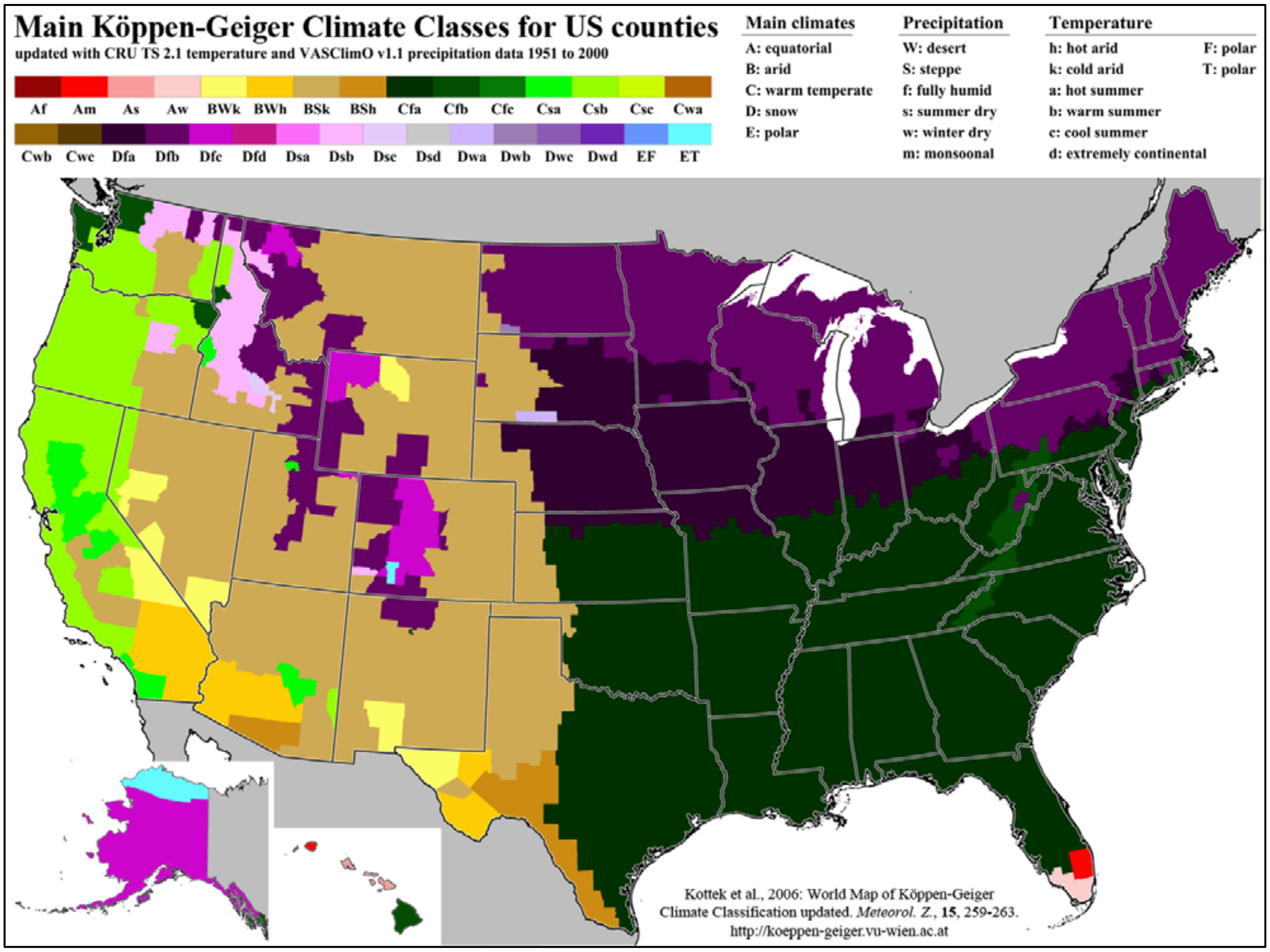
9.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "reoccurring average weather found in any particular place" (NOAA, 2011c). 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" (NOAA, 2011c). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NOAA, 2011d).

The majority of Minnesota falls into climate group D. Climates classified as D are "moist continental mid-latitudinal climates," with "warm to cool summers and cold winters" (NOAA, 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" (NOAA, 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" (NOAA, 2011a) (NOAA, 2011b) In addition, there are many thunderstorms during summer months. Michigan has two sub-climate categories, which are described in the following paragraphs.

Dfa – The Köppen-Geiger climate classification system classifies a region of southern, and southwestern Minnesota 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. (NOAA, 2011a) (NOAA, 2011b)

Dfb – The Köppen-Geiger climate classification system classifies the majority of Minnesota 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. (NOAA, 2011a) (NOAA, 2011b)



Source: (Kottek, 2006)

Figure 9.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Air Temperature

Average summer temperatures in Minnesota range from the low 70s in the south, to the mid-60s in the north. Historically and statistically, July is Minnesota's hottest month. During winter months, cities such as International Falls experience average annual temperatures of 37.4 °F. In Tower, average temperatures drop to below zero approximately 71 times per year. (NOAA, 2015d)

The following paragraphs describe temperature variations as they occur within Minnesota's various climate classification zones:

Dfa – Marshall, located in southwestern Minnesota, is within the climate classification zone Dfa. The average annual temperature in Marshall is approximately 44.9 °F; 17.2 °F during winter months; 70.2 °F during summer months; 44.7 °F during spring months; and 46.9 °F during autumn months (NOAA, 2015b).

Dfb – St. Paul, the capital of Minnesota, is located in central Minnesota and within the climate classification zone Dfb. The average annual temperature in St. Paul is approximately 45.7 °F; 18.0 °F during winter months; 70.6 °F during summer months; 46.0 °F during spring months; and 47.6 °F during autumn months. Bemidji, located in northern Minnesota, is also within the climate classification zone Dfb. The average annual temperature in Bemidji is approximately 38.7 °F; 9.5 °F during winter months; 64.9 °F during summer months; 38.8 °F during spring months; 41.0 °F during autumn months. (NOAA, 2015b)

Precipitation

In southeast Minnesota, the mean annual precipitation is approximately 34 inches. In northern areas of the state, annual precipitation accumulation is significantly less, with an average of 19 inches. Statewide, the majority of precipitation (two-thirds) falls between May and September. "Statewide, two of the driest years were 1910 and 1976, while two of the wettest were 1965 and 1977" (Boulay, 2015). The greatest 24-hour precipitation accumulation occurred near Hokah on August 19, 2007 with a total of 15.10 inches of rainfall. The greatest annual maximum precipitation accumulation was in 1991, with a total of 53.52 inches in St. Francis, Anoka County (Boulay, 2015).

Seasonal snowfall in Minnesota is also significant. In northern Minnesota, average annual snowfall totals can reach approximately 80 inches along Lake Superior and other highland areas. In southern Minnesota, near the Iowa border, average annual snowfall totals drop to approximately 40 inches. In western areas of the state, near the North Dakota and South Dakota border, snowfall totals also average approximately 40 inches. Statewide, "snow cover of one inch or more over the state occurs on an average of about 110 days annually, ranging from 85 days in the south to 140 days in the north" (Boulay, 2015). The greatest total snowfall to occur in Minnesota was during the winter of 1949 through 1950, with a total of 170.5 inches (Boulay, 2015). Heavy snowfalls, with accumulations greater than four inches, "are common any time mid-November through mid-April" (Boulay, 2015).

The following paragraphs describe precipitation as it occurs within Nevada's various climate classification zones:

Dfa – Marshall, located in southwestern Minnesota, is within the climate classification zone Dfa. The average annual precipitation accumulation in Marshall is approximately 28.28 inches; 2.86 inches during winter months; 10.89 inches during summer months; 7.79 inches during spring months; and 6.74 inches during autumn months. (NOAA, 2015b)

Dfb – St. Paul, the capital of Minnesota, is located in central Minnesota and within the climate classification zone Dfb. The average annual precipitation accumulation in St. Paul is approximately 31.87 inches; 2.73 inches during winter months; 13.06 inches during summer months; 8.38 inches during spring months; and 7.70 inches during autumn months. Bemidji, located in northern Minnesota is also within the climate classification zone Dfb. The average annual precipitation accumulation in Bemidji is approximately 26.63 inches; 2.18 inches during winter months; 11.54 inches during summer months; 5.92 inches during spring months; and 6.99 inches during autumn months. (NOAA, 2015b)

Severe Weather Events

Minnesota is located “along the northern edge of the region of maximum tornado occurrence in the United States” (MDNR, 2015z). Approximately 27 tornadoes occur each year in Minnesota. Tornadoes can occur in Minnesota during any month between March and November. Statistically, the majority of Minnesota’s tornadoes occur in June. Nearly 75 percent of the state’s tornadoes have occurred during the three months of May, June, and July. The largest tornado event occurred on June 17, 2010 when 48 tornadoes touch down. The previous record was set on June 16, 1992 with an occurrence of 27 tornadoes. The greatest number of tornadoes to occur in one single year was in 2010, with a record of 113 tornadoes. Of these 110 storms, 71 occurred during the month of June. Since 1950, MDNR has recorded 1,721 tornadoes. These storms have resulted in 99 deaths and 1,981 injuries (MDNR, 2015z).

Severe winter storms and blizzards are also common to Minnesota, with heavy snowfalls and blizzard-like conditions affecting the “state on an average of about two times each winter” (Boulay, 2015). Blizzard conditions “are when visibilities are reduced to less than one-quarter of a mile for several hours due to falling and/or blowing snow. The wind must be at least 35 mph” (Boulay, 2015). The most deadly and destructive blizzards to occur in the state “were those of January 11-13, 1888, and of November 11-12, 1940, which resulted in the loss of any lives and a heavy toll of livestock” (Boulay, 2015). Another severe blizzard occurred January 10 through 12, 1975. This storm resulted in 20-foot snowdrifts, road closures, the death of approximately 15,000 livestock, winds that reached 80 miles per hour (mph), and 14 deaths. During one particularly harsh winter in 1996, more than 12 blizzards occurred. The greatest 24-hour snowfall accumulation recorded was near Finland on January 7, 1994 with a total of 36 inches (Boulay, 2015) (MDNR, 2015aa).

Flash flooding is also common to Minnesota, with 117 flash flooding events having occurred since 1970 statewide. (MDNR, 2015ab)

9.1.15. Human Health and Safety

9.1.15.1. 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 9.1.1, Infrastructure.

9.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (USEPA), the U.S. Department of Health and Human Services, and others protect human health and the environment. In Minnesota, this resource area is regulated by Minnesota Occupational Safety and Health Administration (MNOSHA) under Minnesota Department of Labor and Industry (MNDOLI), MPCA, and Minnesota Department of Health (MDH). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Minnesota's State Plan is an OSHA-approved "State Plan," which has adopted most OSHA regulations, but has unique labor standards for toxic chemical handling and exposure, agriculture, repetitive motion injuries, heat exposure, and noise exposure. The State Plan applies to private, state, and local employees working in Minnesota (OSHA, 2015a). Occupational safety and health regulations are enforced at the private, state, and local level by MNOSHA and at the federal level by OSHA. Public health is regulated by the MDH.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations. Table 9.1.15-1 below summarizes the major Minnesota laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 9.1.15-1: Relevant Minnesota Human Health and Safety Laws and Regulations

State Law and Regulation	Regulatory Agency	Applicability
Minnesota Statute: Chapter 115B	MPCA	Establishes the Minnesota Environmental Response and Liability Act, to manage contaminated sites in Minnesota.
Minnesota Administrative Rules: Chapter 7151	MPCA	Establishes standards for new and existing aboveground storage tanks, including labeling, inspections, and spill prevention to protect the public health and environment.
Minnesota Statute: Chapter 182	MNDOLI	Establishes the Minnesota Occupational Safety and Health Act to ensure job safety and safe work conditions.
Minnesota Administrative Rules: Chapter 5205	MNDOLI	Defines Minnesota's occupational safety and health standards to protect the health of workers in various industries.
Minnesota Administrative Rules: Chapter 5206	MNDOLI	Establishes Minnesota employee right-to-know requirements to protect workers from occupational exposure to hazardous substances.
Minnesota Administrative Rules: Chapter 5208	MNDOLI	Requires employers with more than 25 employees to establish an accident and injury reduction program, including reporting of occupational injuries and illnesses.
Minnesota Statute: Chapter 299K	Minnesota Department of Public Safety	Establishes requirements hazardous chemical emergency planning and response per Emergency Planning and Community Right To Know Act.

9.1.15.3. Environmental Setting: Existing Telecommunication Sites

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

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

Trenches and confined spaces –In rare cases, FirstNet deployment, operation, and maintenance activities may involve work in trenches or confined spaces. Installation and maintenance of underground utilities in urban areas or utility manholes[124] are examples of when trenching or confined space work could occur. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016a)

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

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work (International Finance Corporation, 2007).

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

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 9.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area (OSHA, 2016a).

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and

[124] 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.

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. (OSHA, 2016a)

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

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings. (OSHA, 2016a)

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, BLS uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as both telecommunication equipment installers and repairers, except line installers (SOC code 49-2022), or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2014, there were 3,130 telecommunication equipment installers and repairers, and 1,710 telecommunication line installers and repairers (Figure 9.1.15-1) working in Minnesota (BLS, 2015c). In 2013, the most recent year data are available, Minnesota did not have any cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013b).

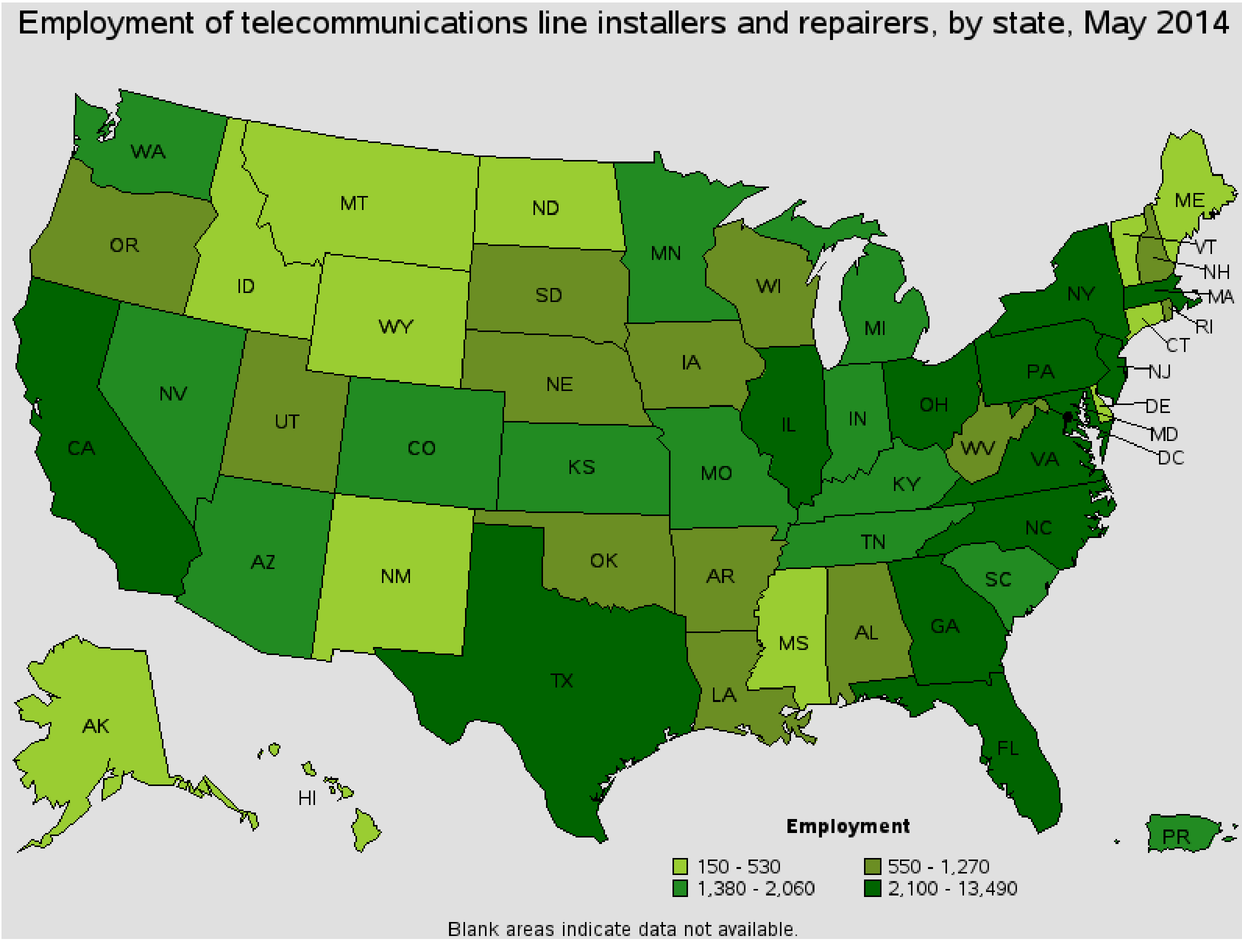


Figure 9.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015d)

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 (BLS, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Minnesota has not had any fatalities within the telecommunications industry or 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 40 fatalities in Minnesota between 2003 and 2014, with the highest fatality year being 2004, with 7 fatalities (BLS, 2015e).

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. MDH collects environmental and public health data through the Minnesota Public Health Data Access portal (MDH, 2015i). The same data are reported with more specificity at the federal level through the Centers 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 Minnesota, between 1999 and 2013, there were 161 fatalities due to a fall from, out of, or through a building or structure; 40 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 15 fatalities due to exposure to electric transmission lines (Centers for Disease Control and Prevention, 2015a). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

9.1.15.4. Contaminated Properties at or near Telecommunication Sites

Existing and surrounding land uses, including landfills or redeveloped brownfields, near telecommunication sites have the potential to impact human health and safety. Furthermore, undocumented environmental practices of 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[125] or listed on the National Priorities List (NPL), as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

Minnesota's Cleanup Section administers the Superfund Program, and is managed under MPCA (MPCA, 2015n). As of November 2015, Minnesota had 82 RCRA Corrective Action sites,[126] 684 brownfield sites, and 25 proposed or final Superfund/NPL sites (USEPA, 2015b). Based on a December 2015 search of USEPA Cleanups in My Community (CIMC) database, there are no Superfund sites (USEPA, 2015u) and no RCRA Corrective Action sites (USEPA, 2015u) in Minnesota where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

[125] The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) enacted in 1980, commonly referred to as the Superfund Program, governs abandoned hazardous waste sites, and collects a tax on chemical and petroleum industries. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986; see Appendix C, Environmental Laws and Regulations. (USEPA, 2011)
[126] Data gathered using USEPA's CIMC search on December 16, 2015, for all sites in Minnesota, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2015b).

Brownfield sites in Minnesota may be enrolled in the Brownfield Program managed by the MPCA, which includes the Petroleum Brownfields Program and Voluntary Investigation and Cleanup Program (MPCA, 2015o). One example of a brownfield site is the Brooklyn Center in Twin Lakes, MN. The site was formerly a low-lying wetland filled with construction demolition debris, which contaminated 65,000 cubic yards of soil with carcinogenic and non-carcinogenic polynuclear aromatic hydrocarbons (PAHs) and petroleum. The site received more than $1M in redevelopment and investigation funding, transforming the site into an office/warehouse space for medical technology companies (Minnesota Department of Employment and Economic Development, 2014).

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 TRI database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The “releases” do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities) As of October 2015, Minnesota had 497 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, Minnesota released 242.1 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from fossil fuel electric power generation. This accounted for 0.64 percent of nationwide TRI releases, ranking Minnesota 40 of 56 U.S. states and territories based on total releases per square mile. (USEPA, 2015e)

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of November 2, 2015, Minnesota had 102 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System. (USEPA, 2015f)

The National Institutes of Health (NIH), U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to “visually explore data from the USEPA’s TRI and Superfund Program” (NIH, 2015a). Figure 9.1.15-2 provides an overview of potentially hazardous sites in Minnesota.

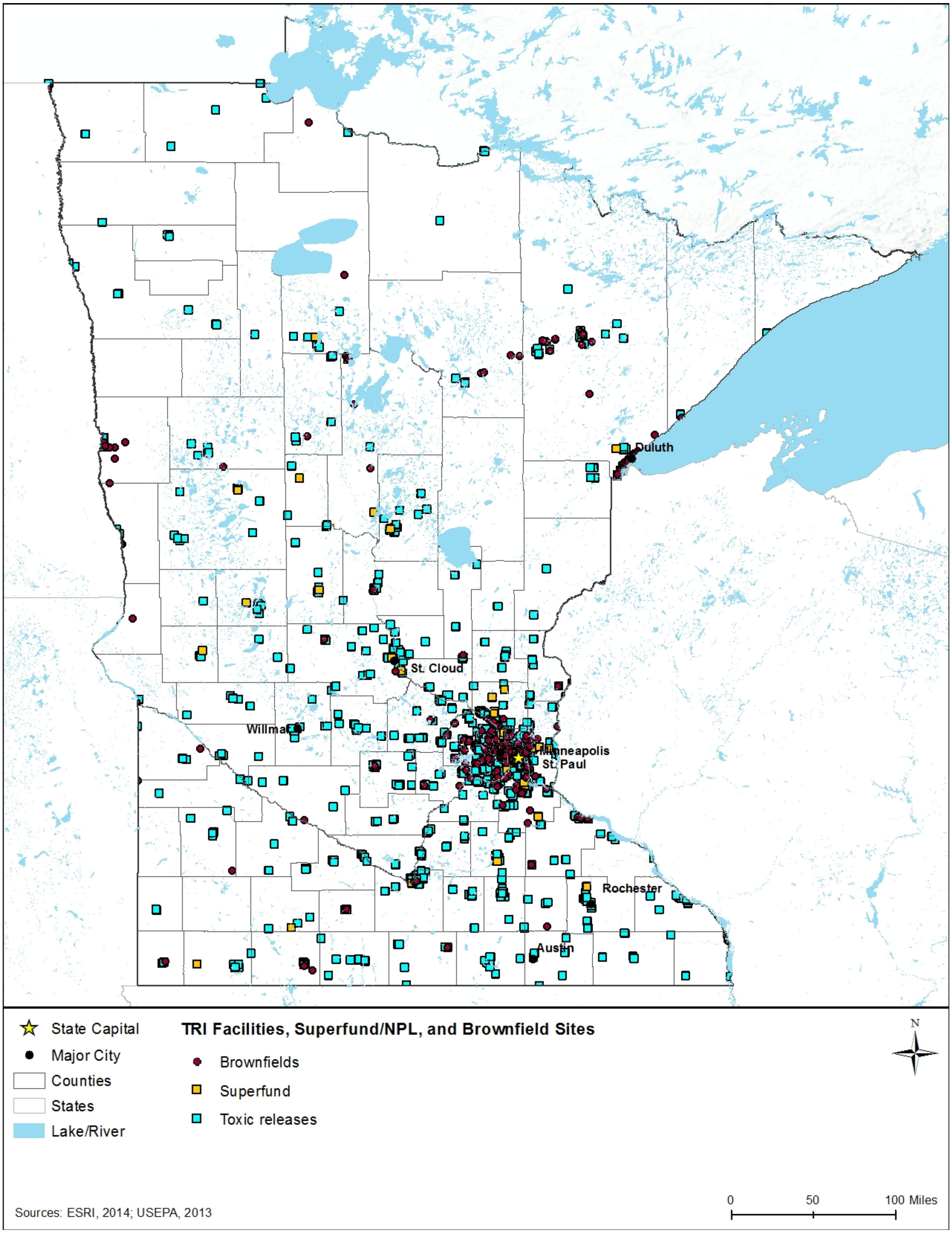


Figure 9.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Minnesota (2013)

Source: (NIH, 2015b)

In addition to hazardous waste contamination, another health and safety hazard includes surface and subterranean mines. 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). In 2006, Minnesota began mapping AMLs through the Underground Mine Mapping Project to identify hazardous features such as shafts and potential trespass areas. To date, the project has mapped two of five ranges (Central Mesabi Range and East Mesabi Range), identifying 89 underground mines with 413 shafts in the Central Mesabi Range, and 86 mines with 361 shafts in the East Mesabi Range (MDNR, 2015ac). As of December 2015, there were no Priority 1 or 2 AMLs (sites posing health and safety hazards in Minnesota (U.S. Department of Interior, 2015a), therefore hazards relating to mines will not be discussed further.

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

According to BLS data, Minnesota had 53 occupational fatalities between 2003 and 2014 statewide from exposure to "harmful substances or environments," although these were not specific to telecommunications (BLS, 2015e). By comparison, the BLS reported three fatalities in 2011 and three fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015f). In 2014, BLS also reported four fatalities[127] within the telecommunications line installers and repairers occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently

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

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 MDH Site Assessment and Consultation Unit conducts exposure and health investigations, health assessments, and consultations that identify and assess human exposure risks at contaminated sites. Public health assessments, consultations, and advisories for documented hazardous waste sites are distributed to appropriate government agencies and to citizens upon their request (MDH, 2015a). At the federal level, the Centers 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, Minnesota reported a rate of five injuries and fatalities due to reported acute toxic substance release incidents per 100,000 population (Centers for Disease Control and Prevention, 2015b).

9.1.15.5. 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).

Telecommunications workers are often called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. Climbing and working from tower structures damaged by wind increases the risk of slips, trips, or falls. During natural and manmade disasters, access to the telecommunication sites can be obstructed by debris.

Spotlight on Minnesota Superfund Sites: Reilly Tar & Chemical Corporation

The Reilly Tar & Chemical Corporation site (also known as the St. Louis Park Plant) is an 80-acre site in St. Louis Park, MN (Hennepin County). Between 1917 and 1972 the site was used for coal tar distillation and wood treatment. During its operation, thousands of gallons of wastewater were discharged weekly into a nearby bog, which contaminated soil and groundwater with polyaromatic hydrocarbons (PAH). Six public drinking water wells were contaminated and closed in the City of St. Louis Park, and one in the City of Hopkins.

In 1985, the USEPA constructed a drinking water treatment plant for two of the contaminated wells, and backfilled the bog with clean soil in 1986. Additional wells pumped contaminated groundwater into a third treatment plant, which was installed in 1992. Since 2002, the site has been redeveloped into a public park, ball fields, residential units, and commercial businesses. (USEPA, 2015h) Groundwater monitoring and pump and treatment systems remain in place.

In recent years, potential exposure risk to PAHs has increased as development increases. Following demolition of the Reilly Industries facility in 1972, contaminated soil was piled onsite, forming a hill in the southwestern portion. In addition to construction activity, gullying and erosion of the hill has exposed previously inaccessible, contaminated soil. (Centers for Disease Control and Prevention, 2009) As recently as 2015, onsite construction crews building a pedestrian bridge exposed a tar-like sludge, requiring perimeter fencing and safety measures (Figure 9.1.15-3) (KARE, 2015). Since the contaminated soil was covered but left in place, any site work that involves digging must first be approved by the USEPA and the MPCA. Mitigation measures required during these operations include safe handling of contaminated soils, personal protective equipment for workers, and air monitoring to protect residents. (USEPA, 2015h)

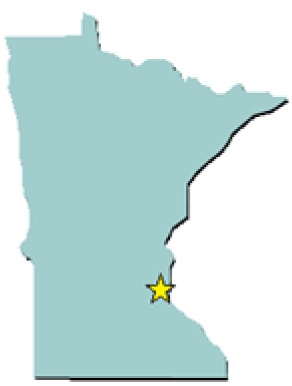


Figure 9.1.15-3: Fencing Around St. Louis Park Pedestrian Bridge Construction Site, St. Louis Park, MN

Source: (KARE, 2015)

Telecommunication Worker Occupational Health and Safety

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

Currently, MNDOLI 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 154 NRC-reported incidents for Illinois in 2015 with known causes, 10 incidents were attributed to natural disaster (e.g., natural phenomenon), while 144 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, in June 2013, southern Minnesota experienced severe thunderstorms and associated flooding, hail, and winds that caused extensive damages to infrastructure and properties. More than 500,000 customers lost electricity due to damaged or downed power lines, the largest power outage in Xcel Energy's history (Minnesota Climatology Working Group, 2015). 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, Minnesota had seven weather-related fatalities (six due to extreme cold and one due to winter storm) and seven non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NOAA, 2015e)

Spotlight on Minnesota Natural Disaster Sites: April 2013 Southwestern Minnesota Severe Winter Storm

Southwestern Minnesota experienced significant amounts of freezing rain and ice from April 9-11, 2013, that resulted in $26M in damages (Office of Governor Mark Dayton, 2013a). Nearly two inches of ice buildup on trees, branches, and wires downed 3,000 utility poles and 832 miles of utility lines (Figure 9.1.15-4). The resulting damage caused outages for 100,000 customers over 9 days, and dangerous conditions for utility workers and other responders. Public and first responder communications were disrupted across the region for 48 hours (Office of Governor Mark Dayton, 2013b). A Presidential Disaster Declaration (DR-4113) on May 3, 2013 provided $8M in public assistance grants for response and recovery actions (FEMA, 2015b).

Figure 9.1.15-4: Ice Accumulation and Downed Power Lines South of Luverne, MN (April 10, 2013)

Source: (Sioux Valley Energy, 2013)

9.2. ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental impacts, beneficial, or adverse, resulting from the Proposed Action and Alternatives. As this is a programmatic evaluation, site- and project-specific issues are not assessed. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, include the No Action Alternative. The No Action Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the proposed Alternatives.

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

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

9.2.1. Infrastructure

9.2.1.1. Introduction

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

9.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 9.2.1-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of Proposed 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.

9.2.1.3. 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 9.2.1-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if such impacts would be realized at one or more isolated locations. Such impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

The capacity of local health, public safety, and emergency response services would experience less than significant impacts during construction or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare – and that is if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders, local health officials, and public safety officials to communicate during emergency response situations. Based on the impact significance criteria presented in Table 9.2.1-1, potential negative impacts would be less than significant. Substantial beneficial impacts are likely to result from implementation.

Table 9.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	No effect on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is potentially significant, but with mitigation is less than significant.	Minor delays to access to care and emergency services that do not impact health outcomes.	No impacts on access to care or emergency services.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial 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

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 9.2.1-1, any potential impacts would be less than significant during deployment, due the temporary and small-scale nature of the deployment or operations activities. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of the deployment activities.

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

Commercial telecommunication systems, communications, or level of service would experience no impacts, as such commercial assets would be using a different spectrum for communications. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.[128] 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 project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the

[128] 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.

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.

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

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

Activities with the Potential to Have Impacts

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs)[129], huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase, however, it is anticipated that this tie-in would cause less than significant impacts as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing telecommunications poles.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the 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 resources in different ways resulting in both potentially negative and potentially positive impacts. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.

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

- 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.
    - 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 such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site-specific plans.
    - Deployable Technologies: Deployable technologies such as COWs, COLTs, and SOWs are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. Also, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be launched or recovered from existing paved surfaces, it is anticipated that there would be no impacts to infrastructure resources because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent impacts on utilities, if new infrastructure required tie-in to the electricity grid. These impacts are expected to be less than significant as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), and would be regionally based around the on-going phase of deployment, and minor. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy. These potential impacts are expected to be less than significant.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur. These potential impacts would be expected to be minor and temporary, as explained above.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would also likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and also minimize disruptions and misinformation resulting from limited or disrupted service. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative[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 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 road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that

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

FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

9.2.2. Soils

9.2.2.1. Introduction

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

9.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 9.2.2-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of Proposed 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.

9.2.2.3. 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 Minnesota and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment could impair water and habitat quality, and potentially affect aquatic plants and animals (NRCS, 2000). Areas exist in Minnesota that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Fluvents, Orthents, Psamments, Udalfs, Udepts, Udolls, and Ustolls (see Section 9.1.2.4, Soil Suborders, and Figure 9.1.2-2).

Based on the impact significance criteria presented in Table 9.2.2-1, building 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).

Table 9.2.2-1: 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

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 Proposed Actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 9.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet project sites, as well as the implementation of BMPs and mitigation measures (Chapter 19), minimal topsoil mixing is anticipated.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Heavy equipment 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 9.1.2.4, Soil Suborders). The most compaction susceptible soils in Minnesota are hydric soils with poor drainage conditions, which include Albolls, Aqualfs, Aquents, Aquepts, Aquolls, Hemists, and Udalfs. These suborders are found across the state (see Figure 9.1.2-2). 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 9.2.2-1, 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 (see Chapter 19).

9.2.2.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and POP structures and would not impact soil resources because it would not produce perceptible changes to soil resources.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, with no impacts to soil resources. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, or adding equipment to satellites launched for other purposes, would not impact soil resources because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have no impact to soil resources.

Activities with the Potential to Have Impacts

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion

and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.

- Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
- New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of construction activity.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, 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.

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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. These impacts are expected to be less than significant due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.2.5. 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to 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 soil erosion would result in less than significant impacts as described above. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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 9.1.2, Soils.

9.2.3. Geology

9.2.3.1. Introduction

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

9.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 9.2.3-1. As described in Section 9.2, 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 Proposed 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 9.2.3-1: Impact Significance Rating Criteria for Geology

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Seismic Hazard	Magnitude or Intensity	High likelihood that a project activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within an earthquake hazard zone or active fault.	No likelihood of a project activity being located in an earthquake hazard zone or active fault.
	Geographic Extent	Hazard zones or active faults are highly prevalent within the state/territory.		Earthquake hazard zones or active faults occur within the state/territory, but may be avoidable.	Earthquake hazard zones or active faults do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Volcanic Activity	Magnitude or Intensity	High likelihood that a project activity could be located near a volcano lava or mud flow area of influence.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located near a volcanic ash area of influence.	No likelihood of a project activity located within a volcano hazard zone.
	Geographic Extent	Volcano lava flow areas of influence are highly prevalent within the state/territory.		Volcano ash areas of influence occur within the state/territory, but may be avoidable.	Volcano hazard zones do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Landslide	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within a landslide area.	No likelihood of a project activity located within a landslide hazard area.
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Potential Paleontological Resources impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is potentially significant, but with mitigation is less than significant.	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

9.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts to the project, such as seismic hazards, landslides, and volcanic activity, and those that would be impacts from the project, such as land subsidence, mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geology are discussed below.

Seismic Hazard

A concern related to deployment is placement of equipment in highly active seismic zones. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 9.1.3.8, the majority of Minnesota is not at risk to significant earthquake events (Figure 9.1.3-4). No earthquake over magnitude 5.0 on the Richter scale has ever occurred in the state. Based on the impact significance criteria presented in Table 9.2.3-1 seismic impacts from deployment or operation of the Proposed Action would have no impact on seismic activity; however, seismic impacts to the Proposed Action could be potentially significant if FirstNet’s deployment locations were within high-risk earthquake hazard zones. 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 Minnesota, 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 Minnesota, as they do not occur in Minnesota; therefore, volcanoes do not present a hazard to the state.

Landslides

As discussed in Section 9.1.3.8, the majority of Minnesota is at low to moderate risk of experiencing landslide events. Based on the significance criteria presented in Table 9.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have potential significant impacts as it is likely that the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas in which landslides are highly prevalent. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. The highest potential for landslides in Minnesota is found along the Red River in areas that are underlain by clay deposits. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Minnesota's major cities, including Duluth and Rochester, 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) could help avoid or minimize the potential impacts.

Land Subsidence

As discussed in Section 9.1.3.8 and shown in Figure 9.1.3-6, portions of Minnesota are vulnerable to land subsidence due to karst topography. Based on the significance criteria presented in Table 9.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have potential significant impacts; however, subsidence impacts to the Proposed Action could be potentially significant to the Proposed Action if FirstNet's deployment locations were within areas at high risk to karst topography or mining areas. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography, 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 karst topography. However, where infrastructure is subject to subsidence hazards, BMPs and mitigation measures, as discussed in Chapter 19, could help avoid or minimize the potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources are not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 9.2.3-1, 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, FirstNet would avoid construction in areas where these resources exist.

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 9.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. It is anticipated that potential impacts to specific areas known to contain paleontological resources would be avoided, minimized, or mitigated, and any potential impacts would be limited and localized. Potential impacts to fossil resources should be considered on a site-by-site basis, and BMPs and mitigation measures (see Chapter 19) could further help avoid or minimize the potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 9.2.3-1, impacts could be potentially significant if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and less significant as the proposed activities are not likely to require the 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.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

Implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities have the potential to be impacted by geologic hazards, some activities could result in potential impacts to geology, and other activities would have no impacts. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. In most cases, there would be no impacts to geologic resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to geologic resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very likely to impact geologic resources, it is anticipated that this activity would have no impact to geologic resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POP), huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water is not expected to impact geologic resources including marine paleontological resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or

disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.

  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. Where deployable technologies would be implemented on existing paved surfaces, there would be no impacts to/from geologic resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: In most cases, the installation of permanent equipment on existing structures, adding equipment to satellites launched for other purposes, or the use of portable devices that use satellite technology would not impact geologic resources because those activities would not require ground disturbance. However, where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects are likely to be small scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small scale, and as a result, these potential impacts are expected to be less than significant. These impacts are expected to be less than significant due the temporary and small-scale nature of the deployment or operations activities.

Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to geology associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections.

The operation of the Preferred Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant as it is anticipated that deployment locations would avoid, as practicable or feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. See Chapter 19, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts

9.2.3.4. 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. 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 hazard. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be less than significant due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize.

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 are subject to increased seismic activity, landslides, and land subsidence. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to geologic resources (or from geologic hazards) as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.2.3, Geology.

9.2.4. Water Resources

9.2.4.1. Introduction

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

9.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 9.2.4-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of Proposed 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 9.2.4-1: 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

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
Floodplain degradation*	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with mitigation is less than significant.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is potentially significant, but with mitigation is less than significant.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (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
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, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690).
NA = not applicable

9.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Most of Minnesota's surface waterbodies are in poor condition (see Table 9.1.4-2, Figure 9.1.4-2). Nearly 90 percent of pollution in Minnesota's surface water can be attributed to nonpoint sources. Pollutants including phosphorus, nitrates, bacteria, and sediments come from runoff from paved surfaces, constructions sites, lawns, and feedlots, as well as storm sewers and failing septic systems.

Additionally, all of the surface waters in the state have been degraded to some extent. Nearly 80 percent of Minnesota's assessed rivers and streams are impaired, and nearly all of the state's assessed lakes, reservoirs, and ponds are impaired. Designated uses of rivers and streams in Minnesota include drinking water, aquatic life, and recreation. Designated uses of lakes, ponds, and reservoirs include aquatic life, recreation, and warm water aquatic consumption. (USEPA, 2012a)

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 storm water pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality.

Therefore, based on the impact significance criteria presented in Table 9.2.4-1 water quality would likely be less than significant particularly if BMPs and mitigation measures incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching[131] 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 Minnesota dewatering requirements. Any groundwater extracted during dewatering activities would be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Minnesota aquifers, there is potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 9.2.4-1, there would likely by less than significant impacts on groundwater quality within most of the state. In areas where groundwater is close to the surface, then site-specific analysis, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on humans, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 9.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely

[131] Telecommunications activities involve laying conduit, with minimal trenching. Trenching activities would likely be at a minimal depth (less than 36 inches) and width (6 to 12 inches).

deployment activities, on the watershed or subwatershed level, would occur inside the 500-year floodplain, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would be temporary, lasting no more than one season or water year,[132] or occur only during an emergency.

Examples of activities that would have less than significant impacts include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that include pervious surfaces such as gravel parking lots.
- Land uses that do not change the flow of water or drainage patterns.
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures would reduce the risk of additional impacts to floodplain degradation (see Chapter 19).

Drainage Pattern Alteration

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

According to the significance criteria in Table 9.2.4-1 any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered less than significant.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited storm water runoff.
- Where storm water is contained on site and does not flow to or impact surface waterbodies off-site on other properties.
- Activities designed so that the amount of storm water generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for storm water.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river, create a substantial and measurable increase in the rate and amount of

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[132] 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, 2016d)

surface water, or change the hydrologic regime, and any effects would be short-term, impacts to drainage patterns would be less than significant. BMPs, mitigation measures, and avoidance could be implemented to further reduce any potentially significant impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals 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 9.2.4-1. Projects that include minor consumptive use of surface water with less than significant impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have less than significant impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain but 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 storm water 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, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 9.1.4.7, approximately 75 percent of the state's drinking water supply comes from groundwater, and nearly all of the water utilized for agricultural irrigation comes from groundwater. Most of Minnesota's groundwater is of good quality, but pollutants such as nitrates, chlorides, and volatile organic compounds threaten groundwater quality. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. (MPCA, 2013c) Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would unlikely cause any impacts to water quality. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation, 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 should be less than significant since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should be considered to avoid areas that would extract groundwater from potable groundwater sources in the area.

9.2.4.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to water resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to water resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to water resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have no impact to water resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water would impact water resources. Site-specific impact assessment would be required to marine and shoreline environments prior to installation to fully assess potential impacts to coastal and marine environments.
  - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids; groundwater impacts from trenching activities are not expected. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance could cause impacts to water quality from

increased suspended solids 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, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Deployable Technologies: Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites or deployment in unpaved areas. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be no impacts to water resources because there would be no ground disturbance.

Deployment of drones, weather balloons, blimps, aerostats, or manned 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; 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 water resources associated with deployment of this infrastructure could include water quality impacts, but are expected to be less than significant due the temporary and small-scale nature of the deployment or operations activities. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure would likely be less than significant due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities, and are expected to have no impacts as there would be no ground disturbing activity and it is likely routine maintenance activities would be conducted along exiting roads and utility ROWs. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to water resources if the deployment occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up. The amount of impact depends on the land area affected, installation technique, and location. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource’s current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be less than significant impacts to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods of time, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be less than significant. Site maintenance, including mowing or herbicides, may result in less than significant effects to water quality, due to the small scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to water resources because of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.4, Water Resources.

9.2.5. Wetlands

9.2.5.1. Introduction

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

9.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 9.2.5-1. As described in Section 9.2, 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 Proposed 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.

9.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Table 9.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct wetland loss (fill or conversion to non-wetland)	Magnitude or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Indirect effects: [2] change in function(s)[3] change in wetland type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[a] "Magnitude" is defined based on the type of wetland impacted, high or low quality. Category 1 are the highest quality, highest functioning wetlands.
[b] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.
[c] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

There are more than 10.6 million acres of wetlands throughout Minnesota (USFWS, 2014e). Palustrine (freshwater) wetlands are found on river and lake floodplains across the state, although more concentrated in the northern half of Minnesota, as shown in Figure 9.1.5-1.

Based on the impact significance criteria presented in Table 9.2.5-1, 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 Minnesota, as discussed in Wetlands, Section 9.1.5.4, calcareous fens are regulated high quality wetlands as they are one of the rarest natural communities in the country. There are approximately 200 calcareous fens in Minnesota, with the majority being only a couple acres in size. (MDNR, 2015j) If any of the proposed deployment activities were to occur in high quality wetlands, potentially significant impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would be required, in addition to BMPs and mitigation measures to avoid potentially significant impacts to wetlands.

Potential Other Direct Effects

Direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as storm water discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 9.2.5-1, construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) may cause potentially significant impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds are potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts 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 Minnesota include:

- *Vegetation Clearing*: removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- *Ground Disturbance*: Increased amounts of storm water runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed

infiltration capacity could cause wetland water depths to rise more rapidly following storm events.

- *Direct Hydrologic Changes (flooding or draining)*: Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- *Direct Soil Changes*: Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameter, such as the alkaline conditions of calcareous fens (which are high quality wetlands in Minnesota).
- *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:[133] Changes in Function(s)[134] or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of functions related to wetlands in Minnesota that could potentially be impacted from construction-related deployment activities include:

- *Flood Attenuation:* Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they can lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function

[133] 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.

[134] 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.

- *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 9.2.5-1 impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered potentially less than significant. Since the majority of wetlands in Minnesota are not considered high quality, deployment activities could have less than significant indirect impacts on wetlands in the state. BMPs and mitigation measures could be implemented, as feasible and practicable, to reduce potential impacts to all wetlands.

9.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations would be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launched for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wetlands, it is anticipated that this activity would have no impact to wetlands.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.

  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.
  - New Build – Aerial Fiber Optic Plant: Potential impacts could be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if land-based deployables are deployed on unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct

impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, blimps, or piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant due to the small amount of land disturbance (generally less than one acre) and the short term timeframe of deployment activities. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there could be ongoing potential other direct impacts to wetlands if heavy equipment is used for routine operations and maintenance application of herbicides occurs to control vegetation along all ROWs and near structures, depending on the proximity to wetlands. These impacts are expected to be less than significant due to the limited nature of deployment activities. It is also anticipated that routine maintenance activities would be conducted on existing roads and utility ROWs. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.5.5. 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 because of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be less than significant due to the small-scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the 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 ROWs 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.5, Wetlands.

9.2.6. Biological Resources

9.2.6.1. Introduction

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Minnesota 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 potential impacts are identified in Chapter 19.

9.2.6.2. 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 9.2.6-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of Proposed Actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 9.2.6.3, 9.2.6.4, and 9.2.6.5, respectively, are presented as a range of possible impacts. Refer to Section 9.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Minnesota.

Table 9.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury /mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: 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 Minnesota 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 Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Minnesota for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: 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 Minnesota for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Minnesota for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: 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 Minnesota for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Minnesota.		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, 2016d)

9.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Minnesota 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 9.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, these events are expected to be relatively small in scale. The implementation of BMPs and mitigation measures and avoidance measures would help to minimize or altogether avoid potential impacts to plant population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical 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 minimize or avoid potential impacts.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the Proposed Action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Increasing or decreasing hydrology in an area as an indirect effect, could lead to moisture stress and/or mortality of plant species that are adapted to specific hydrologic regimes. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment, though BMPs and mitigation measures could help to minimize or avoid the potential impacts.

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action given the small scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action given the small scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity.

When non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. Natural or native community species evolve together into an ecosystem with many checks and balances that limit the population growth of any one species. These checks and balances include such things as: predators, herbivores, diseases, parasites, and other organisms competing for the same resources and limiting environmental factors. However, when an organism is introduced into an ecosystem in which it did not evolve naturally, those limits may not exist and its numbers can sometimes dramatically increase. The unnaturally large population numbers could then have severe impacts to the environment, local economy, and human health. Invasive species could out-compete the native species for food and habitats and sometimes even cause their extinction. The Minnesota Noxious Weed Control Act (MS 18.75 through 18.91) purpose is to protect the public from the "injurious effects" of listed noxious weeds, and provides information regarding "procedures for controlling and eradicating noxious weeds on all lands within the state." A total of 29 state-listed noxious weeds/complexes are regulated in Minnesota as set forth in the Minnesota Noxious Weed Law (MS 18.75 through 18.91). One of these species occurs on the Federal Noxious Weed List. (USDA, 2014)

The potential to introduce invasive plants within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs could help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, the same type of Proposed Action infrastructure could result in a range impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology[135], 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 Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to terrestrial vegetation. If required, and if done in existing huts, installation of new associated equipment would also have no impacts to terrestrial vegetation because there would be no ground disturbing activity. The section below addresses potential impacts to terrestrial vegetation if construction of new huts or other equipment is required or construction for laterals/drops is conducted.
  - 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 terrestrial vegetation because there would be no ground disturbance associated with this activity. The section below addresses potential impacts to terrestrial vegetation if construction of new boxes, huts, or other equipment is required.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water would not impact terrestrial vegetation because there would be no ground disturbance associated with this activity (see Section 9.2.4, Water Resources, for discussion of potential impacts to water resources). The section below addresses potential impacts associated with construction of landings and/or facilities on shore to accept submarine cables.
- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (e.g., antennas or microwave dishes) on an existing tower, which would not result in impacts to terrestrial vegetation if no additional disturbance is required to install the hardware on the tower. The potential addition of power units, structural hardening, tower replacement, and other equipment installation

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

could impact terrestrial vegetation. Potential impacts of those activities that would affect terrestrial vegetation are discussed below.

- Deployable Technologies: Where deployable technologies would be implemented on existing paved or other unvegetated surfaces, or where aerial deployable technologies may be utilized on existing paved or other unvegetated surfaces, it is anticipated that there would be no impacts to terrestrial vegetation because there would be no disturbance to vegetation.

- 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 to biological resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects if BMPs and mitigation measures are not implemented.
  - 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 relatively minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private

easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects if BMPs and mitigation measures are not implemented.

  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to terrestrial vegetation as mentioned above, installation of new associated huts or equipment or construction for laterals/drops, if required, could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be temporary and not conducted in locations designated as vital or critical for any period.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects if BMPs and mitigation measures are not implemented.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, 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 deployment occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. These potential impacts are expected to be less than significant due to the small-scale of expected deployment activities. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may result in less than significant effects due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however, impacts are expected to be less than significant due to the small-scale of expected activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. However, impacts are expected to remain less than significant due to the relatively small-scale of FirstNet activities at individual locations. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to terrestrial vegetation associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. The impacts can vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.6.3, Terrestrial Vegetation.

9.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Minnesota 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 9.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable but minimal for some FirstNet projects, individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

<u>Terrestrial Mammals</u>

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Minnesota. 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 (USDOT FHWA, 2015e). Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur.

Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

If tree-roosting bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small scale and would be dependent on the location and type of deployment activity, and tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and violate MBTA and BGEPA. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (FAA, 2012b) (Gehring, Kerlinger, & Manville, 2011).

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

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state. Direct injury/mortality are not anticipated to be widespread or affect bird populations if BMPs are followed to avoid or minimize these effects.

Direct mortality and injury to birds of Minnesota 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 would be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures.

Reptiles and Amphibians

In Minnesota, reptiles and amphibians occur in a wide variety of habitats, such as forest, prairie, wetland, and riparian communities, and are widespread throughout the state. Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals.

Environmental consequences pertaining to amphibians are discussed in Section 9.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Minnesota are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat, and impeding access to resources and mates. About 39 percent of Minnesota has experienced extensive land use change due to cropland creation and about 7 percent of the state has experienced extensive land use change due to pastureland creation. However, a large portion of the state, about 31 percent, remains as unfragmented forest, particularly the Superior National Forest, Kabetogama State Forest, George Washington State Forest, and Chippewa national Forest in the northeastern region of the state. (NRCS, 2010)

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 Minnesota's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Minnesota and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bear) by decreasing the availability of forest for cover from predators or foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals (e.g., bats, foxes) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by BMPs and mitigation measures.

Birds

The direct removal of migratory bird nests are protected 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 in IBAs within the state as birds may temporarily avoid these areas. (Hill, et al., 1997)

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[136] 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.

Reptiles and Amphibians

Important habitats for Minnesota's amphibians and reptiles typically consist of wetlands and the surrounding upland forest. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 19) would be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 9.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Minnesota's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[137]

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state. Impacts to sensitive invertebrate species are discussed below in Section 9.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur.

[136] 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.
[137] See Section 9.2.5, Wetlands, for a discussion of BMPs for wetlands.

Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the project 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 Minnesota's amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

Some large mammals (e.g., black bears) will perform short seasonal migrations between foraging/breeding habitats and denning habitats. Some small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[138]

Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.

[138] A location chosen by an animal for hibernation

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. According to the Audubon Society, a total of 54 IBAs, providing over 11 million acres of land, have been identified in Minnesota, including breeding[139], migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, grasslands, sage brush, and wetland/riparian[140] areas (Audubon Society, 2015b). 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 deployment/operation, and duration, though BMPs and mitigation measures would help to avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. For example, wood frogs (*Rana sylvatica*) use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, Atwood, Dunkle, & Karr, 2010). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, 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 small scale in nature; no effects to migratory patterns of Minnesota's terrestrial invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Minnesota.

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[139] Breeding range: "The area utilized by an organism during the reproductive phase of its life cycle and during the time that young are reared" (*EPA 2015a*) (USEPA, 2015r)

[140] 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." (*EPA 2015b*)

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small scale. Reproductive effects as a result of displacement and disturbance are 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. The majority of FirstNet deployment or operation activities are likely to be small scale in nature, and BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the spiny softshell turtle (*Apalone spinifera*) will lay its eggs in exposed soil in late spring or summer. (USGS, 2015f)

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. Minnesota maintains a list of prohibited invasive species (MS 84D.05), which includes some terrestrial mammals such as Asian raccoon dog (*Nyctereutes procyonoides*), European rabbit (*Oryctolagus cuniculus*), and European wild boar (*Sus scrofa scrofa*) (MDNR 2015). In Minnesota, it is “unlawful to possess, import, purchase, transport, or introduce” listed prohibited species unless a specialized permit is obtained. The state also maintains a list of regulated invasive species (MS 84D.07), which includes terrestrial wildlife species such as Egyptian goose (*Alopochen aegyptiacus*), mute swan (*Cygnus olor*), and Sichuan pheasant (*Phasianus colchicus strachi*) (*MDNR 2015*). In Minnesota, it is “legal to possess, sell, buy, and transport regulated invasive species, but they may not be introduced into a free-living state” (MS 84D.07).

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites; although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers.

Potential invasive species effects to Minnesota's wildlife are described below.

Terrestrial Mammals

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations.

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, mute swans could impact native waterfowl and wetland birds causing nest abandonment or impacts to rearing young due to their aggressive behavior. Further, this invasive bird could lead to declines in submerged aquatic vegetation that support native fish and other wildlife (MDNR, 2015n). FirstNet deployment activities could result in short-term or temporary changes to specific project sites; these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities. Invasive species effects to birds could be minimized or avoided following the BMPs described in Chapter 19.

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 could pose a threat to Minnesota's forest and agricultural resources. Species such as the gypsy moth (*Lymantria dispar*), emerald ash borer (*Agrilus planipennis*), and Asian longhorn beetle (*Anoplophora glabripennis*) are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs and mitigation measures would help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action. Invasive species effects related to terrestrial invertebrates could be minimized with the implementation of BMPs and mitigation measures (Chapter 19).

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wildlife resources. If required, and if done in existing huts, installation of new associated equipment would also have no impacts to wildlife. The section below addresses potential impacts to wildlife if construction of new huts or other equipment is required or if construction for laterals/drops is conducted.
  - 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 wildlife. The section below addresses potential impacts to wildlife if construction of new boxes, huts, or other equipment is required.
- 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, which would not result in impacts to wildlife if no additional disturbance is required to install the hardware on the tower. The potential addition of power units, structural hardening, tower replacement, and physical security measures such as lighting

could impact wildlife resources. Potential impacts of those activities that would affect wildlife are discussed below.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would not impact wildlife if those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have no impact to wildlife resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities are anticipated to be less than significant to wildlife resources:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects if BMPs and mitigation measures are not implemented.
  - 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 wildlife resources could be impacted, it is anticipated that effects to wildlife would be temporary and not conducted in locations designated as vital or critical for any period.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to 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 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.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to wildlife resources as mentioned above, installation of new associated huts or equipment or construction for laterals/drops, if required, could result in direct injury/mortality; habitat loss and alternation; effects of migratory patterns; indirect injury or mortality; reproductive effects; and invasive species effects depending on the site location and amount of ground disturbance.
- New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife (see Section 9.2.4, Water Resources, for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality; habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical time periods, effects to migratory patterns as well as reproductive effects and indirect injury/mortality could occur.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and indirect injury or mortality, effects to migratory patterns, as well as reproductive effects.
  - 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.

- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to wildlife on roadways from vehicular movement. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, the species' phenology, and the nature and extent of the habitats affected. These impacts and associated BMPs and mitigation measures to help mitigate or reduce these impacts are described in Chapter 19. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to wildlife resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may result in less than significant effects to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Wildlife may also be impacted if increased access leads to an increase in the legal or illegal take of biota. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and therefore would likely be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. The impacts could vary greatly among species and geographic region. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the 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 9.1.6.4, Terrestrial Wildlife.

9.2.6.5. Fisheries and Aquatic Habitats

Potential impacts to fisheries and aquatic habitats occurring in Minnesota 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, 2012b)

Based on the impact significance criteria presented in Table 9.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, individual behavior of fish species would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, the construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location depending on the nature of the deployment activity. Additionally, deployment activities with potential impacts to sensitive aquatic habitats could be addressed through BMPs and mitigation measures.

Indirect Injury/Mortality

Water quality and quantity 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, though BMPs and mitigation measures to protect water resources (see Section 9.2.4, Water Resources) would 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. FirstNet deployment 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 would help to 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, though BMPs would help to avoid or minimize the potential impacts.

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 and biodiversity.

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 project sites and these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. BMPs and mitigation measures would help to avoid or minimize the potential for introducing invasive aquatic plant and animal species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

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 Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to fisheries and aquatic habitats because there would be no disturbance of the aquatic environment. If required, and if done in existing huts, installation of new associated equipment would also result in no disturbance and have no impacts to fisheries and aquatic habitats. The section below addresses potential impacts to fisheries and aquatic habitats if construction of new huts or other equipment is required or construction for laterals/drops is conducted.
    - 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 fisheries and aquatic habitats because there would be no habitat disturbance. The section below addresses potential impacts to fisheries and aquatic habitats if construction of new boxes, huts, or other equipment is required.
- 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, which would not result in impacts to fisheries and aquatic habitats if no additional disturbance is required to install the hardware on the tower. The potential addition of power units, structural hardening, tower replacement, and physical security

measures could impact fisheries and aquatic habitats. Potential impacts of those activities that would affect fisheries and aquatic habitats are discussed below.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats if those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have no impact to 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 development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. If areas to be disturbed would result in erosion or sedimentation into aquatic habitats, impacts to fisheries and aquatic habitats could occur, but it is expected effects would be temporary and not conducted in locations designated as vital or critical for any period.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed,

but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.

- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could, if conducted near water resources that support fish, result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects if conducted near a water resource that supports fish.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to fisheries and aquatic habitats as mentioned above, installation of new associated huts or equipment or construction for laterals/drops, if required near water resources, could result in direct injury/mortality; habitat loss and alternation; effects of migratory patterns; indirect injury or mortality; reproductive effects; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited 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 if BMPs are not implemented.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads is not expected to result in impacts to fisheries and aquatic habitats as towers and structures would not be constructed in waterbodies. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies that support fish, could result in habitat loss or indirect injury/mortality, although highly unlikely.
  - 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.
  - 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. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration and fragmentation, indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less significant due to the small scale of deployment activities and the limited number of aquatic species expected to be impacted. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Construction of new access roads could cause erosion concerns. Site maintenance 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.

Fisheries and aquatic habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above.

Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts from habitat loss, alteration and fragmentation, indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant due to the limited nature of expected deployment activities. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As 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 there would be less than significant impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. The impacts can vary greatly among species and geographic region, but they are still expected to remain less than significant due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation

Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to fisheries and aquatic habitats as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.6.5, Fisheries and Aquatic Habitats.

9.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Minnesota 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 9.2.6-2. 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 Proposed 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 9.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 9.2.6-2, 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, fish, invertebrates, and plants with known occurrence in Minnesota are described below.

<u>Terrestrial Mammals</u>

One endangered and two threatened mammal species are federally listed and known to occur in the state of Minnesota; they include the Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), and northern long-eared bat (*Myotis septentrionalis*). Direct mortality to the federally listed Canada lynx or gray wolf could occur from vehicle strikes, as these species 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.

Direct mortality or injury to the federally listed northern long-eared bat could occur if tree clearing activities occurred at roosting sites while bats were present (USFWS, 2015f) (USFWS, 2015g) (*USFWS 2012*, *2015a*). While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could lead to adverse effects to these species; when disturbed by noise or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 2016a).

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

One endangered and one threatened bird species are federally listed and known to occur in the state of Minnesota; they include the piping plover (*Charadrius melodus*) and the red knot (*Calidris canutus rufa*). Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Fish

One endangered fish species is federally listed and known to occur in the state of Minnesota, the Topeka shiner (*Notropis topeka*). The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One candidate reptile species is known to occur in the state of Minnesota, the eastern massasauga (*Sistrurus catenatus*). Candidate species are not currently protected eastern under the ESA, however, USFWS recommends conservation measures still be applied for these species. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians are known to occur in Minnesota. Therefore, no injury or mortality effects to federally threatened and endangered amphibians are expected as a result of the Proposed Action.

Invertebrates

Seven endangered and one threatened invertebrate species are federally listed and known to occur in the state of Minnesota; they include the Dakota skipper (*Hesperia dacotae*), Higgins' eye pearlymussel (*Lampsilis higginsii*), Karner blue butterfly (*Lycaeides melissa samuelis*), Poweshiek skipperling (*Oarisma poweshiek*), sheepnose mussel (*Plethobasus cyphyus*), snuffbox mussel (*Epioblasma triquetra*), spectaclecase mussel (*Cumberlandia monodonta*), and winged mapleleaf (*Quadrula fragosa*).

Direct mortality or injury could occur to the Dakota skipper, Karner blue butterfly, or Poweshiek skipperling if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by this species.

The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to the Higgins' eye pearlymussel, sheepnose mussel, snuffbox mussel, spectaclecase mussel, or winged mapleleaf are unlikely but could occur from entanglements resulting from the Proposed Action.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

<u>Plants</u>

One endangered and three threatened plant species are federally listed and known to occur in the state of Minnesota; they include the Leedy's roseroot (*Rhodiola integrifolia ssp. Leedyi*), Minnesota dwarf trout lily (*Erythronium propullans*), prairie bush-clover (*Lespedeza leptostachya*), and western prairie fringed orchid (*Platanthera praeclara*). Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles, fish, invertebrates, and plants with known occurrence in Minnesota are described below.

<u>Terrestrial Mammals</u>

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Birds

Noise, light, or human disturbance within nesting areas could cause federally listed birds to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress to reptiles resulting in lower productivity. Further, land clearing activities, noise, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians are known to occur in Minnesota. Therefore, no reproductive effects to federally threatened and endangered amphibians are expected as a result of the Proposed Action.

Fish

Deployment activities resulting in increased disturbance (e.g., humans, noise), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 9.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to federally listed fish species in Minnesota are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality could cause stress resulting in lower productivity for federally listed mussels known to occur in Minnesota. In addition, introduction of invasive aquatic species could indirectly affect mussels as a result of fish populations that they rely on for their reproductive cycle being altered (USFWS 1997). Impacts to food sources utilized by the federally listed terrestrial invertebrates could lead to potential adverse effects on these species (USFWS, 2015c). Deployment activities are not expected to cause changes to water quality that could result in impacts.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

No direct 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. Indirect effects to federally listed plants could occur, if land clearing or other actions was taken which then disturbed the pollinators of listed plants. Impacts would be less than significant, due to the small scale of projects and short durations.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially significant. Potential effects to federally listed terrestrial mammals, birds, reptiles, fish, invertebrates, and plants with known occurrence in Minnesota are described below.

Mammals

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, the piping plover use sites throughout Minnesota as stopover and nesting habitat. Piping plovers migrate from the Northern Great Plains, Northern Atlantic Coast, and Great Lakes Area to the coastal habitats in the south (MDNR, 2015ad). Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, may affect, but are not likely to adversely affect federally listed birds.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles

Habitat loss or alteration, particularly from fragmentation or invasive species, could adversely affect nesting and foraging sites of the federally listed reptile species, resulting in reduced survival and productivity.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Fish

Changes in water quality could impact food sources for the federally listed fish species in Minnesota. Further, increased human disturbance, noise, and vessel traffic could cause stress to these species causing them to abandon spawning locations or altering migration patterns.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mussels resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact survival.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, although unlikely to occur, large-scale impacts could diminish the functions and values of the habitat, while in other cases small-scale changes could lead to potential 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, fish, invertebrates, and plants with designated critical habitat in Minnesota are described below.

Terrestrial Mammals

Two of the federally listed terrestrial mammals in Minnesota have federally designated critical habitat. Critical habitat for the Canada lynx was designated in Cook, Koochiching, Lake, and St. Louis counties in northern Minnesota. Critical habitat for the gray wolf was designated in areas of Beltrami, Cook, Itasca, Koochiching, Lake, Lake of the Woods, Roseau, and St. Louis counties in northern Minnesota.

Land clearing, excavation activities, and other ground disturbing activities in these critical habitats in Minnesota could lead to habitat loss or degradation, which could lead to adverse effects to these federally listed mammals 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional

BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed terrestrial mammal species in Minnesota; therefore, no effect to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

One of the federally listed bird species in Minnesota has federally designated critical habitat. Critical habitat for the piping plover was designated in Rocky Point, Pine and Curry Island, and Morris Point in Lake of the Woods County. Land clearing, excavation activities, and other ground disturbing activities in this region of Minnesota could lead to habitat loss or degradation, which could lead to adverse effects to the these birds 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed bird species in Minnesota; therefore, no effect to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles

No designated critical habitat occurs for reptiles in Minnesota. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Fish

The federally listed fish species in Minnesota has federally designated critical habitat. Critical habitat for the Topeka shiner was designated in Lincoln, Murray, Nobles, Pipestone, and Rock counties in southwestern Minnesota. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the federally listed fish species in Minnesota; therefore, no effect to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Invertebrates

Two of the federally listed invertebrate species in Minnesota have federally designated critical habitat. Critical habitat for the Dakota skipper was designated in Chippewa, Clay, Kittson, Lincoln, Murray, Norman, Pipestone, Polk, Pope, and Swift counties in western Minnesota. Critical habitat for the Poweshiek skipperling was designated in Chippewa, Clay, Cottonwood, Douglas, Kittson, Lac Qui Parle, Lincoln, Lyon, Mahnomen, Murray, Norman, Pipestone, Polk, Pope, Swift, and Wilkin counties. Land clearing, excavation activities, and other ground disturbing activities in these regions of Minnesota could lead to habitat loss or degradation, which could lead to adverse effects to these invertebrates depending on the duration, location, and spatial scale of the associated activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in Minnesota; therefore, no effect to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Plants

No designated critical habitat occurs for plants in Minnesota. 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 effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The threatened and endangered species that would be affected would depend on the ecoregion, the species’ phenology, and the nature and extent of the habitats affected.

Activities Likely to Have No Effect

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no effect on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no effect on threatened and endangered species or their habitat. If required, and if done in existing huts, installation of new associated equipment would also have no impacts to threatened and endangered species. The section below addresses potential effects to threatened and endangered species if construction of new huts or other equipment is required or construction for laterals/drops is conducted.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no effect on threatened and endangered species or their habitats. The section below addresses potential effects to threatened and endangered species or their habitats if construction of new boxes, huts, or other equipment is required.
- 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, which would not result in effects to threatened and endangered species or their habitats if no additional disturbance is required to install the hardware on the tower. The potential addition of power units, structural hardening, tower replacement, and physical security measures such as lighting could affect threatened and endangered species. Potential effects of those activities that would affect threatened and endangered species or their habitats are discussed below.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would have no effect on threatened and endangered if those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to affect protected species, it is anticipated that this activity would have no effect on protected species.

Activities that May Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure 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 – Submarine Fiber Optic Plant: The installation of cables in bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential effects to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - 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 affected, it is anticipated that the effects to threatened and endangered species would be temporary and activities would not be conducted in locations designated as vital or critical for any period.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no effect on threatened and endangered species as mentioned above, installation of new associated huts or equipment or construction for laterals/drops, if required, could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water and construction of landings and/or facilities on the shore to accept

submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 9.2.4, 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 required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could affect threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers, or structural hardening are required, effects would be similar to new wireless construction. Hazards related to security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. These impacts may affect, but are not likely adversely affect protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

It is anticipated that operational activities are not likely to adversely affect threatened and endangered species through activities associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may affect, but is not likely to adversely affect, threatened and endangered species through direct injury/mortality to less mobile species, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. 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.

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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species 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 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

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 threatened and endangered species resulting in reproductive effects or disruptions in behavioral patterns. Threatened and endangered species may also be impacted if increased access leads to an increase in the legal or illegal take of biota.

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species as a result of direct injury/mortality, reproductive effects, 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. 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 operational activities are not likely to adversely effect, threatened and endangered species, and their habitats as a result of routine operations, management, and monitoring. 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. Chapter 17, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. 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 nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effect on threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.6.6, Threatened and Endangered Species and Species of Concern.

9.2.7. Land Use, Recreation, and Airspace

9.2.7.1. Introduction

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

9.2.7.2. 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 9.2.7-1. As described in Section 9.2, 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 Proposed 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 9.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with Mitigation 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 Mitigation Incorporated**	**Less Than Significant**	**No Impact**
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is potentially significant, but with mitigation is less than significant.	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is potentially significant, but with mitigation is less than significant.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with Mitigation 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

9.2.7.3. 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 Proposed Actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 9.2.7-1, 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 Proposed 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 9.2.7-1, less than significant impacts would be anticipated as any new land use would be small scale and consistent with the surrounding land uses in the area; only short-term impacts during the construction phase would be expected.

Loss of Access to Public or Private Recreation Land or Activities

Access to public or private recreation land or activities could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of ROWs or easements. 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 9.2.7-1, 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 9.2.7-1, 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 9.2.7-1, 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.

9.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace. (See Section 9.1.7.5 Obstructions to Airspace Considerations).
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: It is anticipated that there would be no impacts to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace. (See Section 9.1.7.5 Obstructions to Airspace Considerations).
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.

    - Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: No impacts to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
    - Airspace: No impacts are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have no impacts to airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace. (See Section 9.1.7.5 Obstructions to Airspace Considerations).
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace. (See Section 9.1.7.5 Obstructions to Airspace Considerations).

- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
    - Land Use: There would be no impacts to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: See Activities Likely to Have Impacts below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria. (See Section 9.1.7.5 Obstructions to Airspace Considerations).
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact to land use, it is anticipated that this activity would have no impact to land use.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - <u>Land Use:</u> Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - <u>Recreation:</u> It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - <u>Airspace:</u> No impacts are anticipated – see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - <u>Land Use:</u> These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed 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.
    - <u>Recreation:</u> Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
    - <u>Airspace:</u> No impacts are anticipated – see previous section.
  - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - <u>Land Use:</u> Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.

        - 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 Minnesota'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 navigation facilities.

- Deployable Technologies
    - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
        - Land Use: No impacts are anticipated – see previous section.
        - Recreation: No impacts are anticipated – see previous section.
        - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Minnesota airports. (See obstruction criteria in Section 9.1.7.5 Obstructions to Airspace Considerations). Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
        - Land Use: No impacts are anticipated – see previous section.
        - Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
        - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities, 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above. Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. The degree of change in the visual environment (see Section 9.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. The use of deployable aerial communications architecture could temporarily add new air traffic or aerial navigation hazards. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be less than significant due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. However, deployment activities would most likely occur within compatible land use areas limiting potential impacts. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Deployable Technologies Alternative, it is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Deployed Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections and that activities would not trigger any obstruction criterion or result in changes to flight patterns and airspace restrictions. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall these potential impacts would be less than significant due to the temporary nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 9.1.7, Land Use, Recreation, and Airspace.

9.2.8. Visual Resources

9.2.8.1. Introduction

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

9.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 9.2.8-1. As described in Section 9.2, 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 Proposed 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 9.2.8-1: Impact Significance Rating Criteria for Visual Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is potentially significant, but with mitigation is less than significant.	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is potentially significant, but with mitigation is less than significant.	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

NA = not applicable

9.2.8.3. 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 Minnesota, residents and visitors travel to many state parks and outdoor attractions, such as North Shore Drive in Duluth and Split Rock Lighthouse to view scenic coastlines. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 9.2.8-1, 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 9.2.8-1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term would be considered potentially significant. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience potentially significant impacts to night skies, although potentially minimized to less than significant with implementation of BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

9.2.8.4. 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 to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources as long since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact to visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
    - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds.
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The

degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if additional power units, structural hardening, and physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- *Deployable Technologie*s: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal or areas of surface disturbance, or additional nighttime lighting.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant due to the temporary and small-scale nature of deployment activities. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be less than significant with BMPs and mitigation measures incorporated during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.[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 infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas. If staging or landing areas (depending on the type of technology) require surface disturbance or vegetation clearing, or if these areas were within scenic landscapes or required new nighttime lighting, impacts could occur to the aesthetic character of scenic resources or viewsheds. These impacts are expected to be less than significant as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 19 BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be less than significant. These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units. Chapter 19, BMPs and Mitigation Measures, provides a listing of

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

BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to visual resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.8, Visual Resources.

9.2.9. Socioeconomics

9.2.9.1. Introduction

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

9.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 9.2.9-1. As described in Section 9.2, 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 Proposed Actions that would take place in various landscapes, the potential impacts to socioeconomics addressed in this section are presented as a range of possible impacts.

Table 9.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible economic change.	No change to 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 project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is potentially significant, but with mitigation is less than significant.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

9.2.9.3. 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 Minnesota. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $217,000 in the Minneapolis/St. Paul area, to below $94,000 in the Austin area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment 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 Minnesota. The average unemployment rate in 2014 was 4.1 percent, considerably lower than the national rate of 6.2 percent. The great majority of counties had unemployment rates below the national average (that is, better employment performance). Only a small number of counties, located outside of the 10 largest population concentrations, 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 9.2.9-1 because they would not constitute a "high level of job creation at the state or territory level."

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they can find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

9.2.9.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because they represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 9.2.9-1.

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 to 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 projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
        - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support

industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be less than significant.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be less than significant.

    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

In general, the abovementioned activities would have less than significant beneficial socioeconomic impacts. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be less than significant. See Chapter 19, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be less than significant. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values, all deployment impacts would be limited to the construction phase.

Operation Impacts

Activities with the Potential to Have Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. All operational activities would be conducted by public or private sector employees, and therefore support employment and involve payment of wages. Even if these economic effects are a very small for each operational activity, and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be less than significant
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a less than significant number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be less than significant as they would occur within a limited distance of each site, and would be limited to a relatively small number of site within the state. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.9.5. 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 significant.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. The potential impacts are anticipated to be less than significant as described above. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be less than significant.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be less than significant as they would be limited to a relatively small number of sites within the state. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated 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 9.1.9, Socioeconomics.

9.2.10. Environmental Justice

9.2.10.1. Introduction

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

9.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 9.2.10-1. As described in Section 9.2, 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 Proposed 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 9.2.10-1: Impact Significance Rating Criteria for Environmental Justice

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is potentially significant, but with mitigation is less than significant.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

9.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas That Have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment." (CEQ, 1997) Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences.

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 9.1.10.4) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 9.1.10.3, Environmental Setting:

Minority and Low-Income Populations, Minnesota's population has a lower percentage of All Minorities, and a lower poverty rate, than the region or the nation. Compared to most other states, Minnesota has a relatively low proportion of its area in the high potential category. The high potential areas are distributed across the state, but are somewhat more prevalent in the northern half of the state. Areas with moderate potential for environmental justice are more prevalent than, but show a similar pattern of distribution as, high potential areas. High and moderate potential areas occur both within and outside of the 10 largest population concentrations. Further analysis using the data developed for the screening analysis in Section 9.1.10.4, 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, 2015o; USEPA, 2016e).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts can use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

9.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any

surrounding communities. Therefore, they would not affect environmental justice communities.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have no impacts to environmental justice. If physical access is required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance impacts to environmental justice communities. 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 socioeconomics, it is anticipated that this activity would have no impact to environmental justice.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice

communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise, and dust could be temporarily generated, and traffic could be temporarily disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be less than significant, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant because they would be temporary in nature. See Chapter 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant as operations are expected to be temporary in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation 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 9.1.10, Environmental Justice.

9.2.11. Cultural Resources

9.2.11.1. Introduction

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

9.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 9.2.11-1. As described in Section 9.2, 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 Proposed 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.

9.2.11.3. 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 9.2.11-1, 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 Minnesota, some deployment activities may be in these areas, in which case BMPs (see Chapter 19) would help avoid or minimize the potential impacts.

Table 9.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	Mitigated Adverse Effect[1]	Effect, but Not Adverse	No Effect
Physical damage to and/or destruction of historic properties[2]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	Mitigated Adverse Effect[1]	Effect, but Not Adverse	No Effect
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[a] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 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.

[b] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian Tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these 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 American Indians. It is anticipated that FirstNet would identify potential impacts to such areas by conducting research on particular areas and through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact to cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.

  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as coastal areas of Minnesota 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 (archaeological deposits tend to be associated with bodies of water), 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 Minnesota City, that have larger numbers of historic public buildings.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned 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 effect, but not adversely effect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment 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 Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no effect to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.11.5. Alternatives Impact Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.[142]

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

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

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 effect, but not adversely effect, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no adverse effects to historic properties associated with implementation/running of the deployable technology. No adverse effects would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be no effects to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur, however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to cultural resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.1.11, Cultural Resources.

9.2.12. Air Quality

9.2.12.1. Introduction

This section describes potential impacts to Minnesota's air quality from deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Minnesota's air quality were evaluated using the significance criteria presented in Table 9.2.12-1. As described in Section 9.2, 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 Proposed Actions that would take place in various landscapes, the potential impacts to Minnesota's air quality addressed in this section are presented as a range of possible impacts.

9.2.12.3. 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 Minnesota that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 9.1.12, Air Quality and Figure 9.1.12-1). Only 10 of Minnesota's 87 counties are designated as maintenance areas for one or more of the following pollutants: CO, lead, PM, and SO_2 (Table 9.1.12-5); counties located in the northern portion of the state are designated nonattainment or maintenance for two NAAQS pollutants (Figure 9.1.12-1).

Table 9.2.12-1 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. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are *de minimis* or conform to the SIP covering nonattainment and maintenance areas.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = not applicable

Based on the significance criteria presented in Table 9.2.12-1, would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. Less than significant emissions could occur for any of the criteria pollutants within attainment areas in Minnesota; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Minnesota (Figure 9.1.12-1), 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.

9.2.12.4. 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 development 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 to 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, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
  - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant due to the limited nature of the deployment. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be less than significant impacts to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be less than significant as they would still be limited in nature. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient 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.

9.2.13. Noise

9.2.13.1. Introduction

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

9.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 9.2.13-1. As described in Section 9.2, 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 Proposed Actions that would take place in various landscapes, the potential noise impacts to Minnesota addressed in this section are presented as a range of possible impacts.

9.2.13.3. 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 9.2.13-1, 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 9.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the Proposed Action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

9.2.13.4. 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, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise impacts and while others would not.

In addition, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- 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: Lightning up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact to those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.
    - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
    - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise levels from the use of heavy equipment and machinery.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in short-term and temporarily increased noise levels to local residents and other noise sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
    - Installation of Optical Transmission or Centralized Transmission Equipment: Noise associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the noise emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise over baseline levels temporarily.
- Wireless Projects
    - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise levels.

- Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact the local noise environment temporarily.
- Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, mobile equipment deployed via heavy trucks could generate noise from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be less than significant due to the temporary duration of deployment activities. Additionally, pre-existing noise levels achieved during some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise levels. Several vehicles traveling together could also create short-term noise impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts would be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate less than significant, short-term impacts on any residential areas or other noise-sensitive receptors under the flight path of these vehicles.

However, once these operations cease, noise levels would quickly return to baseline levels. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures

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.

9.2.14. Climate Change

9.2.14.1. Introduction

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

9.2.14.2. 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 9.2.14-1. As described in Section 9.2, 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 Proposed Actions that would take place in various landscapes, the potential impacts to climate and climate change-vulnerable resources addressed in this section are presented as a range of possible impacts.

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 MMT in 2013 (USEPA, 2015w), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO_2 and other GHGs from other projects and human activities, could be significant.

CEQ guidance for the consideration of effects of climate change on the environmental consequences of the Proposed Action is more general. In addition to the consideration of climate change's effects on environmental consequences, it also includes the impact that climate change may have on the projects themselves (CEQ, 2014). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

Table 9.2.14-1: Impact Significance Rating Criteria for Climate

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent	Global impacts observed.		Global impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

9.2.14.3. Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high). By mid-century under a high emissions scenario, the total number of hottest days (days above 95 ºF) is projected 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 Minnesota 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 Minnesota, the frost-free season under a high emissions scenario may extend greater than 25 days longer than the baseline years in portions of the state. (USGCRP, 2014a)

Minnesota is bordered by Lake Superior. 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 4.5 °F, twice the rate of increase in air temperature. 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

Figure 9.2.14-2 and Figure 9.2.14-1 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Minnesota from a 1969 to 1971 baseline.

Dfa – Figure 9.2.14-2 shows that by mid-century (2040 to 2059), temperatures in the Dfa region of Minnesota under a low emissions scenario would increase by approximately 4 °F in the southwest corner of the state, and by 5 °F in the remainder of the region. By the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Minnesota would increase by approximately 6° F. (USGCRP, 2009)

Figure 9.2.14-1 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 Minnesota, temperatures would increase by approximately 10° F. (USGCRP, 2009)

Dfb – Under a low emissions scenario by mid-century temperatures would increase by 5 °F. By the end of the century temperatures under a low emissions scenario in the Dfb region are expected to increase at the same rate as the Dfa region. (USGCRP, 2009)

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 a high emissions scenario. (USGCRP, 2009)

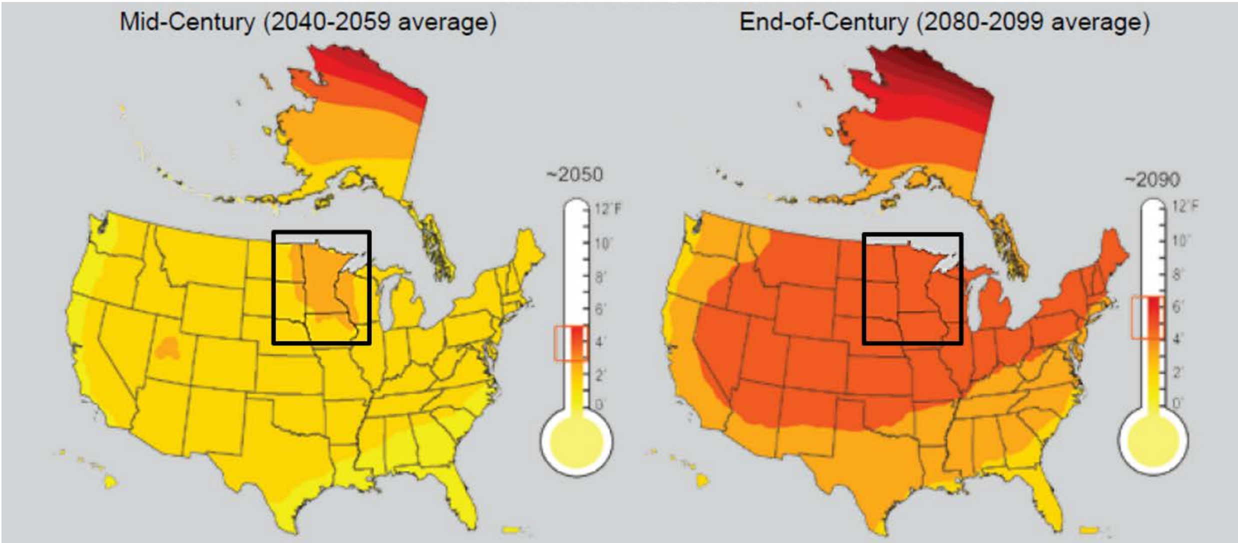

Figure 9.2.14-2 Minnesota Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

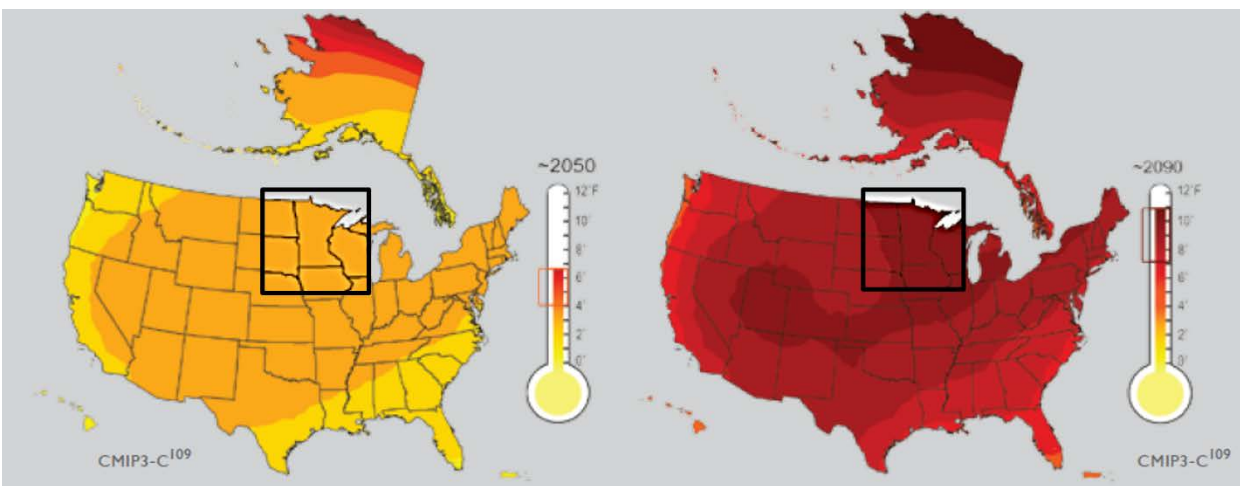

Figure 9.2.14-1: Minnesota High Emission Scenario Projected Temperature Change

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 can 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)

Figure 9.2.14-3 and Figure 9.2.14-4 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 9.2.14-3 shows seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions means more than 70 percent cuts from current levels by 2050. (USGCRP, 2014b)

Figure 9.2.14-4 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 9.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in winter, spring, and fall for the entire state of Minnesota. However, there are no expected changes in precipitation in summer other than fluctuations due to natural variability. (USGCRP, 2014b)

Figure 9.2.14-4 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 is expected to decrease 10 percent. Fall precipitation is anticipated to increase 10 percent over the same period. (USGCRP, 2014b)

Dfb – Precipitation changes for the Dfb region are consistent with projected changes for the Dfa region of Minnesota in both low and high GHG emissions scenarios. (USGCRP, 2014b)

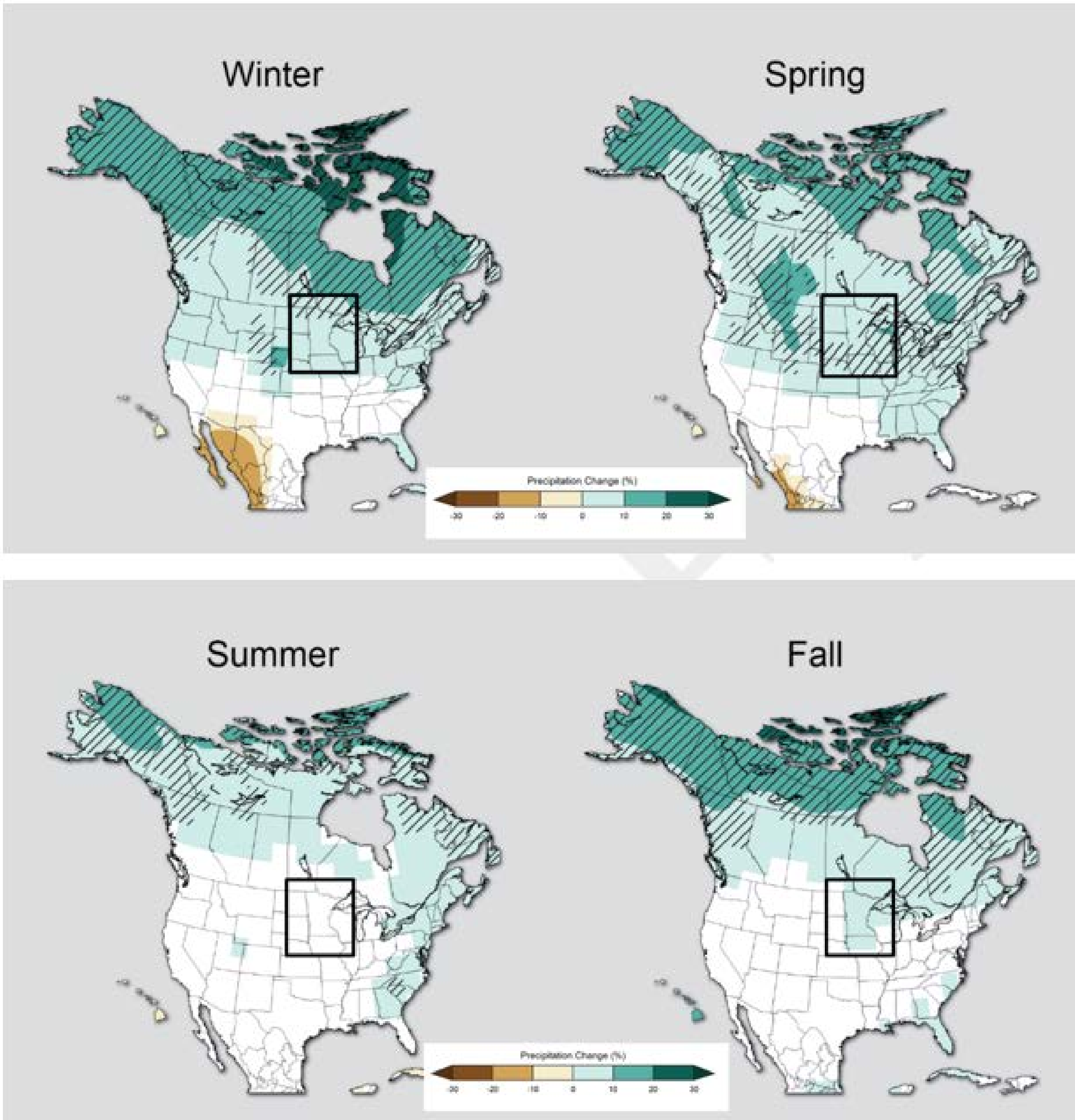

Figure 9.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

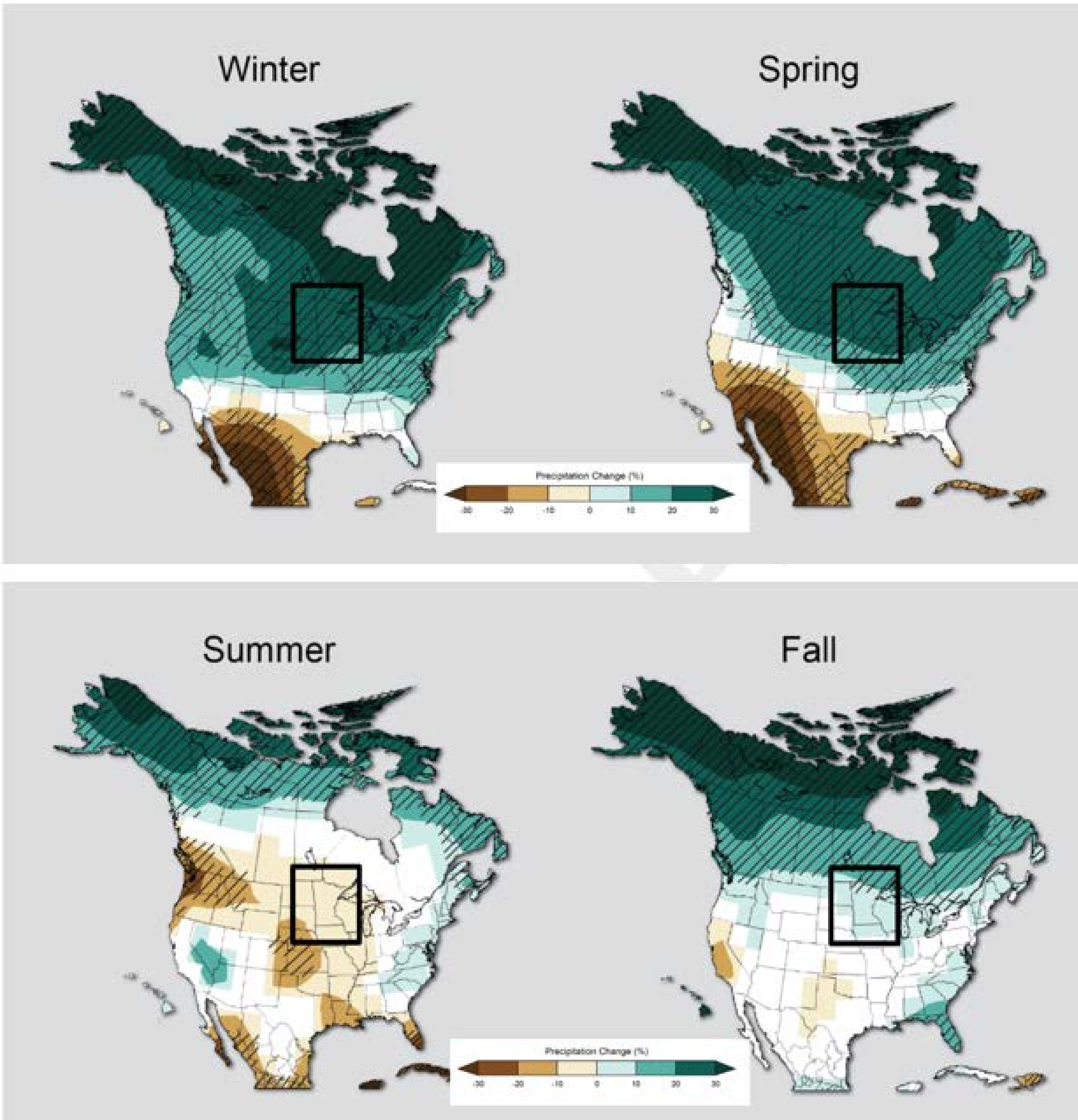

Figure 9.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

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)

9.2.14.4. 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 9.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or on-site electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015c). 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, 2015v), 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 Project-Related Resource Effects

Climate change may impact project-related effects by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. In Minnesota, changes in average temperature and precipitation amounts related to climate variability and climate change may potentially shift agricultural production to cooler areas, as well as alter natural ecosystems as a result of increased stresses to heat, flooding, and drought (White House, 2014). 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, 2015x).

Impact of Climate Change on FirstNet Installations and Infrastructure

Climate change impacts on FirstNet installations and infrastructure will vary from state to state, depending on the placement and vulnerability of the installations and infrastructure, and the impacts that climate change is anticipated to have in that particular location. Climate-change induced flooding may increase the potential for damage. "Large-scale flooding can also occur due to extreme precipitation in the absence of snowmelt (for example, Rush Creek and the Root River, Minnesota, in August 2007 and multiple rivers in southern Minnesota in September 2010)" (White House, 2014). Energy sources such as powerlines and stand-by generators would be similarly elevated or otherwise protected. Towers would also be rated for stronger hurricane-force winds and hardened to protect them from strikes by wind-borne debris. Based on the impact significance criteria presented in Table 9.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

9.2.14.5. 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 Minnesota, including deployment and operation activities.

As described in Section 2.1, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed

Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the network, therefore there will be no impacts to GHG emissions or impacts on these systems from climate change.

Potential to Have Impacts

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration, and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wireless Projects
  - New Build – Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing) trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
  - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
  - Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with

these projects would arise from use of machinery and vehicles to complete these activities.
  - New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
  - Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and backup), and would depend on their size, number, and the frequency and duration of their use.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction as 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 backup), 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 manned or unmanned aircraft were used for a sustained period of time (i.e., months to years). Emissions would depend on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Emissions occurring as a result of soil disturbance and loss of vegetation are expected to be less than significant due to the limited and localized nature of deployment activities. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant with BMPs and mitigation measures incorporated because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. 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 anticipating adverse effects of climate change and taking appropriate steps 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. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.14.6. Alternatives Impact Assessment

The following section assesses potential impacts to climate associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Potential Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operations Impacts

Implementing land-based deployable technologies (COW, COLT, and SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. These activities are expected to be less than significant due to the limited duration of deployment activities.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

Climate change effects have the most noticeable impacts over a long period of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of the deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to 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 9.1.14, Climate Change.

9.2.15. Human Health and Safety

9.2.15.1. Introduction

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

9.2.15.2. 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 9.2.15-1. As described in Section 9.2, 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 Proposed 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 9.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Manmade Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = not applicable

9.2.15.3. 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 9.2.15-1, occupational injury impacts could be potentially significant if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of proposed FirstNet work sites. For example, if fuel is spilled from an onsite fuel tank, the spilled fuel could migrate down gradient and infiltrate underground drinking water sources. The general public may then be exposed to hazardous chemicals in their drinking water if they utilize the same groundwater aquifer.

To protect occupational workers, OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers (OSHA, 2015c).

- Engineering controls;
- Work practice controls;
- Administrative controls; and
- 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,[143] 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

[143] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016b)

hazard from the work site, an example of which would be the transport and offsite disposal of hazardous waste or asbestos containing materials.

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of employer specific workplace rules and operational practices (OSHA, 2015c). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet project sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2015c). Administrative controls may take the form of limiting the number of hours an employee is allowed to work per day, requiring daily safety meetings before starting work, utilizing the buddy system for dangerous tasks, and any other similar 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. (OSHA, 2015c)

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions as a result of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 9.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior’s Abandoned Mine Lands inventory, through the MNDEP, or through an equivalent commercial resource.

By screening sites for environmental contamination and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, and applicable Minnesota 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 MPCA 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 9.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a less than significant beneficial impact, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. Therefore, FirstNet partner(s) would develop disaster response plans that outline specific steps employees should take in the event of a natural or manmade disaster.

9.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment

would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary and intermittent. It is anticipated that there would be no impacts to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have no impact to those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
  - New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines would require excavation activities, working from heights, use of hazardous materials, and site locations in ROW. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to

contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

  - Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
  - New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in limited nearshore and inland bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shore to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and

falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in

sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROW, work over water, and environmental contamination), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure and release of hazardous chemicals and hazardous waste It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be less than significant impacts to human health and safety associated with routine inspections of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.15.5. Alternatives Impact Assessment

The following section assesses potential impacts to human health and safety associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source is an electrical generator, then there would also likely be a need to manage hazardous materials (fuel) onsite. These activities could result in less than significant impacts to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety associated with routine inspections of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, PPE or other mitigation measures may be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be less than significant because of the small scale of likely FirstNet activities; activities associated would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 19, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to human health and safety as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 9.2.15.

MN APPENDIX A – BIOLOGICAL RESOURCES

Table A1: MDNR S1 Ranked Terrestrial Communities of Concern in Minnesota

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Red Pine – White Pine Woodland (Minnesota Point)	Northern Lakes and Forests	A woodland community found on stabilized dunes on Minnesota Point. The tree canopy is dominated by red pine (*Pinus resinosa*), white pine (*Pinus strobus*), and paper birch (*Betula papyrifera*). The shrub layer may contain prickly rose (*Rosa acicularis*), smooth rose (*Rosa blanda*), western poison ivy (*Toxicodendron rydbergii*), pin cherry (*Prunus pensylvanica*), bush honeysuckle (*Diervilla lonicera*), and red raspberry (*rubus idaeus*) (MDNR 2015n).	Found at Minnesota Point, in the northeast part of the state.
Spruce-fir Woodland (North Shore)	Northern Lakes and Forests	A coniferous woodland found along Lake Superior and nearby islands on bedrock and thin soil substrates. The tree canopy contains balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), and black spruce (*Picea mariana*), while the understory contains a variety of lichens and mosses (MDNR 2015n).	Found along the coast of Lake Superior and on nearby islands.
Jack Pine – (Bush-honeysuckle) Woodland (Bracken Subtype)	North Central Hardwood Forests	A woodland community with a tree canopy typically dominated by jack pine (*Pinus banksiana*), but occasionally by red pine with paper birch and quaking aspen (*Populus tremuloides*) intermixed. The understory contains red maple (*Acer rubrum*), lowbush blueberry (*Vaccinium angustifolium*), beaked hazelnut (*Corylus cornuta*), twinflower (*Linnaea borealis*), bush honeysuckle, wintergreen (*Gaultheria procumbens*) and pipsissewa (*Chimaphila umbellata*) (MDNR 2015o).	Found in the north-central part of Minnesota.
Jack Pine – Oak Woodland (Sand)	Driftless Area	A woodland community with a mixture of pine and hardwoods in dry to mesic conditions. Jack pine dominate the tree canopy and are present in the understory, which characterizes this association. The shrub and herbaceous layer contains pipsissewa, lowbush blueberry, pussytoes (*Antennaria* sp.), bluets (*Hedyotis longifolia*), round-headed bush-clover (*Lespedeza capitata*), hairy puccoon (*Lithospermum caroliniense*), and starry false Solomon's seal (*Smilacina stellata*) (MDNR 2015p).	Rare within in the state and only found at three locations in the southeast part of Minnesota.
White Pine – Oak Woodland (Sand)	Driftless Area, Western Corn Belt Plains	A woodland community found in dry to mesic conditions. White pine and northern red oak present (*Quercus rubra*) in the understory and tree canopy characterize this community. The herbaceous layer contains wild sarsaparilla (*Aralia nudicaulis*), zigzag goldenrod (*Solidago flexicaulis*), common enchanter's nightshade (*Circaea lutetiana*), harebell (*Campanula rotundifolia*), bastard toadflax (*Comandra umbellata*), and carrion flowers (*Smilax* spp.) (MDNR 2015p).	Found in the southeast part of Minnesota.

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
White Pine – Sugar Maple – Basswood Forest (Cold Slope)	Driftless Area	A hardwood forest community typically found on steep, north-facing slopes with cool microclimates. The tree canopy is patch and comprised of white pine, yellow birch (*Betula alleghaniensis*), balsam fir, sugar maple (*Acer saccharum*), paper birch, and basswood (*Tilia americana*). The shrub layer ranges from patchy to continuous and may contain red-berried elder (*Sambucus canadensis*), highbush cranberry (*Viburnum trilobum*), dwarf alder (*Rhamnus alnifolia*), chokecherry (*Prunus virginiana*), and downy arrowwood (*Viburnum rafinesqueanum*) (MDNR 2015q).	Found in the southeastern part of Minnesota.
Swamp White Oak Terrace Forest	Driftless Area	A floodplain forest found on terraces of the Mississippi River. Swamp white oak is a defining species, found both in the tree canopy, and understory strata. Common associate tree species include green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*), silver maple (*Acer saccharinum*), bitternut hickory (*Carya cordiformis*), American elm (*Ulmus americanus*), and basswood. Shrub species may include wild black currant (*Ribes americanum*), gray dogwood (*Cornus racemosa*), and prickly ash (*Zanthoxylum americanum*). Herbaceous species include moneywort (*Lysimachia nummularia*), green dragon (*Arisaema dracontium*), sensitive fern (*Onoclea sensibilis*), rough bedstraw (*Galium asprellum*) and Gray's sedge (*Carex grayi*) among many others (MDNR 2015r).	Found in the southeastern part of Minnesota.
Black Ash – Sugar Maple – Basswood – (Blue beech) Seepage Swamp	Driftless Area	A floodplain forest found on alluvial soils between bluffs or at the base of steep bluffs. Dominant tree canopy species include black ash (*Fraxinus nigra*), sugar maple, basswood, and occasionally yellow birch and American elm. The herbaceous layer contains crooked aster (*Aster prenanthoides*), false mermaid (*Floerkea proserpinacoides*), and smooth-sheathed sedge (*Carex laevivaginata*) (MDNR 2015s).	Found in the southeastern part of Minnesota.
Beachgrass Dune	Northern Lakes and Forests	A dune community that occurs on the beaches of the Great Lakes on stabilized foredunes. Vegetation ranges due to sand deposition, erosion, and distance from the lake and could be sparse to dominance by many grasses, shrubs, and trees. Areas with erosion are dominated by prairie sandreed (*Calamovilfa longifolia*). Stabilized dunes typically are dominated by little bluestem (*Schizachyrium scoparium*). Sand deposit areas typically are dominated by American beachgrass (*Ammophila breviligulata*). Dune ridges typically contain low evergreen shrubs such as kinnikinnick (*Arctostaphylos uva-ursi*), common juniper (*Juniperus communis*), and creeping juniper (*Juniperus horizontalis*) (Comer 1997).	Present along Lake Superior
Dune Juniper Shrubland	Northern Lakes and Forests	A dune community found on stabilized dunes with flat-tops and are formed by winds. The community is primarily composed of dwarf shrubs, including kinnikinnick, common juniper, and creeping juniper. Little bluestem and American beachgrass may be found in the herbaceous layer (Faber-Langendoen 1997).	Present along Lake Superior

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Dry Barrens Prairie (Northern)	Lake Agassiz Plain	A grassland community found on medium-grain sand, with some exposed sand and dunes. Common herbaceous species present include sand dropseed (*Sporobolus cryptandrus*), Schweinitz's nut sedge (*Cyperus schweinitzii*), western spiderwort (*Tradescantia occidentalis*), and nodding wild rye (*Elymus canadensis*) (MDNR 2015t).	A rare community found in two locations in the northwest part of Minnesota.
Dry Sand – Gravel Brush – Prairie (Northern)	Lake Agassiz Plain	A grassland community found on coarse, gravelly soil on Glacial Lake Agassiz deposits on gently sloping landscapes. Bare spots may be present, covered in lichen. Vegetation includes many forbs and graminoids, such as prairie dropseed, silky aster (*Symphyotrichum sericeum*), and Flodman's thistle (*Cirsium flodmanii*). Some woody species are present and include leadplant (*Amorpha canescens*) and prairie rose (*Rosa arkansana*) (MDNR 2015t).	Found in the northwest part of Minnesota.
Dry Hill Prairie (Northern)	Lake Agassiz Plain	A grassland community found on coarse, gravelly soil on Glacial Lake Agassiz deposits on gently sloping landscapes. Taller shrubs distinguish this community and include prairie willow and bur oak. Herbaceous species may include prairie dropseed, silky aster, and Flodman's thistle (MDNR 2015t).	Found in the northwest part of Minnesota.
Dry Barrens Jack Pine Savanna (Northern)	Lake Agassiz Plain	A grassland community found on medium-grain sands on outwash areas and occasionally on wind-formed dunes. Jack pine is the dominant tree species but bur oak, red pine, and quaking aspen are also sometimes present. The shrub layer may contain meadowsweet (*Spiraea alba*), prairie willow (*Salix humilis*), and lowbush blueberry. Herbaceous plants include bracken (*Pteridium aquilinum*), cow wheat (*Melampyrum lineare*), and mountain rice grass (*Piptatheropsis pungens)* (MDNR 2015u).	Found in the northwest part of Minnesota.
Dry Sand – Gravel Oak Savanna (Northern)	Lake Agassiz Plain	A grassland community with gravelly-soils usually occurring on "glacial lake beach ridges, outwash, and ice-contact deposits (MDNR 2015u)." Bur oak is the dominant tree species present. A patchy shrub layer may contain wolfberry (*Symphoricarpos occidentalis*), American hazelnut (*Corylus americana*), chokecherry (*Prunus virginiana*), and Saskatoon juneberry (*Amelanchier alnifolia*). The herbaceous stratum often contains prairie dropseed, Kalm's brome (*Bromus kalmia*), and Pennsylvania sedge (*Carex pensylvanica var. pensylvanica*) (MDNR 2015u).	Found in the northwest part of Minnesota.
Dry Hill Oak Savanna (Northern)	Lake Agassiz Plain	A grassland community often found on steep slopes with medium to fine soils. Bur oak is the dominant tree species, but quaking aspen may also be present. A more prominent shrub layer characterizes this community and contains American hazelnut, chokecherry, and wolfberry (MDNR 2015u).	Found in the northwest part of Minnesota.

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Mesic Oak Savanna (Northern)	Lake Agassiz Plain	A woodland and shrubland mixed community found on medium to medium-fine soils on gently sloping to flat landscapes. The tree stratum is dominated by bur oak, but quaking aspen is also present. The shrub layer is dominated by leadplant, American hazelnut, and juneberries (*Amelanchier* spp.). The herbaceous layer may contain little bluestem, junegrass (*Koeleria macrantha*), and porcupine grass (*Hesperostipa spartea*) (MDNR 2015v).	Found in the northwest part of Minnesota.
Dry Barrens Oak Savanna (Southern) Jack Pine Subtype	North Central Hardwood Forests, Western Corn Belt Plains, Driftless Area	An herbaceous community found on wind-blown sand dunes. Bur oak, jack pine, and black oak are the dominant tree species. Characteristic herbaceous vegetation include sand dropseed (*Sporobolus cryptandrus*), umbel sedge (*Carex umbellata*), base-branched three-awn (*Aristida basiramea*), slender knotweed (*Polygonum tenue*), wild lupine (*Lupinus perennis*), and silky prairie clover (*Dalea villosa*) (MDNR 2015w).	Found in the southeast part of Minnesota.
Dry Hill Oak Savanna (Southern)	North Central Hardwood Forests, Western Corn Belt Plains, Driftless Area	An herbaceous community with medium to fine textured soils on “moderate to steep, erosion-cut slopes in unsorted, loamy glacial till or loess-mantled-till.” Bur oak is the dominant tree species with some quaking aspen. The shrub layer is more evident than other similar communities and dominant species include smooth sumac (*Rhus glabra*) and chokecherry (MDNR 2015w).	Found in the southeast part of Minnesota.
Mesic Oak Savanna (Southern)	Driftless Area	An herbaceous community found on well-drained soil on gently rolling slopes. The tree stratum is scattered and contains bur oak most often but also may contain northern pin oak. The shrub layer may contain leadplant, chokecherry, wolfberry, low juneberry (*Amelanchier humilis*), and wild plum (*Prunus americana*). The herbaceous layer is comprised of graminoids and forbs, including big bluestem, little bluestem, side-oats grama (*Bouteloua curtipendula*), smooth blue aster (*Aster laevis*), gray-headed coneflower (*Ratibida pinnata*), and prairie phlox (*Phlox pilosa*) (MDNR 2015x).	Found in the southeast part of Minnesota.
Calcareous Fen (Southeastern)	North Central Hardwood Forests, Western Corn Belt Plains, Driftless Area	A fen community usually found on erosional slopes and occasionally on valley terraces. Sterile sedge (*Carex sterilis*) is a characteristic species, but other calcareous fen indicators are absent. Other characteristic species include spring cress (*Cardamine bulbosa*), cowbane (*Oxypolis rigidior*), and edible valerian (*Valeriana edulis*). Red osier dogwood (*Cornus sericea*) is a common shrub/tree species (MDNR 2015y).	Found throughout the southern half of Minnesota.
Estuary Marsh (Lake Superior)	Northern Lakes and Forests	A wetland community found near river mouths around waterbodies with fluctuating water levels. Vegetation is primarily composed of floating plants, including yellow pond lily (*Nuphar variegata*), eelgrass (*Vallisneria americana*), and Canadian elodea (*Elodea canadensis*). Emergent vegetation may include soft-stem bulrush (*Schoenoplectus validus*), broad-leaved arrowhead (*Sagittaria latifolia*), and giant bur-reed (*Sparganium eurycarpum*) (MDNR 2015z).	Found along the northeast coast of Lake Superior.

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Cattail – Sedge Marsh (Prairie)	Lake Agassiz Plain, Northern Glaciated Plains, North Central Hardwood Forests, Western Corn Belt Plains	A marsh community found near shallow open water with mineral soil. Broad-leaved cattail (*Typha latifolia*) forms dense stands that dominate this community but woolly sedge (*Carex pellita*) and bulrush species (*Schoenoplectus* spp.) may also be present (MDNR 2015aa).	Found in the southern half of Minnesota.
Cattail Marsh (Prairie)	Northern Glaciated Plains, North Central Hardwood Forests, Western Corn Belt Plains	A marsh community dominated almost entirely by cattails (*Typha* spp.). This marsh community is often dominated by non-native cattail species, including narrow-leaved cattail (*Typha angustifolia*), but may also have broad-leaved cattail present (MDNR 2015aa).	Found in the southern half of Minnesota.
Bulrush Marsh (Prairie)	Western Corn Belt Plains	"Emergent marshes typically dominated by bulrushes (*Schoenoplectus* spp.). Spikerushes (*Eleocharis* spp.) and tall forbs such as bur reeds and arrowheads may be present but have sparse cover (MDNR 2015ab)."	Found in the southwestern part of Minnesota.
Spikerush – Bur Reed Marsh (Prairie)	Western Corn Belt Plains	"Emergent marshes dominated by a mixture of forbs and graminoids. Bulrushes (*Schoenoplectus* spp.) may be present and even abundant, but spikerushes (*Eleocharis* spp.) and forbs, particularly bur reeds, make up at least 25 percent cover (MDNR 2015ab)."	Found in the southwestern part of Minnesota.
Arrowhead Marsh (Prairie)	Western Corn Belt Plains	An emergent marsh dominated by arrowheads (*Sagittaria* spp.) (MDNR 2015ab). Further information about this community is not available.	Found in the southwestern part of Minnesota.
Wet Seepage Prairie (Southern)	Western Corn Belt Plains	A wet prairie community found on organic soils with slight slopes so that water may seep and remain present. Common herbaceous plants present include tussock sedge (*Carex stricta*), bluejoint (*Calamagrostis canadensis*), interior sedge (*Carex interior*), muhly grass (*Muhlenbergia glomerata*), swamp thistle (*Cirsium muticum*), and fringed brome (*Bromus ciliatus*) (MDNR 2015ac).	Found in the southern half of Minnesota.
Wet Saline Prairie (Southern)	Northern Glaciated Plains, Western Corn Belt Plains	A wet prairie community typically found in areas with high salt concentrations. Vegetation diversity is lower than other related wet prairies and often includes little bluestem as a dominant species, and mat muhly grass and switchgrass also present. Other herbaceous species present include foxtail barley (*Hordeum jubatum*), scratchgrass (*Muhlenbergia asperifolia*), and salt grass (*Distichlis spicata*) (MDNR 2015ac).	Found in the southern half of Minnesota.

Source: (MDNR 2009).

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AML	Abandoned Mine Lands
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CCD	Common Core of Data
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH_4	Methane
CIMC	Cleanups in My Community
CIO	Chief Information Officer
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Trucks
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
CWS	Community Water Systems
DOE	Department of Energy
EDACS	Enhanced Digital Access System
EIA	Energy Information Agency
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Emergency Planning and Community Right to Know Act
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highways Administration
FLM	Federal Land Manager

Acronym	Definition
FLPMA	Federal Land Policy and Management Act of 1976
FR	Federal Register
FRA	Federal Railway Administration
FTA	Federal Transit Authority
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAO	Government Accountability Office
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IBA	International Birding Area
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Regions
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MDI	Methylene Diphenyl Diisocyanate
MHI	Median Household Income
MLRA	Major Land Resource Areas
MOA	Memorandum of Agreement
MMT	Million Metric Tons
MN	Minnesota
MSFCMA	Magnuson-Stevens Fisheries Conservation Management Act
MSL	Mean Sea Level
MT	Million Tons
MYA	Million Years Ago
N_2O	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
NASAO	National Association of State Aviation Officials
NEPA	National Environmental Policy Act
NESCA	Nongame and Endangered Species Conservation Act
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NNL	National Natural Landmarks
NOAA	National Oceanic and Atmospheric Administration

Acronym	Definition
NOTAM	Notices To Airmen
NO_X	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
NRHP	National Register of Historic Places
NSA	National Security Areas
NTIA	National Telecommunications and Information Administration
NTFI	National Task Force On Interoperability
NTNC	Non-Transient Non-Community
NWI	National Wetlands Inventory
NWR	National Wildlife Refuges
NWS	National Weather Service
OCIO	Office of the CIO
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
ORION	Omaha Regional Interop Network
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PAB	Palustrine Aquatic Bed
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetland
PFO	Palustrine Forested Wetland
PGA	Peak Ground Acceleration
PM	Particulate Matter
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetland
PUB	Palustrine Unconsolidated Bottom
R&D	Research and Development
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
ROW	Right-of-Way
SAA	Sense and Avoid
SASP	State Aviation System Plan
SCEC	State Climate Extremes Committee
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SF_6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	Sulfur Dioxide

Acronym	Definition
SO_3	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SO_X	Oxides of Sulfur
SPL	Sound Pressure Level
SRS	Statewide Radio System
STARCOMM	Siouxland Tristate Area Radio Communications
SUA	Special Use Airspace
SWPPP	Storm Water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TNC	Transient Non-Community Systems
TPY	Tons Per Year
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
UA	Unmanned Aircraft
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
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WMA	Wildlife Management Areas
WMD	Wetland Management District
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II

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