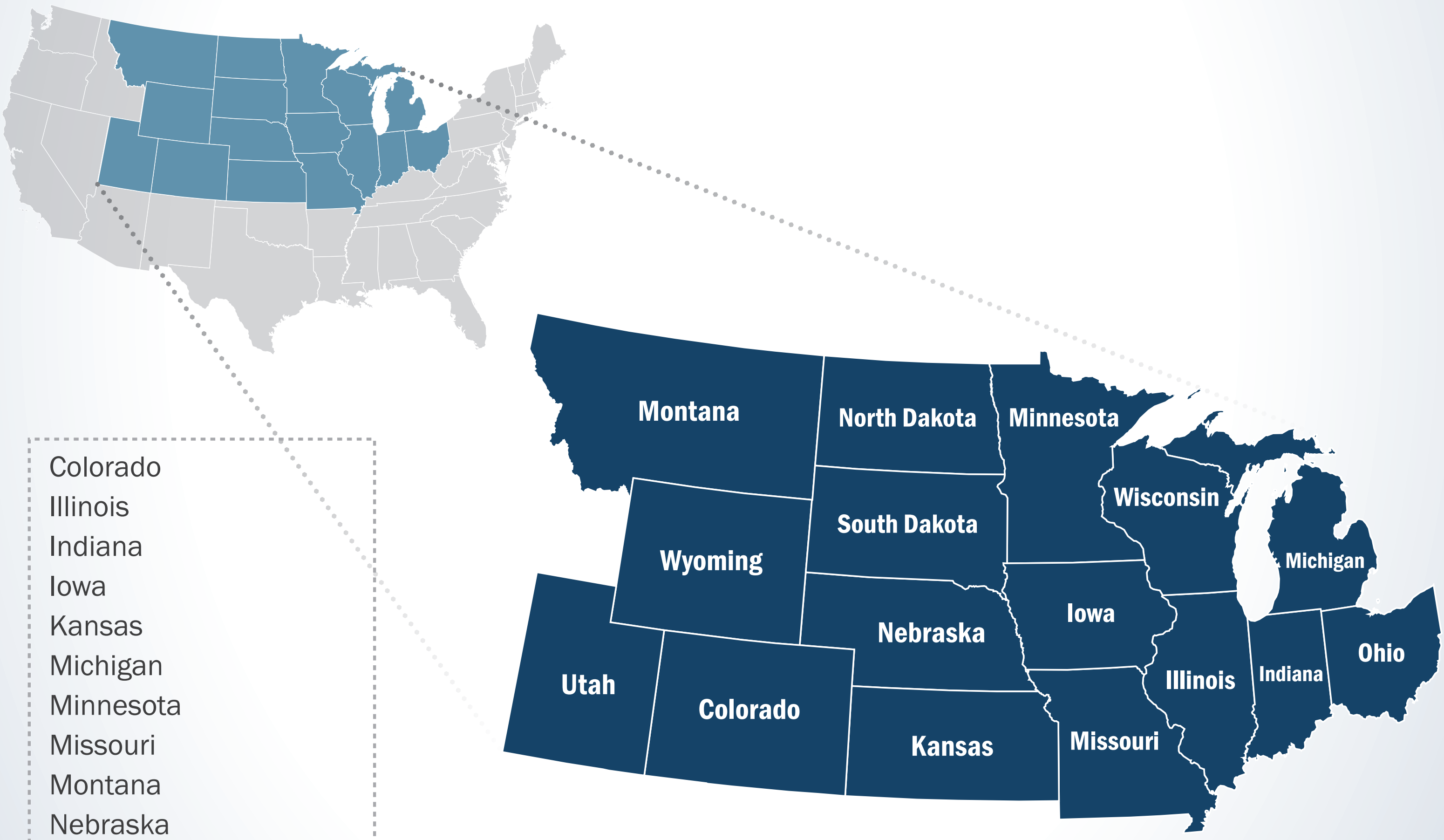
FirstNet®

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

VOLUME 15 - CHAPTER 17



Colorado
Illinois
Indiana
Iowa
Kansas
Michigan
Minnesota
Missouri
Montana
Nebraska
North Dakota
Ohio
South Dakota
Utah
Wisconsin
Wyoming

AUGUST 2016

Page Intentionally Left Blank.

First Responder Network Authority

FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 15 - CHAPTER 17

Amanda Goebel Pereira, AICP
NEPA Coordinator
First Responder Network Authority
U.S. Department of Commerce
12201 Sunrise Valley Dr. M/S 243
Reston, VA 20192

Cooperating Agencies
Federal Communications Commission
General Services Administration
U.S. Department of Agriculture—Rural Utilities Service
U.S. Department of Agriculture—U.S. Forest Service
U.S. Department of Agriculture—Natural Resource Conservation Service
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

August 2016

Page Intentionally Left Blank.

Contents

17. Wisconsin 17-6
17.1. Affected Environment 17-7
17.1.1. Infrastructure 17-7
17.1.2. Soils 17-35
17.1.3. Geology 17-46
17.1.4. Water Resources 17-61
17.1.5. Wetlands 17-72
17.1.6. Biological Resources 17-80
17.1.7. Land Use, Recreation, and Airspace 17-113
17.1.8. Visual Resources 17-138
17.1.9. Socioeconomics 17-151
17.1.10. Environmental Justice 17-167
17.1.11. Cultural Resources 17-173
17.1.12. Air Quality 17-190
17.1.13. Noise 17-201
17.1.14. Climate Change 17-205
17.1.15. Human Health and Safety 17-210
17.2. Environmental Consequences 17-222
17.2.1. Infrastructure 17-222
17.2.2. Soils 17-234
17.2.3. Geology 17-241
17.2.4. Water Resources 17-252
17.2.5. Wetlands 17-266
17.2.6. Biological Resources 17-277
17.2.7. Land Use, Recreation, and Airspace 17-324
17.2.8. Visual Resources 17-339
17.2.9. Socioeconomics 17-347
17.2.10. Environmental Justice 17-360
17.2.11. Cultural Resources 17-367
17.2.12. Air Quality 17-376
17.2.13. Noise 17-382
17.2.14. Climate Change 17-390
17.2.15. Human Health and Safety 17-403
WI Appendix A – Communities of Concern 17-417
Acronyms 17-420
References 17-425
Geographic Information System (GIS) References 17-461

List of Tables

Table 17.1.1-1: Relevant Wisconsin Infrastructure Laws and Regulations.................. 17-8
Table 17.1.1-2: Wisconsin Interstates... 17-9
Table 17.1.1-3: Amtrak Train Routes Serving Wisconsin... 17-11
Table 17.1.1-4: Key Wisconsin Indicators 17-13
Table 17.1.1-5: Public Safety Infrastructure in Wisconsin by Type........................... 17-14
Table 17.1.1-6: First Responder Personnel in Wisconsin by Type............................. 17-14
Table 17.1.1-7: Wisconsin Project 25 Networks 17-18
Table 17.1.1-8: Telecommunications Access Providers and Coverage...................... 17-19
Table 17.1.1-9: Wireless Telecommunications Coverage by Providers in Wisconsin.. 17-20
Table 17.1.1-10: Number of Commercial Towers in Wisconsin by Type.................. 17-27
Table 17.1.1-11: Fiber Provider Coverage 17-30
Table 17.1.2-1: Relevant Wisconsin Soils Laws and Regulations 17-36
Table 17.1.2-2: Characteristics of Major Land Resource Areas in Wisconsin............ 17-38
Table 17.1.2-3: Major Characteristics of Soil Suborders[a] Found in Wisconsin, as depicted in Figure 17.1.2-2 17-41
Table 17.1.3-1: Relevant Wisconsin Geology Laws and Regulations......................... 17-47
Table 17.1.4-1: Relevant Wisconsin Water Laws and Regulations............................ 17-61
Table 17.1.4-2: Section 303(d) Impaired Waters of Wisconsin, 2014 17-67
Table 17.1.4-3: Description of Wisconsin's Principal Aquifers................................. 17-70
Table 17.1.5-1: Relevant Wisconsin Wetlands Laws and Regulations 17-72
Table 17.1.5-2: Wisconsin Wetland Types, Descriptions, Location, and Amount, 2014.. 17-74
Table 17.1.6-1: Relevant Wisconsin Biological Resources Laws and Regulations 17-81
Table 17.1.6-2: USEPA Level III Ecoregions of Wisconsin..................................... 17-85
Table 17.1.6-3: Prohibited and Restricted Invasive Plant Species in Wisconsin 17-90
Table 17.1.6-4: Federally Listed Mammal Species of Wisconsin............................ 17-103
Table 17.1.6-5: Federally Listed Bird Species of Wisconsin 17-105
Table 17.1.6-6: Federally Listed Invertebrate Species of Wisconsin 17-107
Table 17.1.6-7: Federally Listed Plant Species of Wisconsin 17-111
Table 17.1.7-1: Major Land Use in Wisconsin by Coverage Type 17-116
Table 17.1.7-2: Top Five Developed Metropolitan Areas (2014 estimate)............... 17-117
Table 17.1.7-3: Federal Land in Wisconsin... 17-119
Table 17.1.7-4: State Land in Wisconsin... 17-120
Table 17.1.7-5: Indian Reservations and Other Land Holdings of Wisconsin 17-122
Table 17.1.7-6: SUA Designations 17-127
Table 17.1.7-7: Other Airspace Designations.. 17-128
Table 17.1.7-8: Type and Number of Wisconsin Airports/Facilities........................ 17-134
Table 17.1.8-1: Relevant Wisconsin Visual Resources Laws and Regulations 17-138
Table 17.1.8-2: Wisconsin National Historic Landmarks 17-142
Table 17.1.8-3: Examples of Wisconsin State Parks and Associated Visual Attributes.. 17-143
Table 17.1.8-4: Wisconsin State Forests.. 17-144
Table 17.1.8-5: Wisconsin National Parks and Affiliated Areas.............................. 17-144
Table 17.1.8-6: Wisconsin National Wildlife Refuges... 17-149

Table 17.1.8-7: Wisconsin National Natural Landmarks 17-150
Table 17.1.9-1: Land Area, Estimated Population, and Population Density of Wisconsin........ 17-153
Table 17.1.9-2: Recent Population Growth of Wisconsin 17-153
Table 17.1.9-3: Projected Estimated Population Growth of Wisconsin 17-154
Table 17.1.9-4: Population of the 10 Largest Population Concentrations in Wisconsin........ 17-155
Table 17.1.9-5: Selected Economic Indicators for Wisconsin........ 17-158
Table 17.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Wisconsin, 2009–2013 17-159
Table 17.1.9-7: Employment by Class of Worker and by Industry, 2013 17-162
Table 17.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Wisconsin, 2009–2013 17-162
Table 17.1.9-9: Selected Housing Indicators for Wisconsin, 2013 17-163
Table 17.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Wisconsin, 2009–2013 17-164
Table 17.1.9-11: Residential Property Values in Wisconsin, 2013 17-165
Table 17.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Wisconsin, 2009–2013 17-165
Table 17.1.9-13: State and Local Government Revenues, Selected Sources, 2012 .. 17-166
Table 17.1.10-1: Estimated Population by Race and Hispanic Status, 2013........ 17-169
Table 17.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013........ 17-170
Table 17.1.11-1: Relevant Wisconsin Cultural Resources Laws and Regulations.... 17-173
Table 17.1.11-2: Archaeological Sites on the National Register of Historic Places in Wisconsin........ 17-179
Table 17.1.12-1: Wisconsin Ambient Air Quality Standards (WIAAQS) 17-191
Table 17.1.12-2: Major Air Pollutant Source Thresholds........ 17-192
Table 17.1.12-3: *De Minimis* Levels........ 17-195
Table 17.1.12-4: Wisconsin Nonattainment and Maintenance Areas by Pollutant Standard and County........ 17-198
Table 17.1.12-5: Relevant Federal Class I Areas 17-199
Table 17.1.13-1: Relevant Wisconsin Noise Laws and Regulations........ 17-203
Table 17.1.14-1: Wisconsin CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2013 17-207
Table 17.1.15-1: Relevant Wisconsin Human Health and Safety Laws and Regulations 17-211
Table 17.2.1-1: Impact Significance Rating Criteria for Infrastructure........ 17-224
Table 17.2.2-1: Impact Significance Rating Criteria for Soils 17-235
Table 17.2.3-1: Impact Significance Rating Criteria for Geology........ 17-243
Table 17.2.4-1: Impact Significance Rating Criteria for Water Resources 17-254
Table 17.2.5-1: Impact Significance Rating Criteria for Wetlands 17-267
Table 17.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats........ 17-278
Table 17.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species 17-311

Table 17.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace 17-326
Table 17.2.8-1: Impact Significance Rating Criteria for Visual Resources 17-341
Table 17.2.9-1: Impact Significance Rating Criteria for Socioeconomics 17-348
Table 17.2.10-1: Impact Significance Rating Criteria for Environmental Justice 17-361
Table 17.2.11-1: Impact Significance Rating Criteria for Cultural Resources 17-369
Table 17.2.12-1: Impact Significance Rating Criteria for Air Quality 17-377
Table 17.2.13-1: Impact Significance Rating Criteria for Noise 17-384
Table 17.2.14-1: Impact Significance Rating Criteria for Climate 17-391
Table 17.2.15-1: Impact Significance Rating Criteria for Human Health and Safety 17-404

List of Figures

Figure 17.1.1-1: Wisconsin Transportation Networks 17-10
Figure 17.1.1-2: Wireless Network Configuration 17-15
Figure 17.1.1-3: WISCOM Tower Network 17-17
Figure 17.1.1-4: AT&T and Verizon Wireless Availability in Wisconsin 17-21
Figure 17.1.1-5: Sprint, CellCom, and U.S. Cellular Wireless Availability in Wisconsin 17-22
Figure 17.1.1-6: Bertram Communications LLC, Element Mobile, and T-Mobile Wireless Availability in Wisconsin 17-23
Figure 17.1.1-7: Bug Tussel Wireless LLC, Cricket Wireless, and Mosaic Telecom Wireless Availability in Wisconsin 17-24
Figure 17.1.1-8: Other Provider Wireless Availability in Wisconsin 17-25
Figure 17.1.1-9: Types of Towers 17-26
Figure 17.1.1-10: FCC Tower Structure Locations in Wisconsin 17-28
Figure 17.1.1-11: Typical Fiber Optic Network in Wisconsin 17-29
Figure 17.1.1-12: Fiber Availability in Wisconsin for CenturyLink, Charter Communications, and Frontier Communications 17-31
Figure 17.1.1-13: Other Providers Fiber Availability in Wisconsin 17-32
Figure 17.1.2-1: Locations of Major Land Resource Areas in Wisconsin 17-37
Figure 17.1.2-2: Wisconsin Soil Taxonomy Suborders 17-40
Figure 17.1.3-1: Physiographic Regions and Provinces of Wisconsin 17-48
Figure 17.1.3-2: Generalized Surface Geology for Wisconsin 17-52
Figure 17.1.3-3: Generalized Bedrock Geology for Wisconsin 17-53
Figure 17.1.3-4: Wisconsin 2014 Seismic Hazard Map 17-57
Figure 17.1.3-5: Wisconsin Landslide Incidence and Susceptibility Hazard Map 17-58
Figure 17.1.3-6: Karst Topography in Wisconsin 17-60
Figure 17.1.4-1: Major Wisconsin Watersheds and Surface Waterbodies 17-64
Figure 17.1.4-2: Section 303(d) Impaired Waters of Wisconsin, 2014 17-68
Figure 17.1.4-3: Principal and Sole Source Aquifers of Wisconsin 17-71
Figure 17.1.5-1: Wetlands by Type, in Northwestern Wisconsin, 2014 17-76
Figure 17.1.5-2: Wetlands by Type, Northeastern Wisconsin, 2014 17-77
Figure 17.1.5-3: Wetlands by Type, Southern Wisconsin, 2014 17-78
Figure 17.1.6.-1: USEPA Level III Ecoregions in Wisconsin 17-84

Figure 17.1.6.-2: Important Bird Areas in Wisconsin 17-96
Figure 17.1.6-3: ESA Designated Critical Habitat in Wisconsin 17-102
Figure 17.1.7-1: Major Land Use Distribution by Coverage Type........................... 17-118
Figure 17.1.7-2: Land Ownership Distribution.. 17-121
Figure 17.1.7-3: Wisconsin Recreation Resources 17-124
Figure 17.1.7-4: National Air Space Classification Profile 17-126
Figure 17.1.7-5: Composite of Wisconsin Airports/Facilities 17-131
Figure 17.1.7-6: Public Wisconsin Airports/Facilities 17-132
Figure 17.1.7-7: Private Wisconsin Airports/Facilities 17-133
Figure 17.1.7-8: SUAs in Wisconsin 17-136
Figure 17.1.7-9: MTRs in Wisconsin 17-137
Figure 17.1.8-1: Representative Sample of Historic and Cultural Areas that May be Visually Sensitive.. 17-141
Figure 17.1.8-2: Governor Knowles State Forest 17-144
Figure 17.1.8-3: Natural Areas that May be Visually Sensitive 17-145
Figure 17.1.8-4: Apostle Islands National Lakeshore 17-146
Figure 17.1.8-5: Pike Wild River.. 17-148
Figure 17.1.8-6: Avoca River-Bottom Prairie 17-150
Figure 17.1.9-1: Estimated Population Distribution in Wisconsin, 2009–2013........ 17-156
Figure 17.1.9-2: Median Household Income in Wisconsin, by County, 2013 17-160
Figure 17.1.9-3: Unemployment Rates in Wisconsin, by County, 2014 17-161
Figure 17.1.10-1: Potential for Environmental Justice Populations in Wisconsin, 2009–2013.. 17-172
Figure 17.1.11-1: Timeline of Prehistoric Human Occupation 17-175
Figure 17.1.11-2: Approximate Historic Boundaries of Tribes in Wisconsin........... 17-178
Figure 17.1.11-3: National Register of Historic Places (NRHP) Sites in Wisconsin 17-188
Figure 17.1.11-4: Representative Architectural Styles of Wisconsin....................... 17-190
Figure 17.1.12-1: Nonattainment and Maintenance Counties in Wisconsin 17-197
Figure 17.1.12-2: Federal Class I Areas with Implications for Wisconsin.............. 17-200
Figure 17.1.13-1: Sound Levels of Typical Sounds 17-202
Figure 17.1.14-1: Wisconsin CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013 17-207
Figure 17.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties 17-209
Figure 17.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014.. 17-214
Figure 17.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Wisconsin (2013)... 17-217
Figure 17.2.14-1: Wisconsin Low Emission Scenario Projected Temperature Change 17-393
Figure 17.2.14-2: Wisconsin High Emission Scenario Projected Temperature Change 17-393
Figure 17.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario 17-395
Figure 17.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario......................... 17-396

Page Intentionally Left Blank.

17. WISCONSIN

American Indian tribes with a rich cultural history lived in what is now the state of Wisconsin for centuries before the 1600s. In 1634 while searching for a northwestern route to China, the French explorer Jean Nicolet became the first European to come to Wisconsin (Wisconsin Department of Health Services, 2016). The French ceded territory that included Wisconsin to the British at the end of the French and Indian War, which the British then ceded to the United States at the end of the Revolutionary War. In 1848, Wisconsin became the 30th state to join the Union (Wisconsin Historical Society, 2015a). Wisconsin is bordered by Michigan and Lake Superior to the north, Minnesota and Iowa to the west, Illinois to the south, and Lake Michigan to the east. This chapter provides details about the existing environment of Wisconsin as it relates to the Proposed Action.

General facts about Wisconsin are provided below:

- **State Nickname**: The Badger State
- **Land Area:** 54,158 square miles; **U.S. Rank**: 23 (U.S. Census Bureau, 2015a)
- **Capital:** Madison
- **Counties:** 72 (U.S. Census Bureau, 2015k)
- **2014 Estimated Population:** Over 5.7 million people; **U.S. Rank:** 20 (U.S. Census Bureau, 2015a)
- **Most Populated Cites:** Milwaukee and Madison (U.S. Census Bureau, 2015b)
- **Main Rivers:** Mississippi River, Black River, Wisconsin River, Chippewa River, and St. Croix River
- **Bordering Waterbodies:** Lake Michigan, Lake Superior, St. Croix River, and Mississippi River
- **Mountain Ranges:** None
- **Highest Point:** Timms Hill (1,951 ft) (USGS, 2001)

Page Intentionally Left Blank.

17.1. AFFECTED ENVIRONMENT

17.1.1. Infrastructure

17.1.1.1. Definition of the Resource

This section provides information on key Wisconsin 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 17.1.1.3 provides an overview of the traffic and transportation infrastructure in Wisconsin, including road and rail networks and airport facilities. Wisconsin public safety infrastructure could include any infrastructure utilized by a public safety entity[1] as defined in the Title IV 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 Wisconsin are presented in more detail in Section 17.1.1.4. Section 17.1.1.5 describes specific public safety communications infrastructure and commercial telecommunications infrastructure in Wisconsin. An overview of utilities in Wisconsin, such as power, water, and sewer, are presented in Section 17.1.1.6.

17.1.1.2. Specific Regulatory Considerations

Multiple Wisconsin laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community.

Table 17.1.1-1 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.C. § 1401(26)).

Table 17.1.1-1: Relevant Wisconsin Infrastructure Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
Wisconsin Statutes: Chapter 323 Emergency Management	Division of Emergency Management; Emergency Response Commission	Prepares the state and its subdivisions to cope with emergencies resulting from a disaster, or the imminent threat of a disaster; develops and adopts state and local emergency management plans.
Wisconsin Statutes: Chapter 196 Regulation of Public Utilities:	Public Service Commission	Supervises and regulates rates, property rights, equipment, facilities, service territories, and franchises of public utilities (natural gas, electric, water, wastewater, and telecommunications).
Wisconsin Statutes: Chapter 85 Department of Transportation	Department of Transportation	Establishes airports and other air navigation facilities; maintains and operates turnpikes; governs public carriers (passenger rail carriers, railroads, street railways, traction railway, taxicab, limousine, etc.); constructs, reconstructs, maintains, and improves all public roads, causeways, highways, and bridges; provide public transit services.

17.1.1.3. Transportation

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

The Wisconsin Department of Transportation (WisDOT) has jurisdiction over freeways and major roads, airports, railroads, and ports in the state; local counties have jurisdiction for smaller streets and roads. The mission of the WisDOT is to "provide leadership in the development and operation of a safe and efficient transportation system" (WisDOT, 2015a).

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

- 115,145 miles of public roads (FHWA, 2014a) and 14,109 bridges (FHWA, 2015a);
- 3,300 miles of rail network that includes passenger rail and freight (WisDOT, 2014);
- 551 aviation facilities, including airstrips and heliports (FAA, 2016a);
- 14 major ports that includes both public and private facilities (WCPA, 2015); and
- No harbors.

Road Networks

As identified in Figure 17.1.1-1, the major urban centers of the state from northwest to southeast are Eau Claire, Wausau, Green Bay, Oshkosh, Sheboygan, Madison, Appleton, Milwaukee, and

Racine. Wisconsin has five 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 interstate, state, and county roads. Table 17.1.1-2 lists the interstates and their start/end points in Wisconsin. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015b).

Table 17.1.1-2: Wisconsin Interstates

Interstate	Southern or Western Terminus in WI	Northern or Eastern Terminus in WI
I-39	I-90 in Caledonia	US-51 in Rothschild
I-41	US-45 in Richfield	US-41 in Green Bay
I-43	I-90 in Beloit	US-41 in Green Bay
I-90	MN line at Campbell	IL line at Turtle
I-94	MN line at Hudson	I-43 in Milwaukee

In addition to the Interstate System, Wisconsin has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013).

Figure 17.1.1-1 illustrates the major transportation networks, including roadways, in Wisconsin.

National Scenic Byways are designated and managed by the U.S. Department of Transportation's Federal Highway Administration. Wisconsin has one National Scenic Byway (FHWA, 2015c):

- Great River Road

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by WisDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Wisconsin has four State Scenic Byways that crisscross the entire state (WisDOT, 2013):[2]

- Door County Coastal Byway;
- Wisconsin Great River Road;
- Lower Wisconsin River Road; and
- Wisconsin Lake Superior Scenic Byway.

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

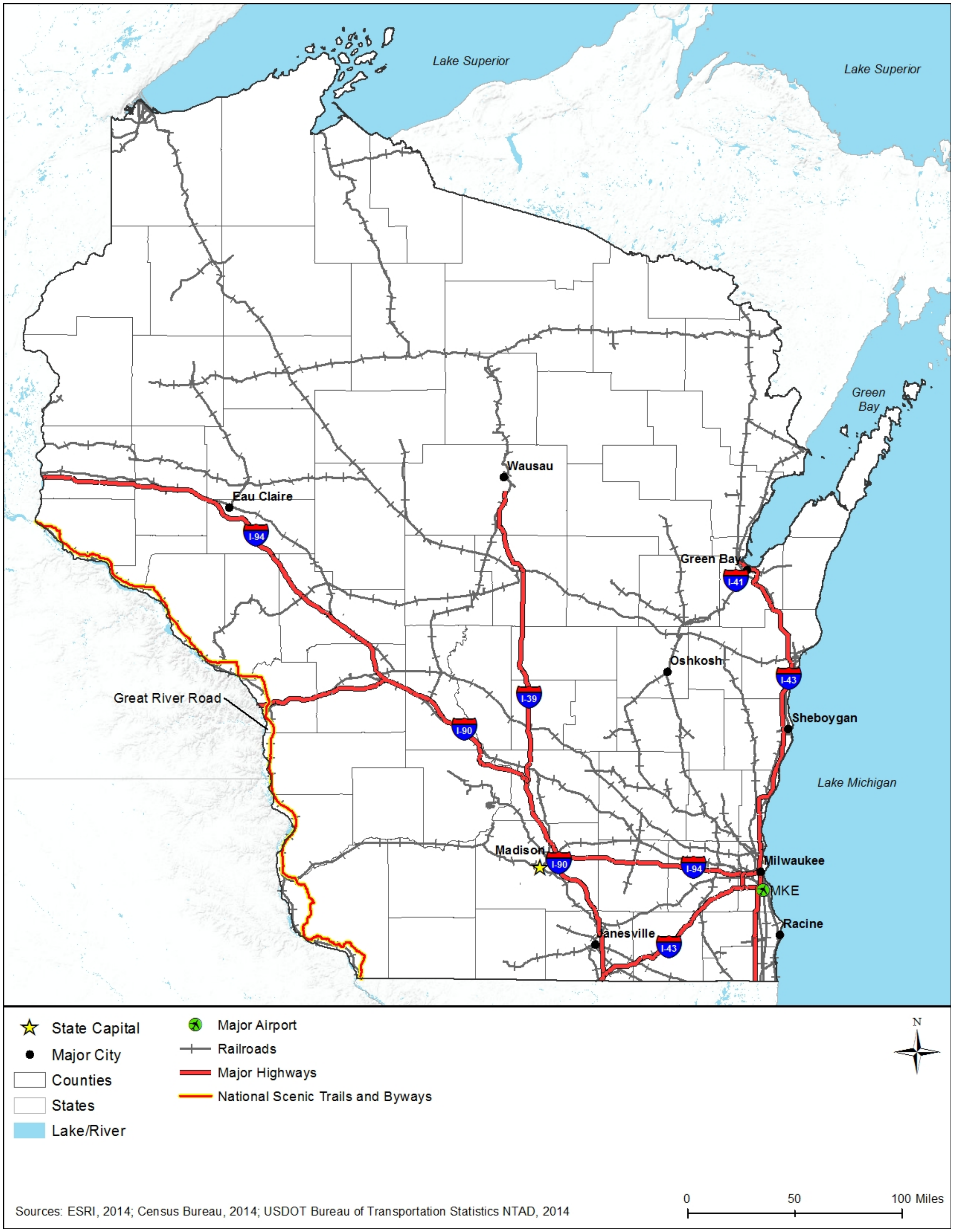


Figure 17.1.1-1: Wisconsin Transportation Networks

Airports

Air service to the state is provided by General Mitchell International Airport (MKE) outside of Milwaukee. Fifteen passenger airlines, the 128th Wing of the Wisconsin Air National Guard, and general aviation operate out of the airport (MKE, 2015). In 2014, MKE served 6,554,152 passengers, handled 143,884,310 pounds of freight and 3,473,098 pounds of air mail, and facilitated 113,248 aircraft operations (MKE, 2014).

Figure 17.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 17.1.7, Land Use, Recreation, and Airspace, provides greater detail on airports and airspace in Wisconsin.

Rail Networks

Wisconsin is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail.

Figure 17.1.1-1 illustrates the major transportation networks, including rail lines, in Wisconsin.

Amtrak runs two lines through Wisconsin: the Empire Builder and Hiawatha. The Empire Builder runs daily between Chicago and Seattle, cutting across southern Wisconsin, and makes six stops in the state (Amtrak, 2015a). The Hiawatha runs 14 trains daily between Chicago and Milwaukee and stops at three stations in Wisconsin (Amtrak, 2015b). Table 17.1.1-3 provides a complete list of Amtrak lines that run through Wisconsin.

Table 17.1.1-3: Amtrak Train Routes Serving Wisconsin

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Wisconsin
Empire Builder	Chicago, IL	Portland/Seattle, WA	46 hours	Milwaukee, Columbus, Portage, Wisconsin Dells, Tomah, La Crosse
Hiawatha	Chicago, IL	Milwaukee, WI	1 hour 29 minutes	Sturtevant, Milwaukee – MKE, Milwaukee Intermodal Station

Source: (Amtrak, 2015c)

In the Chicago metropolitan area, Metra operates a commuter rail service comprised of 11 lines, all of which radiate out from Chicago's downtown into the Chicago suburbs (Metra, 2015). Metra operates on over 1,200 miles of track, which makes it the largest commuter railroad in the nation based on the miles of track; it is the fourth largest commuter railroad based on ridership (Metra, 2015). Metra makes one stop in Wisconsin: the green line ends at Kenosha, Wisconsin. Two percent of Metra's ridership originate in Wisconsin (Metra, 2015).

Freight rail operates on all 3,300 miles of railroad track in Wisconsin (WisDOT, 2014). Freight is moved by 13 freight railroad companies in the state (WisDOT, 2014). Every year, approximately 162 million tons of freight pass through Wisconsin, valued at over $122 billion (WisDOT, 2014).

Harbors and Ports

The state of Wisconsin is home to a number of important port facilities, many of them along the shores of the Great Lakes. Some of these locations are home to Wisconsin's large trade port facilities, while others operate as marinas or small town harbors. The Wisconsin Commercial Ports Association lists fourteen port facilities as important to the state's financial health. The largest of these are the ports of Superior, Green Bay and Milwaukee, though facilities in Marinette, Manitowoc and Sheboygan operate as diversified cargo ports (WCPA, 2015). The locations of the fourteen ports can be seen in Figure 17.1.1-1. The U.S. Census Bureau lists six facilities as having moved cargo internationally in 2013: the ports of Superior, Green Bay, Milwaukee, Manitowoc, Marinette and Racine (U.S. Census Bureau, 2015c).

The Port of Superior shares its grounds with the city of Duluth, Minnesota. It is found on the southwest tip of the Lake Superior, partially in the Superior Bay and partially in the St. Louis Bay. The Port can be reached easily via I-35 or I-535, both of which run through Duluth (DuluthPort, 2015a). Its location at the west end of the St. Lawrence Seaway helps make the port the largest on the Great Lakes, as well as "the farthest-inland freshwater seaport and one of the leading bulk cargo ports in all of North America." Occupying 49 miles of shoreline, the port sees more than 1,000 vessel calls a year. Much of the ports cargo is natural resources, including coal, iron ore, salt and wood pulp. Four Class I railroads provide rail access to the port which allows cargo to move to and from inland America (DuluthPort, 2015b). In 2013, the port was responsible for the import of $53.7 million in trade goods weighing 668.9 million kgs, and the export of $439.7 million weighing 2.99 billion kgs (U.S. Census Bureau, 2015c).

The Port of Green Bay is the most western port on Lake Michigan. It is along the Fox River, just near its mouth at the southern tip of the Lake. Its position near the St. Lawrence Seaway helps make the Port of Green Bay such an important facility (Port of Green Bay, 2015a). Both the Escanaba and Lake Superior Railroad, as well as the Canadian National Railroad, offer service to the port, along with shipping further inland (Port of Green Bay, 2015a). Common cargo moved through the facilities include coal, salt, petroleum and wood pulp, but the port is not limited to this and also transport other cargo like wind turbine components (Port of Green Bay, 2015b). In 2013, the U.S. Census Bureau recorded the Port of Green Bay as having imported $61.2 million in cargo goods, weighing 303.7 million kgs; and the same year exported $53.5 million weighing 25 million kgs (U.S. Census Bureau, 2015c).

The third large shipping facility of note is the Port of Milwaukee. This facility is an important gateway to the U.S. inland waterway system as it is positioned on the western shore of Lake Michigan, around the mouth of the Kinnickinnic River. This location allows shipping to inland states such as Iowa, North and South Dakota and Nebraska. While I-94 provides over-land access to the port, the rail lines of Union Pacific Railway and Canadian Pacific Railway both service the port directly from its piers. Among the ports, common cargo includes steel, wind turbine components and other heavy machinery, coal and salt (Port of Milwaukee, 2015). In 2013, the port imported $152 million in cargo that weighed 1.4 billion kgs and exported $24.7 million of cargo that weighed 1.5 million kgs (U.S. Census Bureau, 2015c).

Facilities in Marinette, Manitowoc, and Sheboygan operate as smaller diversified cargo ports. The Port of Marinette is near the mouth of Menominee River at the northwest corner of the state.

The Port of Manitowoc can be found on the Manitowoc Harbor, on the west bay of Lake Michigan. Lastly, the Port of Sheboygan is found at the entrance of the Sheboygan River, also on Lake Michigan's western shore (WCPA, 2015). The Port of Marinette and the Port of Manitowoc were recorded by the US Census Bureau as having done international trade in 2013. The Port of Marinette was responsible for importing 90.7 million kgs of goods worth $13.5 million, and exporting 7.2 million kgs worth $4.8 million. The Port of Manitowoc exported 199,581 kgs of cargo worth $6.2 million. The Port of Sheboygan did no international trade (U.S. Census Bureau, 2015c).

The Census Bureau also listed the Ports of Racine and Ashland as having done small amounts of trade in 2013. The Port of Racine had minimal imports, but exported $5.7 million worth of goods weighing 2.3 million kgs. The port of Ashland imported $500,000 worth of goods weighing 99,790 tons (U.S. Census Bureau, 2015c).

In addition to ports located on the Great Lakes, Wisconsin is home to several river-based ports, including the Port of LaCrosse and the Port of Prairie du Chien on the Mississippi River (Wisconsin Commercial Ports Association, 2016).

17.1.1.4. Public Safety Services

Wisconsin public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. The general abundance and distribution of public safety services may roughly follow key state demographic indicators. Table 17.1.1-4 presents Wisconsin'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 17.1.9, Socioeconomics; however, these demographics are key to understanding the breadth of public safety services throughout the state.

Table 17.1.1-4: Key Wisconsin Indicators

Wisconsin Indicators	
Estimated Population (2014)	5,757,564
Land Area (square miles) (2010)	54,158
Population Density (persons per sq. mile) (2010)	105
Municipal Governments (2013)	592

Sources: (U.S. Census Bureau, 2015ah) (U.S. Census Bureau, 2015k)

Table 17.1.1-5 presents Wisconsin's public safety infrastructure. Table 17.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 17.1.1-5: Public Safety Infrastructure in Wisconsin by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,029
Law Enforcement Agencies [b]	1,030
Fire Departments [c]	777

[a] Reported by the U.S. Fire Administration.
[b] Number of agencies from state and local law enforcement, local police departments, and sheriffs' offices reported by the U.S. Bureau of Justice Statistics.
[c] Reported by the U.S. Fire Administration.

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

Table 17.1.1-6: First Responder Personnel in Wisconsin by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	1,220
Fire and Rescue Personnel [b]	20,444
Law Enforcement Personnel [c]	20,150
Emergency Medical Technicians and Paramedics [d e]	6,220

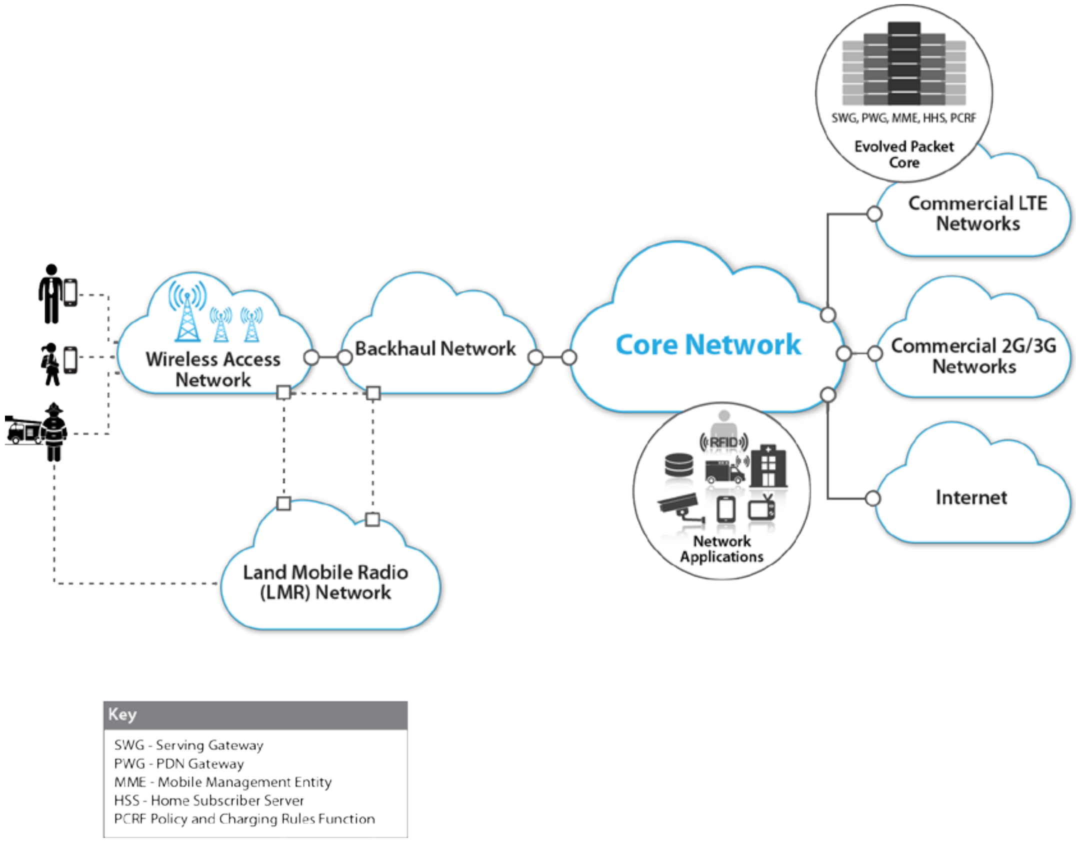
[a] BLS Occupation Code: 43-5031.
[b] BLS Occupation Codes: 33-2011 (Firefighters), 33-2021 (Fire Inspectors and Investigators), 33-1021 (First-Line Supervisors of Fire Fighting and Prevention Workers), and 53-3011 (Ambulance Drivers and Attendants, Except Emergency Medical Technicians). Volunteer firefighters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

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

17.1.1.5. Telecommunications Resources

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

Communications throughout the state are based on a variety of publicly- and commercially-owned technologies. Figure 17.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications.



Prepared by: Booz Allen Hamilton

Figure 17.1.1-2: Wireless Network Configuration

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale, which is national (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information. Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and specifically in Wisconsin. There are five key reasons why public safety agencies often cannot connect through existing communications (NTFI, 2005):

- Incompatible and aging communications equipment,
- Limited and fragmented funding,

- Limited and fragmented planning,
- A lack of coordination and cooperation, and
- Limited and fragmented radio spectrum.

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

Like most states, Wisconsin's public safety LMR network environment is facing transition and reflects the challenges of the need for greater system capabilities requiring, investment in Very High Frequency (VHF)[3] upgrades and 800 MHz site expansion, incremental site hardening and maintenance as well as sustainment of analog to digital Project 25 (P-25)[4] conversion and planning for adoption of broadband and technology modernization (Symons, 2014).

Wisconsin's Interoperable System for Communications (WISCOM) provides statewide coverage for public safety agencies and delivers mutual aid and interoperability communications capability statewide. WISCOM operational control resides with the Wisconsin State Patrol (WSP). The WSP WISCOM Operations center is co-located at the Rubicon tower site, west of Hartford in Washington County in southeastern Wisconsin. (Symons, 2014)

Statewide/Multi-County Public Safety Networks

WISCOM is the state's digital P-25 statewide public safety network operating currently on VHF and 800 MHz, and consisting of a tower network of 103 tower sites.[5] Figure 17.1.1-3 below depicts the WISCOM current and planned sites including active 800 MHz sites (Wisconsin DOT, 2014).

[3]VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA, 2005).
[4] Project 25 (P-25) is a suite of standards for digital radio communications for use by federal, state, and local public safety agencies in North America to enable them to communicate with other agencies and mutual aid response teams in emergencies.
[5] As of Third Quarter 2014.

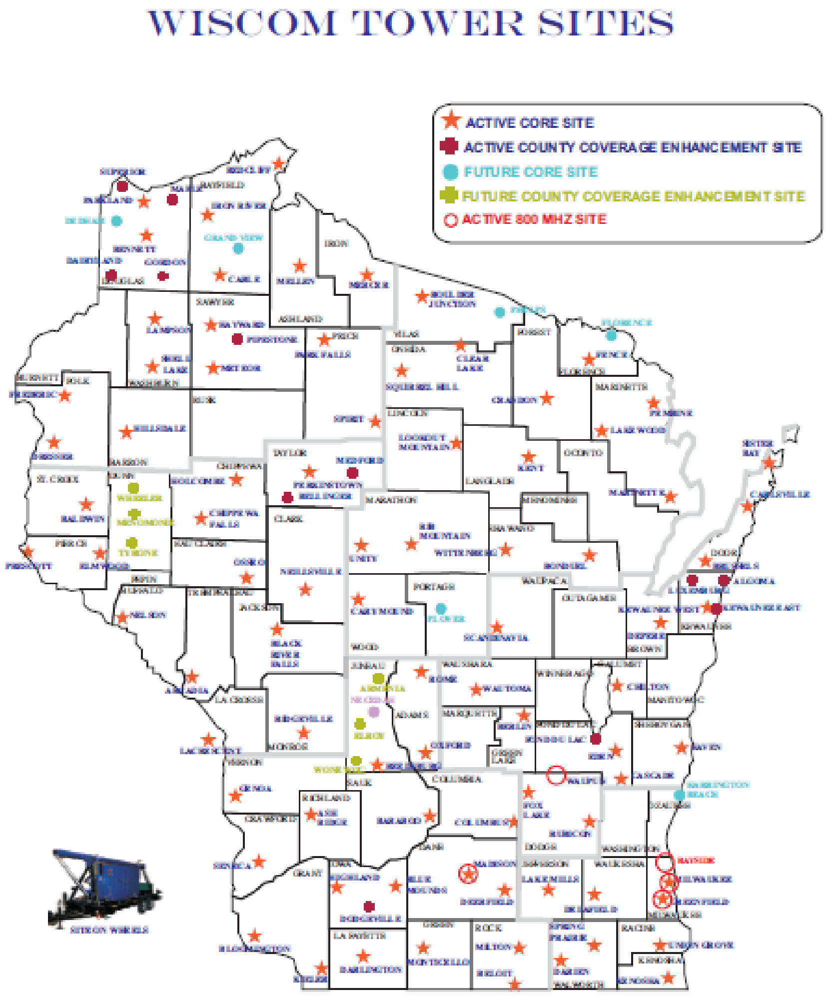


Figure 17.1.1-3: WISCOM Tower Network

Statewide Interoperability Talkgroups are available throughout Wisconsin on VHF and are accessible via local LMR towers, as well as Regional Interoperability Talkgroups such as the Southeast Tactical Talkgroup to provide regionalized mutual aid and incident response communications (RadioReference.com, 2015a). The WSP, organized around seven regional deployment locations, uses WISCOM as its main communication system, reserving VHF channels for backup (RadioReference.com, 2015b). The Wisconsin Hospital Emergency Preparedness Program (WHEPP) is deploying WISCOM LMR radios to hospitals statewide to facilitate emergency communications preparedness (RadioReference.com, 2015c). WISCOM supported 19,795 subscribers and 1,710 talkgroups on its 103 online tower sites in 2014 (Symons, 2014).

County/City Public Safety Networks

There are eight Public Safety digital P-25 networks operating in Wisconsin, seven of which are County coverage networks with WISCOM serving as the P-25 network providing statewide coverage. Table 17.1.1-7 indicates the frequencies at which these P-25 networks operate, with the majority of these network operating in the 800MHz band (Project 25.org, 2015).

Table 17.1.1-7: Wisconsin Project 25 Networks

Project 25 Network	Frequency Band
Greenfield Public Safety	800 MHz
Manitowoc County Public Safety	800 MHz
Milwaukee County Public Safety	800 MHz
Outagamie/Winnebago County Public Safety System	800 MHz
Sustained Interoperability Radio Emergency Notification	700 MHz
Washington County Public Safety	VHF
Watertown Public Services	800 MHz
Wisconsin Interoperable System for Communications (WISCOM)	VHF/800 MHz

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

Within the digital P-25 portfolio of networks in Wisconsin, the sole 700 MHz P-25 network operating in Wisconsin is Sustained Interoperable Radio for Emergency Notification (SIREN), a network that covers both Brown (home to the city of Green Bay) and Outagamie counties (RadioReference.com, 2015d). SIREN services a broad mix of public safety agencies in the counties including police, fire, and EMS, as well as supporting municipal public works and airport LMR users. Milwaukee County (home to Milwaukee City) and the county's surrounding areas are serviced by a diverse set of systems and frequencies. The Milwaukee County Public Safety P-25 network operates at 800 MHz and supports sheriff, fire, EMS departments as well as municipal public works and county corrections (RadioReference.com, 2015e).

Outside of the eight digital P-25 networks, the majority of the other county and city public safety networks in Wisconsin are predominantly VHF and Ultra High Frequency (UHF) [6] legacy networks which service local LMR communications requirements. For example, Barron County (in northwestern Wisconsin) has access to WISCOM, but VHF systems continue to support dispatch and public safety tactical communications, while UHF is used for jail and sheriff extended coverage repeater communications (RadioReference.com, 2015f).

Public Safety Answering Points (PSAPs)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 150 PSAPs in Wisconsin serving Wisconsin's 72 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Wisconsin'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 Wisconsin'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.

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

Carriers, Coverage, and Subscribers

Wisconsin'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 17.1.1-8 presents the number of providers of switched access[7] lines, Internet access,[8] and mobile wireless services including coverage.

Table 17.1.1-8: Telecommunications Access Providers and Coverage

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access line [a]	169	97.9% of households
Internet access [b]	92	56% of households
Mobile wireless [c]	10	94% 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 17.1.1.5, Last Mile Fiber Assets.
Sources: (FCC, 2014a) (FCC, 2014b) (NTIA, 2014)

Table 17.1.1.9 shows the wireless providers in Wisconsin along with their geographic coverage. The following five maps, Figure 17.1.1-4 to Figure 17.1.1-8, show: the combined coverage for the top two providers (each of which covers the entire state); Sprint, CellCom, and U.S. Cellular's coverage; Bertram Communications LLC, Element Mobile, and T-Mobile's coverage; Bug Tussel Wireless LLC, Cricket Wireless, and Mosaic Telecom's coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.[9]

[7] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)" (FCC, 2014b).
[8] Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers
[9] The broadband map utilized data collected as part of the broadband American Recovery and Reinvestment Act initiative. The data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). Each state's broadband data was downloaded accordingly. The data pertaining to broadband data/coverage for census blocks, streets, addresses, and wireless were used. Census blocks, roads, and addresses were merged into one file and dissolved by similar business and provider names. Square miles were calculated for each provider. The maps show all providers over 5% on separate maps; providers with areas under 5% were merged and mapped as "[State Name] Other Fiber Providers". All Wireless providers

Table 17.1.1-9: Wireless Telecommunications Coverage by Providers in Wisconsin

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	89.58%
Verizon Wireless	83.94%
U.S. Cellular	46.22%
Sprint	38.97%
CellCom	34.86%
T-Mobile	11.70%
Bertram Communications, LLC	10.62%
Element Mobile	10.33%
Bug Tussel Wireless, LLC	8.72%
Mosaic Telecom	6.94%
Cricket Wireless	6.63%
Other[a]	25.59%

Source: (NTIA, 2014)
[a] Other: Provider with less than 5% coverage area. Providers include: Netwurx; Country Wireless; Fastbytes Wireless; Cirrinity LiteWire; Northern Telephone and Data; T6 Broadband; Mercury Network Corporation; Prairie iNet; Excel.Net, Inc.; AirRunner Networks, LLC; WaupacaOnline; Internet Kmoraine; SonicNet Inc.; Starwire Technologies; WIConnect Wireless LLC; Door County Broadband; E-Vergent Wireless; SonicPCS; WizTech, LLC; HierComm Networks, LLC; 24-7 Telcom, Inc.; NEIT; Nextera Communications; Business Only Broadband; JCWIFI.com; MHTC; Geneva On-Line, Inc.; Fast-Air Internet, Inc.; Wonderwave.net Internet, Inc.; Clearwire; Air Fiber; Orchard Wireless.net

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.

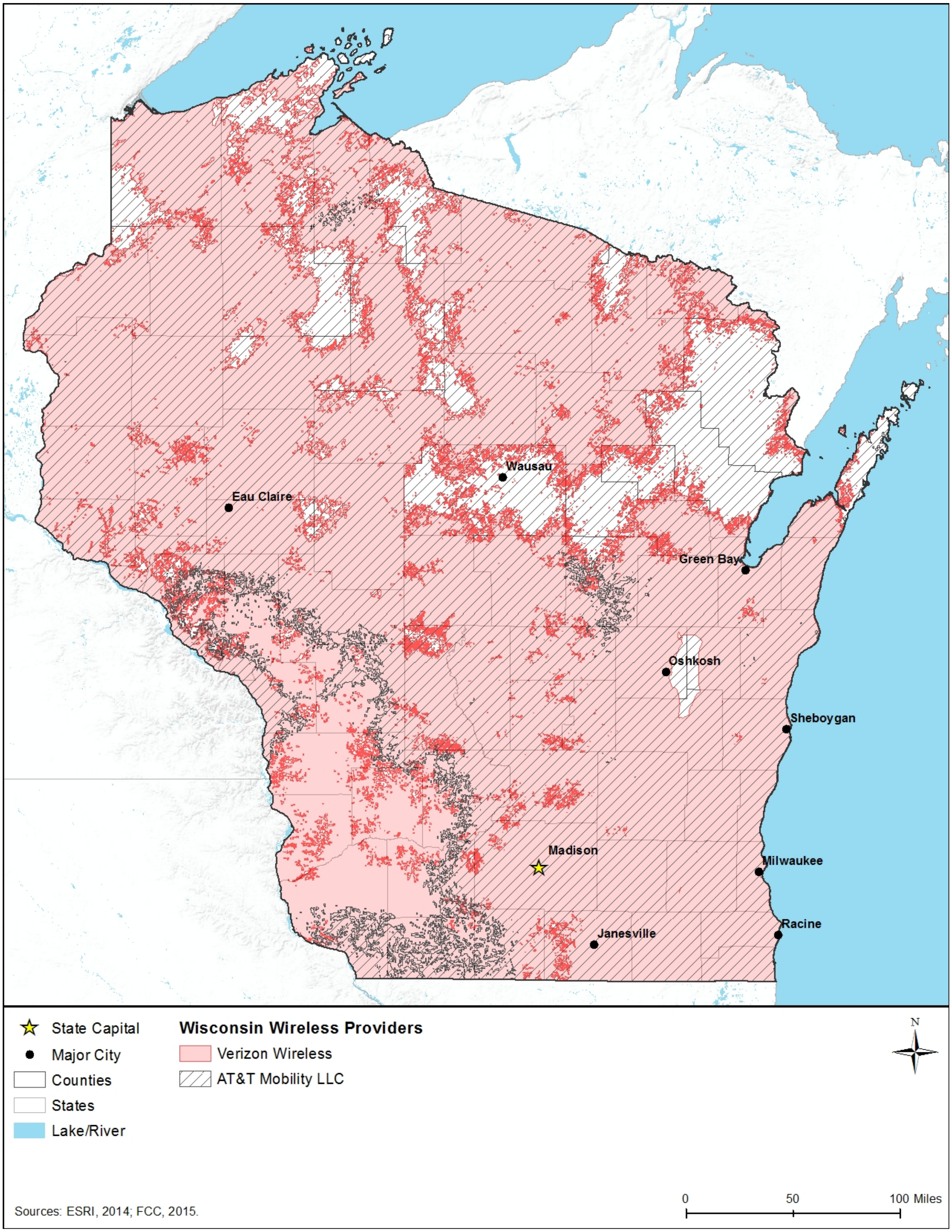


Figure 17.1.1-4: AT&T and Verizon Wireless Availability in Wisconsin

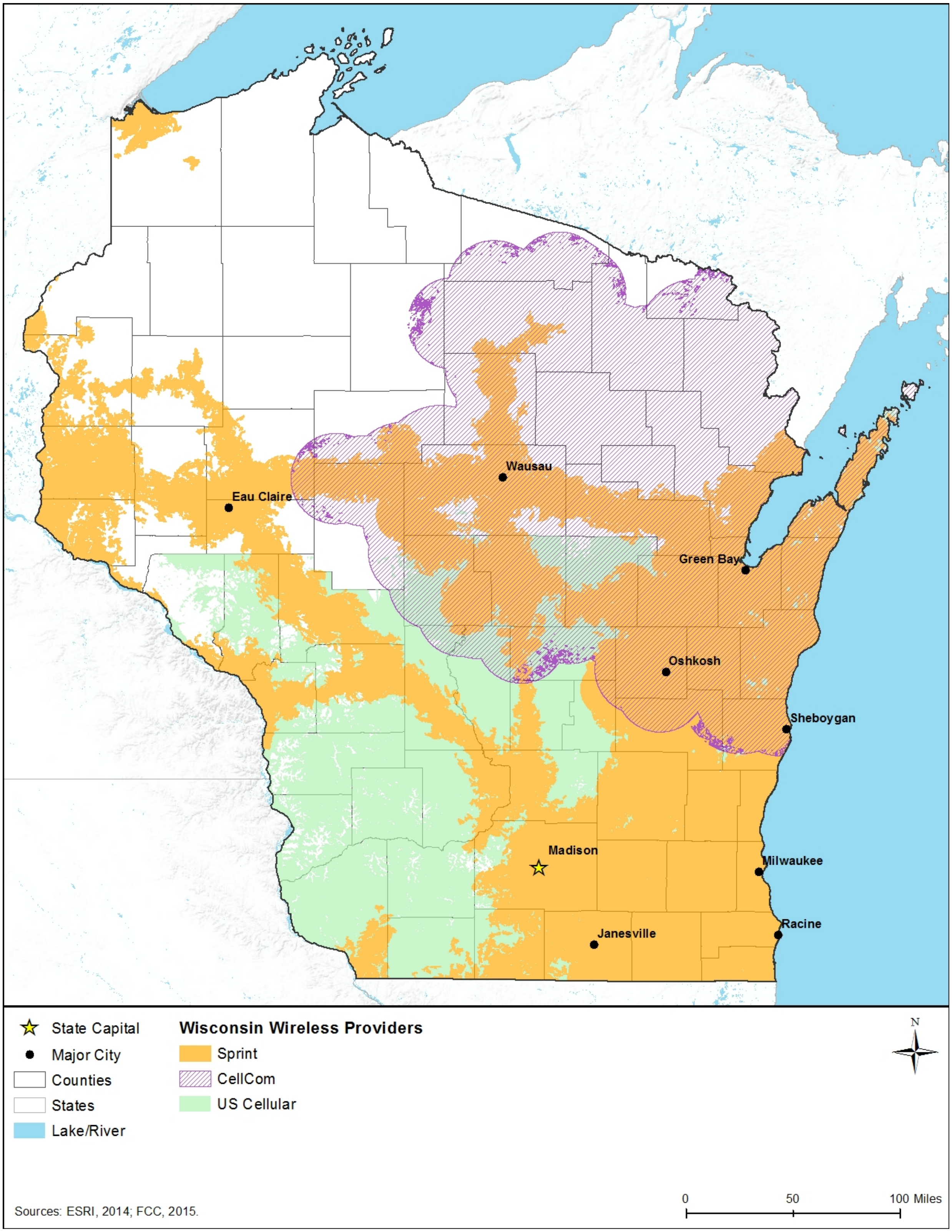


Figure 17.1.1-5: Sprint, CellCom, and U.S. Cellular Wireless Availability in Wisconsin

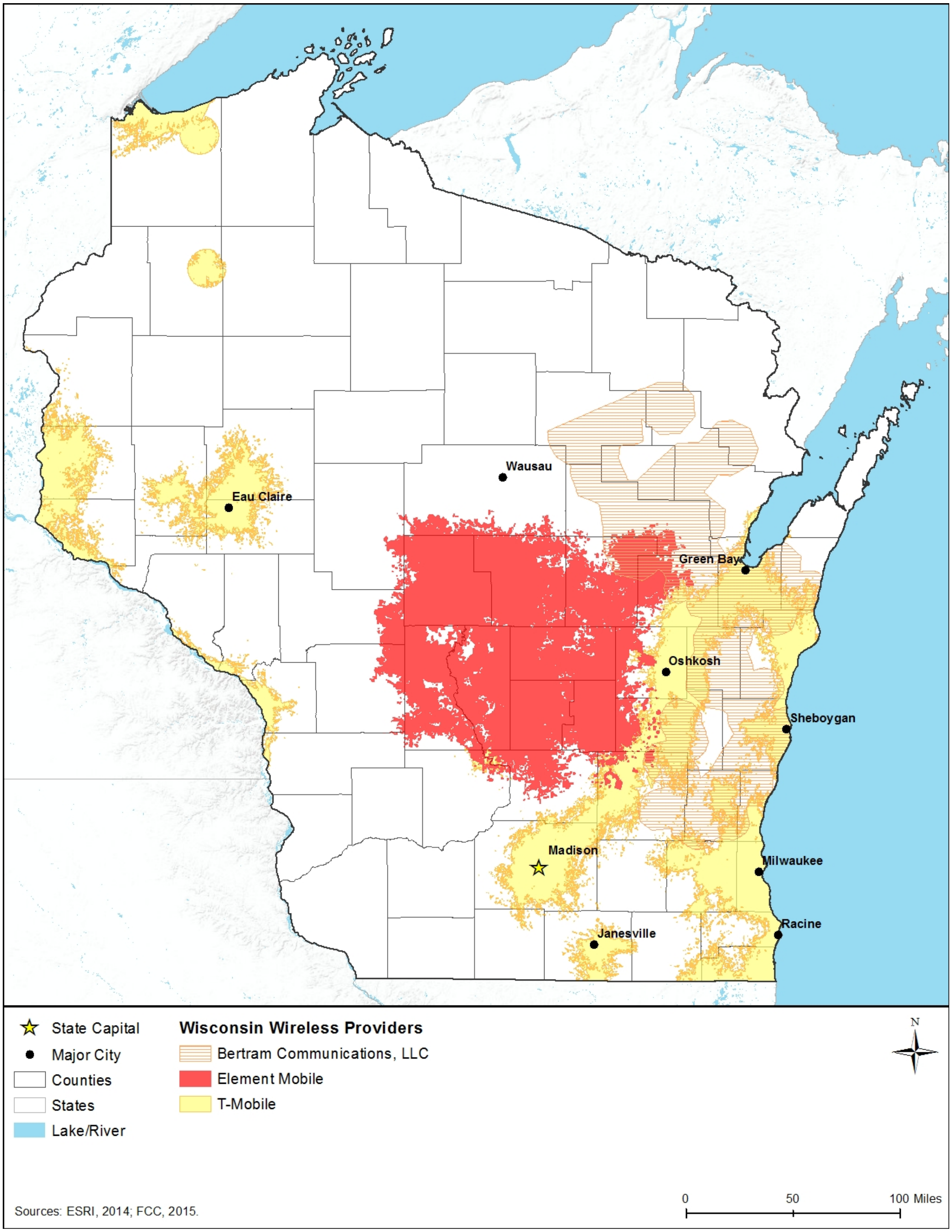


Figure 17.1.1-6: Bertram Communications LLC, Element Mobile, and T-Mobile Wireless Availability in Wisconsin

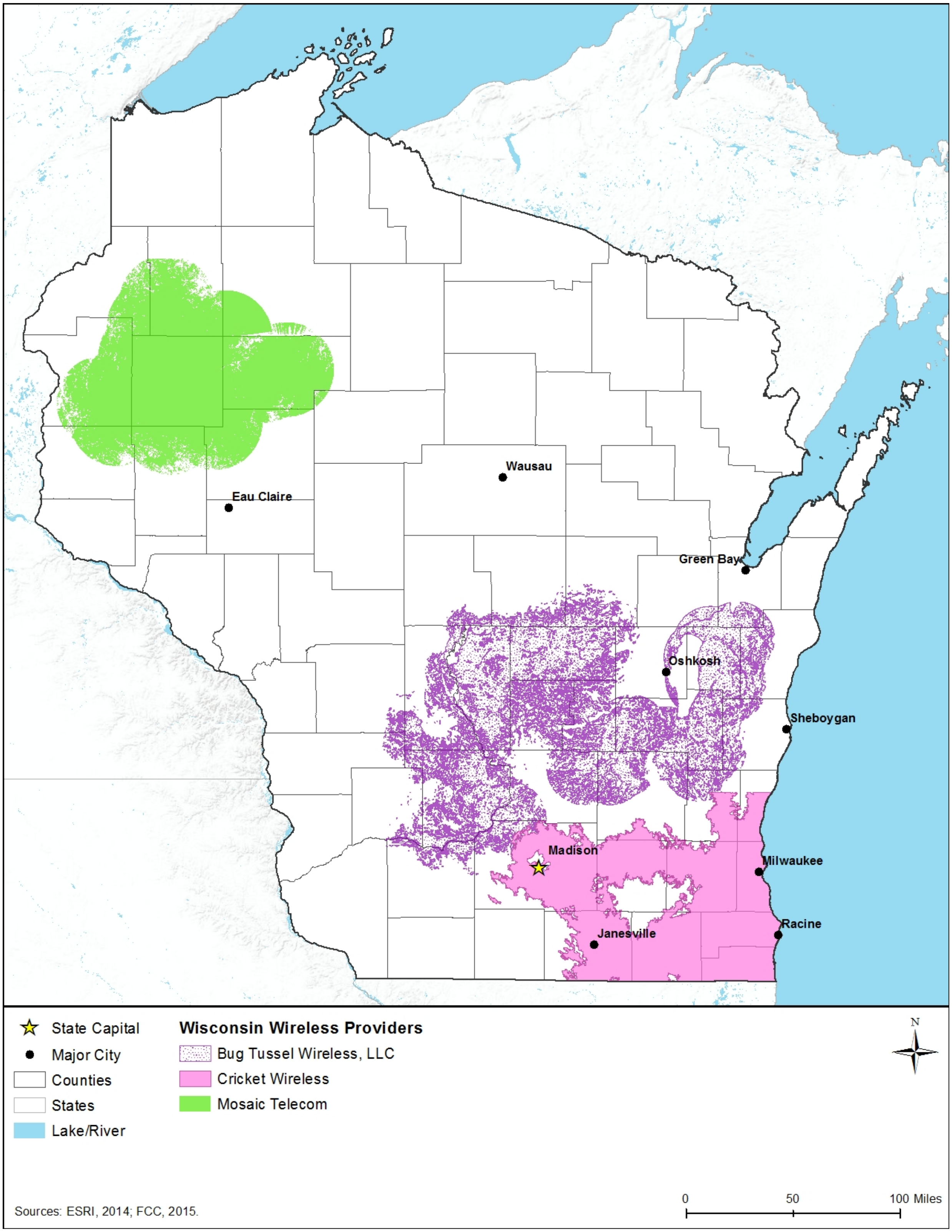


Figure 17.1.1-7: Bug Tussel Wireless LLC, Cricket Wireless, and Mosaic Telecom Wireless Availability in Wisconsin

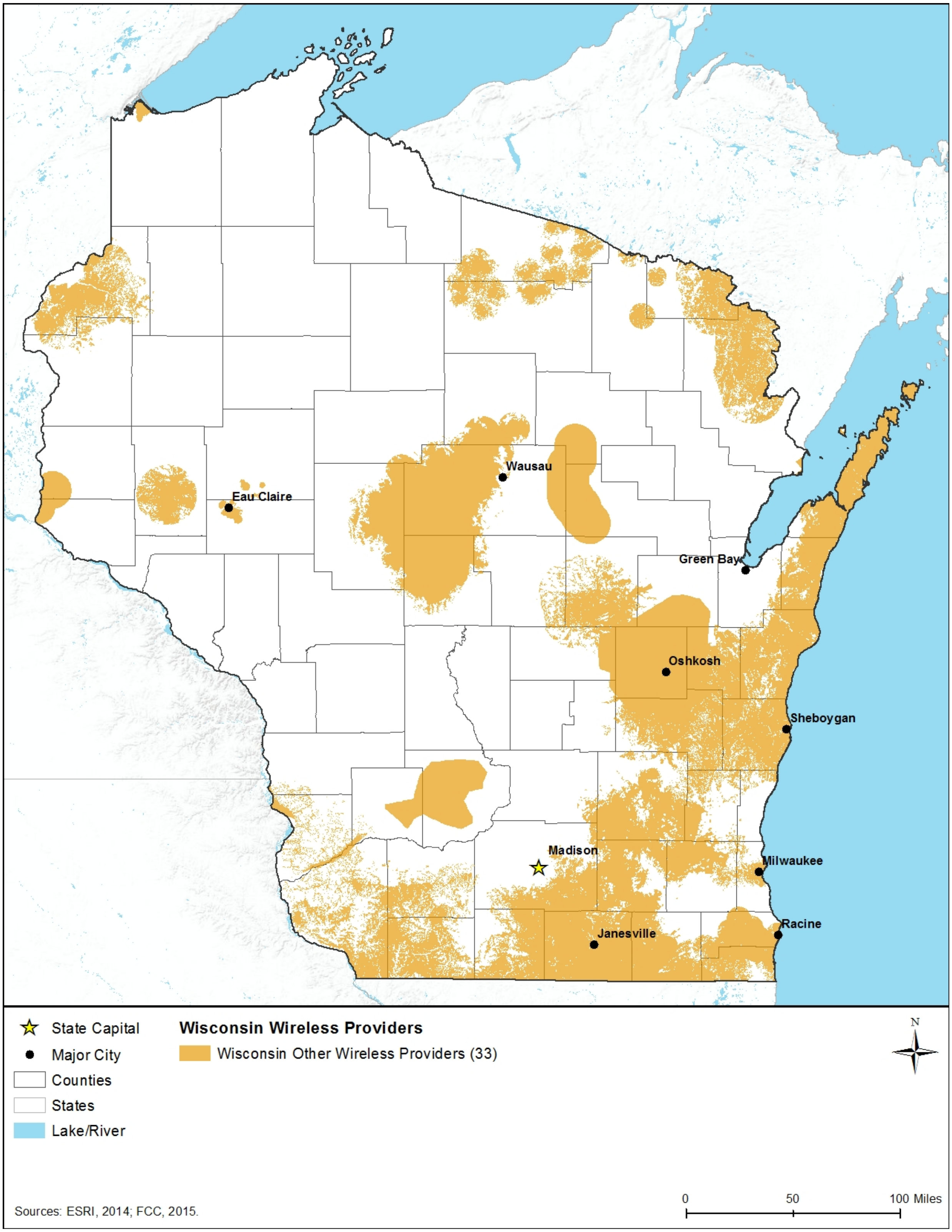


Figure 17.1.1-8: Other Provider Wireless Availability in Wisconsin

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, Chapter 90 Communiations Site Management, 2009). Figure 17.1.1-9 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 17.1.1-9: Types of Towers

Telecommunications tower infrastructure proliferates throughout Wisconsin, although tower infrastructure is concentrated in the more populated areas of Wisconsin; Milwaukee, Madison, Green Bay, Kenosha, Racine, Appleton, Waukesha, Oshkosh, Eau Claire, and Janesville. (U.S. Census Bureau, 2012c) Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016).[10] Table 17.1.1-10 presents the number of

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

towers (including broadcast towers) registered with the FCC in Wisconsin, by tower type, and Figure 17.1.1-10 presents the location of those structures, as of June 2016.

Table 17.1.1-10: Number of Commercial Towers in Wisconsin by Type

Constructed[a] Towers[b]		**Constructed Monopole Towers**	
100ft and over	360	100ft and over	1
75ft – 100ft	685	75ft – 100ft	1
50ft – 75ft	559	50ft – 75ft	23
25ft – 50ft	342	25ft – 50ft	56
25ft and below	61	25ft and below	13
Subtotal	**2,007**	**Subtotal**	**94**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	50	100ft and over	2
75ft – 100ft	58	75ft – 100ft	1
50ft – 75ft	9	50ft – 75ft	9
25ft – 50ft	5	25ft – 50ft	7
25ft and below	0	25ft and below	1
Subtotal	**122**	**Subtotal**	**20**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	10	100ft and over	0
75ft – 100ft	125	75ft – 100ft	0
50ft – 75ft	53	50ft – 75ft	2
25ft – 50ft	27	25ft – 50ft	0
25ft and below	0	25ft and below	0
Subtotal	**215**	**Subtotal**	**2**
Constructed Tanks[d]			
Tanks	52		
Subtotal	**52**		
Total All Tower Structures		**2,512**	

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, 2016c)

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

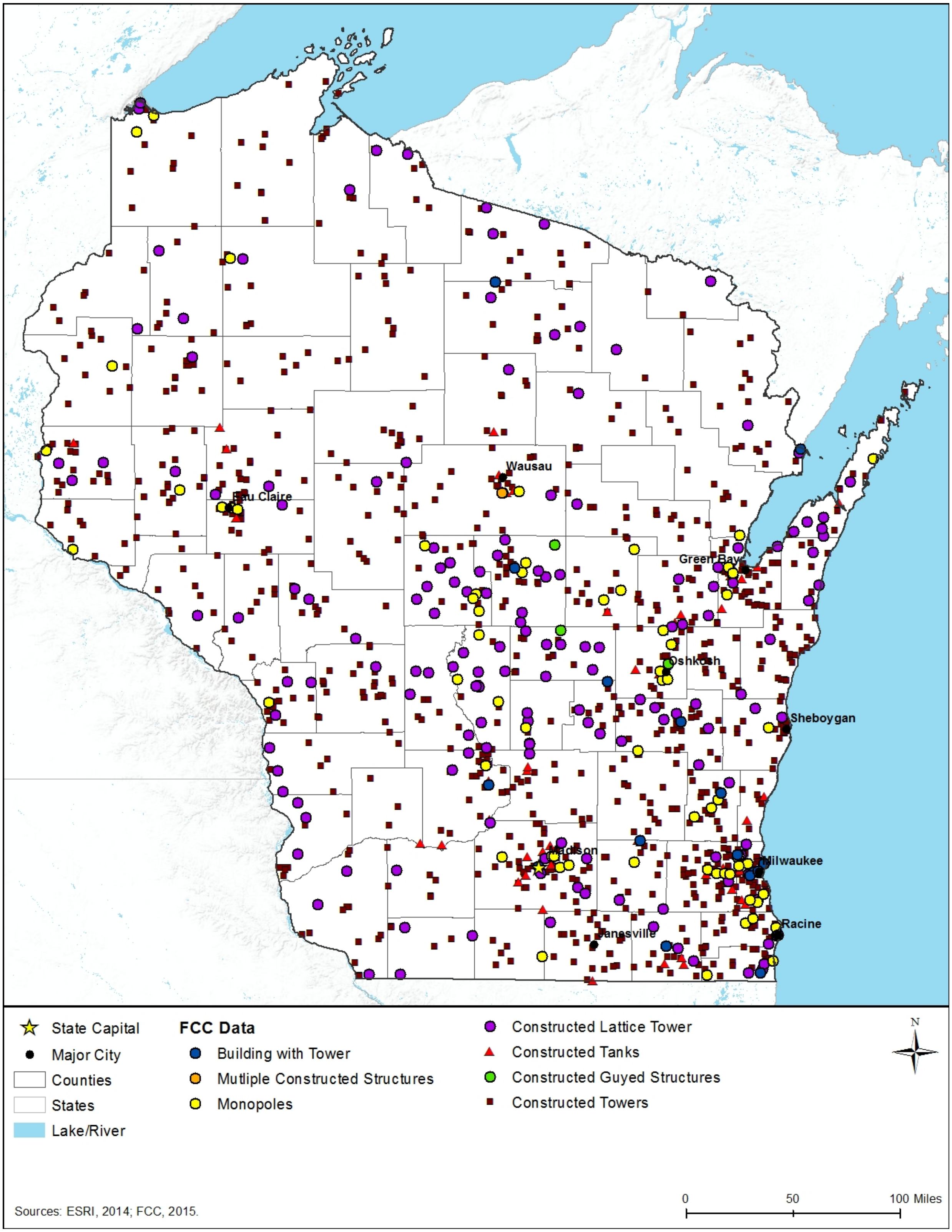


Figure 17.1.1-10: FCC Tower Structure Locations in Wisconsin

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way. A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 17.1.1-11. 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).

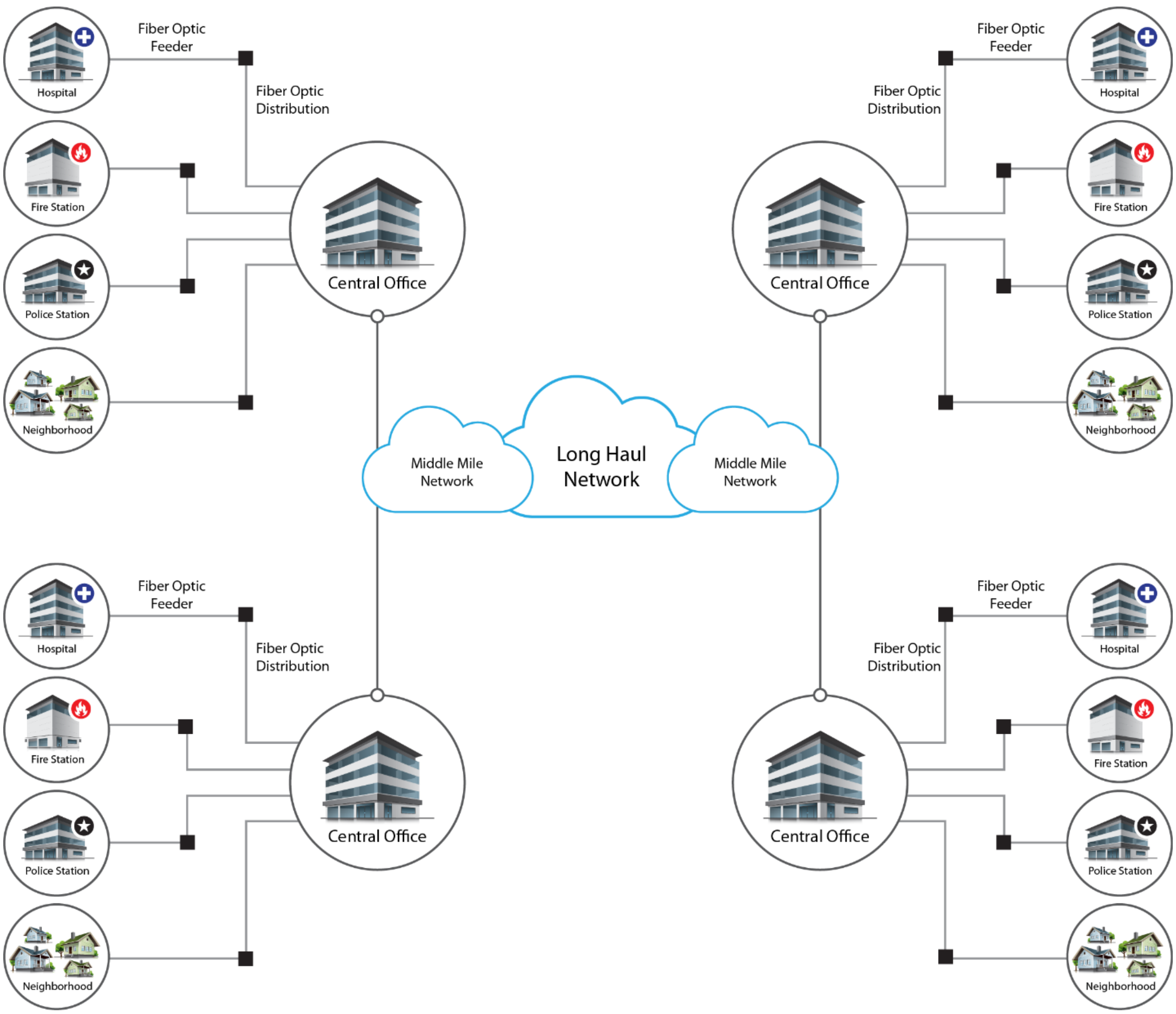


Figure 17.1.1-11: Typical Fiber Optic Network in Wisconsin

Prepared by: Booz Allen Hamilton

Last Mile Fiber Assets

In Wisconsin, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Wisconsin, there are 63 fiber providers that offer service in the state, as listed in Table 17.1.1-11. Figure 17.1.1-12 shows coverage for CenturyLink, Charter Communications, and Frontier Communications, and Figure 17.1.1-13 shows coverage for all other providers with less than 5 percent coverage area, respectively.

Table 17.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
CenturyLink	15.88%
Charter Communications	10.23%
Frontier Communications	10.08%
Other[a]	26.61%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5% coverage area. Providers include: Time Warner Cable; AT&T Wisconsin; TDS; Norvado; MegaPath Corporation; Mosaic Telecom; Frontier Rhinelander Telephone Company; Vernon Telephone Cooperative, Inc.; Packerland Broadband; Union Telephone Company; Mediacom; Marquette-Adams Telephone Cooperative, Inc.; Northwest Communications; West Wisconsin Telcom Cooperative; Solarus; Bevcomm; Nsight Telservices; Tri-County Communications Cooperative; Nelson Telephone Cooperative; Richland-Grant Telephone Cooperative Inc.; Baldwin Telecom, Inc.; Western Wisconsin Communications; Grantsburg Telcom; Amherst Telephone Company; Lakeland Communications, Inc.; Price County Telephone Company; Lemonweir Valley Telephone Company; Citizens Telephone Cooperative, Inc.; Wittenberg Telephone Company; LaGrant Connections, LLC; Reedsburg Utility Commission; Bloomer Telephone Company; BruceTel Communications LLC; LaValle Telephone Cooperative; Coon Valley Farmers Telephone Company; Manawa Telephone Company; Comcast; MHTC; Clear Lake Telephone Company LLC; Hillsboro Telephone Company, Inc.; Niagara Telephone Company; Siren Telephone Company, Inc.; Merr.com; Lakefield Telephone Company; Sharon Telephone Co.; TW Telecom; Cochrane Cooperative Telephone Company; Spring Valley Telephone Company, Inc.; Three Lakes Cable TV; 24-7 Telcom, Inc.; Bergen Telephone Company; Chippewa Valley Cable, Inc.; Northern Telephone and Data; Level 3 Communications, LLC; Genuine Telecom; Choicetel LLC; Midcontinent Communications; Nextgen Communications, LLC; Community Antenna System, Inc.; Cogent Communications

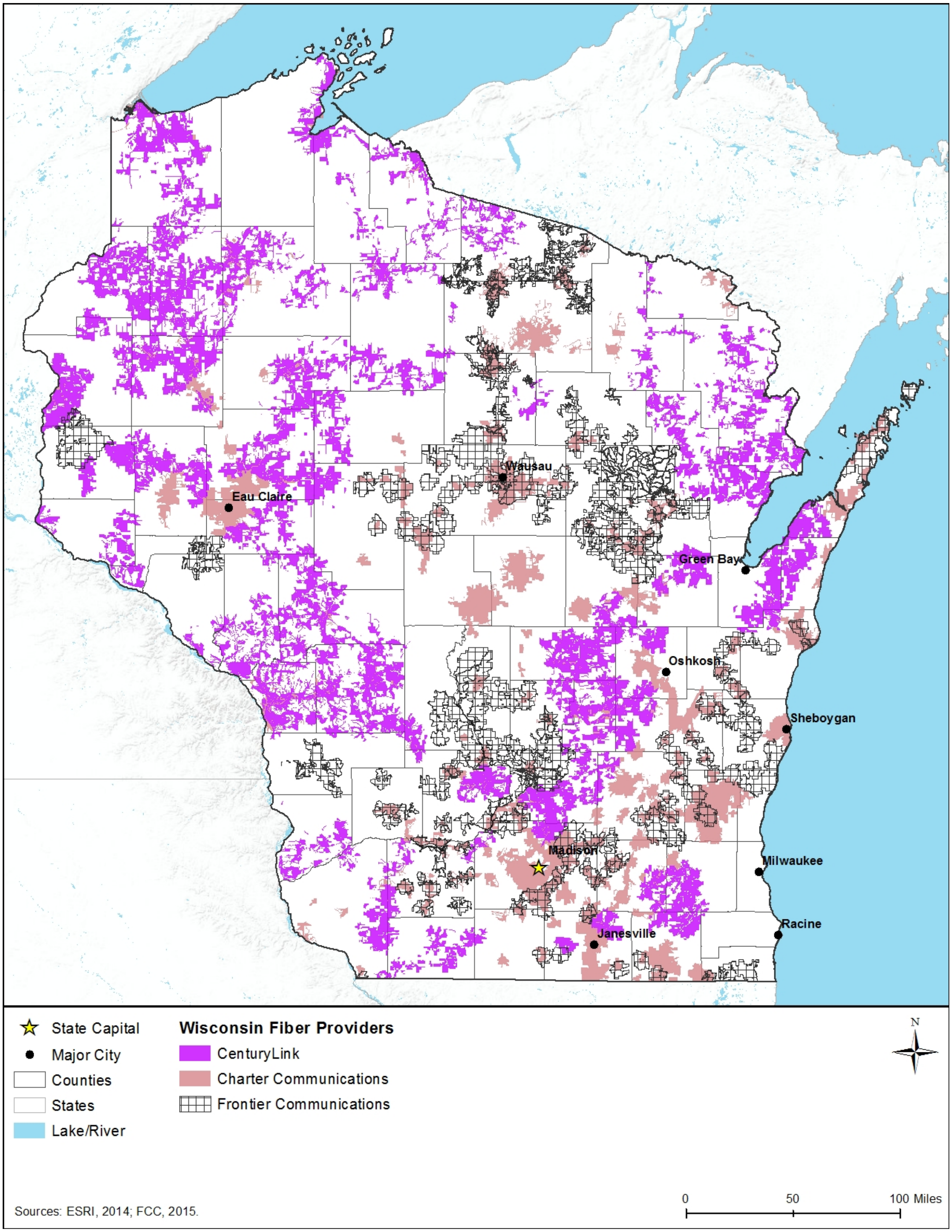


Figure 17.1.1-12: Fiber Availability in Wisconsin for CenturyLink, Charter Communications, and Frontier Communications

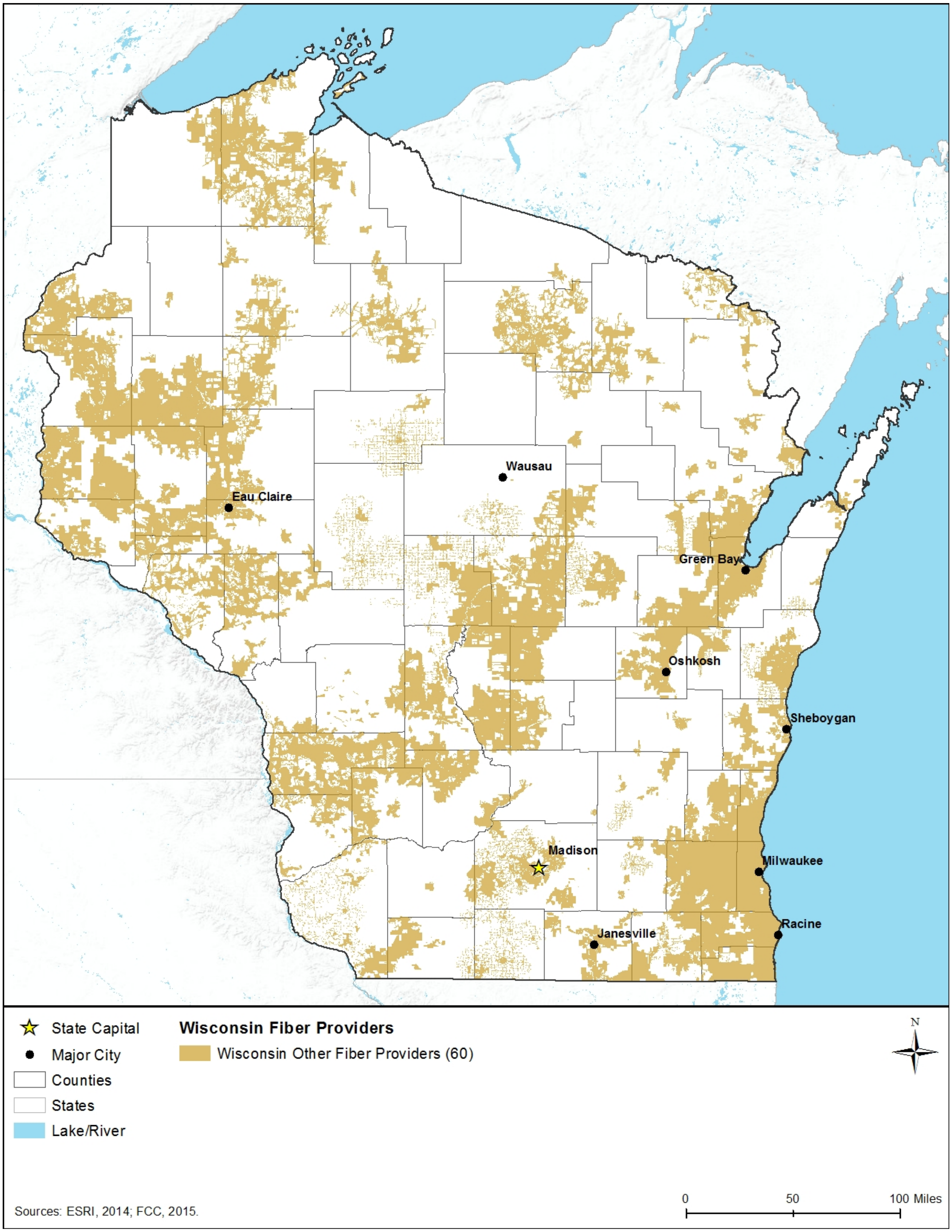


Figure 17.1.1-13: Other Providers Fiber Availability in Wisconsin

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.

17.1.1.6. Utilities

Utilities are the essential systems that support daily operations in a community and cover a broad array of public services, such as electricity, water, wastewater, and solid waste. Section 17.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Wisconsin's electric utilities are regulated by the Public Service Commission (PSC). It is the responsibility of the PSC to set the rates of utilities and lead large-scale construction projects (PSC, 2015a). In the case of electric utilities, these projects include the construction of electricity generation plants and large power lines. The PSC also oversee mergers between electricity utilities (PSC, 2015b). Its jurisdiction includes all public utilities, municipal electric systems, and electric cooperatives, with each supplying service within its own territory (PSC, 2015c). Most of Wisconsin's electricity generation comes from coal powered plants; "in 2013, coal provided 62 percent of the states' power" (EIA, 2015a). Of the 61,064,796 megawatt-hours[11] produced that year, 37,449,264 megawatt-hours came from coal facilities (EIA, 2015b). Another 9.3 percent of the generated electricity came from renewable sources such as hydroelectric facilities, wind or biomass fuels (EIA, 2015a). Natural gas and nuclear power accounted for 8,053,503 (13.2 percent) and 9,447,096 (15.5 percent) megawatt-hours, respectively. Coal, natural gas and nuclear power have been the largest generators of electricity in the state since 2003 (EIA, 2015b). Wisconsin's industrial sector uses 32 percent of the states generated electricity, residential consumers use 24.7 percent, transportation uses 22.8 percent, and the commercial sector uses 20.5 percent (EIA, 2015a).

Water

Many water utilities in Wisconsin have aspects of their service regulated by the PSC, including the setting of utility rates, handling customer complaints, and promoting water conservation. Though their authority does not extend to "regional water authorities, cooperatives, water trusts, and private wells," they do oversee some 580 drinking systems (PSC, 2015d). The quality of

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

water provided by public drinking water systems is overseen by the Department of Natural Resources' (DNR) Bureau of Drinking Water and Groundwater. Their authority is derived from the Federal Safe Drinking Water Act (SDWA), which outlines water system requirements. Among their other duties, the DNR staff maintain an inventory, review monitoring results, and conduct inspections to make sure public water systems meet of the SDWA (DNR, 2014a).

Public water systems can be broken into four categories: municipal community systems (MC), other than municipal community systems (OTM), non-transient non-community systems (NN) and transient non-community systems (NT). Non-community transient systems, such as restaurants, churches and campgrounds account for 83 percent of the total 11,420 water systems. Most of the state's drinking water is sourced from groundwater, but some of the largest population centers use lakes as a source. Public water systems ae required to annually test their water and report their findings to their customers and the DNR. In 2013, 95.5 percent of public water systems met their standards (DNR, 2014a).

Wastewater

Many wastewater utilities in Wisconsin have aspects of their service regulated by the PSC. This includes setting utility rates, handling customer complaints, and promoting water conservation. The PSC has jurisdiction over just nine wastewater utilities, as local governments and municipalities oversee their own systems (PSC, 2015d). The Wisconsin DNR is responsible for many other aspects of wastewater oversight, including the review of construction plans for municipal or industrial systems. They also handle the Wisconsin Pollutant Discharge Elimination System (WPDES) permit process that allows for discharge of pollutants and treated water (DNR, 2015a). These WPDES permits "contain all the monitoring requirements, special reports, and compliance schedules appropriate to the facility in question." Permits may be obtained for specific types of wastewater discharge, including those allowing for discharge of agricultural waste and stormwater (DNR, 2015b). The DNR also certifies wastewater facility operators to ensure their competency. Wastewater plants are assigned to a class based on the treatment process, and this class coincides with a tiered system of operator certifications. The certification of an operator must coordinate with the class of the plan they operate (DNR, 2015c).

Solid Waste Management

The DNR of Wisconsin seeks to help manage solid waste disposal in the state by working with "local governments, private industry, other organizations and individual citizens to reduce waste and increase reuse and recycling." One of their most important functions is the permitting and licensing of many types of solid waste facilities, including landfills, incinerators, transfer facilities, and composting facilities. The inspection of proposed waste management sites by the DNR is required before the permitting process can begin in earnest (DNR, 2015d). Among other facilities, the state is home to 63 currently licensed and active solid waste landfills (DNR, 2015e). Landfill operators must monitor their sites to ensure contaminants from the landfill do not spread (DNR, 2015f). As of January 2015, the state had 141,525,621 cubic yards of space remaining in its landfills (DNR, 2015g). New recycling laws ban a number of materials from landfilling and give authority to municipalities to manage recycling programs for them. An average of 2 million tons of materials are recycled or composted each year as an alternative to landfilling (DNR, 2015h). In 2014, a total of 710,233 tons of materials were recycled (DNR, 2015i).

17.1.2. Soils

17.1.2.1. Definition of the Resource

The Soil Science Society of America defines soil as:

i. "The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants." (NRCS, 2015a)

ii. "The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics." (NRCS, 2015a)

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

- *Parent Material*: The original geologic source material from the soil formed affects soil aspects, including color, texture, and ability to hold water.
- *Climate*: Chemical changes in parent material occur slowly in low temperatures. 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.

17.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 17.1.2-1 below.

Table 17.1.2-1: Relevant Wisconsin Soils Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Wisconsin Stormwater Discharge Permits (Chapter NR 216, Wisconsin Administrative Code)	Wisconsin Department of Natural Resources (DNR)	As part of the stormwater discharge permitting process, an erosion control plan must be developed and completed (State of Wisconsin, 2015).

17.1.2.3. Environmental Setting

Wisconsin is composed of two Land Resource Region (LRR),[12] as defined by the Natural Resources Conservation Service (NRCS) (NRCS, 2006):

- Central Feed Grains and Livestock Region, and
- Northern Lake States Forest and Forage Region.

Within and among Wisconsin's two LRRs are 13 Major Land Resource Areas (MLRA),[13] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming. The locations and characteristics of Wisconsin's MLRAs are presented in Figure 17.1.2-1 and Figure 17.1.2-2.

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[14] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[15] with wet and dry seasons alternately swell and shrink, which presents integrity risks to structural foundations (Rogers, Olshansky, & Rogers, 2004). Soils can also be affected by a variety of surface uses that loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting[16] (discussed further in the subsections below).

[12] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[13] Major Land Resource Area: "A geographic area, usually several thousand acres in extent, that is characterized by a particular pattern of soils, climate, water resources, land uses, and type of farming" (NRCS, 2006).
[14] The flora and fauna of a region.
[15] Expansive soils are characterized by "the presence of swelling clay minerals" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil" (Rogers, Olshansky, & Rogers, 2004).
[16] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, Soil-Disturbance Field Guide, 2009).

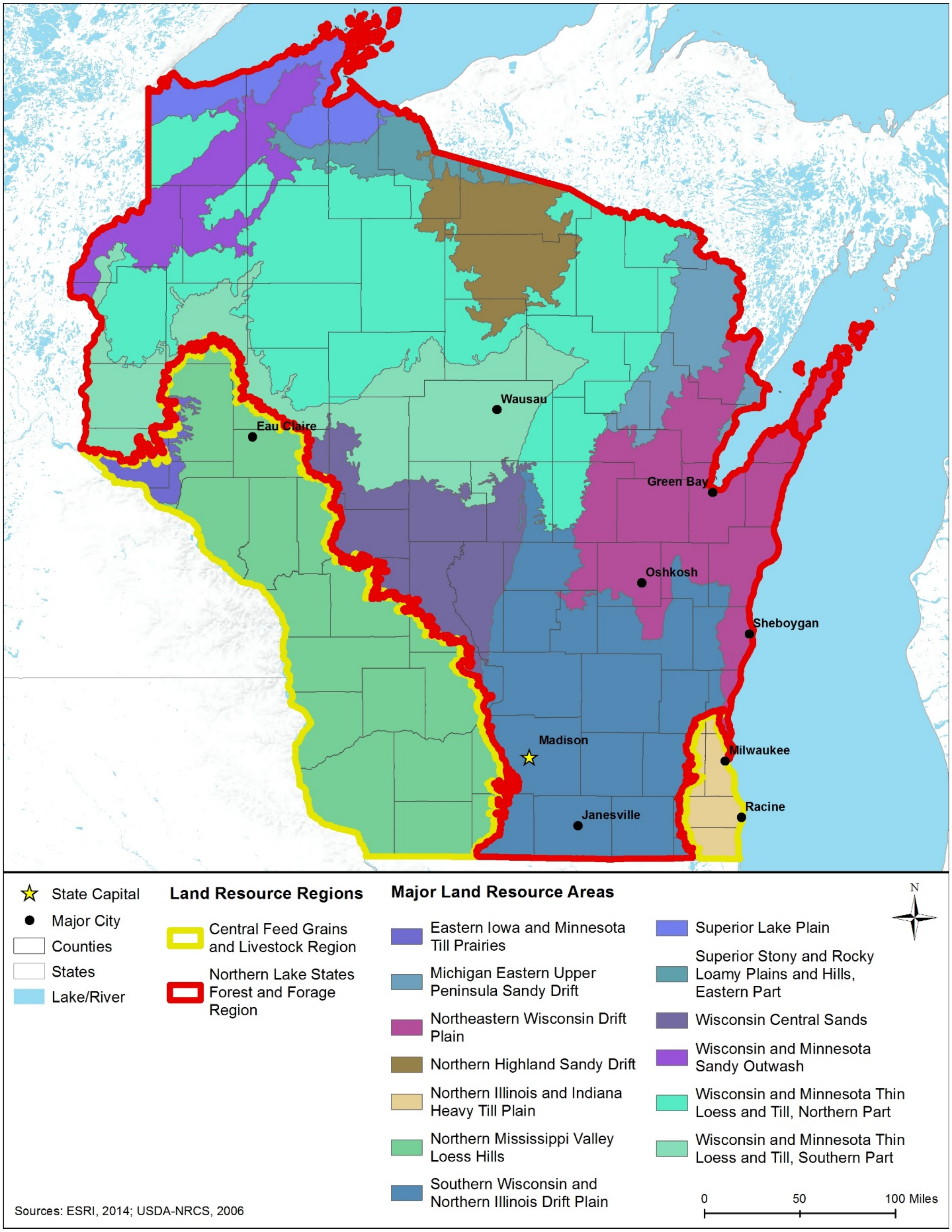


Figure 17.1.2-1: Locations of Major Land Resource Areas in Wisconsin

Table 17.1.2-2: Characteristics of Major Land Resource Areas in Wisconsin

MLRA Name	Region of State	Soil Characteristics
Eastern Iowa and Minnesota Till Prairies	Western Wisconsin	Alfisols[a] and Mollisols[b] are the dominant soil orders. These loamy[c] and typically very deep soils range from very poorly drained to well drained.
Michigan Eastern Upper Peninsula Sandy Drift	Eastern Wisconsin	Alfisols, Entisols,[d] Histosols,[e] and Spodosols[f] are the dominant soil orders. These clayey to sandy soils range from very poorly drained to excessively drained. They range from shallow to very deep.
Northeastern Wisconsin Drift Plain	Eastern Wisconsin	Alfisols, Histosols, and Spodosols are the dominant soil orders. These clayey to sandy soils range from very poorly drained to excessively drained, and are very deep.
Northern Highland Sandy Drift	Northern Wisconsin	Histosols and Spodosols are the dominant soil orders. These mucky, sandy, or loamy soils range from very poorly drained to excessively drained, and are very deep.
Northern Illinois and Indiana Heavy Till Plain	Southeastern Wisconsin	Alfisols, Histosols, Inceptisols,[g] and Mollisols are the dominant soil orders. These soils typically range from moderately well drained to poorly drained, and are moderately deep to very deep. They are "silty or clayey in the subsoil."
Northern Mississippi Valley Loess Hills	Southwestern Wisconsin	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.
Southern Wisconsin and Northern Illinois Drift Plain	Southern Wisconsin	Alfisols, Histosols, and Mollisols are the dominant soil orders. These loamy soils typically range from poorly drained to well drained, and are very deep.
Superior Lake Plain	Northern Wisconsin	Alfisols, Entisols, Inceptisols, and Spodosols are the dominant soil orders. These clayey, sandy, silty, or loamy soils are very deep.
Superior Stony and Rocky Loamy Plains and Hills, Eastern Part	Northern Wisconsin	Histosols and Spodosols are the dominant soil orders. These soils range from very poorly drained to excessively drained, and range from shallow to very deep. They are clayey to sandy.
Wisconsin Central Sands	Central Wisconsin	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders, with Mollisols less so. These clayey to sandy soils are typically moderately deep to deep. They range from very poorly drained to well drained.
Wisconsin and Minnesota Sandy Outwash	Northwestern Wisconsin	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	Northern Wisconsin	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	Central Wisconsin	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] 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, 2015b)

[b] 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, 2015b)
[c] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts." (Purdue University Consumer Horticulture, 2006)
[d] 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, 2015b)
[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, 2015b)
[f] 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, 2015b)
[g] 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, 2015b)
Source: (NRCS, 2006)

17.1.2.4. 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;[17] there are 12 soil orders in the world and they are characterized by both observed and inferred[18] 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, 2015c). The STATSGO2[19] soil database identifies 14 different soil suborders in Wisconsin (NRCS, 2015d). Figure 17.1.2-2 depicts the distribution of the soil suborders, and Table 17.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[17] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015o).
[18] "Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)" (NRCS, 2015c).
[19] 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.

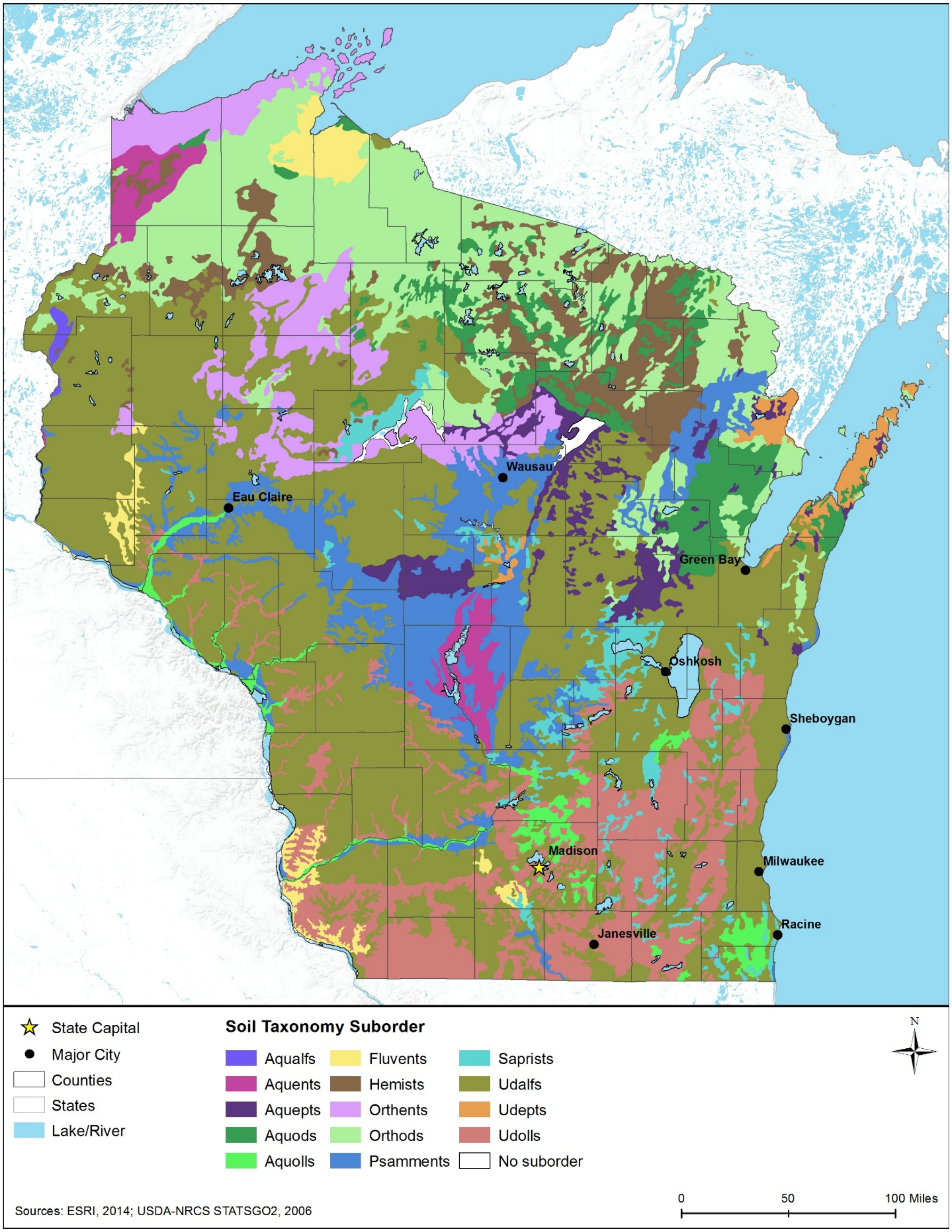


Figure 17.1.2-2: Wisconsin Soil Taxonomy Suborders

Table 17.1.2-3: Major Characteristics of Soil Suborders[a] Found in Wisconsin, as depicted in Figure 17.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
Alfisols	Aqualfs	Generally have warm and aquic (saturated with water long enough to cause oxygen depletion) conditions. Aqualfs are used as cropland for growing corn, soybeans, and rice, and most have some artificial drainage or other water control. Nearly all Aqualfs have likely supported forest vegetation in the past.	Loam	0-2	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
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, Loamy sand, Sand, Stratified loamy very fine sand to silt 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	Erosion and Compaction
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, groundwater is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Loamy sand, Silt Loam, Stratified very fine sand to silt	0-2	Poorly drained	Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
Spodosols	Aquods	Aquods are characterized by a shallow fluctuating water table, with water-loving vegetation, ranging from moss, shrubs, and trees in cold areas to mixed forests and palms in the warmest areas. Although some Aquods have been cleared and are used as cropland or pasture, most are used as forest or wildlife habitat, as they are naturally infertile (but they can be highly responsive to good management).	Gravelly sandy clay loam, Sand, Very fine sandy loam	0-3	Very poorly drained to somewhat poorly drained	No, Yes	A, B, D	Low, Medium, High	High, Moderate, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
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 loam, Silt loam, Silty clay	0-2	Very poorly drained to poorly drained	Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently-deposited sediments on flood plains, fans, and deltas 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.	Silt loam, Silty clay loam, Stratified sand to silt loam, Variable	0-3	Somewhat poorly drained to well drained	No	B, C	Medium	Moderate, Low	Medium	Low	Erosion
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	0-2	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	Erosion and Compaction
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Variable, Very gravelly coarse sand	12-60	Well drained to excessively drained	No	A, B	Low, Medium	High, Moderate	Low to Medium, depending on slope	Low	Erosion

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
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.	Cobbly sandy clay loam, Fine sand, Gravelly coarse sand, Gravelly loamy sand, Loamy sand, Sand, Sandy loam, Stratified cobbly coarse sand to sand, Very fine sandy loam	0-40	Moderately well drained to excessively drained	No	A, B	Low, Medium	High, Moderate	Low to Medium, depending on slope	Low	Erosion
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Coarse sand, Fine sand, Gravelly sand, Loamy fine sand, Loamy sand, Sand	0-35	Somewhat poorly drained to excessively drained	No	A, B, D	Low, Medium, High	High, Moderate, Very Low	Low to High, depending on slope	Low	Erosion
Histosols	Saprists	Saprists have organic materials are well decomposed, and many support natural vegetation and are used as woodland, rangeland, or wildlife habitat. Some Saprists, particularly those with a mesic or warmer temperature regime, have been cleared, drained, and used as cropland.	Gravelly loamy sand, Muck, Sandy loam, Silty clay	0-2	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	Erosion and Compaction
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Clay, Clay loam, Extremely gravelly coarse sand, Fine sand, Fine sandy loam, Gravelly fine sandy loam, Gravelly loam, Gravelly sandy loam, Loam, Loamy sand, Sand, Sand and gravel, Sandy clay loam, Sandy loam, Silt loam, Silty clay loam, Unweathered bedrock, Weathered bedrock	0-60	Somewhat poorly drained to somewhat excessively drained	No	B, C	Medium	Moderate, Low	Medium	Low	Erosion
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the Northwest and mixed or hardwood forest in the East. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Extremely gravelly sandy loam, Fine sandy loam	0-6	Well drained	No	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	Low	Erosion

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Channery clay, Clay loam, Coarse sand, Loam, Silt loam, Silty clay loam, Stratified fine sand to silt, Stratified gravelly loamy sand to silty clay loam, Stratified sandy loam to silty clay	0-20	Somewhat poorly drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low	Erosion

[a] Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.
[b] Hydric Soil: "A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS, 2015e). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydric while others are not.
[c] Based on Runoff Potential, described in Section 17.1.2.5
Sources: (NRCS, 2015d) (NRCS, 1999)

Page Intentionally Left Blank.

17.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[20] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 17.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Wisconsin.

Group A. Sand, loamy sand or sandy loam soils. This group of soils has “low runoff potential and high infiltration rates[21] 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, Aquods, Hemists, Orthents, Orthods, Psamments, and Saprists fall into this category in Wisconsin.

Group B. Silt loam or loam soils. This group of soils has a “moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures” (Purdue University, 2015). This group has medium runoff potential. Aquents, Aquepts, Aquods, Aquolls, Fluvents, Orthents, Orthods, Psamments, Udalfs, Udepts, and Udolls fall into this category in Wisconsin.

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. Fluvents, Udalfs, and Udolls fall into this category in Wisconsin.

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

17.1.2.6. Soil Erosion

“Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity” (NRCS, 2015f). Water-induced erosion can transport soil into streams, rivers, and lakes, degrading water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil particles displaced by wind can cause human health problems and reduced visibility, creating a public safety hazard (NRCS, 1996a). Table 17.1.2-3 provides a summary of the erosion potential

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

for each soil suborder in Wisconsin. Soils with medium to high erosion potential in Wisconsin include those in the Aqualfs, Aquents, Aquepts, Aquods, Aquolls, Fluvents, Hemists, Orthents, Orthods, Psamments, Saprists, Udalfs, Udepts, and Udolls suborders, which are found throughout the state (Figure 17.1.2-2).

17.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (USFS, 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 17.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Wisconsin. Soils with the highest potential for compaction and rutting in Wisconsin include those in the Aqualfs, Aquents, Aquepts, Aquods, Aquolls, Hemists, and Saprists suborders, which are found across the state (Figure 17.1.2-2).

17.1.3. Geology

17.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 17.1.4), Human Health and Safety (Section 17.1.15), and Climate Change (Section 17.1.14).

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

- Section 17.1.3.3, Environmental Setting: Physiographic Regions[22] and Provinces[23]
- Section 17.1.3.4, Surface Geology

[22] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).
[23] Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

- Section 17.1.3.5, Bedrock Geology[24]
- Section 17.1.3.6, Paleontological Resources[25]
- Section 17.1.3.7, Fossil Fuel and Mineral Resources
- Section 17.1.3.8, Geologic Hazards[26]

17.1.3.2. 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 17.1.3-1 below.

Table 17.1.3-1: Relevant Wisconsin Geology Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Wisconsin Administrative Code Chapter NR 45.04	Wisconsin Department of Natural Resources (DNR)	Fossils can be collected for noncommercial purposes (education, personal collection), but must be removed by hand and no more than five pounds of fossil material may be removed per day. No fossils can be collected on state natural areas, state wild rivers, state parks, state trails, Havenwoods state forest preserve, state recreation areas, Point Beach and Kettle Moraine state forests, and any other site designated a "noncollection site" by DNR.
Wisconsin Commercial Building Code	Wisconsin Department of Commerce	Provides seismic guidelines for commercial buildings.

17.1.3.3. Environmental Setting: Physiographic Regions and Provinces

The concept of physiographic regions was created in 1916 by geologist Nevin Fenneman as a way to describe areas of the United States based on common landforms (i.e., not climate or vegetation). Physiographic regions are areas of distinctive topography, geography, and geology. "Important physiographic differences between adjacent areas are, in a large proportion of cases, due to differences in the nature or structure of the underlying rocks." There are eight distinct physiographic regions in the continental United States: 1) Atlantic Plain, 2) Appalachian Highlands, 3) Interior Plains, 4) Interior Highlands, 5) Laurentian Upland, 6) Rocky Mountain System, 7) Intermontane Plateaus, and 8) Pacific Mountain System. Regions are further sub-divided into physiographic provinces based on differences observed on a more local scale. (Fenneman, 1916)

Wisconsin is within two physiographic regions: Interior Plains (Central Lowland Province) and Laurentian Upland (Superior Upland Province) (Figure 17.1.3-1). These physiographic designations are discussed in greater detail below.

---

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

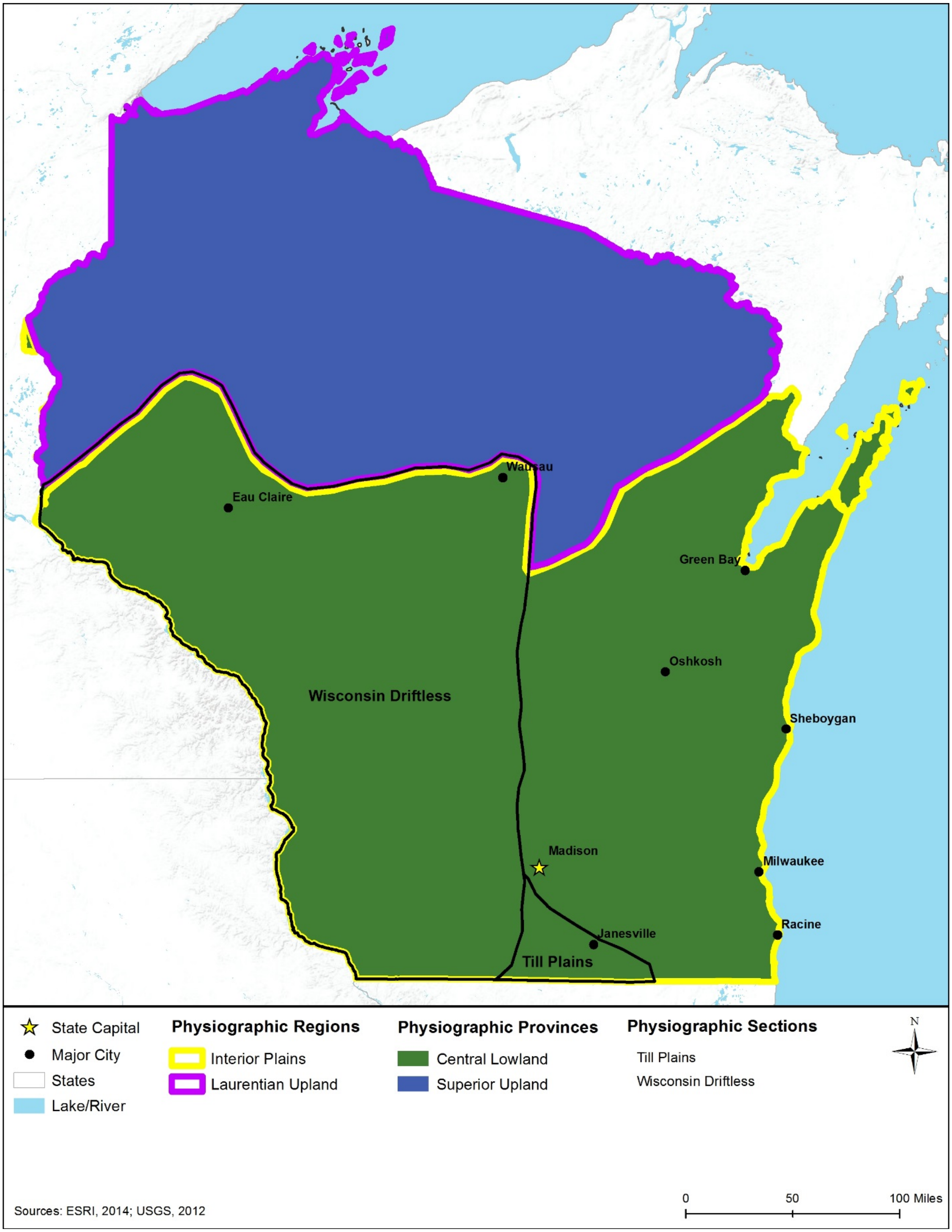


Figure 17.1.3-1: Physiographic Regions and Provinces of Wisconsin

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[27] and igneous[28] rocks dating to the Precambrian Era (older than 542 million years ago [MYA] underlie the entire region.[29] 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, 2014a).

As reported above, the Interior Plains Region within Wisconsin is composed of one physiographic province: the Central Lowland (USGS, 2008).

<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 Wisconsin, the Central Lowland includes much of the southern portion of the state. The western portion of Wisconsin's Central Lowland Province is often referred to as the Wisconsin Driftless Area, in recognition of the fact that Wisconsinan age glaciers (100,000 to 10,000 years ago) bypassed this area, and instead remained to the north and east (Illinois DNR, 2015). The Driftless Area is comprised of approximately 12,700 square miles and is characterized as an eroded plateau that is covered in loess[33] deposits that are tens of feet thick. Much of the area is underlain by dolomite,[34] sandstone,[35] and limestone,[36] and, to a lesser extent, shale[37] and gneiss[38]

---

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

[28] Igneous Rock: "Rocks that solidified from molten or partly molten material, such as magma" (USGS, 2005).

[29] 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.

[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, 2014f).

[31] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015g).

[32] Mudstone: "A very fine-grained sedimentary rock formed from mud" (USGS, 2015g).

[33] Loess: "A wind-blown deposit of sediment made mostly of silt-sized grains" (USGS, 2015g).

[34] Dolomite: "A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral ($CaMgCO_3$)" (USGS, 2015g).

[35] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015g).

[36] Limestone: "A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation." (USGS, 2015g)

[37] Shale: "Sedimentary rock derived from mud. Commonly finely laminated (bedded). Particles in shale are commonly clay minerals mixed with tiny grains of quartz eroded from pre-existing rocks." (USGS, 2015g)

[38] Gneiss: "A coarse-grained, foliated metamorphic rock that commonly has alternating bands of light and dark-colored minerals" (USGS, 2015g).

(DNR, 2012a). "The rough, unglaciated terrain features wooded uplands, rolling hills, narrow valleys, numerous streams, springs, and cliffs and bluffs" (Illinois DNR, 2015).

A portion of the southern part of Wisconsin's Central Lowland Province is referred to as the Till Plain. Glacial features are common throughout the Till Plain in southern Wisconsin. For example, drumlins[39] composed of sand and gravel are common throughout this portion of the state (Wisconsin Geological & Natural History Survey, 2013a). A moraine[40] stretches throughout Sheboygan, Washington, and Waukeha Counties. "Pot-shaped depressions, or kettles, formed when large blocks of buried ice melted after the ice lobes receded" (Wisconsin Geological & Natural History Survey, 2013b).

Laurentian Upland Region

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

Superior Upland Province – The Superior Upland Province is comprised of the southern portion of the Laurentian Upland Region within Wisconsin. "The rocks of the Superior Upland are mostly Precambrian [older than 542 MYA] metamorphic rocks and overlying Paleozoic rocks (Cambrian [542 to 488 MYA])." 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 Wisconsin, the Superior Upland is characterized by "forests, lakes, and wetlands. Most of these lakes and wetlands occupy kettles in broad plains deposited by rivers carrying meltwater and [outwash][41] sediment." The highest point in Wisconsin, Timms Hill (1,949 ft), a glacial deposit, is within the Superior Upland Province. (Wisconsin Geological & Natural History Survey, 2013c) (USGS, 2001)

17.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[42] 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.

[39] Drumlin: "An elongated ridge of glacial sediment sculpted by ice moving over the bed of a glacier" (USGS, 2013b).
[40] Moraine: "A hill-like pile of rock rubble located on or deposited by a glacier" (USGS, 2015g).
[41] Outwash: "Glacial outwash is the deposit of sand, silt, and gravel formed below a glacier by meltwater streams and rivers" (USGS, 2015g).
[42] Till: "An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water." (USGS, 2013c)

Depending on the structural characteristics and chemical compositions of the surface materials, heavy precipitation can cause slope failures,[43] subsidence,[44] and erosion. (Thompson, 2015)

As shown in Figure 17.1.3-2, most of the surficial materials in Wisconsin are from deposits attributed to the Laurentide glaciation which covered Wisconsin between 26,000 and 10,000 years ago. The Laurentide Ice Sheet covered much of northern and eastern Wisconsin, but was prevented from entering western and southwestern portions of the state by topographical highlands. “The landscape of the area glaciated during the last part of the Wisconsin Glaciation is notably different than that of areas glaciated earlier in the Ice Age (where erosion has destroyed most of the earlier glacial landforms) and areas that were never glaciated. For example, the outermost limit of the last glacier is marked by a conspicuous ridge of glacially deposited debris. The many lakes and wetlands and the irregular landscape that characterize so many areas of eastern and northern Wisconsin are also a direct result of the last glacier.” (Wisconsin Geological & Natural History Survey, 2013d)

17.1.3.5. Bedrock Geology

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015a) reveals important information about a region's surface and subsurface characteristics (i.e., 3-dimensional geometry), including dip (slope of the formation),[45] rock composition, and regional tectonism[46]. 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).

As noted in Section 17.1.3.3, Wisconsin contains some of the oldest geologic formations in North America. Wisconsin's Superior Upland Province is primarily underlain by igneous and metamorphic[47] Precambrian rocks dating to 2.8 to 1.0 billion years ago (BYA); these rocks include basaltic[48] and rhyolitic[49] lava flows, granite,[50] diorite,[51] and gneiss.[52] Wisconsin's Central Lowland Province is underlain by Paleozoic sedimentary rocks dating to 501 to 359 MYA; these rocks include sandstone, dolomite, and shale. (Wisconsin Geological & Natural History Survey, 2011)

---

[43] 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).

[44] Subsidence: “Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials” (USGS, 2000).

[45] 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).

[46] Tectonism: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust” (NPS, 2000).

[47] Metamorphic Rock: “A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids” (USGS, 2015g).

[48] Basalt: “A dark, fine-grained, extrusive (volcanic) igneous rock with a low silica content (40% to 50%), but rich in iron, magnesium and calcium” (USGS, 2015g).

[49] Rhyolite: “A volcanic rock chemically equivalent to granite, usually light colored, very fine-grained or glassy-looking. May have tiny visible crystals of quartz and/or feldspar dispersed in a glassy white, green, or pink groundmass” (USGS, 2015g).

[50] 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, 2015g).

[51] Diorite: “Intrusive igneous rock made of plagioclase feldspar and amphibole and/or pyroxene. Similar to gabbro only not as so dark, and containing less iron and magnesium” (USGS, 2015g).

[52] Gneiss: “A coarse-grained, foliated metamorphic rock that commonly has alternating bands of light and dark-colored minerals” (USGS, 2015g).

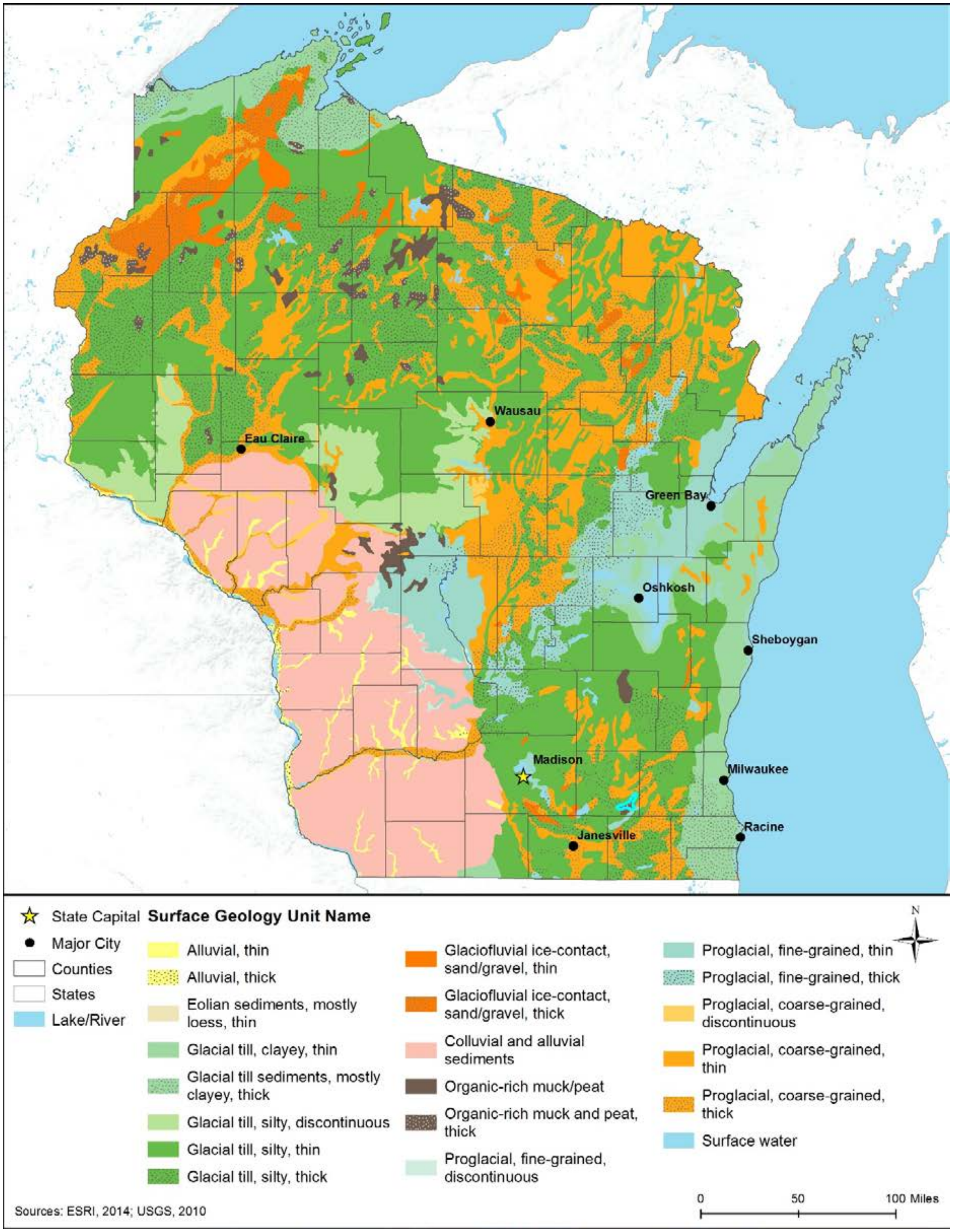


Figure 17.1.3-2: Generalized Surface Geology for Wisconsin

Figure 17.1.3-3 displays the general bedrock geology for Wisconsin.

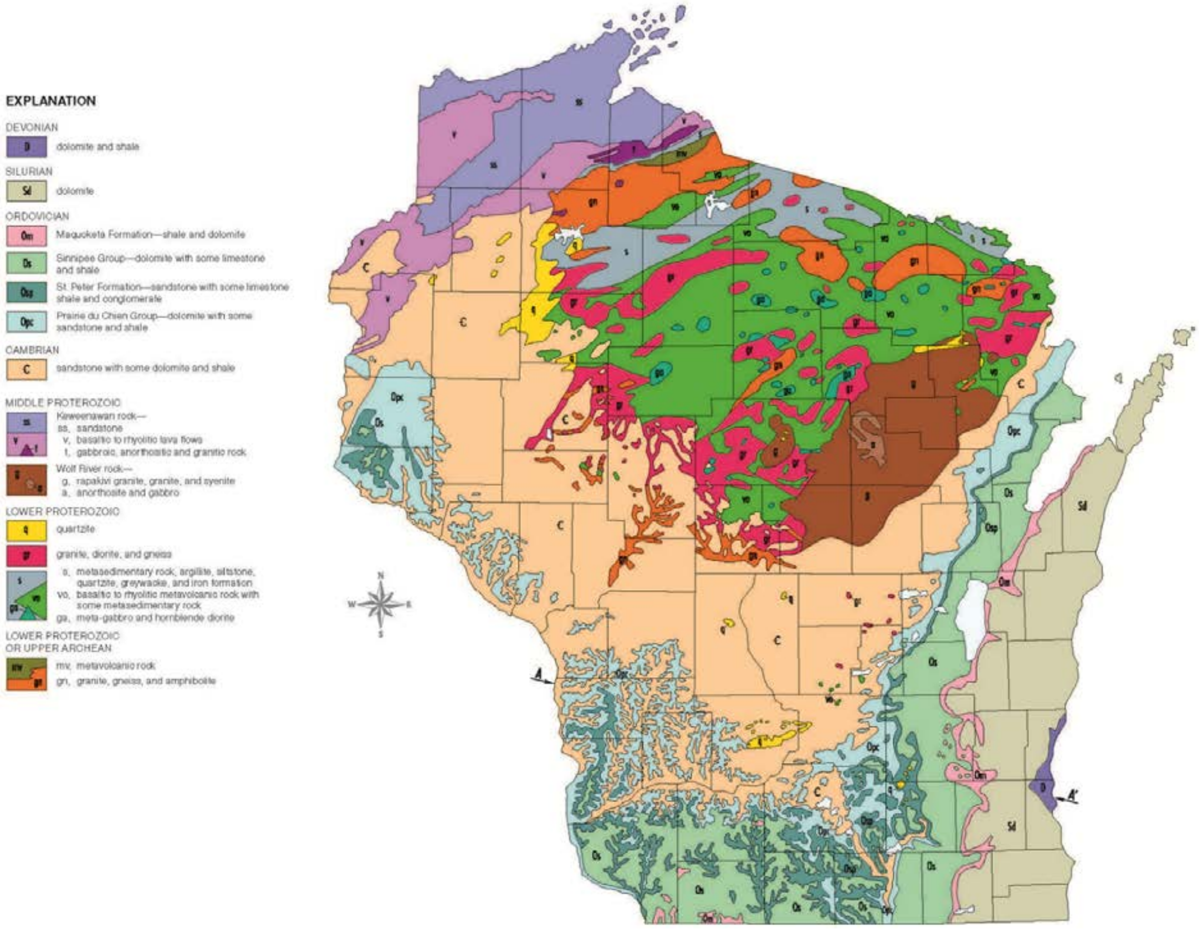
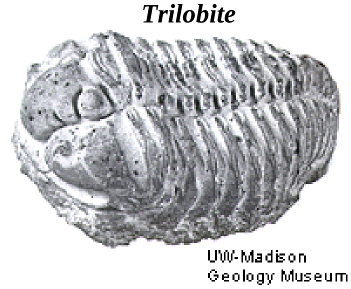


Figure 17.1.3-3: Generalized Bedrock Geology for Wisconsin

Source: (University of Wisconsin-Extension, 2005)

17.1.3.6. Paleontological Resources

Wisconsin State Fossil
Trilobite



Source: (DNR, 2015k)

Paleozoic Era (542 to 251 MYA) fossils are found in sedimentary rocks throughout Wisconsin, particularly in the eastern and southern portions of the state (Nehm & Bemis, 2002). During the early and middle Paleozoic Era, Wisconsin was nearly entirely covered by a warm shallow sea; marine fossils have been recorded from throughout the Paleozoic Era. Cambrian (542 to 488 MYA) brachiopods,[53] *Dikelocephalus*, and fossils of soft bodied animals, have been found in the Krukowski

[53] 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).

Quarry in central Wisconsin. Ordovician (488 to 444 MYA) fossils include cephalopods,[54] colonial corals, and bryozoans,[55] while Silurian (444 to 416 MYA) fossils also include stromatoporids, trilobites,[56] brachiopods, clams (Paleontology Portal, 2015). Silurian fossils also include trilobites, which have been designated as the Wisconsin State Fossil (DNR, 2015k). Devonian Period (416 to 359 MYA) fossils include cephalopods, gastropods,[57] bivalves,[58] bryozoans, brachiopods, corals, trilobites, sponges, crinoids,[59] shells from single-celled animals, conodonts,[60] and teeth and scales from sharks and fish. The next record of fossils comes from the Quaternary Period (2.6 MYA to Present). During portions of this timeframe, Wisconsin was covered by glacial ice sheets (particularly during the Wisconsinan glacial advance [100,000 to 10,000 years ago]), allowing for the preservation of terrestrial animals including horses, beavers, and the wooly mammoth. Along the Great Lakes, fossils from whales, walrus, and seals have been recorded (Paleontology Portal, 2015).

17.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

Wisconsin does not produce crude oil or natural gas. The state relies on imports of both resources (EIA, 2015c).

Minerals

As of 2015, Wisconsin's total mineral production was valued at \$3.6B, ranking 5th nationwide (in terms of dollar value). This accounts for less than 5 percent of the total nationwide mineral production. As of 2015, Wisconsin's leading mineral commodities were industrial sand and gravel, construction sand and gravel, crushed stone, lime, and dimension stone.[61] (USGS, 2016a).

[54] 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).
[55] Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies" (Smithsonian Institution, 2016).
[56] 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)
[57] Gastropods: "Any member of a large class of mollusks (Gastropoda), commonly called snails. Gastropods live in marine, freshwater, and terrestrial habitats. They have a univalve, often spiral shell (or none at all), a muscular foot for locomotion, and distinctive sensory organs." (Smithsonian Institution, 2016)
[58] Bivalve: "A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing" (Smithsonian Institution, 2016).
[59] 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)
[60] Conodont: "Any member of a group of worm-like, vertebrate organisms common from the Ordovician to the Triassic. Conodont dental batteries are important tools for Paleozoic and early Mesozoic biostratigraphy" (Smithsonian Institution, 2016).
[61] Dimension stone: "Natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape" (USGS, 2016b).

17.1.3.8. Geologic Hazards

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

Earthquakes

Between 1973 and March 2012, there were no earthquakes of a magnitude 2.5 (on the Richter scale[62]) or greater in Wisconsin (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 (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 happen where tectonic plates converge. "When these plates collide, one plate slides (subducts) beneath the other, where it is reabsorbed into the mantle of the earth" (U.S. Census Bureau, 2015d). 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). Wisconsin is located far from any convergence boundaries, but is located in the Great Lakes tectonic zone (Sims, 1993).

Figure 17.1.3-4 depicts the seismic risk throughout Wisconsin. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (percent g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 percent g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 percent g. (USGS, 2010)

Areas of greatest seismicity in Wisconsin are concentrated in the southern portions of the state (Figure 17.1.3-4); the box surrounding the range of colors shows the seismic hazards in the state. Though the potential for earthquakes is minimal throughout Wisconsin, one earthquake that produced perceptible shaking was recorded south of Milwaukee in 1947. "The shock was felt in a 160 kilometer wide strip from Sheboygan to the Wisconsin-Illinois border and extended from the lakeshore to Waukesha, 40 kilometers inland." Earthquakes emanating in other states and Canadian provinces, including South Carolina, Missouri, Quebec, Illinois and Ohio, have been felt in Wisconsin (USGS, 2015c).

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

Landslides

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

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

As shown in Figure 17.1.3-5, the potential for landslides throughout Wisconsin is minimal. This is due to the state's flat topography and position within the stable portion of the North American continent (see Section 17.1.3.3).

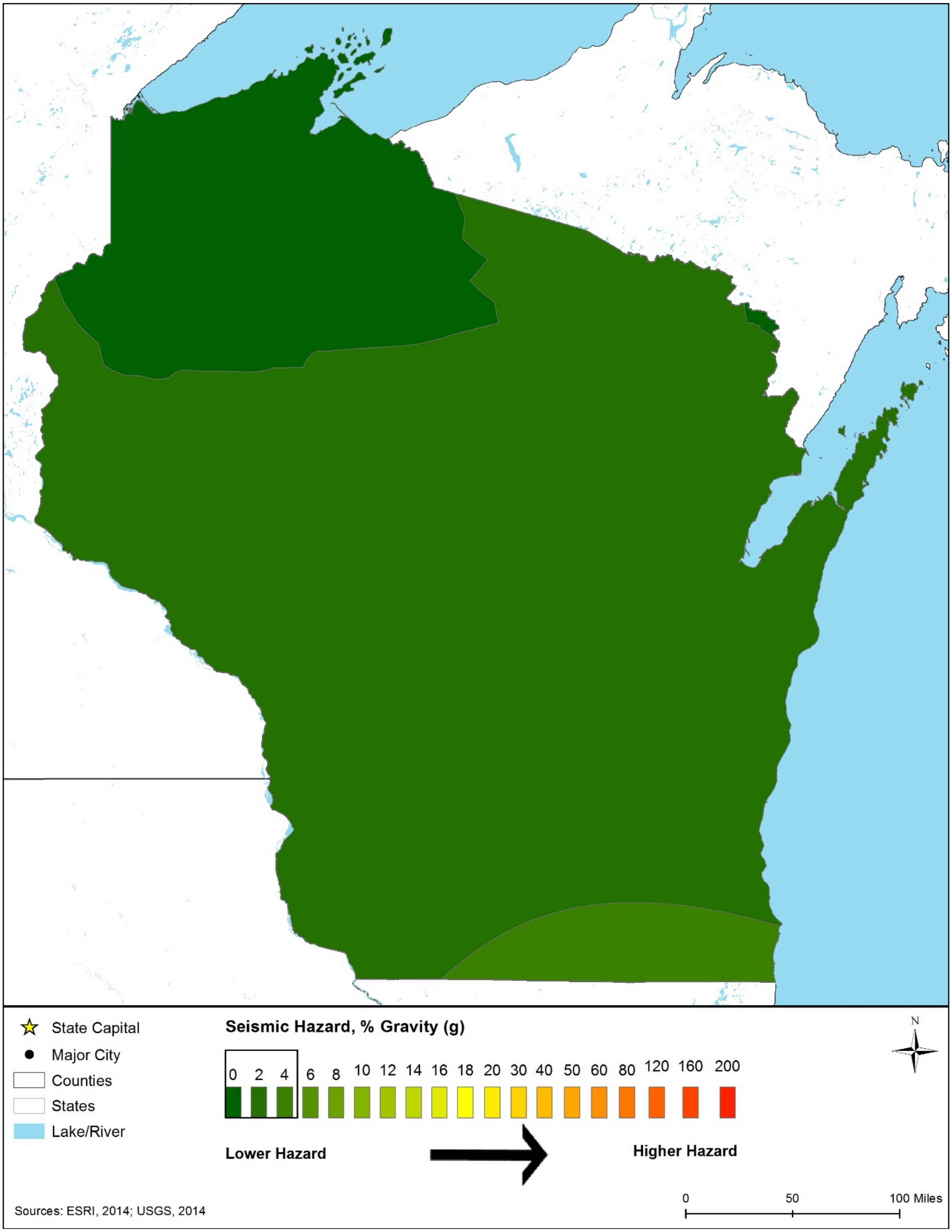


Figure 17.1.3-4: Wisconsin 2014 Seismic Hazard Map

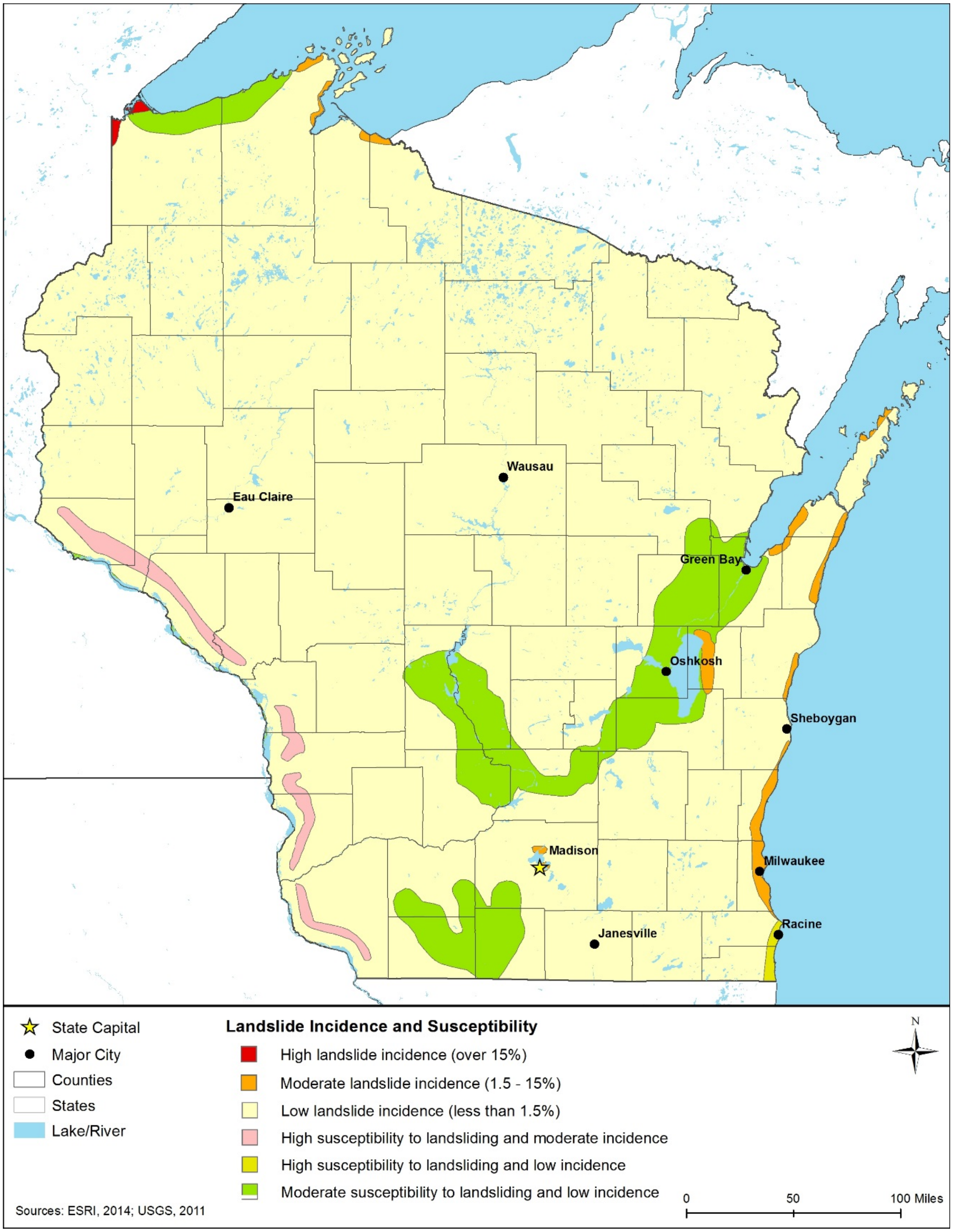


Figure 17.1.3-5: Wisconsin Landslide Incidence and Susceptibility Hazard Map[63]

[63] Susceptibility hazards not indicated in Figure 17.1.3-5 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

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) Land subsidence in Wisconsin has been observed in southern portions of the state (Wisconsin Geological & Natural History Survey, 2013e). The main triggers of land subsidence can be aquifer compaction, drainage of organic soils, mining, sinkholes, and and the presence of karst topography. More than 80 percent of subsidence in the United States is due to over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains. If an aquifer is confined by layers of silt or clay, which do not transport groundwater, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000).

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

In Wisconsin, the main cause of land subsidence is karst[64] topography due to underlying bedrock composed of dolomite[65] (Figure 17.1.3-6). Karst topography "is most likely to occur in a V-shaped swath that extends southeast from St. Croix County along the Mississippi River, across the bottom two tiers of counties, and northeast along Lake Michigan up to Marinette County." Karst topography in Wisconsin frequently leads to sinkhole development. Sinkholes typically measure less than 10 feet in diameter in Wisconsin. On occasion, sinkholes measuring more than 100 feet across have been observed in the state. (Wisconsin Geological & Natural History Survey, 2013f)

Sinkhole near Eagle, WI

Source: (Wisconsin Geological & Natural History Survey, 2013f)

anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014h)

[64] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater" (USGS, 2015g).

[65] Dolomite: "A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral" ($CaMgCO_3$) (USGS, 2015g).

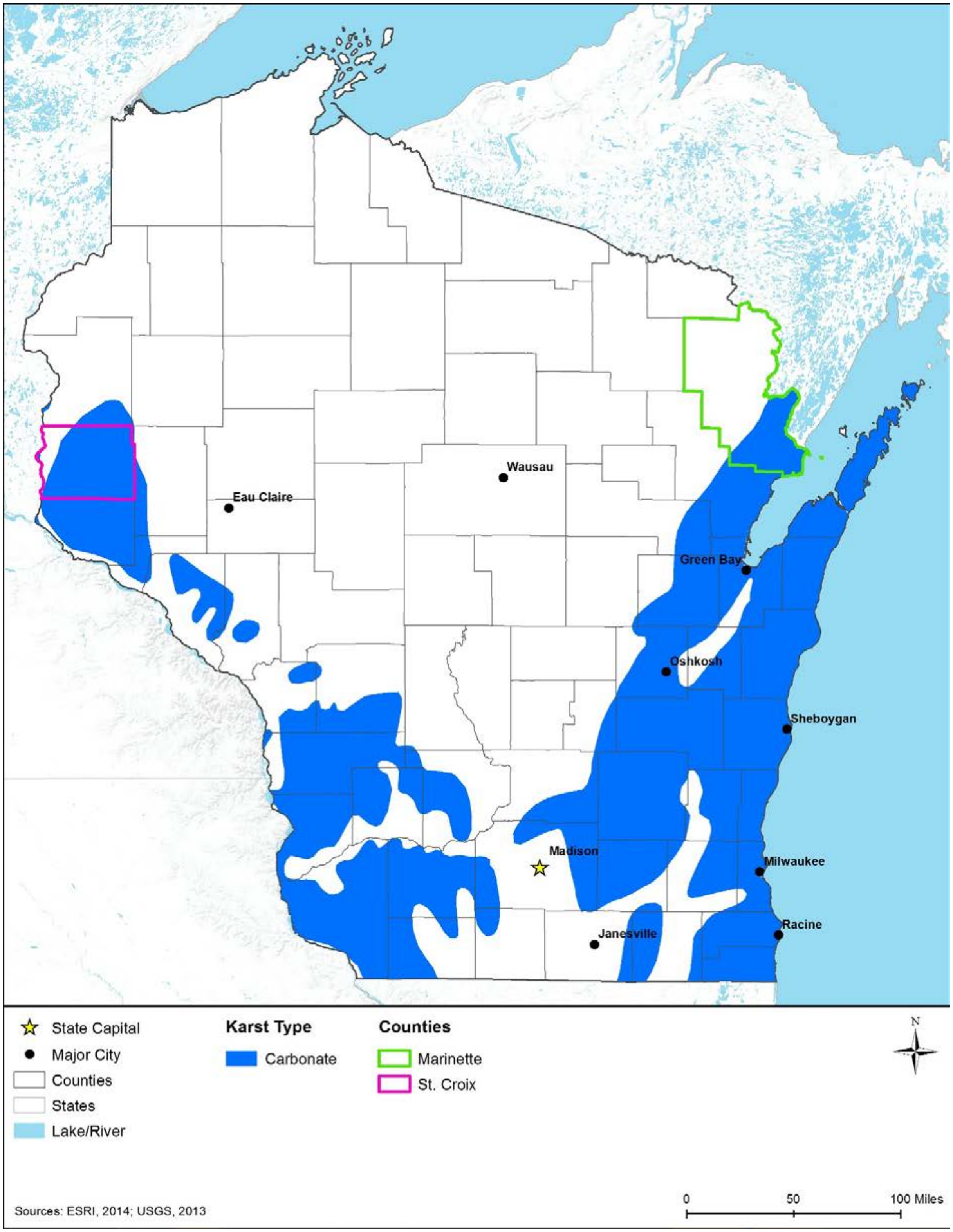


Figure 17.1.3-6: Karst Topography in Wisconsin

17.1.4. Water Resources

17.1.4.1. 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 17.1.5). These resources can be grouped into watersheds which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological health (USGS, 2014d).

17.1.4.2. 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 17.1.4-1 identifies the relevant laws and regulations for water resources in Wisconsin.

Table 17.1.4-1: Relevant Wisconsin Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Wisconsin Pollutant Discharge Elimination System Program	DNR	Construction activities that disturb one or more acre of land (DNR, 2011a).
Waterway Permit Program	DNR	Permits for activities adjacent to water or using water: agricultural livestock operations, aquatic plant management, dams, stormwater, wastewater, water supply, construction within waterways or wetlands (e.g., dredging) (DNR, 2016a).
Clean Water Act (CWA) Section 404 permit, Wisconsin Regional General Permit	U.S. Army Corps of Engineers (USACE), St. Paul District	Certain discharges of dredge or fill material into surface waters are eligible for authorization under the Regional General Permit and do not require individual CWA Section 404 permits. Some activities under the Regional General Permit require no notification of USACE and some activities require a permit application to the USACE and DNR (USACE, 2011).
CWA Section 401 permit	DNR	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from DNR indicating that the proposed activity will not violate water quality standards (DNR, 2013a).

17.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams, as well as coastal waters. According to the DNR, Wisconsin has 15,000 lakes and 88,000 miles of rivers. It also has 1,000 miles of shoreline along Lake Superior and Lake Michigan (DNR, 2015q).

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). Wisconsin's waters (lakes, rivers, and streams) are divided into 24 major watersheds, or drainage basins (Figure 17.1.4-1). Visit http://dnr.wi.gov/water/basin/ for information and additional maps about each DNR watershed's location, size, and water quality.

The Lake Superior Basin, along the north coast of Wisconsin, drains into Lake Superior (DNR, 2015m). To the east, the Green Bay Basin contains 18 watersheds, draining the area from the city of Green Bay to the border with Michigan. The basin consists of all waters draining to Green Bay between the city of Green Bay and the Wisconsin-Michigan border (DNR, 2015n). In the southwest part of the state, the Lower Wisconsin River Basin includes the lower Wisconsin River to its confluence with the Mississippi River, draining nearly 5,000 square miles. Water quality issues in this basin include nonpoint source pollution, such as hydrologic modifications, agricultural activities, and high concentrations of rough fish (DNR, 2015o).

Freshwater

As shown in Figure 17.1.4-1, major rivers in Wisconsin include the Mississippi River, along with its major tributaries such as the Chippewa, Black, and Wisconsin Rivers. The Mississippi River runs for approximately 200 miles through the state. Wisconsin has nearly 13,000 rivers and streams, with around 32,000 miles of perennial or continuous streams, the remainder of Wisconsin's approximately 88,000 miles of streams flow intermittently during the spring and other high water times. There are around 4,700 dams on rivers throughout the state, with around half constructed for recreational purposes. There are also 1,600 miles of rivers and streams in Wisconsin designated as "outstanding." These are discussed further in Section 17.1.4.4. (DNR, 2015p)

Wisconsin also contains more than 15,000 lakes (DNR, 2015q). Lake Winnebago is nearly 132,000 acres in size, with a maximum depth of approximately 21 feet (DNR, 2015r). Lake Winnebago's watershed covers nearly 600 square miles between the Upper and Lower Fox Rivers. Water quality issues that threaten the lake and its watershed include urban stormwater discharges from the cities of Menasha, Neenah, and Oshkosh. Elevated phosphorus and suspended solids, along with animal waste and soil erosion, all present threats to water quality (USEPA, 2013a).

Lake Superior borders the northern edge of Wisconsin, and stretches along eastern Minnesota, the Upper Peninsula of Michigan, and Ontario, Canada. At 31,700 square miles in size, with approximately 2,700 miles of shoreline, Lake Superior is the largest freshwater lake in the world. It has an average depth of about 500 feet and an average temperature of 40 degrees Fahrenheit.

It holds approximately 3,000 cubic miles of water. Much of the land surrounding the lake is heavily forested, and due to the relatively low amount of sediments, nutrients, and organic materials entering the lake, the water is clear to about eight feet deep. Lake Superior is considered the cleanest of the Great Lakes, although toxic pollutants including PCBs, dioxin, and mercury have been detected in the water. Other threats to the lake come from habitat degradation and loss, exotic species, erosion, and contaminated sediments. (DNR, 2015s) (DNR, 2015t)

Lake Michigan is over 22,000 square miles in size, the second largest of all of the Great Lakes. Over 400 miles of coastline are located in Wisconsin (DNR, 2015u). Lake Michigan's basin covers approximately 45,000 square miles, with the northern portion generally sparsely populated and covered with second-growth forest. In contrast, the southern portion of the basin is extremely developed, from Northwest Indiana up through Chicago to Milwaukee. This development threatens the lake from stressors including urban runoff, loss of native habitat, and improperly treated sewage discharge (USEPA, 2014a). Invasive species from overharvesting and commercial alterations of Great Lakes seaways have depleted native fish populations, and most of the dominant lake biota is either introduced or invasive species, such as alewife, rainbow smelt, ruffe, white perch, Pacific salmon and trout, gobies, zebra mussel, and exotic zooplankton (DNR, 2015u).

An international agreement knows as the “Great Lakes Water Quality Agreement” was formed in 1987 between the United States and Canada. This agreement required the creation of Lake-wide Action and Management Plans (LAMPs) for each Great Lake basin, including Lake Michigan and Lake Superior. These plans identify management goals and actions shared among the stakeholders of each Lake's basin. (DNR, 2012b)

17.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

The 252 miles of the St. Croix River, along with its major tributary, the Namekagon River, in northwestern Wisconsin (Figure 17.1.4-1) is a federally designated National Wild and Scenic River in Wisconsin (see Appendix C, Environmental Laws and Regulations, for more information about the Wild and Scenic Rivers Act). The river offers scenic views, wildlife viewing, and numerous recreation activities including Class I-II rapids (National Wild and Scenic Rivers System, 2015a). Twenty four miles of the Wolf River has also been designated a National Wild and Scenic River. It is considered one of the rugged and scenic rivers in the Midwest, and is not developed for public use (National Wild and Scenic Rivers System, 2015b).

Figure 17.1.4-1: Major Wisconsin Watersheds and Surface Waterbodies

In addition to federally designated Wild and Scenic Rivers, Wisconsin's system of state Wild Rivers affords "the people of the state an opportunity to enjoy natural streams, to attract out-of-state visitors and assure the well-being of our tourist industry, and to preserve some rivers in a free flowing condition and protect them from development" (DNR, 2015v). The following rivers, or portions of the rivers, have been designated as Wild Rivers: Pike River (Marinette County); Pine-Popple Rivers (Florence and Forest Counties); Martin Hanson Wild River (Portion of the Brunsweiler River in Ashland County); and Totagatic River (Bayfield, Burnett, Sawyer, and Washburn Counties) (Figure 17.1.4-1) (DNR, 2015v)

Outstanding and Exceptional Resource Waters

Certain surface waters designated as Outstanding Resource Waters (ORWs) or Exceptional Resource Waters (ERWs) are afforded further protections from pollutants, due to their good water quality, support of valuable fisheries and wildlife habitat, outstanding recreational opportunities, and low impacts from human activities. Waters designated as ORWs receive the highest protection standards. They usually have zero point source discharges and new discharges are only permitted if their effluent is equal to or better than background quality of the surface water. ERW designations are only slightly less stringent. If there are existing point sources when the waterbody is designated, it is typically designated an ERW. Like ORWs, new discharges must maintain background water quality. However, an exception can be made where human health would otherwise be compromised. Wisconsin has designated a total of 97 lakes, 6 impoundments,[66] and 254 streams as ORWs, and 1,544 streams as ERWs. (DNR, 2013b)

National Estuarine Research Reserve

Additionally, the Lake Superior National Estuarine Research Reserve (NERR) encompasses over 16,000 acres of freshwater estuaries. These include riverine and riparian habitat, riverine islands, emergent freshwater marsh, scrub swamp and interdunal wetlands, hardwood, aspen, and dry forests, and open sand beach and dunes. The NERR is located at the confluence of the St. Louis River and Lake Superior and provides an opportunity to better understand freshwater estuaries and coastal resources. (NOAA, 2015a)

17.1.4.5. 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,[67] the causes of impairment, and probable sources. Table 17.1.4-2 summarizes the water quality of Wisconsin's assessed major

[66] The U.S. Department of Energy defines an impoundment as "A body of water formed by damming a river or stream, commonly known as a reservoir" (DOE, 2016).
[67] 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, 2015a)

waterbodies by category, percent impaired, designated use,[68] cause, and probable sources. Figure 17.1.4-2 shows the Section 303(d) waters in Wisconsin as of 2014.

As shown in Table 17.1.4-2, various sources affect Wisconsin's waterbodies, causing impairments. These include mercury, sediment, nutrients, habitat alterations, organic enrichment/oxygen depletion, polychlorinated biphenyls, and pathogens. Wisconsin has developed TMDLs for impaired waterbodies that address pollutants including total suspended solids, total phosphorus, and sediment (USEPA, 2015s).

17.1.4.6. Floodplains

Floodplains are lowlands along inland or coastal waters, including flood-prone areas of offshore islands. The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as "any land area susceptible to being inundated by water from any source" (44 Code of Federal Regulations [CFR] 59.1) (FEMA, 2000). Through FEMA's flood hazard mapping program, the agency identifies flood hazards and risks associated with the 100-year flood, which is defined as "a flood that has a 1 percent chance of occurring in any given year," to allow communities to prepare and protect against flood events (FEMA, 2013).

Floodplains provide suitable and sometimes unique habitat for a wide variety of plants and animals, and are typically more biologically diverse than upland areas due to the combination of both terrestrial and aquatic ecosystems. Vegetation along stream banks provides shade, which helps to regulate water temperature for aquatic species. During flood events, sediment and debris settle out and collect on the floodplain, enriching the soil with additional nutrients. Pollutants from floodwater runoff are also filtered by floodplain vegetation and soils; thereby improving water quality. Furthermore, floodplains protect natural and built infrastructure by providing floodwater storage, erosion control, water quality maintenance, and groundwater recharge. Historically, floodplains have been favorable locations for agriculture, aquaculture, and forest production due to the relatively flat topography and nearby water supply. Floodplains can also offer recreational activities, such as boating, swimming, and fishing, as well as hiking and camping (FEMA, 2014a).

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

Table 17.1.4-2: Section 303(d) Impaired Waters of Wisconsin, 2014

Water Type[a]	Amount of Waters Assessed (acres/ miles)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Bay/ Harbor	NA	NA	Fish and Aquatic Life, Fish Consumption	Total Phosphorus, sediment/total suspended solids, Polychlorinated Biphenyls (PCBs), mercury	Contaminated sediments, discharges from municipal separate storm sewer systems, legacy/historical pollutants
Great Lakes Beaches	NA	NA	Fish and Aquatic Life, Recreation	E. coli	NA
Great Lakes Shoreline	NA	NA	Fish consumption	PCBs, mercury	NA
Impoundment	NA	NA	Fish and Aquatic Life, Recreation, Fish Consumption	Total Phosphorus, Mercury, PCBs, Dioxin	Non-point source (rural or urban), upstream source
Inland Beach	NA	NA	Recreation	E. coli	NA
Lake	793,898 acres (fish and aquatic life); 388,770 acres (recreation); 272,947 acres (fish consumption)	31% (fish and aquatic life); 67% (recreation); 91% (fish consumption)	Fish and Aquatic Life, public health and welfare, recreation, fish consumption	Total Phosphorus, sediment/total suspended solids, mercury,	Non-point source (rural or urban), non-irrigated crop production, discharges from municipal separate storm sewer systems
Rivers	19,624 miles (fish and aquatic life); 133 miles (recreation); 1,383 miles (fish consumption)	28% (Fish and Aquatic Life); 90% (recreation) 90% (fish consumption)	Fish and Aquatic Life, recreation, fish consumption	Total Phosphorus, sediment/total suspended solids, fecal coliform, E. coli, PCBs, mercury	NA

[a] This information comes from the Wisconsin 303(d) integrated report (DNR, 2014b), rather than USEPA (USEPA, 2015s)
NA- Not Available
Source: (DNR, 2014b); (DNR, 2014c)

Figure 17.1.4-2: Section 303(d) Impaired Waters of Wisconsin, 2014

There are two primary types of floodplains in Wisconsin.

- **Riverine and lake floodplains** occur along rivers, streams, or lakes where overbank flooding (rivers and streams) and fluctuating levels (lakes) may occur, inundating adjacent land areas (FEMA, 2014b). Riverine floodplains in Wisconsin can range from flat, wide areas in the coastal and plains region, to more narrow channels confined to steep valleys in hilly areas (Wisconsin Department of Military Affairs, 2011).
- **Coastal floodplains** in Wisconsin border the shorelines of Lake Michigan and Lake Superior. Coastal flooding can occur when strong wind and storms increase water levels on the adjacent shorelines (FEMA, 2013). All 15 counties that border Lake Michigan experience coastal flooding (Wisconsin Department of Military Affairs, 2011).

There are several causes of flooding in Wisconsin, including flash floods, debris and ice jam floods, local drainage floods, and flooding from high groundwater. The counties and cities located along the Wisconsin and Mississippi Rivers, along with Lake Michigan, are some of the state's most populous, and almost some of the most vulnerable to flooding. These include the cities of Milwaukee, Green Bay, Kenosha, and Racine. Smaller streams and rivers are also known to flood periodically, including the Milwaukee, Wolf, Bad, Pecatonica, Kickapoo, Menomonee, and Chippewa Rivers. (Wisconsin Department of Military Affairs, 2011)

One in six Presidential Emergency Declarations declared from 1971 to April 2011 in Wisconsin have been due to flooding, and these tend to be the most widespread. In the summer of 1993, a Presidential Disaster Declaration was made for 47 counties due to extremely heavy rainfall. Damages exceeded $740 million dollars. (Wisconsin Department of Military Affairs, 2011)

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 547 communities in Wisconsin through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Wisconsin had 17 communities participating in the CRS (FEMA, 2014d).[69]

17.1.4.7. 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

[69] A list of the 17 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

and springs. Groundwater is contained in either confined (bound by clays or nonporous bedrock) or unconfined (no layer to restrict the vertical movement of groundwater) aquifers (USGS, 1999). When the water table reaches the ground surface, groundwater will reappear as either streams, surface bodies of water, or wetlands. This exchange between surface water and groundwater is an important feature of the hydrologic (water) cycle.

Wisconsin's principal aquifers consist of dolomite, sandstone, and aquifers of alluvial and glacial origin. Approximately 70 percent of drinking water in Wisconsin comes from groundwater resources. Generally, the water quality of Wisconsin's aquifers is suitable for most uses, although water treatment can be needed to decrease iron or manganese concentrations and hardness that naturally occur in the water. Threats to groundwater quality include excessive fluoride, radium, and hydrogen-sulfide concentrations. (Moody, Carr, Chase, & Paulson, 1986)

Table 17.1.4-3 provides details on aquifer characteristics in the state; Figure 17.1.4-3 shows Wisconsin's principal aquifers. There are no sole source aquifers in Wisconsin (USEPA, 2015s).

Table 17.1.4-3: Description of Wisconsin's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin Varying origins and lithology of discontinuous deposits	Throughout the state	Hardness concentrations are highest in the east, and iron and manganese concentration exceedances have been reported across the state.
Cambrian-Ordovician aquifer system Consists of dolomite, dolomitic sandstone, sandstone, and siltstone	Generally found in western, southern, and eastern Wisconsin	Hard to very hard water, with some iron, manganese, hydrogen sulfide, radium, and fluoride concentration exceedances reported.
Silurian-Devonian aquifers Dolomite from the Silurian and Devonian age	Far eastern Wisconsin	Extremely hard water, with high concentrations of dissolved solids. Iron concentrations routinely exceed limits, as do manganese concentrations to a lesser extent.

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

Figure 17.1.4-3: Principal and Sole Source Aquifers of Wisconsin

17.1.5. Wetlands

17.1.5.1. Definition of the Resource

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

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

17.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 17.1.5-1 summarizes the major Wisconsin state laws and permitting requirements relevant to the state's wetlands.

Table 17.1.5-1: Relevant Wisconsin Wetlands Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Clean Water Act (CWA) Section 404 permit, Wisconsin Regional General Permit	USACE, St. Paul District	Dredging or filling of surface waters can be authorized by this permit except in calcareous fens[70], and wetlands within 300 feet of calcareous fens (USACE, 2011).
Wetlands Permit Program	DNR	"Excavating or placement of any material in low areas or wetlands" (DNR, 2015w).
Wisconsin Coastal Management Program (WCMP)	DNR	Wisconsin Regional General Permit may not be authorized for any activity in coastal wetlands in ridge and swale complexes or wetlands adjacent to the Mink, Kakagon, or Bad Rivers unless authorized under the WCMP (USACE, 2011).
Wisconsin Pollutant Discharge Elimination System Program	DNR	Construction activities that disturb one or more acre of land (DNR, 2011a).

[70] Calcareous fens are located on slight slopes, are composed of non-acidic peat, and are supplied with cold, calcium-rich groundwater. As a results, calcareous fens are dominated by calcium-loving plant species. (DNR, 2015bg)

State Law / Regulation	Regulatory Agency	Applicability
CWA Section 401 permit	DNR	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from DNR indicating that the proposed activity will not violate water quality standards (DNR, 2013a).

17.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. 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, Carter, Golet, & LaRoe, 1979)

Three of these Systems, Riverine, Lacustrine, and Palustrine, are present in Wisconsin, as detailed in Table 17.1.5-2. There are no regulated high quality wetlands in Wisconsin.[71]

[71] The wetland acreages were obtained from the USFWS (2014) National Wetlands Inventory. Data from this inventory was downloaded by state at https://www.fws.gov/wetlands/. The wetlands data contains a wetlands classification code, which are a series of letter and number codes, adapted to the national wetland classification system in order to map from (e.g., PFO). Each of these codes corresponds to a larger wetland type; those wetland areas are rolled up under that wetlands type. The codes and associated acres that correspond to the deepwater habitats (e.g., those beginning with M1, E1, L1) were removed. The wetlands

Table 17.1.5-2: Wisconsin Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description [a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests, hardwood swamps, and silver maple-ash swamps are examples of PFO wetlands.	Throughout the state	4,290,591
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Throughout the state	
Palustrine emergent wetlands	PEM	Palustrine emergent wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens, prairie potholes, and sloughs.	Throughout the state	1,114,401
Palustrine unconsolidated bottom	PUB	PUB and PAB are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Throughout the state	104,062
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep[72], and other miscellaneous wetlands are included in this group.	Throughout the state	47,663
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	282
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.	Concentrated in northwest and southern Wisconsin	53,210
			TOTAL	**5,610,209**

Sources: (Cowardin, Carter, Golet, & LaRoe, 1979) (USFWS, 2015b) (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

---

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.
[72] 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)

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, 2015c)

Palustrine Wetlands

In Wisconsin, palustrine wetlands include the majority of vegetated freshwater wetlands. The more common types of palustrine wetlands found in the state include marshes (PSS), wet meadows (PEM), scrub/shrub (PSS), and forested wetlands (PFO). Common vegetation found in marshes include cattails (*Typha latifolia*), bulrushes (*Scirpus spp.*), pickerelweed (*Pontederia cordata*), giant bur reed (*Sparganium eurycarpum*), and lake sedges (*Carex lacustris*), and these wetlands are characterized by standing water. Wet meadows (or sedge meadows) are dominated by grasses and reeds, but marsh milkweed (*Asclepias incarnate*), sneezeweed (*Helenium autumnale*), mint (*Mentha*), blue flag iris (*Iris versicolor*), and a number of goldenrod (*Solidago sp.)* and aster (*Asteraceae sp.*) species can also be found. These wetlands typically do not have standing water, but their soils are saturated. Scrub/shrub wetlands, such as alder (*Alnus sp.*) thickets and bogs, have vegetation that includes woody shrubs, along with smaller trees like dogwood (*Cornus florida*), willow (*Salix sp.*), tag alder (*Alnus serrulata*), and bog birch (*Betula pumila*). Bogs and forested floodplains are also found in the forested wetlands of Wisconsin, with vegetation including trees measuring 20 feet high or more, such as silver maple (*Acer saccharinum*), black ash (*Fraxinus nigra*), green ash (*Fraxinus pennsylvanica*), elm (*Ulmus Americana*), black spruce (*Picea mariana*), white cedar (*Thuja occidentalis*), and tamarack (*Larix laricina*). (DNR, 2015x)

Nearly half of Wisconsin's original ten million acres of wetlands have been lost, with the remaining concentrated in the northern third of Wisconsin. In Wisconsin's more populous southern counties, wetland loss has measured far over 75 percent. Many of the remaining wetlands are partly altered wetlands. Land disturbances, such as draining, clearing, repeated burning, grazing, or plowing have allowed for invasive species to move into these wetland areas, further reducing their ecological value. (DNR, 2015y)

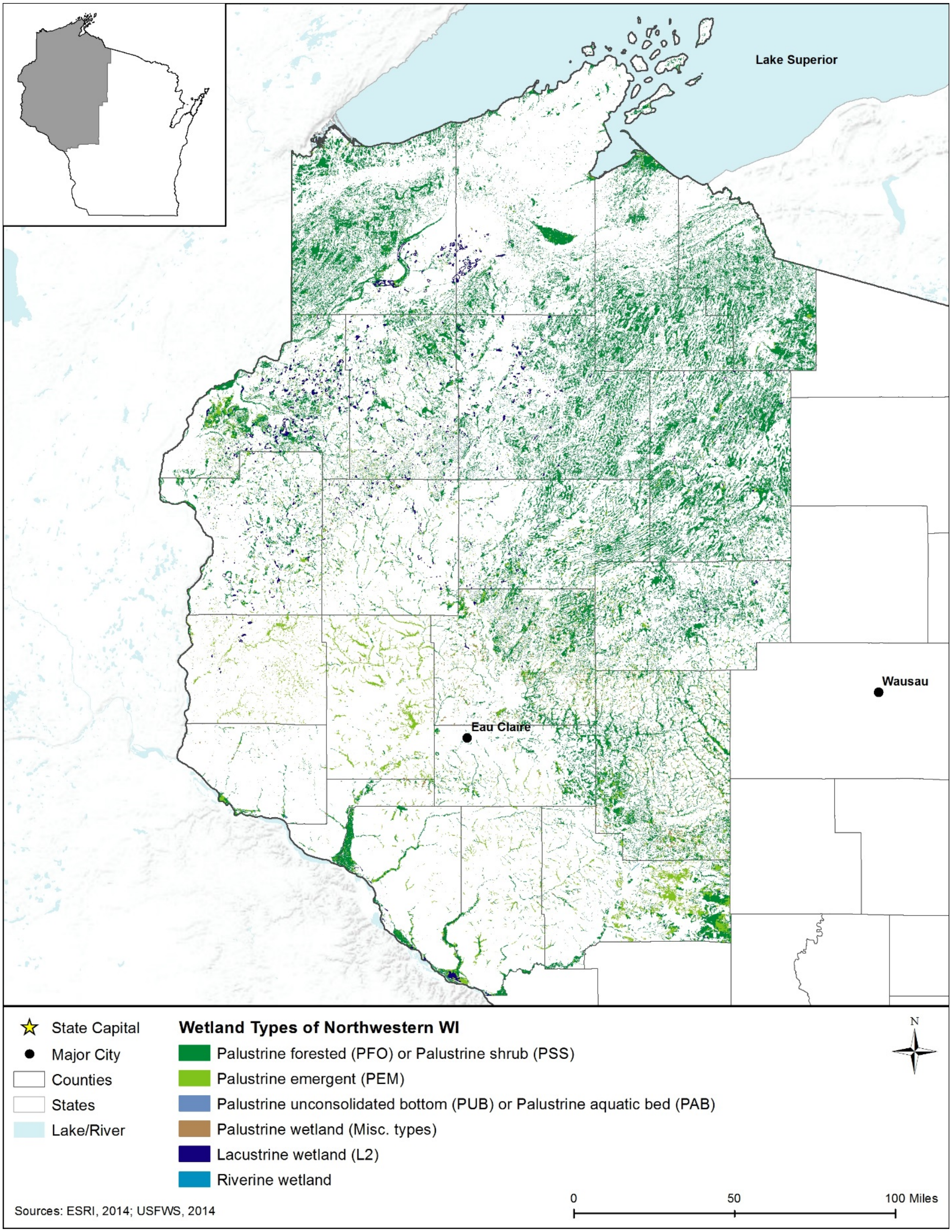


Figure 17.1.5-1: Wetlands by Type, in Northwestern Wisconsin, 2014

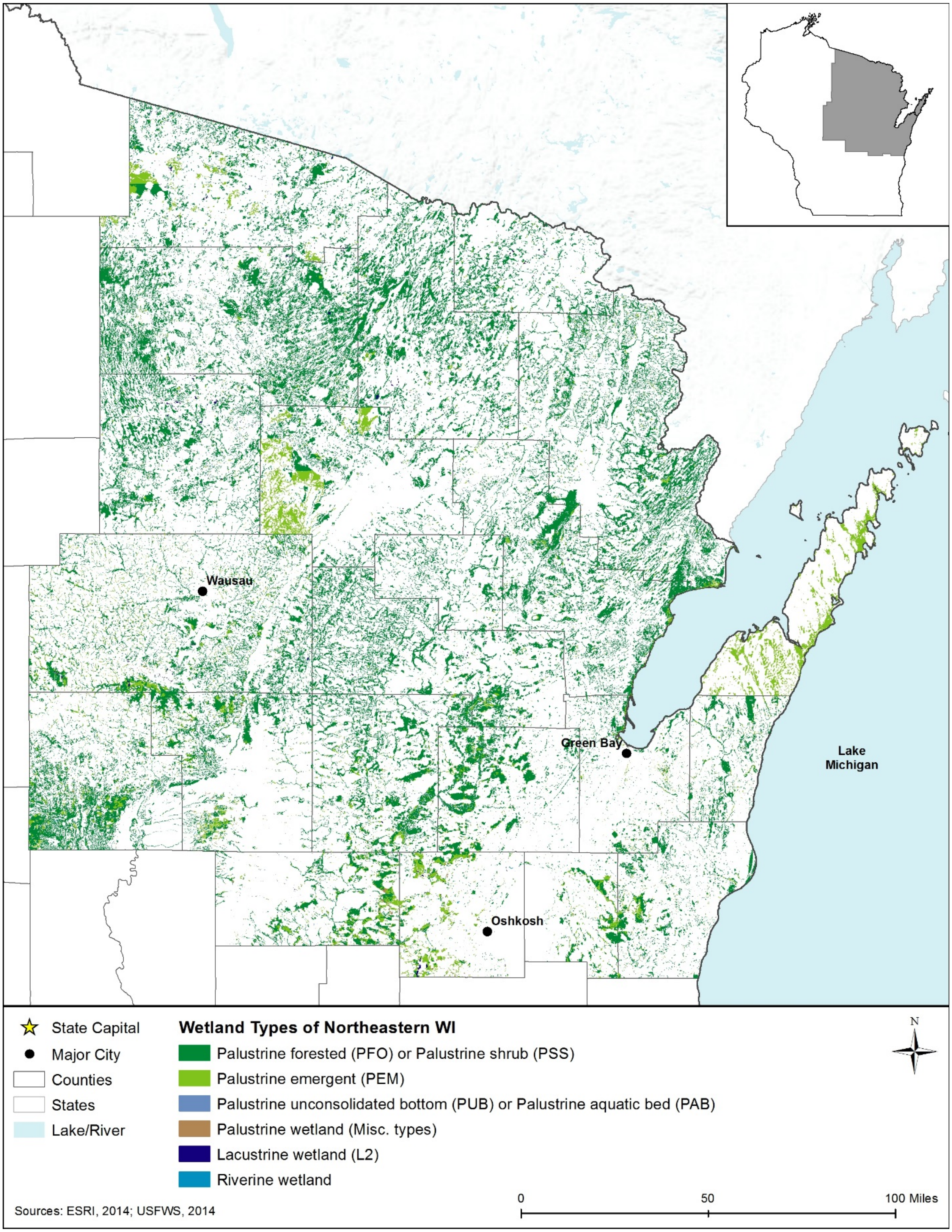


Figure 17.1.5-2: Wetlands by Type, Northeastern Wisconsin, 2014

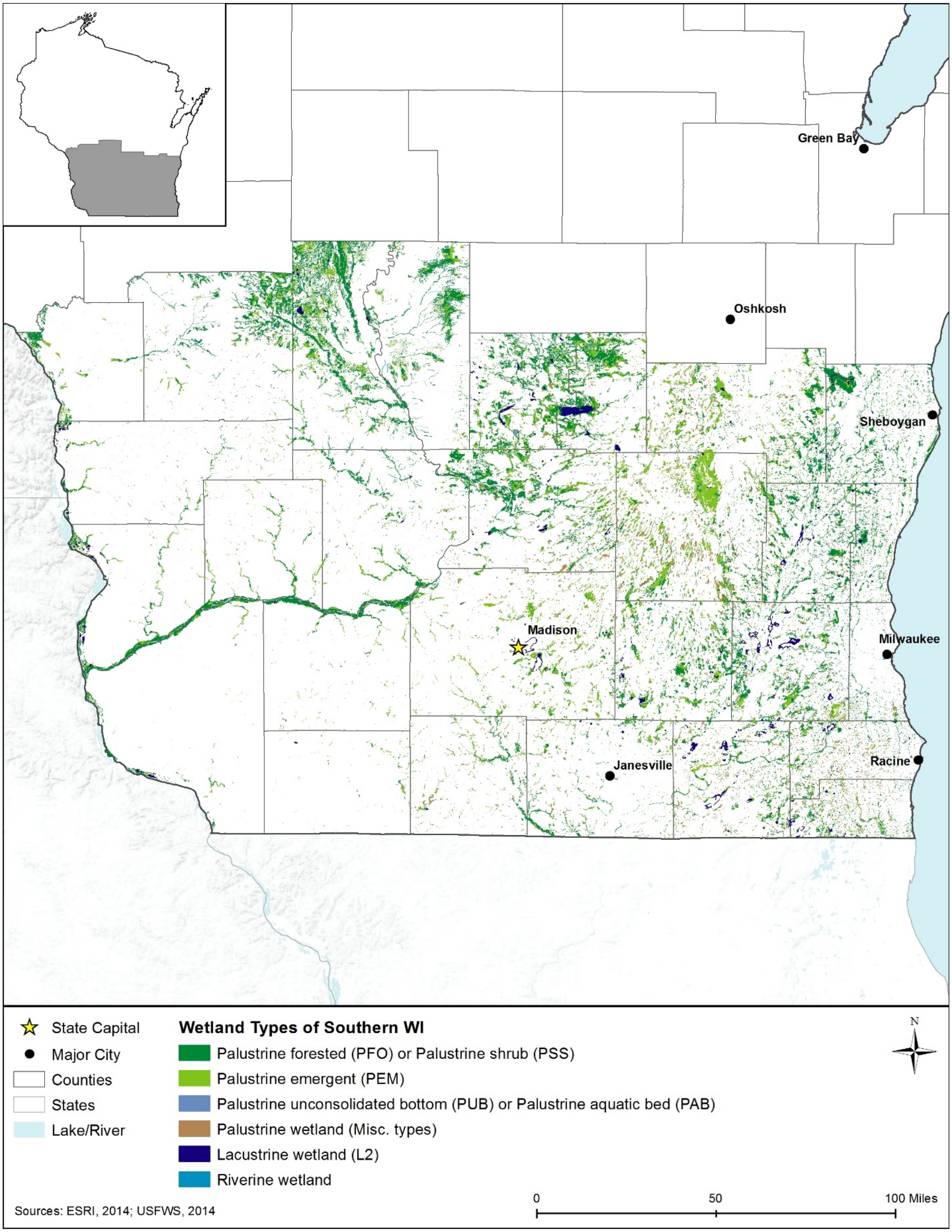


Figure 17.1.5-3: Wetlands by Type, Southern Wisconsin, 2014

Coastal Wetlands

Coastal wetlands in Wisconsin are found along its shorelines with Lake Superior and Lake Michigan. These wetlands include hardwood swamps, coniferous swamps, shrub swamps, spring seeps, sedge meadows, bogs, fens, and marshes. Ridge and swale complexes (discussed in Section 17.1.5.4 below) along with unique wetland types including freshwater estuaries and interdunal wetlands, found only along the coastline of the Great Lakes (DNR, 2015z). Interdunal wetlands are rare in Wisconsin. There are less than ten known locations in the state, with all but one site less than ten acres in size. They are found within active dune fields of the Great Lakes shores, in wind-created hollows that intersect the water table. They can also be found where sand encroaches on wetlands, isolating the wetland. Representative plants include bladderworts (*Utricularia vulgaris*), ladies-tress orchids (*Spiranthes sp.)*, spike rushes (*Eleocharis palustris*), silverweed (*Potentilla anserina*), pipewort (*Eriocaulon cinereum*), Baltic rush (*Juncus balticus*), little green sedge (*Carex viridula*), and twig rush (*Cladium mariscoides*). (DNR, 2015aa)

17.1.5.4. Wetlands of Special Concern or Value

Ridge and Swale Complexes

Under the USACE Wisconsin Regional General Permit, activities in coastal wetlands identified as ridge and swale complexes are not allowed unless authorized under the Wisconsin Coastal Management Program (WCMP). Activities in ridge and swale complexes are also subject to a consistency determination that must be granted by WCMP, unless specifically exempted. (USACE, 2011). Ridge and swale complexes along the Great Lakes are the most intact along Lake Michigan, although a few can also be found along Lake Superior. They are often forested beach or dune ridges that alternate with wet forested or open swales that run parallel to the coast, and are influenced by water depth. The swales can range from open (sedge meadow, emergent marsh, or fen) to shrub (alder, bog birch) to forested wetland (black ash, white cedar). These areas provide habitat for upland, wetland, and shoreline plants. (DNR, 2015ab)

National Estuarine Research Reserve

As discussed in Section 17.1.4.4, the Lake Superior NERR encompasses over 16,000 acres of freshwater estuaries. These areas include riverine and riparian habitat, riverine islands, emergent freshwater marsh, scrub swamp and interdunal wetlands, hardwood, aspen, and dry forests, and open sand beach and dunes. The Lake Superior NERR is one of the most recently designated NERRs in the country. It is located at the confluence of the St. Louis River and Lake Superior, and provides an opportunity to better understand freshwater estuaries and coastal resources. (NOAA, 2015a)

Figure 17.1.5-4: Lake Superior NERR

Source: (NOAA, 2010)

Other Important Wetlands Sites in Wisconsin

- Wildlife Areas in Wisconsin are designated to sustain natural communities and wildlife habitat for traditional outdoor recreational uses, including hunting, fishing, and trapping for outdoor recreation; some of these areas include wetlands (DNR, 2015ac). To learn more about state Wildlife Areas, visit http://dnr.wi.gov/topic/lands/WildlifeAreas/.
- National Natural Landmarks range in size from 15 acres to over 51,000 acres, and are owned by the U.S. Forest Service, U.S. Fish and Wildlife Service, DNR, University of Wisconsin, The Nature Conservancy, tribal, private corporations, and individuals (NPS, 2015a). Section 17.1.8, Visual Resources, describes Wisconsin's National Natural Landmarks.
- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including U.S. NRCS, U.S. National Park Service, DNR, and easements managed by natural resource conservation groups such as Mississippi Valley Conservancy and Natural Heritage Land Trust. 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 67,000 acres in conservation easements in Wisconsin (NCED, 2015).

17.1.6. Biological Resources

17.1.6.1. Definition of the Resource

This chapter describes the biological resources of Wisconsin. Biological resources include terrestrial[73] vegetation, wildlife, fisheries and aquatic[74] habitats, and threatened[75] and endangered[76] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Wisconsin supports a wide diversity[77] of biological resources ranging from coniferous and northern hardwood forests, undulating plains and hills, and lakes and wetlands in the north and central region of the state to hilly uplands, hardwood forests, oak savannas, and tallgrass prairie settings in the southern portion of the state (Omernik, Chapman, Lilllie, & Dumke, 2008). Each of these topics is discussed in more detail below. Beginning in the 19th century, much of the natural vegetation in the central and southern portion of the state was gradually replaced by agriculture. Agricultural operations supporting cropland for corn and soybeans, as well as forage and feed grains to support dairy operations now dominate the land uses in central and southern Wisconsin.

[73] Terrestrial: "Pertaining to land" (USEPA, 2015o).
[74] Aquatic: "Pertaining to water" (USEPA, 2015o).
[75] Threatened species are "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C. §1532(20)).
[76] Endangered species are "any species which is in danger of extinction throughout all or a significant portion of its range" (16 U.S.C. §1532(6)).
[77] Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015o).

17.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Wisconsin are summarized in detail in Appendix C, Environmental Laws and Regulations. Table 17.1.6-1 summarizes major state laws relevant to Wisconsin's biological resources.

Table 17.1.6-1: Relevant Wisconsin Biological Resources Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Wisconsin Invasive Identification, Classification, and Control Rule – Wisconsin Administrative Code (WAC) DNR Laws Chapter 40.01 through 40.09 (WAC, 2015a) and Regulations Chapter 23.22 (1) through (9) (Invasive Weeds); Chapter 23.235 (1) through (5) (Nuisance Weeds); and Chapter 23.24 (1) through (6) (Aquatic Plants). (WAC, 2015a)	DNR	Requires the state of Wisconsin to identify, classify, and control invasive species in the state as part of the DNRs statewide invasive weed program. The statewide program is based on a plan to control invasive species in the state, administer a program related to invasive aquatic plants, encourage cooperation among state agencies and other entities to control invasive species in the state, seek public and private funding, provide education and encourage research, and promulgate rules to identify, classify, and control invasive species. As set forth under the provisions of the Rule, the Wisconsin DNR is responsible for establishing and updating the list of prohibited and regulated invasive species.
Wisconsin Noxious Weeds Chapter 66.0407 (1) through (5)	DNR	Requires the complete killing of weeds above the ground surface by the use of chemicals, cutting, tillage, cropping system, pasturing livestock, and a combination of these treatments to prevent the weeds from maturing to a bloom or flower stage.
Wisconsin Endangered and Threatened Species Law State Statute 29.604 and Administrative Rule Chapter 27 and 29 (Wisconsin State Legislature, 2015) (WAC, 2015b) (WAC, 2015c)	DNR	Establishes, defines, and guides Wisconsin's endangered and threatened species laws. The state law restricts the taking, possession, or marketing of endangered species by establishing a program for the conservation and restoration of endangered and threatened species (Administrative Rule Chapter 29.604 (1)). The implementation and enforcement of this law is established by Wisconsin DNR's endangered and threatened species list, which includes three parts: wild animals and plants on the U.S. list of endangered and threatened species, wild animals and plants on the U.S. list of endangered and threatened native species, and a list of endangered and threatened Wisconsin species (Administrative Rule Chapter 29.604 (3) (a)).

17.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology,[78] soils, climate[79], and water of a given geographic area and correlates with distinct areas identified as ecoregions[80]. Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems of regional extent. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015) (World Wildlife Fund Global, 2015). Ecoregion boundaries often coincide with physiographic regions of a state. Based on the state of Wisconsin's location between Lake Superior, Lake Michigan, and the Mississippi River, Wisconsin contains five main geographic regions including three upland regions, such the Northern Highlands, Western Uplands, and Central Plains; and two lowland regions, such as the Lake Superior Lowlands the Eastern Ridges and Lowlands (USEPA, 2015b).

Ecoregion boundaries often coincide with physiographic regions of a state. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions. This section provides an overview of the terrestrial vegetation resources for Wisconsin at USEPA Level III. (USEPA, 2016a)

As shown in Figure 17.1.6.-1, the USEPA divides Wisconsin into six Level III ecoregions. The six ecoregions support a variety of different plant communities, all predicated on their general location within the state. Three of the upland regions occur in the northern portion of the state that is heavily forested and contain higher elevations, as well as the western and central portion of the state characterized by limestone and sandstone bluffs along the Mississippi River and the buttes and gorge along the Wisconsin River. The two lowland regions occur in the far northern portion of the state near Lake Superior and the rolling hills that extend from Green Bay south to Illinois along Lake Michigan. A small portion of the Central Corn Belt Plains, a Level III ecoregion, is located in the southeast corner of the state near Kenosha. Vegetation communities range from hardwood forests in the northern highlands that consist of maple, hemlock, and yellow birch mixed with coniferous[81] forests consisting of white and red pine to prairie and oak savanna communities in the Great Plains region within the southern portion of the state. Table 17.1.6-2 provides a summary of the general abiotic[82] characteristics, vegetative communities, and

[78] "Geology is the study of the planet earth- the materials it is made of, the processes that act on those materials, the products formed, and the history of the planet and its life forms since its origin" (USEPA, 2015o).

[79] 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, 2015o)

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

[81] Conifer: "A tree that produces cones, such as a pine, spruce, or fir tree." (USEPA, 2015o)

[82] 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, 2016d).

the typical vegetation found within each of the six Wisconsin ecoregions. (Omernik, Chapman, Lilllie, & Dumke, 2008)

Figure 17.1.6.-1: USEPA Level III Ecoregions in Wisconsin

Table 17.1.6-2: USEPA Level III Ecoregions of Wisconsin

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Great Plains				
47	Western Corn Belt Plains	A region composed of nearly level to gently rolling and glaciated till plains and hilly loess[83] plains. Historically, the region consisted of a tall-grass prairie vegetation community. Today, over 75 percent of this region is used for cropland agriculture and forage for livestock and dairy farming operations. Consistent annual precipitation during the growing season and moist, fertile soils make this one of the most productive corn and soybean agricultural areas in the world.	Tall-grass Prairie	**Grasses –** prairie cordgrass (*Spartina pectinata),* big bluestem (*Andropogon gerardii),* Indian grass (*Sorghastrum nutans)*, rosinweed (*Silphium integrifolium)*, little bluestem (*Andropogon scoparius*), sideoats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), prairie dropseed *(Sporobolus heterolepis)* **Forbs –** prairie coneflower (*Ratibida pinnata)*, yellow coneflower (*Echinacea paradoxa)*, purple coneflower (*Echinacea pallida)*, prairie milkweed (*Ascelpias sullivantii*), common milkweed (*Asclepias syriaca*)
Geographic Region: Northern Forests				
50	Northern Lake and Forests	A region consisting of nutrient poor glacial soils, coniferous and northern hardwood forests, undulating till plains, morainal hills, lacustrine basins, and sandy outwash plains. The soils in the region are thicker than those to the north and lack arability compared to soils in the adjacent regions to the south. The lakes in this region are clearer and less productive than those in the regions to the south.	Coniferous Forests, Northern Hardwood Forests, White and Red Pine Forests, Pine Barrens, Jack Pine, Sugar-Maple/Basswood Forest, Hemlock/Sugar-Maple Forest, Boreal Forest	**Conifer Trees –** Jack pines (*Pinus banksiana*), red pine (*P. resinosa*), white pine (*Pinus strobus*), eastern hemlock *(Tsuga canadensis)* **Hardwood Trees –** yellow birch *(Betulla allegheniensis)*, white birch *(Betula papyrifera),* sugar-maple *(Acer saccharum)*, basswood *(Tilia Americana*), Hill's oak *(Quercus ellipsoidalis)*, bur oak (*Querus macrocarpa*), red oak *(Quercus borealis)*

[83] Loess: "A buff-colored, wind-blown deposit of fine silt, which is frequently exposed in bluffs or steep faces. The loess of the US is thought to be the fine materials first transported and deposited by the waters of melting ice sheets during the glacial period (USEPA, 2015o).

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Eastern Temperate Forests				
51	North Central Hardwood Forests	Primarily a transitional area between the predominantly forested Northern Lakes and Forests region to the north and the agricultural regions to the south, this region consists of mosaic forests, wetlands and lakes, cropland agriculture, pasture, and dairy operations.	Hardwood Forest, Aspen/Birch/Pine Forest, Oak-maple Forests, Sugar-Maple/Birch/Pine Forests, Basswood/Oak Forests	**Conifer Trees –** red pine *(P. resinosa),* white pine *(Pinus strobus),* eastern hemlock *(Tsuga canadensis)* **Hardwood Trees –** quaking aspen *(Populus tremuloides),* yellow birch *(Betula allegheniensis),*white birch *(Betula papyrifera)* red maple *(Acer rubrum),* sugar maple *(Acer saccharum),* Hill's oak *(Quercus ellipsoidalis),* bur oak *(Querus macrocarpa),* red oak *(Quercus borealis),* basswood *(Tilia Americana),* black Ash *(Fraxinus nigra),* black oak *(Quercus velutina),* beech *(Fabus grandifolia)*
Geographic Region: Great Central Plains				
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 (*Querus macrocarpa*), red oak (*Quercus borealis*), basswood (*Tilia Americana*), black ash (*Fraxinus nigra*), black oak (*Quercus velutina*), beech (*Fabus grandifolia*)
53	Southeastern Wisconsin Till Plains	A transition region that supports a range of vegetation types located between the hardwood forests and oak savannas to the west and the tall-grass prairies of the Central Corn Belt Plains to the south. Land uses consist mainly of cropland for forage and feed grains to support dairy operations.	Oak Savannas, Oak Forest, Tall-grass Prairie, Sugar-Maple-Basswood Forest	**Grasses –** prairie cordgrass (*Spartina pectinata*), big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), rosinweed (*Silphium integrifolium*), little bluestem (*Andropogon scoparius*), sideoats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), prairie dropseed (*Sporobolus heterolepis*) **Forbs –** prairie coneflower (*Ratibida pinnata*), yellow coneflower (*Echinacea paradoxa*), purple coneflower (*Echinacea pallida*), prairie milkweed (*Ascelpias sullivantii*), common milkweed (*Asclepias syriaca*) **Conifer Trees –** red pine (*P. resinosa*), white pine (*Pinus strobus*), eastern hemlock *(Tsuga canadensis)* **Hardwood Trees –** red maple *(Acer rubrum),* sugar maple *(Acer saccharum),* Hill's oak *(Quercus ellipsoidalis),* bur oak *(Querus macrocarpa),* red oak *(Quercus borealis),* basswood *(Tilia Americana)*

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
54	Central Corn Belt Plains	Extensive prairie communities mixed with oak hickory forests once occupied the glaciated plains of this region. The area has gradually been replaced by agricultural land uses specializing in corn and soybean production, as well as cattle, sheep, and poultry operations.	Tall-grass Prairie, Oak-Prairie Savanna, Oak-Hickory Forest	**Hardwood Trees –** quaking aspen (*Populus tremuloides*), yellow birch (*Betula allegheniensis*), white birch (*Betula papyrifera*) red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), white oak (*Quercus alba*), Hill’s oak (*Quercus ellipsoidalis*), bur oak (*Querus macrocarpa*), red oak (*Quercus borealis*), shagbark hickory (*Carya ovata*), butternut hickory (*Carya cordiformis*), black walnut (*Juglan nigra*), yellow poplar (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), basswood (*Tilia Americana*), black oak (*Quercus velutina*), beech (*Fabus grandifolia*) **Riparian Trees –** pin oak (*Quercus palustris*), silver maple (*Acer saccharinum*), American elm (*Ulmus Americana*), black ash (*Fraxinus nigra*), cottonwood (*Populus deltoids*), black willow (*Salix nigra*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*)

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

Communities of Concern

The state of Wisconsin 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[84] that could result from implementation of an action.

The Wisconsin Natural Heritage Inventory Program (NHIP) maintains data on the locations and status of rare species and includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. The list includes species legally designated as "endangered" or "threatened," as well as species listed in the advisory "special concern" category. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the Wisconsin NHIP ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Wisconsin. Communities ranked as an S1 by the NHIP are of the greatest concern. This rank is typically based on the range of the community, the number of occurrences, the viability of the occurrences, recent trends, and the vulnerability of the community. The NHIP inventory list is meant to be dynamic. As new data become available, ranks are revised as necessary to reflect the most current information. (DNR, 2016b)

In Wisconsin, there are 58 NHIP natural communities, 1 surrogate community, and 8 aquatic community types. Thirteen of these vegetative communities are ranked as S1 communities[85] in Wisconsin; these communities represent the rarest terrestrial habitat in the state. These communities occur throughout the state, with the majority of the communities located within northern and southern Wisconsin, with more unique communities located along the Great Lakes shorelines and dune fields. (Wisconsin NHIP, 2015)

Wisconsin Appendix A contains a table that provides a description of the vegetation communities of conservation concern in Wisconsin along with their state rank, distribution, abundance, and the associated USEPA Level III ecoregions.

Wisconsin also implements the 2005 Wisconsin Strategy for Wildlife Species of Greatest Conservation Need, also known as the Wisconsin State Wildlife Action Plan (WAP). The WAP is a comprehensive document that helps guide wildlife conservation decision making for the Wisconsin DNR. The last Wisconsin WAP was completed in 2005 (DNR, 2005a). The 2015

[84] 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, 2015o).
[85] 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" (MFWP and MNHP, 2015).

Wisconsin WAP is currently under revision; the Draft WAP was made available in August 2015 (DNR, 2005b).

To manage the threats and conservation actions for Wisconsin's Species of Greatest Conservation Need (SGCN) – Wisconsin's DNR assigns each species to one or more of the 66 natural communities in the state. These natural communities include the critical habitats needed to support healthy populations within Wisconsin. For terrestrial and wetland habitats, the natural community classification system developed by the DNR's NHIP is used. For aquatic habitats, a simplified system of river, stream, and lake communities is used. These 66 natural communities are then grouped within 8 major habitat categories: northern forest, southern forest, oak savanna, barrens, grassland, wetland, aquatic, and miscellaneous. One "surrogate" community (i.e., surrogate grasslands) was also identified (DNR, 2005a).

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive plants. Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (Government Publishing Office, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C.§7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S., 88 of which are terrestrial, 19 aquatic, and 5 parasitic (USDA, 2014a).

Noxious weeds are a threat to Wisconsin's range of forests, savannas, moraine, pine and oak barrens, and tall-grass prairie habitat types. Noxious weeds can have adverse ecological and economic impacts to these habitats by displacing native species, degrading wildlife habitat, and increasing soil erosion[86]. The Wisconsin Invasive Species Identification, Classification, and Control Rule, or "Invasive Species Rule" (NR 40) stipulates that it is illegal to possess, transport, transfer, or introduce certain invasive species in Wisconsin without a permit (WAC, 2015d). The Invasive Species Rule creates a comprehensive, science-based system with criteria to classify invasive species into two categories: "prohibited" and "restricted". Prohibited invasive species do not occur in the state, or only occur in a few places and are known to cause environmental or economic harm; eradication and prevention is still feasible for these species. Restricted invasive species are already widely established in the state and can cause high environmental and economic impacts; complete eradication is unlikely (DNR, 2015ad).

The Wisconsin DNR regulates invasive species using the Invasive Species Rule and by maintaining an invasive species list of plants, aquatic invertebrates, terrestrial and aquatic vertebrates, fungus, algae and cyanobacteria, fish and crayfish, and terrestrial invertebrates. The Wisconsin DNR is responsible for updates to that list, as necessary. In addition, the Invasive Species Rule establishes preventive measures to show what actions can be taken to slow the spread of invasive species. Of the plant species, there are 68 species in the prohibited category,

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

14 plant species in the prohibited/restricted category, and 63 plant species in the restricted category for a total of 145 regulated species (DNR, 2015ae).

Three of the plant species occur on the Federal Noxious Weed List, including Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), and multiflora rose (*Rosa multiflora*) (USDA, 2014b). The following species in Table 17.1.6-3 are regulated in Wisconsin in either the prohibited, prohibited/restricted, or regulated categories.

Table 17.1.6-3: Prohibited and Restricted Invasive Plant Species in Wisconsin

Common Name	Scientific Name
Prohibited Category	
Japanese chaff flower	*Achyranthes japonica*
Fiveleaf akebia or Chocolate vine	*Akebia quinata*
Porcelain berry	*Ampelopsis brevipedunculata*
Giant reed	*Arundo donax*
Mosquito fern	*Azolla pinnata*
Common barberry	*Berberis vulgaris*
Fanwort, Carolina fanwort	*Cabomba caroliniana*
Narrow leaf bittercress	*Cardamine impatiens*
Asian loeseneri bittersweet	*Celastrus loeseneri*
Diffuse knapweed	*Centaurea diffusa*
Russian knapweed	*Centaurea repens*
Yellow star thistle	*Centaurea solstitialis*
Australian swamp crop or New Zealand pygmyweed	*Crassula helmsii*
Scotch broom	*Cytisus scoparius*
Grecian foxglove	*Digitalis lanata*
Chinese yam	*Dioscorea batatas or Dioscorea polystacha*
Indian yam	*Dioscorea oppositifolia*
Brazilian waterweed or wide-leaf anacharis	*Densa*
Anchored water hyacinth	*Eichhornia azurea*
Water hyacinth, floating	*Eichhornia crassipes*
Giant knotweed	*Fallopia sachalinensis or Polygonum sachalinense*
Bohemian knotweed	*Fallopia x bohemicum, Polygonum x bohemicum*
Mudmat	*Glossostigma cleistanthum*
Giant hogweed	*Heracleum mantegazzianum*
Hydrilla	*Hydrilla verticillata*
European frogbit	*Hydrocharis morsus−ranae*
Floating marsh	*Hydrocotyle ranunculoides*
Indian Swampweed	*Hygrophila polysperma*
Policeman's helmet	*Impatiens glandulifera*
Water spinach, swamp morning- glory	*Ipomoea aquatica*
Oxygen−weed, African elodea or African waterweed	*Lagarosiphon major*
Perennial or broadleaved pepperweed	*Lepidium latifolium*
Sericea or Chinese lespedeza	*Lespedeza cuneata or Lespedeza sericea*
Asian marshweed	*Limnophila sessiliflora*
Japanese honeysuckle	*Lonicera japonica*
Wanded loosestrife	*Lythrum virgatum*
Japanese stilt grass	*Microstegium vimineum*
Parrot feather	*Myriophyllum aquaticum*
Brittle naiad; or lesser, bushy, slender, spiny or minor naiad or waternymph	*Najas minor*

Common Name	Scientific Name
Sacred Lotus	*Nelumbo nucifera*
Yellow floating heart	*Nymphoides peltata*
Java water dropwort or Vietnamese parsley	*Oenanthe javanica*
Wavy leaf basket grass	*Oplismenus hirtellus ssp. undulatifolius*
Ducklettuce	*Ottelia alismoides*
Princess tree	*Paulownia tomentosa*
Butterfly dock	*Petasites hybridus*
Amur Cork Tree	*Phellodendron amurense*
Water lettuce	*Pistia stratiotes*
Mile−a−minute vine	*Polygonum perfoliatum or Persicaria perfoliata*
Kudzu	*Pueraria montana or P. lobata*
Sawtooth oak	*Quercus acutissima*
Lesser celandine	*Ranunculus ficaria*
Himalayan blackberry	*Rubus armeniacus*
Wineberry or wine raspberry	*Rubus phoenicolasius*
Hawaii arrowhead	*Sagittaria sagittifolia*
Giant Salvinia	*Salvinia herzogii*
Giant salvinia	*Salvinia molesta*
Johnsongrass	*Sorghum halepense*
Water Soldiers	*Stratiotes aloides*
Medusahead	*Taeniatherum caput-medusae*
Spreading hedgeparsley	*Torilis arvensis*
Water chestnut	*Trapa natans*
Colt's foot	*Tussilago farfara*
Southern cattail	*Typha domingensis*
Graceful cattail	*Typha laxmannii*
Pale or European swallow−wort	*Vincetoxicum rossicum or Cynanchum rossicum*
Japanese wisteria	*Wisteria floribunda*
Chinese wisteria	*Wisteria sinensis*
Prohibited/Restricted Category	
Wild chervil	*Anthriscus sylvestris*
Hill mustard	*Bunias orientalis*
European marsh thistle	*Cirsium palustre*
Poison hemlock	*Conium maculatum*
Hairy willow herb	*Epilobium hirsutum*
Tall or reed mannagrass	*Glyceria maxima*
Japanese hops	*Humulus japonicus*
Lyme grass or sand ryegrass	*Leymus arenarius or Elymus arenarius*
Dalmatian toadflax	*Linaria dalmatica*
Amur honeysuckle	*Lonicera maackii*
Phragmites or Common reed non-native ecotype	*Phragmites australis non-native ecotype*
Seaside goldenrod	*Solidago sempervirens*
Japanese hedgeparsley or erect hedgeparsley	*Torilis japonica*
Black orLouise’s swallow−wort	*Vincetoxicum nigrum or Cynanchum louiseae*
Restricted Category	
Amur maple	*Acer tataricum ssp. ginnala*
Bishop's goutweed	*Aegopodium podagraria*
Tree of heaven	*Ailanthus altissima*
Garlic mustard	*Alliaria petiolata*
Black alder	*Alnus glutinosa*
Wormwood	*Artemisia absinthium*
Japanese barberry	*Berberis thunbergii*

Common Name	Scientific Name
Flowering rush	*Butomus umbellatus*
Creeping bellflower	*Campanula rapunculoides*
Siberian peashrub	*Caragana arborescens*
Plumeless thistle	*Carduus acanthoides*
Musk thistle or Nodding thistle	*Carduus nutans*
Oriental bittersweet	*Celastrus orbiculatus*
Spotted knapweed	*Centaurea biebersteinii, Centaurea maculosa, or Centaurea stoebe*
Brown knapweed	*Centaurea jacea*
Black knapweed	*Centaurea nigra*
Tyrol knapweed	*Centaurea nigrescens*
Celandine	*Chelidonium majus*
Canada thistle	*Cirsium arvense*
Crown vetch	*Coronilla varia*
Hound’s tongue	*Cynoglossum officinale*
Cut−leaved teasel	*Dipsacus laciniatus*
Common teasel	*Dipsacus sylvestris or Dipsacus fullonum*
Russian olive	*Elaeagnus angustifolia*
Autumn olive	*Elaeagnus umbellata*
Helleborine orchid	*Epipactis helleborine*
Burning bush	*Euonymus alatus*
Cypress spurge	*Euphorbia cyparissias*
Leafy spurge	*Euphorbia esula*
Japanese knotweed	*Fallopia japonica or Polygonum cuspidatum*
Queen of the meadow	*Filipendula ulmaria*
Hemp nettle, brittlestem hemp nettle	*Galeopsis tetrahit*
White bedstraw	*Galium mollugo*
Dame’s rocket	*Hesperis matronalis*
Balfour's touch-me-not	*Impatiens balfourii*
Yellow iris	*Iris pseudacorus*
Field scabiosa	*Knautia arvensis*
Morrow’s honeysuckle	*Lonicera morrowii*
Tartarian honeysuckle	*Lonicera tatarica*
Bell’s or showy bush honeysuckle	*Lonicera x bella*
Moneywort	*Lysimachia nummularia or L. nummerlaria*
Garden yellow loosestrife	*Lysimachia vulgaris*
Purple loosestrife	*Lythrum salicaria*
White mulberry	*Morus alba*
Aquatic forget-me-not	*Myosotis scorpioides*
Woodland forget- me-not	*Myosotis sylvatica or M. sylvaticum*
Eurasian watermilfoil	*Myriophyllum spicatum*
Spiny naiad	*Najas marina*
Wild parsnip	*Pastinaca sativa*
Ribbon grass or gardener’s garters	*Phalaris arundinacea var. picta*
Scarlet pimpernel or Burnet saxifrage	*Pimpinella saxifraga*
White poplar	*Populus alba*
Curly-leaf pondweed	*Potamogeton crispus*
Common buckthorn	*Rhamnus cathartica*
Glossy buckthorn	*Rhamnus frangula or Frangula alnus*
Rose acacia or Bristly locust	*Robinia hispida*
Black locust	*Robinia pseudoacacia*
Multiflora rose	*Rosa multiflora*
Tansy	*Tanacetum vulgare*

Common Name	Scientific Name
Narrow-leaf cattail	*Typha angustifolia*
Hybrid cattail	*Typha x glauca*
Siberian elm	*Ulmus pumila*
Garden heliotrope or Valerian	*Valeriana officinalis*

Source: (DNR, 2015ae)

17.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Wisconsin, divided among mammals,[87] birds,[88] reptiles and amphibians,[89] and invertebrates.[90] 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,[91] nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Wisconsin. 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 Wisconsin DNR the state is home to at least 75 mammal species, 36 reptile species (snakes, turtles, and lizards), 19 amphibian species (frogs and salamanders), more than 25,000 invertebrate species, 284 resident bird species, and over 300 migratory bird species (DNR, 2005b).

Mammals

Common and widespread large mammalian species in Wisconsin include black bear (*Ursus americanus*), wolf (*Canis lupus*), sheep (*Ovis aries*), white-tailed deer (*Odocoileus virginianus*), and elk (*Cervus canadensis*). Common smaller mammalian species include the eastern chipmunk (*Tamias striatus*), woodchuck (*Marmota monax*), ground squirrel, red squirrel (*Sciurus vulgaris*), American beaver (*Castor canadensis*), pocket gopher (*Geomys bursarius*), deer mouse (*Peromyscus spp.*), various vole species, muskrat (*Ondatra zibethicus*), southern bog lemming (*Synaptomys cooperi*), porcupine (*Erethizon dorsatum*), and jumping mouse (*Zapus hudsonius*). Most mammals are widely distributed in the state. There are three threatened and endangered mammals located in Wisconsin. Section 17.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

In Wisconsin white-tailed deer, elk, wolf, and black bear are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game birds. There are 19 species of furbearers in Wisconsin (DNR, 2014d). Of these 19 species, the following11 species of furbearers may be legally hunted or

[87] Mammals: “Warm-blooded vertebrates that give birth to and nurse live young; have highly evolved skeletal structures; are covered with hair, either at maturity or at some stage of their embryonic development; and generally have two pairs of limbs, although some aquatic mammals have evolved without hind limbs” (USEPA, 2015o).
[88] Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves” (USEPA, 2015o).
[89] 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, 2015o).
[90] Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015o).
[91] Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

trapped in Wisconsin: gray (*Sciurus carolinensis*) and fox squirrel (*Sciurus niger*), cottontail rabbit (*Sylvilagus spp.*), snowshoe hare (*Lepus americanus*), coyotes (*Canis latrans*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), skunk (*Mephitis* and *spilogale putorius*), weasel (*Mustela spp.*), and bobcat (*Lynx rufus*) (DNR, 2013c).

Wisconsin has identified 14 mammals as SGCN. The SGCN list consists of at-risk species that are rare or declining, and State Wildlife Grants can provide funding for efforts to reduce their potential to be listed as endangered. Although these species have been targeted for conservation they are not currently under legal protection. The SGCN list is updated periodically and is used by the state of Wisconsin to focus their conservation efforts and as a basis for implementing their State WAP (DNR, 2005b).

Birds

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

According to the Checklist of Wisconsin Birds, over 437 species of resident and migratory birds have been documented and known to occur in Wisconsin, with 284 of those species known to have breeding populations[93] in the state of Wisconsin (Wisconsin Society for Ornithology 2015) (Wisconsin Society for Ornithology, 2015). Among the 437 extant[94] bird species in Wisconsin, 59 SGCN have been identified (DNR, 2015af).

Wisconsin is located within the Mississippi Flyway. The Mississippi Flyway covers the entire state of Wisconsin and spans from the coast of the Gulf of Mexico in the south to the Canadian border to the north. Large numbers of migratory birds utilize this flyway and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations" (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes year round within the state and have summer breeding range in northern Wisconsin (eBird, 2015a). Golden eagles are generally found in a variety of habitat types

[92] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015o).
[93] Population: "Aggregate of individuals of a biological species that are geographically isolated from other members of the species and are actually or potentially interbreeding" (USEPA, 2015o).
[94] Extant: "A species that is currently in existence (the opposite of extinct)" (USEPA, 2015o).

anywhere they occur, but they generally nest in mountains and cliffs. Golden eagles are found throughout the state during the winter season (eBird, 2015b).

A number of Important Bird Areas (IBAs) have also been identified in Wisconsin. 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[95] for native bird populations.

According to the National Audubon Society (AS), a total of 91 IBAs have been identified in Wisconsin (Figure 17.1.6-2), including breeding,[96] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as pine barrens; hardwood forests; peatlands; swamp, pond, bog, and wetland areas; native prairie grasslands; shorelines; grasslands, sage brush, and wetland/ riparian[97] areas (National Audubon Society, 2015).

Figure 17.1.6-2 depicts the IBAs in Wisconsin. These IBAs, which cover approximately 3.2 million acres are widely distributed throughout the state, although the largest concentration of IBAs are located in the central and north central regions of the state, along river corridors and the Great Lakes shorelines. These IBAs occur in national wildlife refuges, state parks and forests, wildlife sanctuaries, and along known river corridors and along major lake shorelines. The largest IBAs in the state include the Upper Mississippi/Trempealeau National Wildlife Refuges, which occur in southern Wisconsin and cover approximately 194,000 acres and the Moose Junction Peatlands, which occur in northern Wisconsin and cover approximately 192,000 acres. There are three threatened and endangered birds are located in Wisconsin; Section 17.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[95] Critical habitat: "A designated area that is essential to the conservation of an endangered or threatened species that may require special management considerations or protection" (USEPA, 2015o).
[96] 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, 2015o).
[97] 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, 2015o).

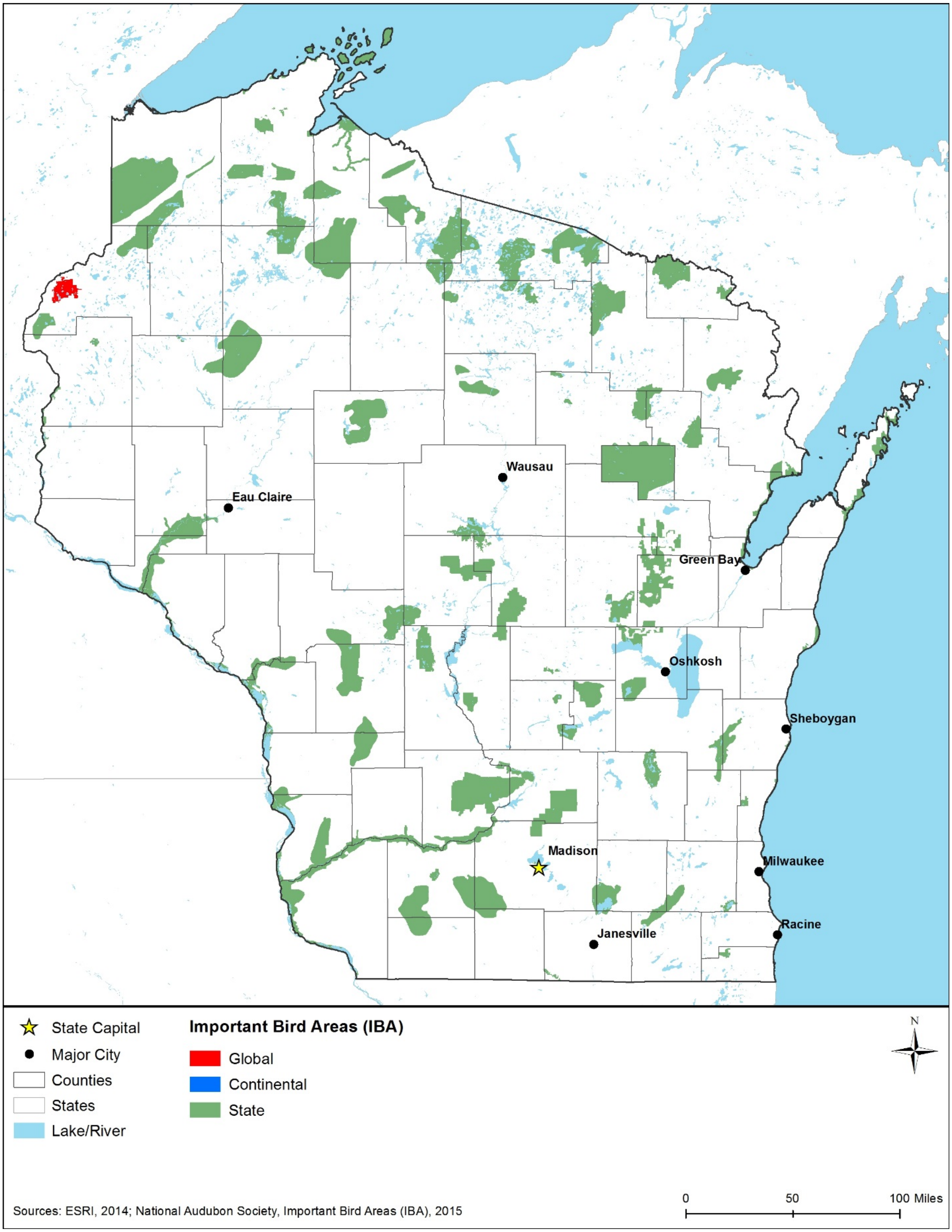


Figure 17.1.6.-2: Important Bird Areas in Wisconsin

Reptiles and Amphibians

A total of 55 native reptile and amphibian species occur in the state of Wisconsin, including 7 salamanders, 12 frogs and toads, 11 turtles, 4 lizards, and 21 snakes (DNR, 2014e). These species occur in a wide variety of habitats from the central plains in the south to moist hardwood forests in the north. Amphibian and reptile species also prefer habitats with cover provided by long grass, pockets of shrubby vegetation, and near the riparian areas adjacent to river, lake, and stream banks. Very few species are widespread throughout the state, and are instead more commonly found in areas near bodies of water, along sandy banks or open sandy soils, and within ponds and wetland areas, as turtles, frogs, and salamanders are attracted to these types of habitats. Of the 55 native reptile and amphibian species, 23 SGCN (Wisconsin Natural Heritage Inventory Program, 2014).

Wisconsin's reptile and amphibian species are classified as nongame species. Hunting and trapping is not allowed for reptile and amphibian species that do not have an open season, however licenses are issued for the sale of three native amphibian species that can be legally collected in Wisconsin: eastern tiger salamanders (*Ambystoma tigrinum*), mudpuppies (*Necturus maculosus*), and northern leopard frogs (*Lithobates pipiens*). The state also allows the sale of native dead turtles during the open turtle season. The open season for frogs is from May 1 through December 31; the open season for aquatic turtles is July 15 through November 30 (DNR, 2004).

Invertebrates

Wisconsin is home to approximately 25,000 species of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes (DNR, 2015ag). Occurrences of these invertebrate species are recorded in the Wisconsin Macroinvertebrate Database, which to date has documented 20,000 collection efforts in aquatic and wetland habitats that represent approximately 4,000 different taxa (DNR, 2005a). These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates.

In the U.S., one third of all agricultural output depends on pollinators.[98] In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. Bees play an important role in natural and agricultural systems as pollinators of flowering plants that provide food, fiber, animal forage, and ecological services like soil and water conservation (University of Wisconsin, 2015). "As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites" (NRCS, 2009). It is estimated that approximately 500 species of bees occur in Wisconsin, but the official number is unknown (Sperling, 2009). Similarly, the number of butterfly species that occur in the state is unknown, but species from 5 families have been recorded. Of the 25,000 recorded invertebrate in the state, partner invertebrate experts developed a list of 530 SGCN.

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

These species span 19 groups, and include 58 non-arthropod invertebrate, 22 non-insect arthropods,[99] and 450 insects (DNR, 2005a).

Invasive Wildlife Species

Wisconsin has adopted the invasive species rule (Wisconsin Administrative Code Chapter 40) that prohibits the possession, transfer, or introduction of certain terrestrial wildlife species. The Wisconsin DNR maintains a list of prohibited[100] species organized into prohibited and restricted categories. These lists are published under WAC Chapter NR 40.04 (WAC, 2015d). The prohibited species list includes three mammal species, including feral pigs (*Sus domestica*), and 1 bird species; there are no mammal or bird species listed in the restricted category (DNR, 2005b). The DNR is also concerned with the presence of the mute swan (*Cygnus olor*), and is acting to control populations in the state (DNR, 2007a). Insect species of concern include the gypsy moth (*Lymantria dispar dispar*), hemlock woolly adelgid (*Adelges tsugae*), and emerald ash borer (*Agrilus planipennis*) (DNR, 2015ah) (DNR, 2015ai) (DNR, 2015aj). Invasive wildlife species are important to consider when proposing a project since project activities may result in conditions that favor the growth and spread of invasive wildlife populations. These situations may result from directly altering the landscape or habitat to a condition that is more favorable for an invasive species, or by altering the landscape or habitat to a condition that is less favorable for a native species.

17.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Wisconsin, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Wisconsin landscape with regard to aquatic wildlife are the fisheries present within over 15,000 lakes that span the state, in addition to fisheries present within the Great Lakes, such as Lake Michigan and Lake Superior. Wisconsin also boasts over 13,000 miles of trout streams, with over 5,400 miles (41 percent) classified as high quality Class I[101] trout streams (DNR, 2015ak). No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in the state of Wisconsin. Critical habitat for threatened and endangered fish species, as defined by the Endangered Species Act (ESA), does not exist within Wisconsin.

---

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

[100] Prohibited species: "live, exotic wildlife species, subspecies, or hybrid of that species, including viable embryos or gametes, that may not be possessed, sold, purchased, exchanged, or transported in Montana, except as provided in MCA 87-5-709 or ARM 12.6.2220" (MFWP, 2015a).

[101] Class I trout streams: "The Wisconsin Department of Natural Resources uses three categories to classify different types of trout streams throughout Wisconsin. Class I streams are high quality trout waters that have sufficient natural reproduction to sustain populations of wild trout, at or near carrying capacity. Streams in this category do not require stocking of hatchery trout. They often consist of small stream sections in the headwaters with small or slow-moving trout. (Wisconsin Department of Tourism, 2015a)

Freshwater Fish

Wisconsin is home to breeding populations of more than 160 species of freshwater fish, including largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), catfish, lake sturgeon (*Acipenser fulvescens*), musky (*Esox masquinong*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), to walleye (*Sander vitreus*), salmon and trout, and smallmouth bass (*Micropterus dolomieu*). These species are grouped into 27 families, as follows: lampreys, sturgeons, paddlefishes, herrings, trouts, smelts, mudminnows, pikes, minnows and carps, suckers, bullhead catfishes, pirate perches, trout perches, codfishes, killifishes, silversides, sticklebacks, temperate basses, sunfishes, perches, drums, sculpins, gars, bowfins, freshwater eels, mooneyes, and gobies[102] (DNR, 2015al).

Wisconsin has five native species of lamprey, including the American brook lamprey (*Lampetra appendix*) (DNR, 2016c). The sea lamprey (*Petromyzon marinus*) is an invasive species, introduced through the Erie Canal, and is managed through methods including construction of physical barriers and chemical sterilization (DNR, 2015am). The southern brook lamprey (*Ichhyomyzon* sp. cf. *gagei*) is a species of special concern in Wisconsin (DNR, 2016c).

The sturgeon family includes two species, the lake sturgeon (*Acipenser fulvescens*) and the shovelnose sturgeon (*Scaphirhynchus platorynchus*). The lake sturgeon is identified as a threatened species of concern and a SGCN (DNR, 2016d). Unlike many other Wisconsin fish species, sturgeon species have no scales, and instead are covered with rows of bone like plants on the back, sides, and stomach. In Wisconsin, lake sturgeons occur in the drainage basins of the Mississippi River, Lake Michigan, and Lake Superior, and has been introduced into several lakes. Shovelnose sturgeon occurs in the Mississippi River and Wisconsin River. (DNR, 2008a) (DNR, 2016e) (DNR, 2016c)

The paddlefish (*Polyodon spathula*) is the only paddlefish species in Wisconsin. Paddlefish occur in large rivers and lakes, spawning in early spring. It is a threatened species within the state of Wisconsin. (DNR, 2016e) (DNR, 2016f)

Herrings in Wisconsin consist of two native species, the skipjack herring (*Alosa chrysochloris*), and the gizzard shard (*Dorosoma cepedianum*). Skipjack herring prefer open water, larger rivers, lakes, and channels below dams. They may congregate in swift currents below dams; they have also been caught in the nearshore areas of Lake Michigan. The skipjack herring is listed as endangered in Wisconsin. The alewife (*Alosa pseudoharengus*) is an exotic species now found in the state.

Over 40 species of carps and minnows, a grouping that includes shiners and daces, occur in Wisconsin. This group has three species believed to be extirpated within the state, three endangered species, five threatened species, and five species of special concern. An additional four species, including the grass carp (*Ctenopharyngodon idella*) are invasive species.

[102] These 27 families are comprised of many different individual species. For a list of the species, including their scientific classification (Latin names), see Wisconsin Fish Species List at http://dnr.wi.gov/topic/fishing/documents/species/wifish.pdf.

Wisconsin contains 21 sucker species, including one extirpated species, creek chubsucker (*Erimyzon oblongus*), one endangered species, black redhorse (*Moxostoma duquesnei*), four threatened species, and one species of special concern.

The bullhead catfish family contains 12 species, including one extirpated species and one endangered species. Black bullheads (*Ictalurus melas*), brown bullheads (*Ictalurus nebulosus*), and yellow bullheads (*Ictalurus natalis*) are common game species in Wisconsin. These species are scaleless, have broad bands of teeth, and six barbells, or whisker-like feelers. Bullheads are found in large schools along the bottom of streams and vegetated shallows. These fish have few predators and do well in harsh environments, even surviving outside of water for several hours. (DNR, 2016g) (DNR, 2016c)

Trout and salmon in Wisconsin include several popular sport fishes and species of special concern, including the cisco or lake herring (*Coregonus artedii*), a species of special concern*;* deepwater cisco (*Coregonus johannae)* and shortnose cisco (*Coregonus reighardi),*both extinct species; and shortjaw cisco (*Coregonus zenithicus),* a species of special concern. More common trout species, such as the rainbow trout (*Oncorhynchus mykiss)* and brook trout (*Salvelinus fontinalis*), are also present in Wisconsin. Trout are commonly stocked as game fish in Wisconsin lakes and streams, but brook trout are the only stream trout native to the state. (DNR, 2016c) (DNR, 2008b)

The sunfish family consists of 11 species, including the longear sunfish (*Lepomis megalotis*) is listed as threatened in the state. This grouping includes commonly known species, such as the bluegill (*Lepomis macrofhirus),* smallmouth bass (*Micropterus dolomieu),* largemouth bass (*Micropterus salmoides),* and the white crappie (*Pomoxis annularis).* Bluegill occur in the Lake Michigan, the Mississippi River, and the Lake Superior drainage basins; as a result of game stocking it occurs in nearly every lake and stream in the state. (DNR, 2016c) (DNR, 2012c)

The perch family consists of 24 native species, including one threatened and two endangered species, three species of concern, and one extirpated species. The gilt darter (*Percina evides)* is a threatened species. The crystal darter (*Ammocrypta asprella)* and bluntnose darter (*Etheostoma chlorosomum)* are both endangered species. The orangethroated darter (*Etheostoma spectabile*) is extirpated in Wisconsin. Common species include the yellow perch (*Perca flavescens*), occurs in the glaciated regions of the state. (DNR, 2016c) (DNR, 2012d)

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

Shellfish and Other Invertebrates

Wisconsin is home to 58 mollusk species and species of crustaceans, including 51 native freshwater mollusks that primarily occur in warm water rivers (DNR, 2015an). Approximately

52 freshwater bivalve[103] species occur in Wisconsin's waters, with a large percentage of the species occurring throughout the Mississippi River system (Stern, 1990). The freshwater bivalve species in Wisconsin include five families, three of which are native (Sphaeriidae, Margaritiferidae, and Unionidae). Of the 5 families, the Unionidae is the most diverse, with approximately 50 species. Of the 51 native freshwater mollusk species, 26 (over 50 percent) are rare and declining and considered SGCN (DNR, 2005a) (DNR, 2015ag). Wisconsin's waters are also home to approximately 22 non-insect arthropod species including fairy shrimp, holartic clam shrimp, copepods, sow bugs, amphipods, crayfish, and spiders (DNR, 2005a).

Invasive Aquatic Species

As previously discussed, Wisconsin has adopted regulations that prohibit the possession, transport, importation, sale, transfer, or introduce of certain invasive species in without a permit. The Wisconsin DNR maintains a list of prohibited and restricted species. These lists are published under WAC Chapter NR 40.04 (WAC, 2015d). The list of prohibited aquatic species consists of 10 fish and crayfish and 12 aquatic invertebrates, including 3 snails, 3 water fleas, 1 clam, 1 crab, 2 shrimp, and 2 mollusks (DNR, 2015ae). The list of restricted aquatic species consists of 5 categories of fish and crayfish species, including 28 fish species and 1 crayfish species (MFWP, 2015b). Species commonly detected in Wisconsin include zebra mussels (*Dreissena polymorpha*) and Eurasian water milfoil (*Myriophyllum spicatum*). The Wisconsin DNR also regulates 16 aquatic invasive plant species, such as flowering rush (*Butomus umbellatus*), Curly-leaf pondweed (*Potamogeton crispus*), Hydrilla (*Hydrilla verticillata*), African elodea (*Lagarosiphon major*), Brittle water nymph (*Najas minor*), and Starry stonewort (*Nitellopsis obtuse*) (DNR, 2015ao). The red-eared slider (*Trachemys scripta elegans*) (a turtle species) is an invasive species used in the pet trade; it was removed from Wisconsin's prohibited list in 2015 (DNR, 2015ad).

17.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

The USFWS is responsible for administering the ESA (16 U.S.C. §1531 et seq.) in Wisconsin. The USFWS Great Lakes Office has identified 11 federally endangered and 10 federally threatened species known to occur in Wisconsin (USFWS, 2015d). Of these 21 federally listed species, three of them have designated critical habitat[104] (USFWS, 2015e). The 21 federally listed species include 3 mammals, 3 birds, 8 invertebrates, and 7 plants and are discussed in detail under the following sections (USFWS, 2015d). 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.

[103] Bivalve: "An aquatic mollusk whose compressed body is enclosed within a hinged shell. For example, clams, oysters and mussels are bivalves." (USEPA, 2015o)
[104] Critical habitat includes "the specific areas (i) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species" (16 U.S.C. §1532(5)(A)).

Figure 17.1.6-3: ESA Designated Critical Habitat in Wisconsin

Mammals

One endangered and two threatened mammals are federally listed for Wisconsin as summarized in Table 17.1.6-4. The Canada lynx (*Lynx canadensis*) and gray wolf (*Canis lupus*) are both found in the northern regions of the state, while the northern long-eared bat (*Myotis septentrionalis*) can be found throughout. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Wisconsin is provided below.

Table 17.1.6-4: Federally Listed Mammal Species of Wisconsin

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Wisconsin	Habitat Description
Canada Lynx	*Lynx canadensis*	T	No	Boreal forests west of Lake Superior in the northern regions of Wisconsin.
Gray Wolf	*Canis lupus*	E	No	High elevation forests adjacent to grasslands in the northern half of the state.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Caves and tree snags throughout the entire state, especially during winter hibernation.

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

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

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

Gray Wolf. The gray wolf is a member of the dog (canine) family, with fur color which may be white, red, brown, black, and many variations in between. The species reaches an approximate length of 6 feet, weigh approximately 100 pounds, and typically live up to 5 years (USFWS, 2010). 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 were delisted by the USFWS in 2012, then relisted in 2014. 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 Wisconsin, the species is primarily found in the northern half of the state (USFWS, 2010) (USFWS, 2015g).

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

Northern Long-eared Bat. The northern long-eared bat is "a medium-sized bat with a body length of 3 to 3.7 inches and a wingspan of 9 to 10 inches" (USFWS, 2015h); it was listed as threatened under the ESA in May 2015 (80 Federal Register 17974, April 2, 2015). The northern long-eared bat's range includes 37 states from the east coast to the north-central U.S. (USFWS, 2015h). The species' range extends from eastern Montana to Maine, with Wisconsin and the Great Lakes in approximately the middle of its range. The species is found throughout all 72 counties of Wisconsin (USFWS, 2015i). Suitable winter habitat includes caves and abandoned mines, while trees and snags provide suitable roosting habitat the remainder of the year (USFWS, 2014a) (USFWS, 2015e). The winter hibernation season is from October 1st to May 15th, and the summer maternity season is from April 1st to September 30th (USFWS, 2015e).

The main threat to this bat is white-nose syndrome, which began in New York in 2006 and is now found in at least two-thirds of the bat's range. The USFWS estimates species numbers have declined up to 99 percent based on historical hibernacula counts as a result of this disease. Because populations have declined so dramatically, development activities that permanently or temporarily remove forested habitat now have a greater potential to directly or indirectly effect the northern long-eared bat depending on the time of year habitat impacts occur. Protection of hibernacula using gates to exclude human entry and minimizing the loss or disturbance of roosting summer habitat are recommended to prevent further loss of this species (USFWS, 2014a) (USFWS, 2015e).

Birds

Two endangered and one threatened bird species are federally listed and known to occur in the state of Wisconsin as summarized in Table 17.1.6-5. All three listed bird species are primarily found around the Great Lakes region of the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Wisconsin is provided below.

Table 17.1.6-5: Federally Listed Bird Species of Wisconsin

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Wisconsin	Habitat Description
Kirtland's Warbler	*Setophaga kirtlandii*	E	No	Jack pine habitats in the north and central areas of the state.
Piping Plover	*Charadrius melodus*	E	No	Sparsely vegetated beaches in the northeastern region.
Red Knot	*Calidris canutus rufa*	T	No	Bays in the north and eastern regions of the state during migration stopovers.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2015d)

Kirtland's Warbler. The Kirtland's warbler (*Setophaga kirtlandii*) is a yellow-breasted songbird with dark blue and black back feathers; it is approximately 6 inches long, and the males have a mask with white eye rings while the females do not. The species was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). The Kirtland's warbler is found throughout the central and northwestern Great Lakes region. Within Wisconsin, the Kirtland's warbler is known or believed to occur in at least six counties (Adams, Douglas, Jackson, Marinette, Vilas, and Washburn counties) in the northeastern, northwestern, and central areas of the state (Kirtland's Warbler Recovery Team, 1985) (USFWS, 2015j).

Though red pine plantations have also been used by the species, habitat for the Kirtland's warbler primarily consists of jack pine areas with sparse ground cover. The species prefers dry, sandy soils with rapid water drainage to prevent flooding from rainfall. Burned jack pine habitats have been noted as very significant to the species, with much more successful nesting rates in these areas, though ground cover is still important when choosing a site. Threats to the Kirtland's warbler include habitat loss due to its specific habitat needs, the increase of forest fire control, parasitic threats from the crown-headed cowbird (*Molothrus ater*), and predation during nesting and at its Bahamas mating grounds (Kirtland's Warbler Recovery Team, 1985) (Michigan Department of Natural Resources, 2015).

Piping Plover. The piping plover (*Charadrius melodus*) 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 U.S. Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, Virgin Islands (50 FR 50726 50734, Dec 11, 1985) (USFWS, 2015k). Piping plovers breed in three geographic regions of North America, composed of two separate subspecies (USFWS, 2015l). The birds breeding within Wisconsin in the central United States and Canada are of the subspecies *C. m. melodus*, and have a range

Piping Plover. Photo credit: USFWS

between the Great Lakes and the Atlantic (USFWS, 2015k). Critical habitat was designated for the Great Lakes population in 2001, and the Northern Great Lakes population in 2002, however no critical habitat for the piping plover has been mapped in Wisconsin (USFWS, 2015l). Piping plover subspecies (*C. m. melodus*) can be found in at least four Wisconsin counties, including Ashland, Douglas, Manitowoc, and Marinette counties in the north and northeastern parts of the state (USFWS, 2015k).

Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Nesting often occurs in palustrine wetlands[105] in the Northern Great Plains (USFWS, 1988). Piping plover feed on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates. Current threats to this species include habitat loss and habitat degradation, human disturbance, pets, predation[106], flooding from coastal storms, and environmental contaminants (USFWS, 2015m) (USFWS, 2015n).

Red Knot. The threatened red knot (*Calidris canutus rufa*) is approximately 9 to 11 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.” Individual birds 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). The red knot stops along the Great Lakes region, including northern and eastern regions of Wisconsin, in at least eight of the state’s counties (USFWS, 2015o).

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

Reptiles and Amphibians

There are no federally listed threatened or endangered reptile and amphibian species in Wisconsin. (USFWS, 2015p)

Invertebrates

There are eight endangered invertebrate species that are federally listed and known to occur in the state of Wisconsin as summarized in Table 17.1.6-6. The five mussel species are primarily found within the western regions of the state in the St. Croix and Wisconsin Rivers. The two butterflies and one dragonfly species are generally found within the middle and eastern areas of Wisconsin. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Wisconsin is provided below.

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

Table 17.1.6-6: Federally Listed Invertebrate Species of Wisconsin

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Wisconsin	Habitat Description
Higgins' Eye Pearlymussel	*Lampsilis higginsii*	E	No	Deep, moderately flowing rivers with firm, loose riverbeds in the St. Croix and Wisconsin Rivers.
Hine's Emerald Dragonfly	*Somatochlora hineana*	E	Yes	Marshes and slow moving water next to forests, along the eastern edge of the state.
Karner Blue Butterfly	*Lycaeides melissa samuelis*	E	No	Early successional communities across the middle of the state.
Poweshiek Skipperling	*Oarisma poweshiek*	E	Yes	Prairie fens and tallgrass in the state's eastern region.
Sheepnose Mussel	*Plethobasus cyphyus*	E	No	Shallow shoal areas above coarse sand or gravel on the western edge of the state.
Snuffbox Mussel	*Epioblasma triquetra*	E	No	Swift shoal currents over sand or gravel to bury in, located in the central-eastern and western regions of the state overlapping with Minnesota.
Spectaclecase Mussel	*Cumberlandia monodonta*	E	No	Sheltered areas of large rivers (under rocks or boulders) along most of the western border of the state.
Winged Mapleleaf	*Quadrula fragosa*	E	No	Large freshwater streams with muddy-gravel bottoms within the St. Croix River.

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

Higgins' Eye Pearlymussel. The Higgins' eye pearlymussel (*Lampsilis higginsii*) 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 northern third of the Mississippi tributaries from between Louisiana and Indiana to between Minnesota and Wisconsin. Within Wisconsin, the species is found within the St. Croix River and the Wisconsin River across at least 14 counties on the western side of the state (USFWS, 2015q).

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 clay or 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, which has intensively impacted mussel communities in various locations throughout the species' range (USFWS, 2004).

Hine's Emerald Dragonfly. The Hine's emerald dragonfly (*Somatochlora hineana*) is a dark green dragonfly with two cream-colored horizontal lines and bright green eyes. The species grows to approximately 2.5 inches and may have translucent, yellowish-brown fringed wings. The dragonfly was listed as endangered in 1995 (60 FR 5267 5273, January 26, 1995). The species' range extends from a localized population in southeastern Missouri to the northeastern region of Michigan around the intersection of Lake Michigan and Lake Huron, and has historically been present in Ohio and Indiana. Within Wisconsin, the Hine's emerald dragonfly population is the largest, with populations primarily found along the shore of Lake Michigan, and in the southwest corner of the state (USFWS, 2015r) (Zercher, 2015).

Critical habitat for the species has been established in various locations along Wisconsin's coast with Lake Michigan. One site is located in the Cedarburg Bog State Natural Area approximately 25 miles north of Milwaukee, and another range of sites in northeastern Door County, as shown in Table 17.1.6-6. (USFWS, 2015e).

Habitat for Hine's emerald dragonfly include marshes and sedge meadows fed by calcium-rich groundwater seepage on top of sedimentary bedrock, in locations with slow moving water next to forests. Threats to the dragonfly primarily include habitat loss due to agriculture and human development, successional habitat progression, and alterations to biological and hydrological systems. (Zercher, 2015)

Karner Blue Butterfly. The Karner blue butterfly (*Lycaeides melissa samuelis*) is generally a dark blue or brownish-silver butterfly with orange accents and a black trim. The species is small, with a wingspan of approximately one inch, and has been federally listed as endangered since 1992 (57 FR 59236 59244, Dec 14, 1992) (USFWS, 2015s). Their range extends across 12 states from Minnesota to Maine, including Wisconsin (USFWS, 2008a). The species occurs in at least 17 Wisconsin counties oriented in an approximate band through the center of the state from Minnesota to Lake Michigan (USFWS, 2015s).

Karner Blue Butterfly. Photo credit: USFWS

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, 2008a).

Poweshiek Skipperling. The Poweshiek skipperling (*Oarisma poweshiek*) is a small, dark brown and orange butterfly with streaked, white veins on the underside of its wings (USFWS, 2014c). The species was listed as endangered in 2014 (79 FR 63671 63748, October 24, 2014). The range for the Poweshiek skipperling 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, 2014c). Critical habitat for the Poweshiek skipperling within Wisconsin is indicated as shown in Table 17.1.6-6. Green Lake County and Waukesha County within Wisconsin are believed to support the species within the eastern part of the state (USFWS, 2015t).

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

Sheepnose Mussel. The sheepnose mussel (*Plethobasus cyphyus*) is a medium sized freshwater mussel that usually grows about 5 inches. The sheepnose shell is a light yellow to dull yellowish brown with darker ridges (USFWS, 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, but has been eliminated from two-thirds of the location where it once occurred and now only occurs in 25 streams (USFWS, 2012a) (USFWS, 2015u). In Wisconsin, the species is known to occur along the west side of the state, within northern tributaries of the Mississippi River throughout at least 13 counties (USFWS, 2015u).

The sheepnose mussels live in large rivers and streams with moderate to swift currents and feed on suspended algae, bacteria, detritus, and microscopic animals. This species prefers shallow shoal habitats above coarse 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 endangered snuffbox mussel (*Epioblasma triquetra*) is a small to medium size freshwater mussel that usually grows from 1.8 to 2.8 inches. The snuffbox has a yellow, green, or brown triangular shell with green rays (USFWS, 2012b). This species was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012). The snuffbox total population has reduced by 62 percent from its historical range. Currently this species only occurs in 79 streams and 14 rivers compared to 210 streams and lakes in its historical range (USFWS, 2012b). In Wisconsin, small, geographically isolated populations are found in at least seven counties located in the central-eastern region of the state and along the western edge overlapping with Minnesota's border (USFWS, 2012b) (USFWS, 2015v).

The snuffbox mussels live in small to medium sized creeks, lakes, and rivers and feed on suspended algae, bacteria, and dissolved organic material. This species prefers shoal habitats with swift current over sand and gravel as they usually burrow deep in sand. For reproduction a stable and undisturbed habitat is require with a sufficient population of host fish such as logperch (*Percina caprodes*) and several other darters. 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, 2012b).

Spectaclecase Mussel. The spectaclecase mussel (*Cumberlandia monodonta)* 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 2012c). 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, 2012c) (USFWS, 2015w). In Wisconsin, the interspersed populations are primarily found within seven counties along the western border of the state, straddled with both Minnesota and Iowa (USFWS, 2015w).

Suitable habitat for the spectaclecase mussel include 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, 2012c).

Winged Mapleleaf. The winged mapleleaf (*Quadrula fragosa*) 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, 2015x). Within Wisconsin, the species is known or believed to occur within the St. Croix and Polk counties within the St. Croix River on the western border of the state (USFWS, 2015y) (USFWS, 2015x).

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 (*Dreissena polymorpha*), and habitat loss due to reduced water quality and hydrological alterations (Vaughan, 1997).

Plants

Seven threatened plant species are federally listed and known to occur in the state of Wisconsin as summarized in Table 17.1.6-7. The seven plant species listed all have different ranges throughout the state of Wisconsin that range from the St. Croix River and southwestern regions to northeastern areas along Lake Michigan. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Wisconsin is provided below.

Table 17.1.6-7: Federally Listed Plant Species of Wisconsin

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Wisconsin	Habitat Description
Dwarf Lake Iris	*Iris lacustris*	T	No	Adjacent to shoreline forests around the Green Bay, Lake Michigan shorelines.
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	T	No	Wetlands and prairies with full sunlight, within the southeast region of the state.
Fassett's Locoweed	*Oxytropis campestris var. chartacea*	T	No	Coarse sand shorelines next to shallow lakes, endemic to Wisconsin, found in central and northern locations.
Mead's Milkweed	*Asclepias meadii*	T	No	Grasslands of southeastern Wisconsin.
Northern Wild Monkshood	*Aconitum noveboracense*	T	No	Along cool sites of streams and cliffs in Wisconsin's southwestern region.
Pitcher's Thistle	*Cirsium pitcheri*	T	No	Active grassland dunes in sporadic population clumps along the Lake Michigan shoreline.
Prairie Bush-clover	*Lespedeza leptostachya*	T	No	Tallgrass prairie regions with moderately moist soil lining the western and southern state borders.

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

Dwarf Lake Iris. The Dwarf Lake iris is a perennial, lavender-blue, yellow-accented flower with a short stem and long, wide green leaves which was listed as threatened in 1988 (53 FR 37972 37975, September 28, 28). Regionally, the species' range extends "along the northern shorelines of lakes Michigan and Huron in Wisconsin, Michigan and Ontario, Canada" (USFWS, 2013c). Within Wisconsin, the range of the Dwarf Lake iris is limited to the northeastern region, focused around the Green Bay, Lake Michigan shorelines, within the counties of Brown and Door (USFWS, 2015z).

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

Eastern Prairie Orchid. The eastern prairie orchid *(Platanthera leucophaea),* also known as the eastern prairie orchid, grows between 8 to 40 inches in height with a stalk of up to 40, white flowers, each with three fringed lips and a nectar tube. The species was federally listed as threatened in 1989 (54 FR 39857 39863, September 28, 1989). Regionally, this species is known to occur primarily in the Great Lakes and Illinois region, though also sparsely occurs from Maine south to Georgia. In Wisconsin, the eastern prairie orchid occurs within the southeast region of the state, in nine counties (USFWS, 2015aa).

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

Fassett's Locoweed. The Fassett's locoweed is a perennial plant with silvery color, yellow pea pods, and light red to purple flowers (USFWS, 1991). The species was listed as threatened in 1988 (53 FR 37970 37972, September 28, 1988). As the Fassett's locoweed is endemic, its range is limited to Wisconsin, primarily "in the Central Plains region of the state just east of the eastern edge of extinct Glacial Lake Wisconsin", and has been historically present in Waushara, Portage, and Bayfield counties in the central and northern regions of the state (USFWS, 1991) (USFWS, 2015ab).

Habitat for Fassett's locoweed includes sandy and gravelly shorelines adjacent to shallow lakes fed by groundwater and subject to periodic water level variation. Threats to the plant include human development and contact upon the shorelines, animal grazing, permanent water level or other hydrologic alterations, and agricultural pesticide runoff (USFWS, 1991) (USFWS, 2003).

Mead's Milkweed. Mead's milkweed is a tallgrass herb characterized by a single stem which grows up to 16 inches tall, and was listed as threatened in 1988 (53 FR 33992 33996, September 1, 1988). The species has hairless leaves, a white wax coating, and a singular cluster of flowers at the top (USFWS, 2005c). Regionally, the species' range extends from eastern Kansas to southern Illinois to southern Wisconsin. Mead's milkweed is known or believed to occur in at least five counties within southwestern region of Wisconsin (USFWS, 2015ac).

Habitat for the species includes "moderately wet to moderately dry upland tallgrass prairie or glade/barren habitat characterized by vegetation adapted for drought and fire", which include stable prairie habitats. Threats to the species include habitat loss from farming and commercial development, habitat fragmentation which reduce genetic diversity and pollinators, and hay mowing, which occurs in agricultural areas and can eliminate the early stages of the species' life cycle (USFWS, 2005c).

Northern Wild Monkshood. Northern wild monkshood is a herbaceous perennial of between 1 to 4 feet in height and has adapted for pollination by bumblebees with hood-shaped blue flowers of approximately one inch in length (USFWS, 2015ad). The species was listed as threatened in 1978 (43 FR 17910 17916, April 26, 1978). The species' range is interspersed from central Iowa to eastern New York between "three distinct regions: in and adjacent to the unglaciated portion of Iowa and Wisconsin, the northeastern Ohio glaciated area and the Catskill Mountains of New York" (USFWS, 1983). The wild monkshood is believed or known to occur within at least five counties, Grant, Monroe, Richland, Sauk, and Vernon, in the southwestern region of Wisconsin (USFWS, 2015ad).

The northern wild monkshood habitat occurs along cool sites of streams and cliffs (Peterson & McKenny, 1968). Threats include dams and reservoirs and other sources that have resulted in degradation and loss of habitat, construction and maintenance activity, logging operations, quarrying, grazing, and collection by humans (USFWS, 1983).

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

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

Prairie Bush-clover. The prairie bush-clover is a perennial plant 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, 2015af). The species' range primarily extends from Iowa to the shore of Lake Michigan, reaching north to the twin cities and south to central Illinois. Within Wisconsin, the species is known or believed to occur in at least 11 counties lining the western and southern borders of the state (USFWS, 2015al).

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; hybridization with the more common round-headed bush clover" (USFWS, 2015af).

17.1.7. Land Use, Recreation, and Airspace

17.1.7.1. Definition of the Resources

The following summarizes major land uses, recreational venues, and airspace considerations in Wisconsin, 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, 2015a). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The FAA is charged with the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

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

The FAA Air Traffic Services Unit (the Unit) manages the National Airspace System (NAS) and international airspace assigned to U.S. control and is responsible for ensuring efficient use, security, and safety of the nation's airspace. FAA field and regional offices (e.g., Aircraft Certification Offices, Airports Regional Offices, Flight Standards District Offices [FSDOs], Regional Offices & 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, 2015a). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

17.1.7.2. 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 Wisconsin. However, most site-specific land use controls and requirements are governed by local county, city, and village laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities. The Wisconsin Department of Administration has compiled a series of planning guides for comprehensive planning in Wisconsin. The Land Use Resource Guide (Wisconsin Department of Administration, 2005) is the current state-level guidance for land use planning in Wisconsin.[107]

Several references in Wisconsin statues address airspace hazards. As defined in the Wisconsin Statutes (Chapter 114, Subchapter I), an airport hazard "means any structure, object of natural growth, or use of land which obstructs the airspace required for the flight of aircraft in landing or taking off at an airport or is otherwise hazardous to such landing or taking off (Wisconsin State Legislature, 2015c)." Wisconsin Statutes state regulation of structures is in the public interest as it obtains to potential impacts to navigable airspace. These statutes assure unobstructed conditions for safe flight within airspace over the state and the air traffic pattern of a public airport. (Wisconsin State Legislature, 2015d)

17.1.7.3. Land Use and Ownership

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

Land Use

Table 17.1.7-1 identifies the major land uses by coverage type in Wisconsin. Forest and woodlands comprises the largest portion of land use with 43 percent of Wisconsin's total land occupied by this category (Table 17.1.7-1 and Figure 17.1.7-1). Agriculture is the second largest area of land use with 31 percent of the total land area. Developed areas account for approximately 6 percent of the total land area (USGS, 2011). The remaining percentage of land includes public land, surface water, and other land covers, shown in Figure 17.1.7-1, that are not associated with specific land uses (USGS, 2012c).

[107] Other planning guides are available at http://www.doa.state.wi.us/Divisions/Intergovernmental-Relations/Comprehensive-Planning.

Table 17.1.7-1: Major Land Use in Wisconsin by Coverage Type

Land Use	Square Miles*	Percent of Land
Forest and Woodland	28,144	43.1%
Agricultural Land	20,472	31.4%
Developed Land	3,742	5.7%
Surface Water	11,118	17.0%
Public Land, Surface Water, and other Land Cover not associated with specific land uses	1,516	2.8%

*Square miles are rounded to the nearest whole number. The maps and tables are prepared from the analysis of GIS data and imagery; a margin of error may result in the use of imagery. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data, and the amount of ground truth verification work conducted. Other federal or state data sources may have slightly different totals.
Source: (USGS, 2011)

Forest and Woodland

Forest and woodland areas can be found throughout the state. The largest concentrations of forest are in northwest, northeast, and central Wisconsin. About two-thirds forest and woodland areas throughout Wisconsin are privately owned by families, individuals, and forest industry (approximately 66 percent) (USFS, 2012). The Chequamegon-Nicolet National Forest is in northern Wisconsin. (USFS, 2016a) Section 17.1.6 presents additional information about terrestrial vegetation.

<u>State Forests</u>

State Forests account for 1,048 square miles of state land and are managed by the Wisconsin Department of Natural Resources. The State Forests provide several benefits including wildlife habitat, recreation opportunities, and forest and woodland products. The 2011 Division of Forestry Strategic Direction states that, “The mission of the Division of Forestry is to work in partnership to protect and sustainably manage Wisconsin's forest ecosystems to supply a wide range of ecological, economic and social benefits for present and future generations.” (DNR, 2011b)

<u>Private Forest and Woodland</u>

Approximately two-thirds of Wisconsin's total forestland, is privately owned. These private landowners consist of families, individuals, and other unincorporated groups who own about 82 percent of these private acres. Other private landowners such as forest industry and other companies, tribes, nongovernmental organizations, clubs, and partnerships own the remaining 18 percent of private forestland. The average size of the private forest and woodland parcel is 26 acres. The primary objectives for owning forest are for aesthetics, hunting or fishing, recreation, wildlife habitat, residential use, and a family asset to pass to heirs. (USFS, 2012) For additional information regarding forest and woodland areas, see section 17.1.6, Biological Resources and Section 17.1.8, Visual Resources.

Agricultural Land

Agricultural land exists in every region of the state, with the largest concentrations in the eastern and southern regions of the state (Figure 17.1.7-1). Almost one-third of Wisconsin's total land area is classified as agricultural land (approximately 31 percent, or 20,472 square miles). In 2012, there were 69,754 farms in Wisconsin and most were owned and operated by small, family businesses, with the average farm size of 209 acres (USDA, 2014). Some of the state's largest agricultural uses include dairy, cranberries, corn, soybeans, hay, potatoes, and livestock for dairy and meat (USDA, 2014c).[108]

Developed Land

Developed land in Wisconsin tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 17.1.7-1). Although only 6 percent of Wisconsin land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 17.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 17.1.7-1 shows where these areas are within the Developed land use category.

Table 17.1.7-2: Top Five Developed Metropolitan Areas (2014 estimate)

Metropolitan Area	Population Estimate
Milwaukee	1,376,476
Madison	401,661
Appleton	216,154
Green Bay	206,520
Racine	133,700
Total Estimated Population of Metropolitan Areas	**2,334,511**
Total State Estimated Population	**5,757,564**

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

[108] For more information by county, access the USDA Census of Agriculture website: http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Wisconsin/.

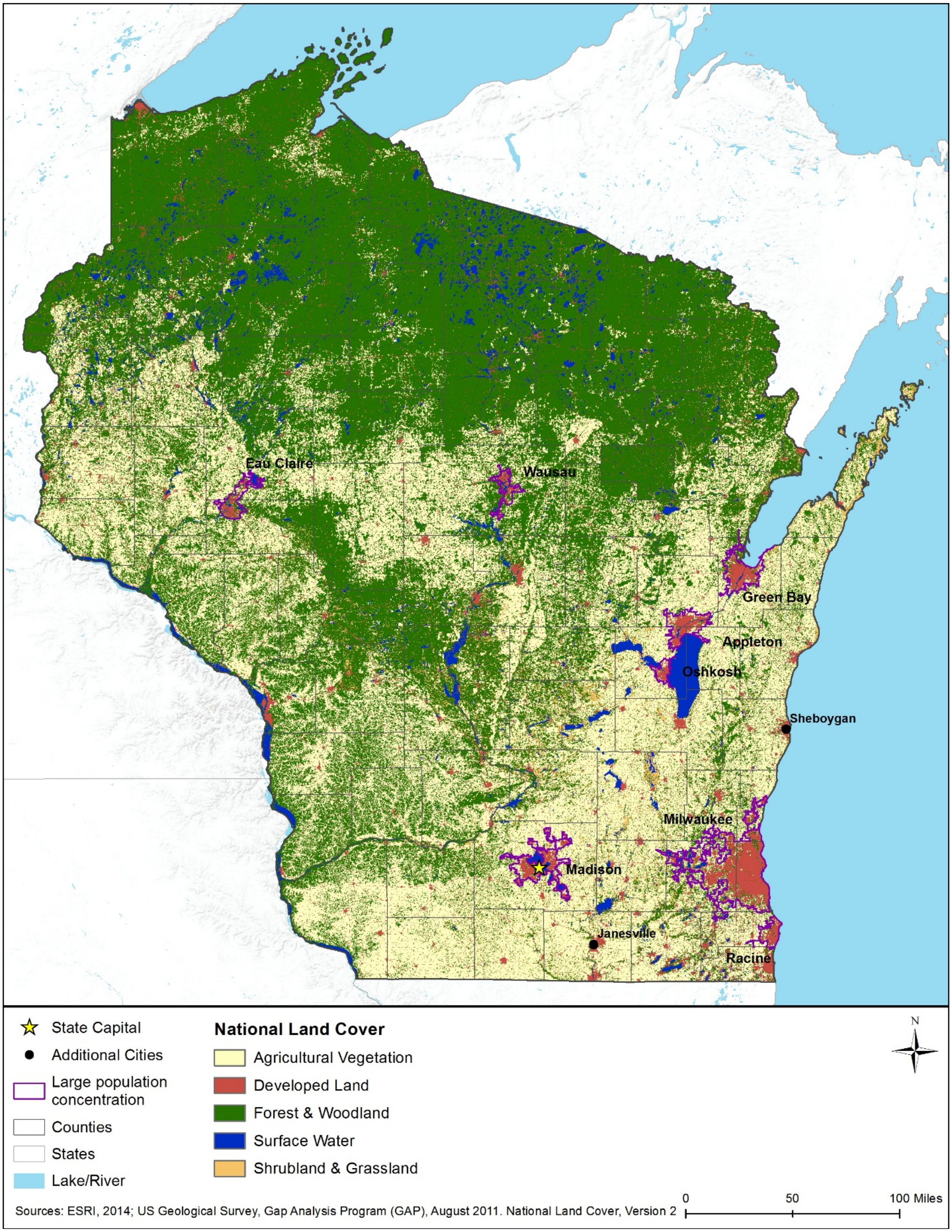


Figure 17.1.7-1: Major Land Use Distribution by Coverage Type

Land Ownership

Land ownership within Wisconsin has been classified into four main categories: private, federal, state, and tribal (Figure 17.1.7-2).[109]

Private Land

The majority of land in Wisconsin is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 17.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, and forest and woodland areas. Private land exists in all regions of the state.[110]

Federal Land

The federal government manages 2,962 square miles (4.5 percent) of Wisconsin land with a variety of land types and uses, including military bases and facilities, national wildlife refuges, national forest, wilderness areas, and National Park Service. Four federal agencies manage the majority of federal lands throughout the state (Table 17.1.7-3 and Figure 17.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state. (USGS, 2012d) (USGS, 2014e)

Table 17.1.7-3: Federal Land in Wisconsin

Agency[1]	Square Miles	Representative Type
Department of Defense	124	Military Bases and Facilities
U.S. Fish and Wildlife Service	385	National Wildlife Refuges
USDA Forest Service	2,241	National Forest and Wilderness Areas
National Park Service[2]	212	National Lakeshore, National Scenic Trails, and National Scenic Riverway
Total	**2,962**	**NA**

Sources: (USGS, 2012d) (USGS, 2014e) (USFS, 2016b)
[1] Table identifies land wholly managed by the Agency; additional properties may be managed by or affiliated with the Agency
[2] Additional trails and corridors pass through Wisconsin that are part of the National Park System

- The Department of Defense owns and manages 124 square miles used for military bases and facilities (Department of Defense, 2014);
- The USFWS owns and manages 385 square miles consisting of 9 NWRs in Wisconsin (USFWS, 2015ag);
- The USDA Forest Service owns and manages 2,241 square miles set aside as the Chequamegon-Nicolet National Forest, Blackjack Springs Wilderness, and Headwaters Wilderness; and

[109] 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.
[110] Total acreage of private land could not be obtained for the state.

- The National Park Service manages 212 square miles consisting of the Apostle Islands National Lakeshore, Ice Age National Scenic Trail, North Country National Scenic Trail, and Saint Croix National Scenic Riverway (NPS, 2016a). (USGS, 2012d) (USGS, 2014e).

State Land[111]

The Wisconsin state government owns approximately 2,240 square miles of land. This land is comprised of state forests, natural areas, state parks, state fishery and wildlife areas, and other uses (Table 17.1.7-4). (USGS, 2012d) (USGS, 2014e)

Table 17.1.7-4: State Land in Wisconsin

Agency	Square Miles	Representative Type
Department of Natural Resources	1,048	State Forests
Department of Natural Resources	139	Natural Areas
Department of Natural Resources	179	State Parks
Department of Natural Resources	201	State Fishery Areas
Department of Natural Resources	844	State Wildlife Areas

Source: (DNR, 2015aq) (USGS, 2012d) (USGS, 2014e)
*Square miles not additive due to overlapping boundaries of the State Forests, State Parks and Recreation Areas, and Wildlife Management Areas.

The Department of Natural Resources manages:

- 1,048 square miles consisting of 9 State Forests,
- 139 square miles consisting of 673 Natural Areas,
- 179 square miles consisting of 50 State Parks,
- 201 square miles consisting of 215 State Fishery Areas, and
- 844 square miles consisting of 202 State Wildlife Areas. (DNR, 2015aq) (USGS, 2012d) (USGS, 2014e)

[111] 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.

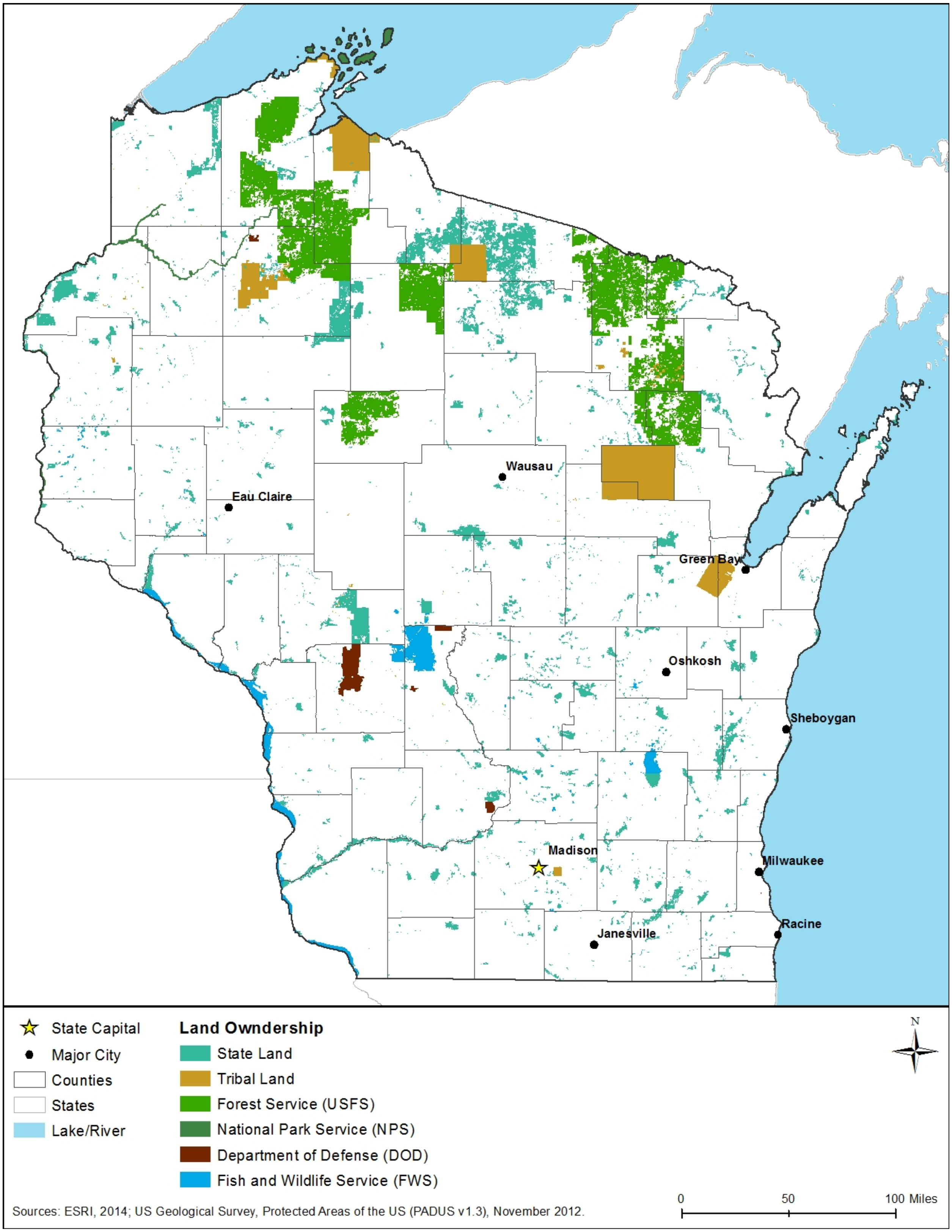


Figure 17.1.7-2: Land Ownership Distribution

Tribal Land

The Bureau of Indian Affairs, along with individual tribes, manages 1,073 square miles, or 1.6 percent of the total land within Wisconsin (Table 17.1.7-5 and Figure 17.1.7-2).[112] These lands are composed of 11 Indian Reservations currently located in the state (USGS, 2012d) (USGS, 2014e). For additional information regarding tribal land, see Section 17.1.11, Cultural Resources.

Table 17.1.7-5: Indian Reservations and Other Land Holdings of Wisconsin

Reservation/Land Holding Name	Square Miles
Bad River Reservation	194
Forest County Potawatomi Reservation	19
Ho-Chunk Nation	28
Lac Courte Oreilles Reservation	128
Lac du Flambeau Reservation	136
Menominee Reservation	365
Mole Lake Reservation	3
Oneida Reservation	102
Red Cliff Reservation	22
St. Croix Reservation	3
Stockbridge Munsee Reservation	73
Total	**1,073**

Sources: (USGS, 2012d) (USGS, 2014e)

17.1.7.4. Recreation

Wisconsin 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 68 State Parks, Forests, and Recreation Areas, and 39 State Trails (DNR, 2015ar). In addition to Lake Superior and Lake Michigan shorelines, and 260 miles of the Mississippi River, Wisconsin has approximately 15,000 inland lakes and 42,000 miles of streams and rivers (Wisconsin Department of Tourism, 2013a). Availability of these resources makes water-based recreation very popular with residents and visitors. The state also ranks third in the nation for the number of snowboard and ski resorts it has (SkiCentral, 2015). Wisconsin has a strong American Indian and European immigrant heritage, and is famous for its beer brewing, dairy farming, and cheese making. Federally, the National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers manage areas in Wisconsin with substantial recreational attributes.

[112] 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.

This section discusses key recreational opportunities and activities representative of various regions of Wisconsin. The state can be categorized by three distinct recreational regions, each of which are presented in the following sub-sections. For information on visual resources such as National Scenic Byways and state-designated Byways, see Section 17.1.8, 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 17.1.11, Cultural Resources.

North Region

The North Region is bordered by Lake Superior, Michigan, and Michigan's Ottawa National Forest to the north, and the St. Croix River and Minnesota to the west (Figure 17.1.7-3).[113] Forests, lakes, rivers and streams also dominate this region's landscape. 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, all-terrain vehicle (ATV), and snowmobile riding. This region is largely rural with small towns and villages, and lakeside cabins. The Apostle Islands National Lakeshore with its 21 islands and eight lighthouses is an extremely popular destination for summer visitors. The park's ice caves now attract thousands of winter recreationists (Wisconsin Department of Tourism, 2013b) (NPS, 2016b). The 255-mile St. Croix National Scenic Riverway, Namekagon River, and the adjacent corridors of woodlands and bluffs provides excellent opportunities for canoeing, boating, fishing, camping and hiking (NPS, 2015d).

The Chequamegon and Nicolet National Forest is composed of geographically dispersed units with a combined total of 1.5 million acres of woodlands and water for hunting, fishing, birdwatching, camping, hiking, biking, off-highway vehicle use, horseback riding, boating, cross-country skiing, and fall foliage viewing (Wisconsin Department of Tourism, 2013c). The Northern Highland American Legion State Forest lakes and rivers also draw recreationists, as do the consistent snowfalls in this region. There are over 400 miles of snowmobile trails and many miles of cross-country skiing trails in this largest state-owned property of 232,000 acres. (DNR, 2015as) Canoeing is the most popular outdoor activity in the Flambeau River State Forest (DNR, 2015at).

The North Country National Scenic Trail passes through northern Wisconsin. Eventually, this trail will be the longest National Scenic Trail in the U.S., passing through seven states for 4,600 miles. (NPS, 2015b) The Ice Age National Scenic Trail traverses the entire state for a total of nearly 1,200 miles (Recreation.gov, 2015).

[113] 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.

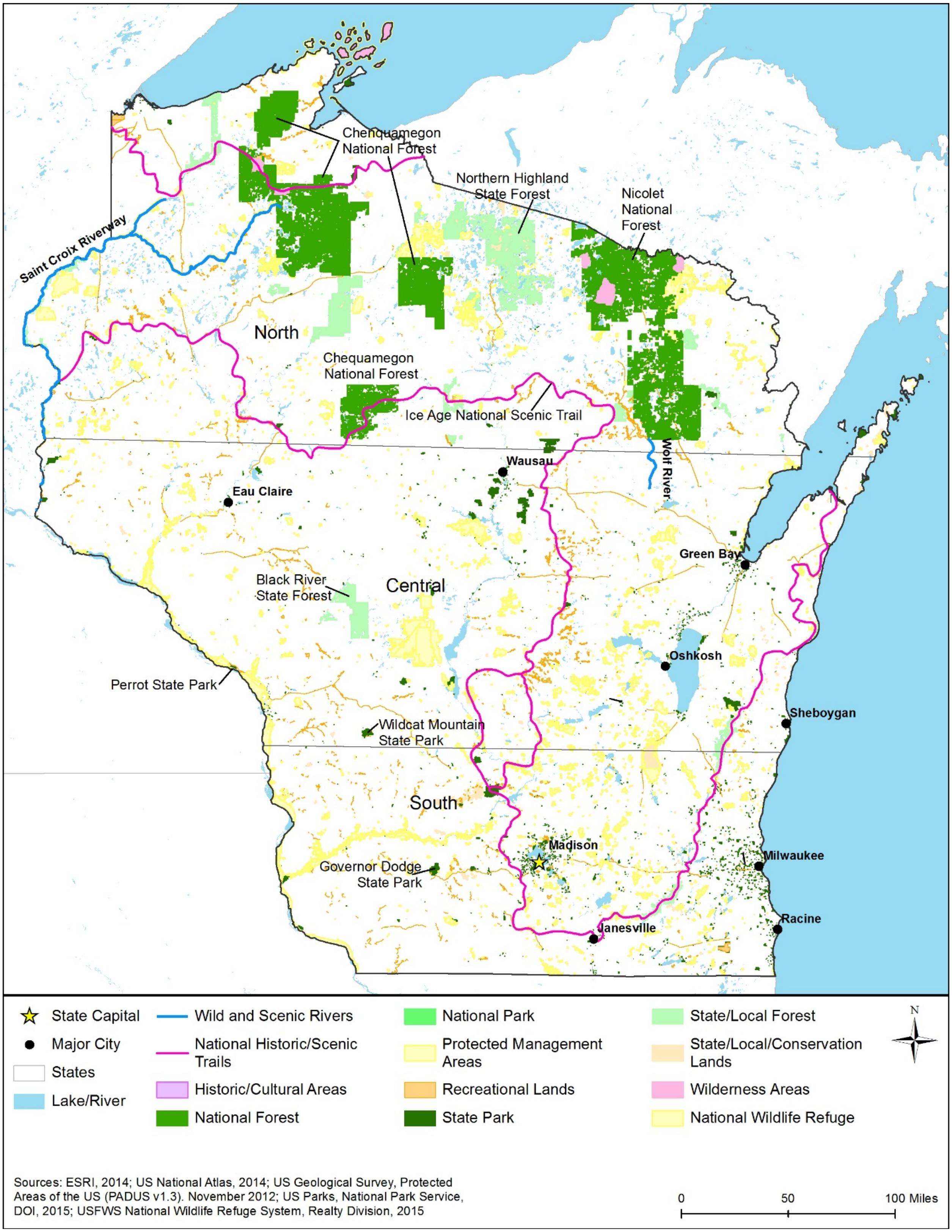


Figure 17.1.7-3: Wisconsin Recreation Resources

Central Region

The Central Region is bordered by the Mississippi River and St. Paul, Minnesota to the west, and Lake Michigan and its Green Bay to the east (Figure 17.1.7-3). This region has many small communities, farm towns, and three larger cities that offer additional opportunities for arts and cultural activities. Eau Claire has many museums, theaters, music venues, and galleries. Snow sports are popular in this region, particularly in the mountains near Wausau, where Granite Peak Ski Area is on the state's highest peak, Rib Mountain. Lake Michigan's Green Bay shoreline, Lake Winnebago, and city of Green Bay draw vacationers to beaches and maritime museums. The Great River Road National Scenic Byway, a 250-mile drive along the Mississippi River bluff from Prescott to Kieler allows visitors to also explore the adjacent locks and dams, and 33 historic river towns along its route. The countryside near the city of Wisconsin Rapids is the largest inland cranberry growing area in the world. The "Cranberry Highway" guides visitors to working cranberry marshes for tours, festivals, and cranberry-inspired foods (Wisconsin Department of Tourism, 2016). These are popular destinations for visitors interested in local tours and craft/food markets. The Elroy-Sparta State Trail was the first U.S. "Rails-to-Trails" project, and the original 32-mile section now connects with other trails in this region for a combined total of over 100-miles. Bikers, hikers, and snowmobilers enjoy this trail system, highlighted by the presence of three massive rock tunnels to travel through (Wisconsin Department of Tourism, 2015a).

South Region

The South Region is bordered by Lake Michigan to the east, Illinois and the suburbs of Chicago to the south, and the Mississippi River and Iowa to the west (Figure 17.1.7-3). The Wisconsin River flows from its headwaters in the north through central Wisconsin and joins the Mississippi at Prairie Du Chien. Scenic, fall foliage, and bald eagle cruises are popular at this river city (Wisconsin Department of Tourism, 2015b). Wisconsin Dells has the largest concentration of indoor and outdoor waterparks in the world (Wisconsin Dells Visitor and Convention Bureau, 2015). The capitol Madison and largest city Milwaukee have a full urban mix of cultural and recreational opportunities. Madison is uniquely sited on an isthmus between two lakes that are very popular to canoers and paddle boarders. The city also is renowned for its "bicycle-friendliness" (Wisconsin Department of Tourism, 2015c). Milwaukee's "Summerfest" is an 11-day music festival that brings more than 800,000 fans to the city. Other events celebrate Wisconsin's beer brewing heritage, arts, and farm-to-fork cuisine. Excellent art, history, and natural science museums, zoos, performing arts centers, and professional sports venues are favored destinations. The nearby Lake Geneva resort community has boutique shopping, fine dining, golf courses, spas, and abundant opportunities for water-related recreation activities (Wisconsin Department of Tourism, 2015d).

17.1.7.5. 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 17.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[114] service is based on the airspace classification (FAA, 2008).

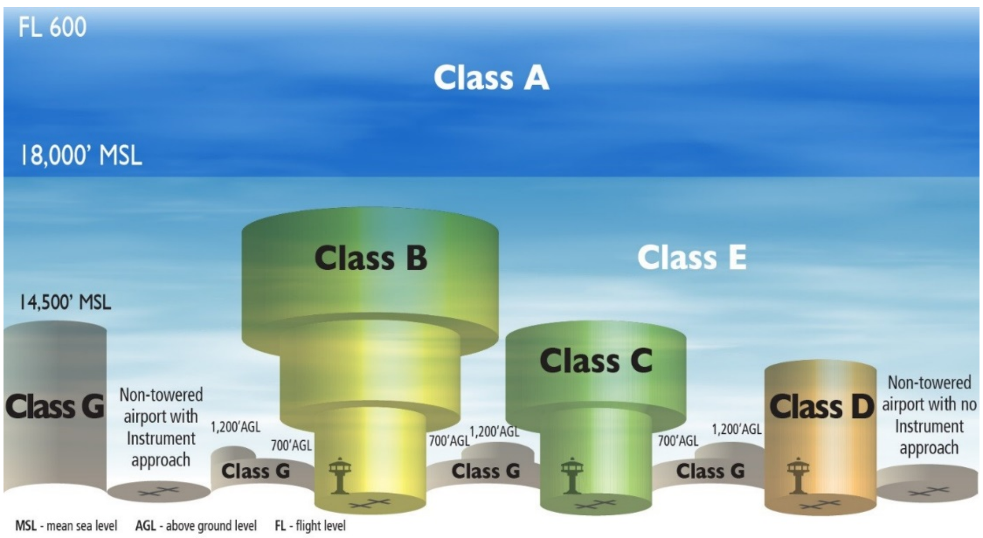


Figure 17.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[115]. 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).[116]

[114] ATC – Approved authority service to provide safe, orderly and expeditious flow of air traffic operations (FAA, 2015b).
[115] MSL – The average level of for the surface of the ocean; "The height of the surface of the sea midway between the average high and low tides" (Merriam Webster Dictionary, 2015b).
[116] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015b).

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

Uncontrolled Airspace

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

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (See Table 17.1.7-6).

Table 17.1.7-6: 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

SUA Type	Definition
	IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic."
Alert Areas	"Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance."
Controlled Firing Areas (CFAs)	"Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path."
National Security Areas (NSA)	"Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual Office, Airspace and Rules, and disseminated via Notices to Airmen (NOTAM). Inquiries about NSAs should be directed to Airspace and Rules."

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

Other Airspace Areas

Other airspace areas, explained in Table 17.1.7-7, 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 17.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute (5,280 feet/mile) miles of an airport where there is a Flight Service Station (FSS) located on an airport, but no operational control tower. The FSS advises the arriving and departing aircraft on particular conditions. • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower. • Remote Airport Information Service – Used for short-term special events.
MTRs	MTRs are for use by the military for training, specifically low level combat tactics where low altitudes and high speed are needed.
TFRs	TFRs are established to: • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the State of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of "permanent" are included in this Draft PEIS, since it indicates a longer, standing condition of the

Type	Definition
	airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

Aerial System Considerations

Unmanned Aerial Systems

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

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

Balloons

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

Obstructions to Airspace Considerations

The Airports Division of the FAA is responsible for the evaluation and analysis of proposed construction or alterations on airports. The FAA Air Traffic Office is responsible for determining obstructions to air navigation as a result of construction off airports that may affect the safe and efficient use of navigable airspace and the operation of planned or existing air navigation and communication facilities. Such facilities include air navigation aids, communication equipment, airports, federal airways, instrument approach or departure procedures, and approved off-airway routes. An Obstruction Evaluation and Airport Airspace Analysis (OE/AAA) is required when there is the potential for airport construction/alteration of a facility that may impinge upon the NAS. Per 14 CFR Part 77.9, the FAA is to be notified about construction or alterations when:

- "Any construction or alteration exceeding 200 ft above ground level (AGL)
- 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, 2015c).

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.

Wisconsin Airspace

The Wisconsin Department of Transportation manages the commercial and public use airport network. The airport system "is a gateway to the world that responsibly and effectively meets business, passenger, freight and recreational air transportation needs while enhancing the economic vitality of Wisconsin communities" (Wisconsin Government, 2016). The Wisconsin Bureau of Aeronautics works with the state government in managing statewide aeronautics. There are three sections of the Bureau, comprised of the Director's Office, Airport Program Section, and Airport Engineering Section, that work together in the development of the aviation transportation system and to assure aviation safety. (Wisconsin Government, 2013) There is one FAA FSDO for Wisconsin located in Milwaukee (FAA, 2015d).

Wisconsin airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the State's airport system, as well as addressing key associated with their airports. (National Association of State Aviation Officials, 2015) Figure 17.1.7-5 presents the different aviation airports/facilities residing in Wisconsin, while Figure 17.1.7-6 and Figure 17.1.7-7 present the breakout by public and private airports/facilities. There are approximately 547 airports within Wisconsin as presented in Table 17.1.7-8 and Figure 17.1.7-6 through Figure 17.1.7-7 (USDOT, 2015a).

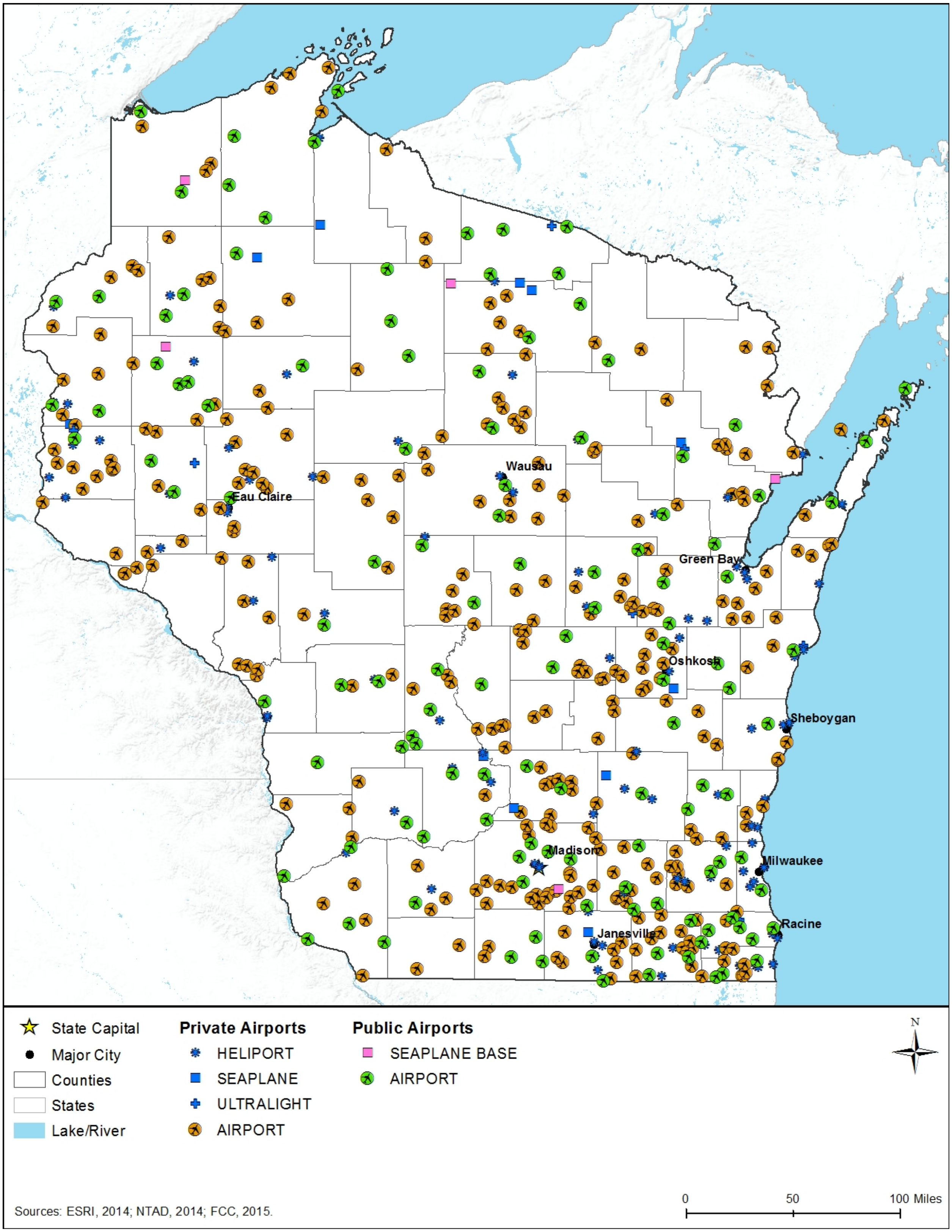


Figure 17.1.7-5: Composite of Wisconsin Airports/Facilities

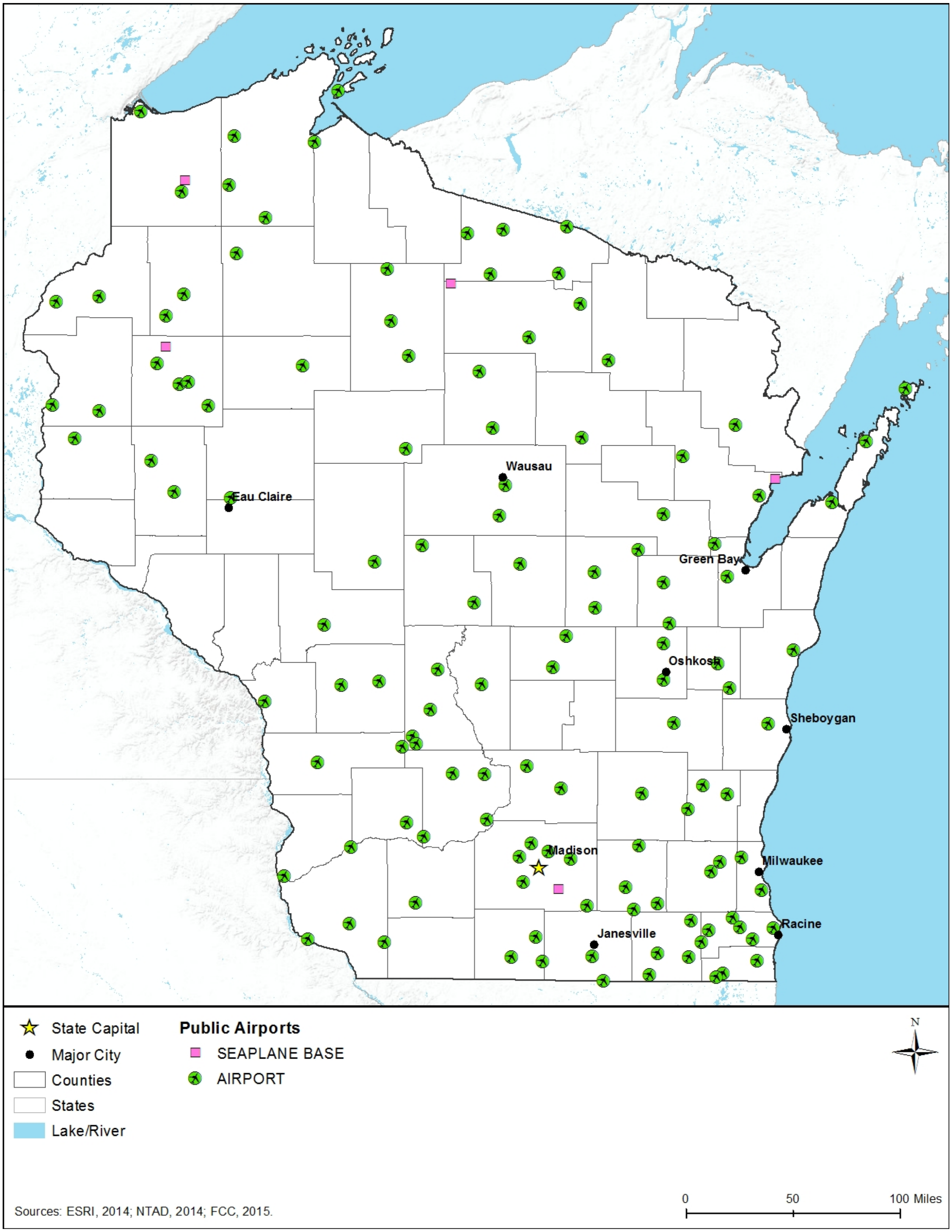


Figure 17.1.7-6: Public Wisconsin Airports/Facilities

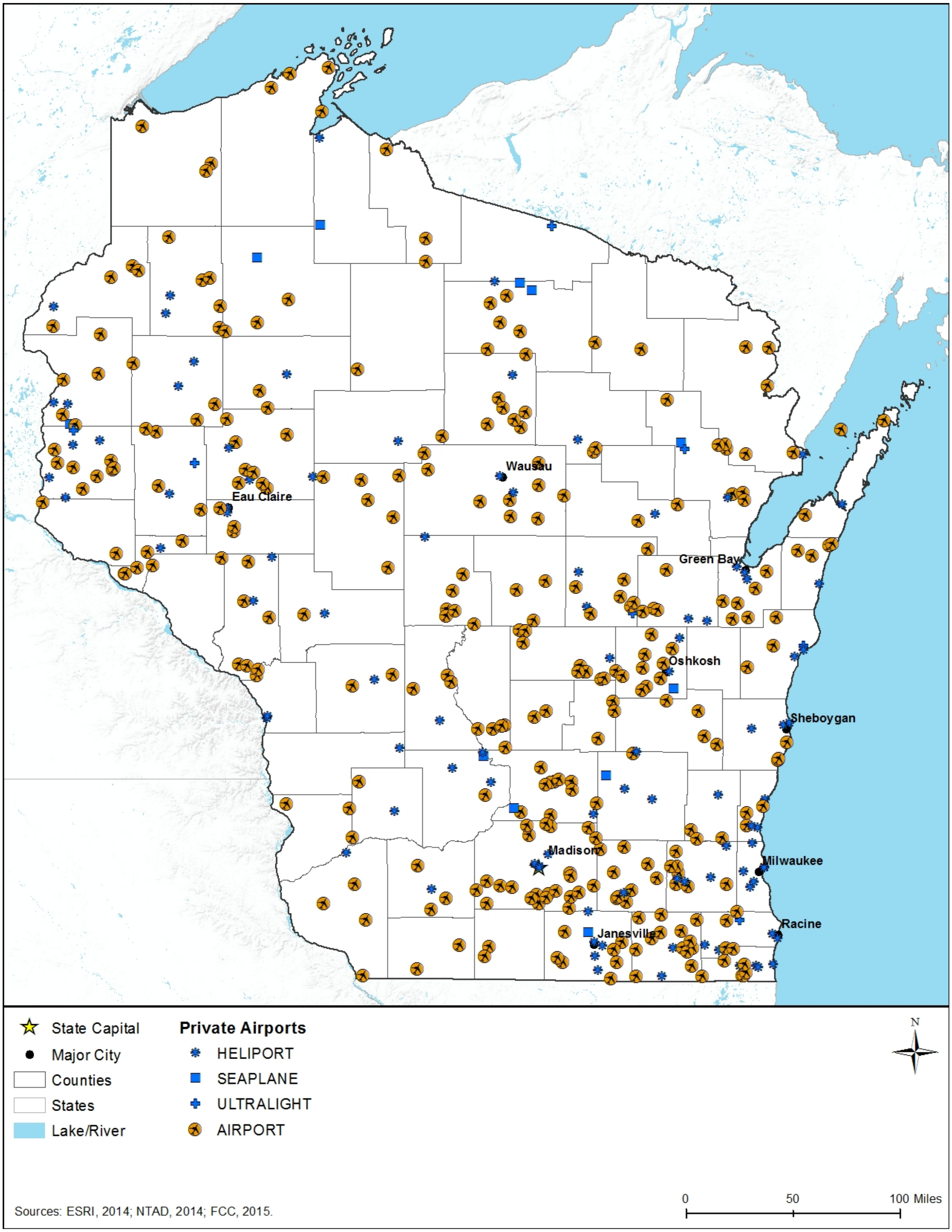


Figure 17.1.7-7: Private Wisconsin Airports/Facilities

Table 17.1.7-8: Type and Number of Wisconsin Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	127	298
Heliport	0	99
Seaplane	5	11
Ultralight	0	7
Balloonport	0	0
Gliderport	0	0
Total	**132**	**415**

Source: (USDOT, 2015a)

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

- Three Class C –
  - Austin Straubel International, Green Bay
  - Dane County Regional Airport-Truax Field, Madison
  - General Mitchell International, Milwaukee
- Eleven Class D –
  - Appleton International, Appleton
  - Volk Field, Camp Douglas
  - Chippewa Valley Regional, Eau Claire
  - Rock County, Janesville
  - Kenosha Regional, Kenosha
  - La Crosse Municipal, La Crosse
  - Lawrence J. Timmerman, Milwaukee
  - Central Wisconsin, Mosinee
  - Wittman Regional, Osh Kosh
  - Sparta/Fort McCoy, Sparta
  - Waukesha County, Waukesha (FAA, 2015e)

SUAs (i.e., five restricted areas and six MOAs) in Wisconsin are as follows:

- Fort McCoy –
  - R-6901A – Surface to 20,000 feet MSL
  - R-6901B – Surface to 20,000 feet MSL
- Sheboygan –
  - R-6903 – Surface to FL 450

- Volk Field –
    - R-6904A – 150 feet AGL to FL 230
    - R-6904B – Surface to FL 230 (FAA, 2016b)

The six MOAs for Wisconsin are as follows:

- Falls –
    - 1 – 500 feet AGL to, but not including, FL 180; Excluding that airspace 1,500 feet AGL and below within a three NM radius of the Black River Falls Municipal Airport, WI
    - 2 – 500 feet AGL to, but not including, FL 180; Excluding that airspace 1,500 feet AGL and below within a three NM radius of the Neillsville Airport, WI
- Minnow –
    - 10,000 feet MSL to, but not including, FL 180; Excluding that airspace within R-6903 when activated
- Volk –
    - East – 8,000 feet MSL to, but not including, FL 180
    - South – 500 feet AGL to, but not including FL 180; Excluding that airspace 1,500 feet AGL and below within a 3 NM radius of the Necedah Airport, WI and Bloyer Field Airport, Tomah, WI
    - West – 100 feet AGL to, but not including, FL 180. (FHWA, 2014b)

The SUAs for Wisconsin are presented in Figure 17.1.7-8. There are no TFRs (see Figure 17.1.7-8) (FAA, 2016c). MTRs in Wisconsin, presented in Figure 17.1.7-9, consist of four Visual Routes, one Instrument Routes, and three Slow Routes.

UAS Considerations

The National Park Service (NPS) signed a policy memorandum on June 20, 2014 that “directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service” (NPS, 2015a). There are two National Park Service units within the State of Wisconsin that have to comply with this agency directive (Wisconsin State Legislature, 2015c).

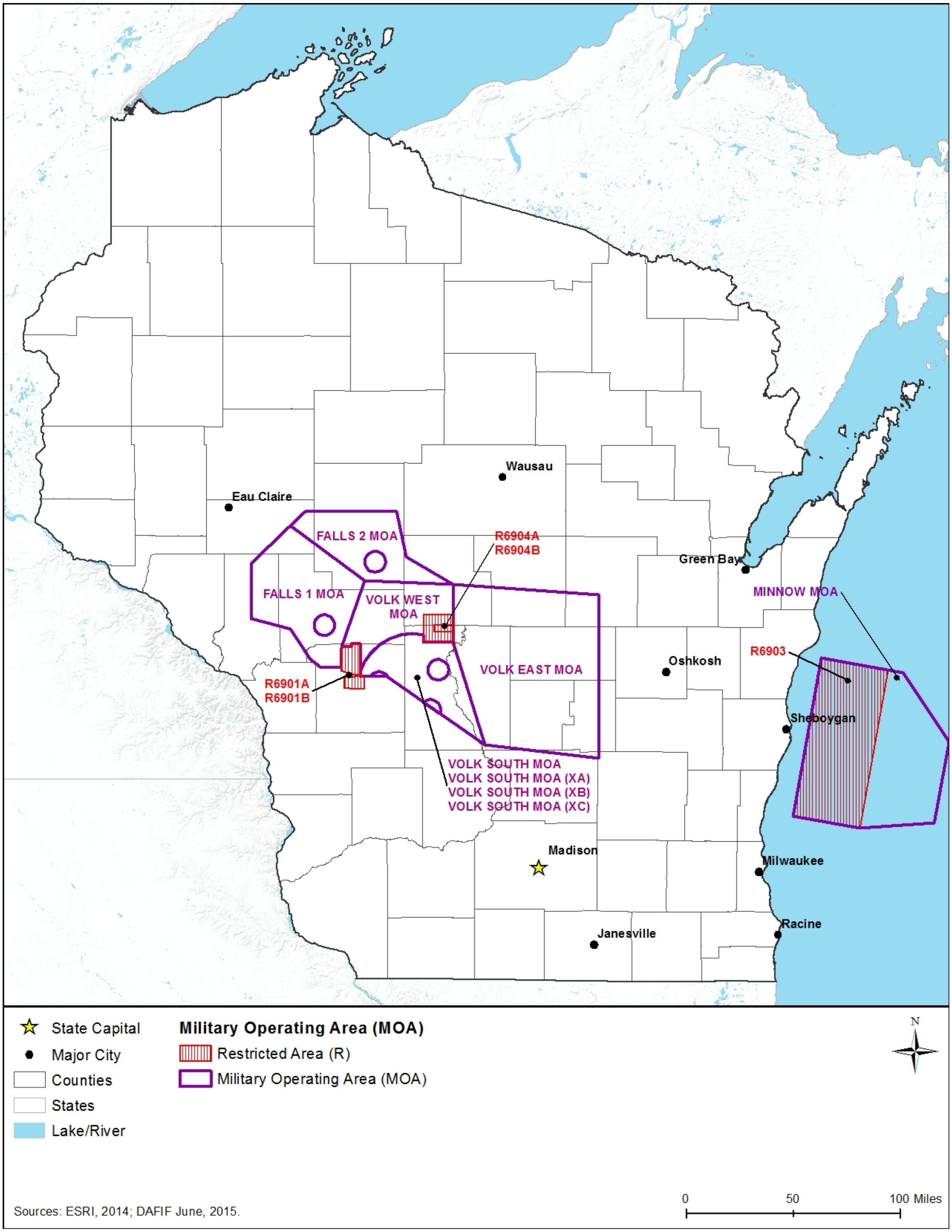


Figure 17.1.7-8: SUAs in Wisconsin

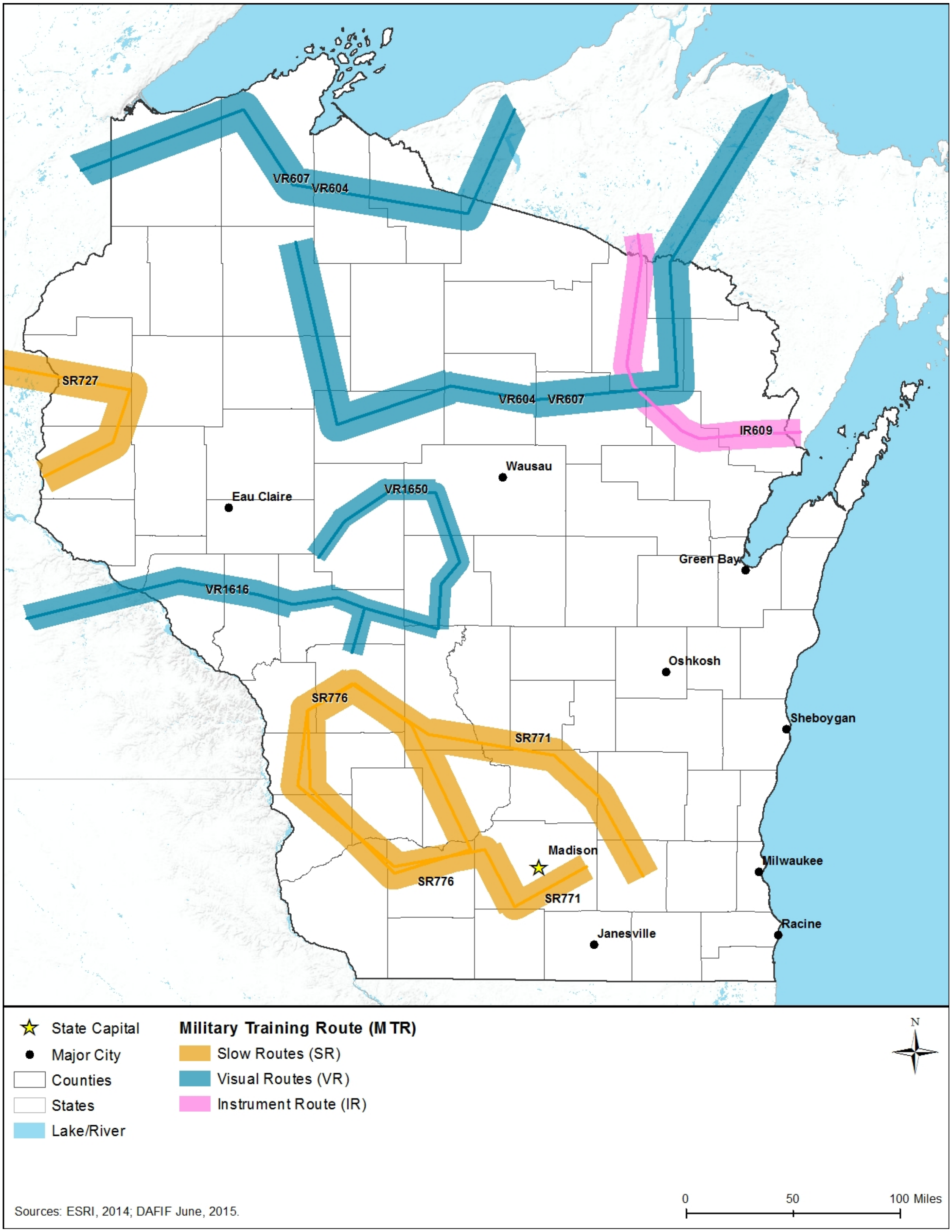


Figure 17.1.7-9: MTRs in Wisconsin

Obstructions to Airspace Considerations

Several references in Wisconsin statues address airspace hazards. As defined in the Wisconsin Statutes (Chapter 114, Subchapter I), an airport hazard "means any structure, object of natural growth, or use of land which obstructs the airspace required for the flight of aircraft in landing or taking off at an airport or is otherwise hazardous to such landing or taking off" (Wisconsin State Legislature, 2015c). Wisconsin Statutes state regulation of structures is in the public interest as it obtains to potential impacts to navigable airspace. These statutes assure unobstructed conditions for safe flight within airspace over the state and the air traffic pattern of a public airport. (Wisconsin State Legislature, 2015c)

17.1.8. Visual Resources

17.1.8.1. 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 definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management, "the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)" (BLM, 1984).

17.1.8.2. Specific Regulatory Considerations

Table 17.1.8-1 presents state laws and regulations that relate to visual resources.

Table 17.1.8-1: Relevant Wisconsin Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Chapter 44 of Wisconsin Statues, Subchapter I – State Historical Society and Local Historical Societies	State Historical Society of Wisconsin	Establishes the State Historical Society of Wisconsin to, among others, "acquire, maintain and operate historic properties representative of the state's rural and urban heritage."
Chapter 44 of Wisconsin Statues, Subchapter II – Historic Preservation Program	State Review Board	Establishes the Historic Preservation Program, authorizes the Wisconsin State Register of Historic Places, and describes the responsibilities of the State Review Board and State Historical Society.
Chapter 30.26 of Wisconsin Statutes - Wild Rivers	DNR	Establishes state wild rivers to "afford the people of this state an opportunity to enjoy natural streams, to attract out-of-state visitors and assure the well-being of our tourist industry." Requires management for these rivers "to assure their preservation, protection and enhancement of their natural beauty, and their unique recreational and other inherent values."

State Law/Regulation	Regulatory Agency	Applicability
Chapter 59 of Wisconsin Statutes, Subchapter VII - Land Use, Information and Regulation, Environmental Protection, Surveys, Planning and Zoning	County Zoning Boards	Promotes, among other things, the protection of "beauty and amenities of landscape and manmade developments" in the development and planning of territory.
Chapter 1.11 of Wisconsin Statutes	DNR	Requires DNR and other state agencies to consider environmental impacts of their actions and policies.
Wisconsin Environmental Policy Act (WEPA)	DNR	Encourages consideration of the environment in state agencies' decision-making processes.

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. Chapter 59 of Wisconsin Statutes, Subchapter VII (see Table 17.1.8-1) ensures that all building and development takes into account the beauty and amenities of landscape when planning and zoning for future development.

17.1.8.3. Character and Visual Quality of the Existing Landscape

Wisconsin's landscape is characterized by forests, glacial lakes, farmland, sandstone formations, and rivers. Visual resources in the state are diverse. In the northwest part of the state offers numerous lakes, pine forests, hardwood forest, moraines, hills, and lake plains. The southwestern part of the state is home to level landscape with rolling ridges, deep-sided valleys and sedimentary rock outcroppings (DNR, 2015au).

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.

17.1.8.4. 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 17.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. Wisconsin has 2,316 NRHP listed sites, which include 42 National Historic Landmarks (NPS, 2016c). 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, 1995a). 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, 1995b).

National Heritage Areas

National Heritage Areas (NHAs) are “places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape” (NPS, 2011a). There are 49 NHAs managed by the NPS to help tell the history of the United States (NPS, 2015c). There are no NHAs in Wisconsin.

State Heritage Area

The Glacial Heritage Area is the only state heritage area in Wisconsin. It is “a coordinated series of parks, preserves, wildlife and natural areas and other conservation lands...[to] provide readily accessible opportunities for residents and visitors to get outdoors to hike, bike, watch wildlife, fish, paddle, hunt, camp, cross country ski, ride horses and participate in other nature-based activities.” (DNR, 2015av)

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as “nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States” (NPS, 2015b). Generally, NHLs may include “historic buildings, sites, structures, objects, and districts” (NPS, 2016d). 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 Wisconsin, there are 42 NHLs, including sites such as the Astor Fur Warehouse, Little While Schoolhouse, Milwaukee City Hall, Silver Mound Archaeological District, and Taliesin (Figure 17.1.8-1) (NPS, 2015e). By comparison, there are over 2,500 NHLs in the United States (NPS, 2015i). Figure 17.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive. Table 17.1.8-2 lists the NHLs present in Wisconsin.

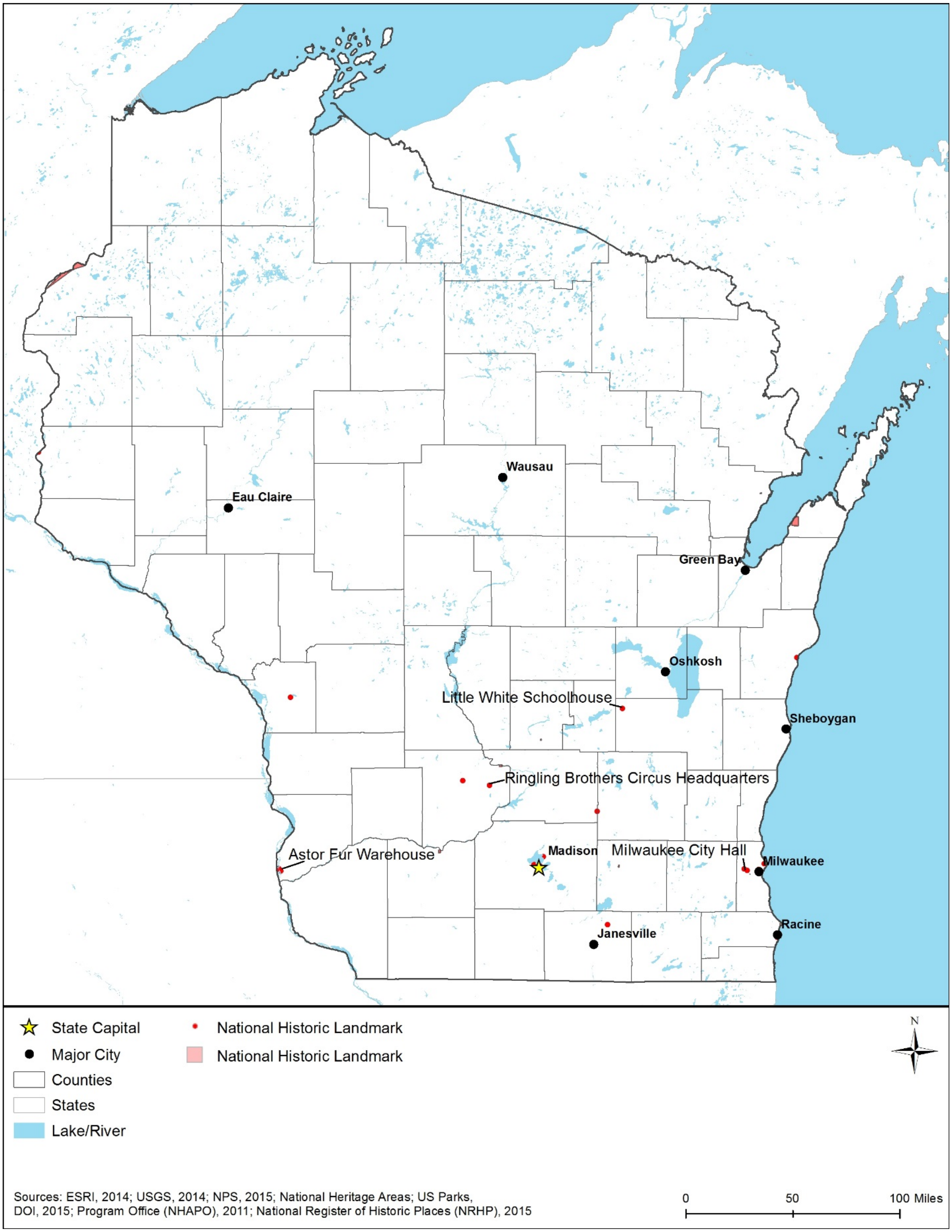


Figure 17.1.8-1: Representative Sample of Historic and Cultural Areas that May be Visually Sensitive

Table 17.1.8-2: Wisconsin National Historic Landmarks

National Historic Landmarks	
Administration Building and Research Tower, S.C. Johnson Company	Milton House
Astor Fur Warehouse	Milwaukee City Hall
Aztalan	Namur Historic District
Harold C. Bradley House	University of Wisconsin North Hall
Brisbois House	National Home for Disabled Volunteer Soldiers Northwestern Branch
USS Cobia	Oconto Site
Dr. Risk Holbrook Day House	Pabst Theater
Dousman Hotel	Ringling Brothers Circus Winter Quarters
Farmers' and Merchants' Union Bank	Schoonmaker Reef
First Unitarian Society Meeting House	Second Fort Crawford Military Hospital
Fountain Lake Farm	Silver Mound Archaeological District
Fourth Street (Meir) School	Soldier's Home Reef
Hamlin Garland House	Taliesin
Greendale Historic District	Ten Chimney's
Thomas A. Greene Memorial Museum	Turner Hall
Herbert and Katherine Jacobs' First House	University of Wisconsin Armory and Gymnasium
Herbert and Katherine Jacobs' Second House	University of Wisconsin Dairy Barn
Herbert Johnson House	University of Wisconsin Science Hall
Robert M. Lafollette Home	Van Hise Rock
Aldo Leopold Shack and Farm	Villa Louis
Little White Schoolhouse	Wisconsin State Capitol

Source: (NPS, 2015e)

State Historic Places, Sites, and Resources

The Wisconsin Historical Society Division of Historic Preservation preserves places of enduring value for the benefit of generations and administers places on both NRHPs and the State Register of "state properties determined to be significant to Wisconsin's heritage". The NPS has designated approximately 2,300 national historic listings in Wisconsin (Wisconsin Historical Society, 2015b). Among these historic places are LaPoint Indian Cemetery, Apostle Islands Lighthouses, Big Bay Sloop Shipwreck, Portage Canal, and Waunakee Railroad Depot (Wisconsin Historical Society, 2015c). Some of these historic places are also designated NHLs by the NPS. Additionally, the Division of Museums and Historic Sites maintains 11 sites to "promote tourism and provide for the…study, appreciation and enjoyment of Midwestern frontier history." These sites contain historic structures and include the Black Point Estate, Circus World, First Capitol, H.H. Bennett Studio, Madeline Island Museum, Old World Wisconsin, Pendarvis, Reed School, Stonefield, Villa Louis and Wade House (Wisconsin Historical Society, 2015d).

17.1.8.5. Parks and Recreation Areas

Parks and recreation areas include State Parks, National Recreation Areas, National Scenic and Recreational Rivers, State Scenic and Recreational Rivers, State Forests, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 17.1.7-3 in Section 17.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in Wisconsin. For additional information about recreation areas, including state parks, see Section 17.1.7, Land Use, Recreation, and Airspace.

State Parks and Forests

State parks contain natural, historic, cultural, and/or recreational resources of significance to Wisconsin residents and visitors. There are 50 state parks throughout Wisconsin, most of which likely contain scenic or aesthetic areas considered to be visual resources or visually sensitive. Table 17.1.8-3 contains a sample of state parks and their associated visual attribute; Figure 17.1.8-3 identifies these parks on the map).[117]

Table 17.1.8-3: Examples of Wisconsin State Parks and Associated Visual Attributes

State Park	Visual Attributes
Big Foot Beach State Park	Lake Geneva, mixed hardwood landscape, sand beaches, rolling terrain, wildlife, prairie
Brunet Island State Park	River views, lagoons, water channels, rolling terrain, wildlife, giant hemlocks, shoreline, aquatic flora
Council Grounds State Park	River views, lake views, rolling topography, mixed hardwood landscape, marshy low lands, Scotch pine plantation
Governor Thompson State Park	Forested landscape, wildlife, wooded upland, wooded wetland, lake views
Wildcat Mountain State Park	River valley views, wildlife, hardwood forests, sandstone cliffs, river views, mountain views, bluffs, steep-sided valleys

Source: (DNR, 2015aw)

In addition to state parks, Wisconsin also has nine state forests (Figure 17.1.8-3).[118] Table 17.1.8-4 lists Wisconsin's State Forests. One state forest is Governor Knowles State Forest (Figure 17.1.8-2).

[117] For a complete list of state parks and their recreational activities, visit the Wisconsin State Parks website at http://dnr.wi.gov/topic/parks/findapark.html.

[118] 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.

Table 17.1.8-4: Wisconsin State Forests

Black River State Forest	Kettle Moraine State Forest
Brule River State Forest	Northern Highland American Legion State Forest
Flambeau River State Forest	Peshtigo River State Forest
Governor Knowles State Forest	Point Beach State Forest
Havenwoods State Forest	

Source: (DNR, 2015aw)

Figure 17.1.8-2: Governor Knowles State Forest

Source: (DNR, 2015ax)

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 for the public's use. In Wisconsin, the NPS states that there are two[119] officially designated National Parks in addition to other NPS affiliated areas, such as National Heritage Areas. There are two National Scenic Trails, one National Lakeshore, and one National Scenic Riverway.

Table 17.1.8-5 identifies the National Parks and affiliated areas located in Wisconsin (see Figure 17.1.8-3). The Apostle Islands National Lakeshore (Figure 17.1.8-4) is comprised of 21 islands and covering 12 miles in Wisconsin offering cultural resources, views of nature and wildlife, and lighthouses. For additional information regarding parks and recreation areas, see Section 17.1.7, Land Use, Recreation, and Airspace.

Table 17.1.8-5: Wisconsin National Parks and Affiliated Areas

Area Name	
Apostle Islands National Lakeshore	North Country National Scenic Trail
Ice Age National Scenic Trail	Saint Croix National Scenic Riverway

Source: (NPS, 2016c)

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

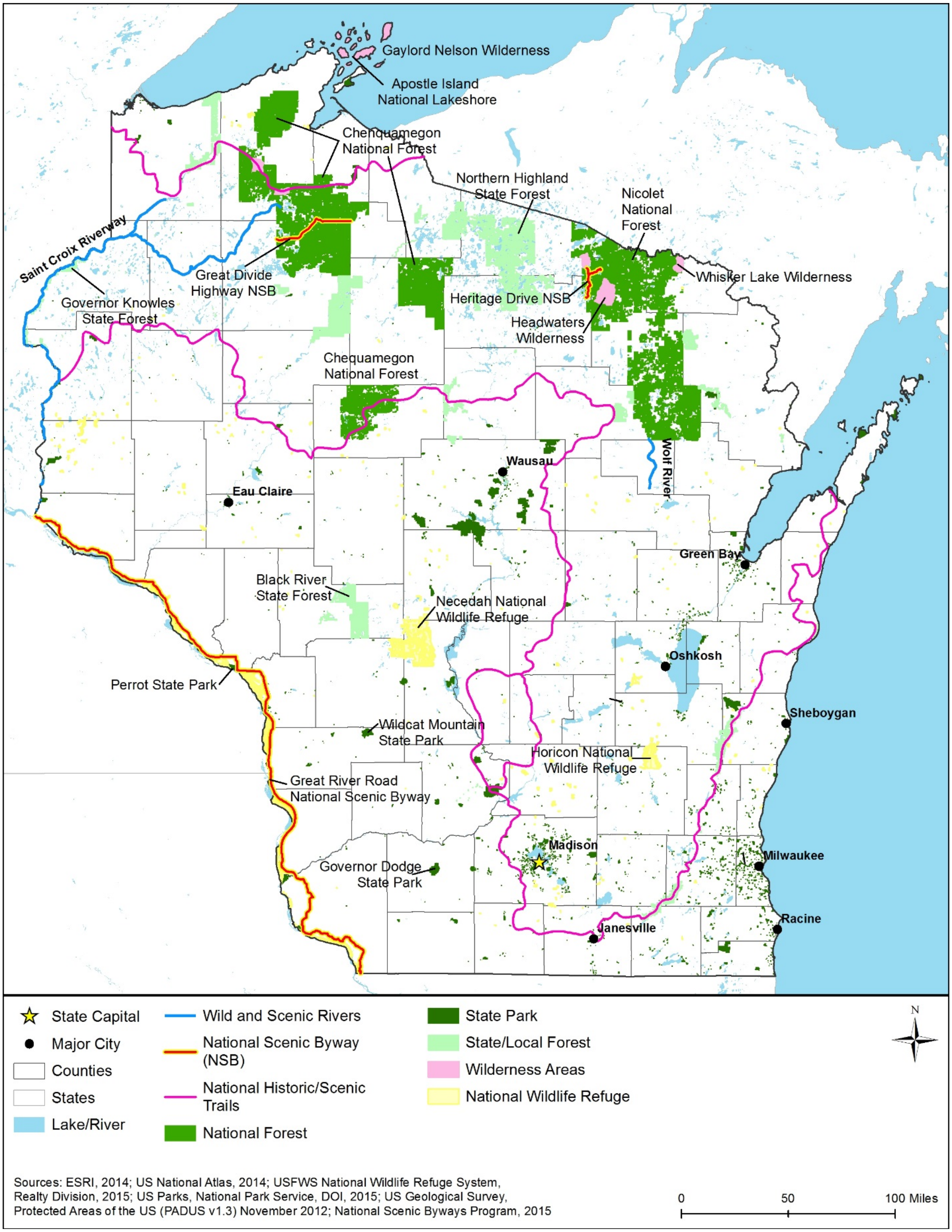


Figure 17.1.8-3: Natural Areas that May be Visually Sensitive

Figure 17.1.8-4: Apostle Islands National Lakeshore

Source: (NPS, 2015f)

Federal and State Trails

Designated under Section 5 of the National Trails System Act (16 U.S.C. § 1241-1251, as amended), National Scenic Trails (NSTs) are defined as extended trails that "provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas though which they pass" (NPS, 2012a). Wisconsin is home to two National Scenic Trails: Ice Age NST and North Country NST (Figure 17.1.8-3) (NPS, 2016c). The Ice Age NST is a 1,200-mile trail that follows the best evidence of North America's glaciation 15,000 years ago along Wisconsin's lakes, river valleys, hills, and ridges. The North Country NST offers over 2,000 miles of trails linking scenic, historic, natural and cultural areas of seven states; in Wisconsin, the North Country NST travels for 200 miles through the northwest portion of the state (NPS, 2016c).

In addition to National Scenic Trails, the National Trails System Act authorized the designation of National Recreational Trails (NRTs) near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2015a). In Wisconsin, there are five NRTs administered by the U.S. Department of Agriculture's Forest Service: Anvil Lake NRT (12 miles), Ed's Lake NRT (6 miles), Rock Lake NRT (13.6 miles), Lauterman Lake NRT (9 miles), and Ice Age NST (40 miles), which is also maintained by the NPS (American Trails, 2015b). Additionally, Wisconsin is home to one USFWS administered NRT, the Nelson-Trevino Canoe Trail, which is a 4.8 mile water trail within the Upper Mississippi River National Wildlife and Fish Refuge (American Trails, 2015c).

Wisconsin boasts numerous trails for nature walking, hiking, skiing and other recreation in the state forests, parks and recreation and wildlife areas. There is no separate designation as scenic or historical for these trails, although all have aesthetic value and some have an accompanying historical value as well. (DNR, 2014f).[120]

[120] The Wisconsin DNR maintains a list of trail information on its website: http://dnr.wi.gov/topic/parks/activities/hike.html.

U.S. Army Corps of Engineers Recreation Areas

There are 12 U.S. Army Corps of Engineers (USACE) lakes and recreation within the state: Eau Galle Lake, Mississippi River (Pools 3 – 10), and Sturgeon Bay & Lake Michigan Ship Canal (USACE, 2015). These lakes and recreation areas are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

State Recreation Areas

There are nine state recreation areas within Wisconsin administered by the Wisconsin DNR (Figure 17.1.8-3). These areas offer fishing, camping, hunting, hiking, swimming, skiing and water activities (DNR, 2015aw). The Wisconsin DNR maintains a list of park information on its website: http://dnr.wi.gov/topic/parks/findapark.html.

17.1.8.6. Natural Areas

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 to "establish a National Wilderness Preservation System for the permanent good of the whole people" to provide "clean air, water, and habitat critical for rare and endangered plants and animals" (Wilderness.net, 2015a). 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" (Wilderness.net, 2015b). Wisconsin is home to seven federally managed wilderness areas, totaling 79,967 acres. Five are managed by the U.S. Forest Service and include Blackjack Springs Wilderness, Headwaters Wilderness, Porcupine Lake Wilderness, Rainbow Lake Wilderness, and Whisker Lake Wilderness (Figure 17.1.8-3). The NPS manages the Gaylord Nelson Wilderness and Wisconsin Islands Wilderness is administered by the U.S. Fish and Wildlife Service (Figure 17.1.8-3) (Wilderness.net, 2015a).

National Forest

The U.S. Forest Service administers the National Forest System established by the Land Revision Act of 1891. Wisconsin is home to one national forest, the Chequamegon-Nicolet National Forest (Figure 17.1.8-3) (USFS, 2015). This forest contains over 1.5M acres of woodlands and water and includes visual resources such as clear springs, wildlife, lakes, streams, ponds, waterfalls and a view of Lake Superior (USFS, 2015).

State Forests and Natural Areas

As mentioned earlier, the Wisconsin DNR "manages the state's forestlands for multiple uses following the principles of sustainable forestry" which include aesthetics (DNR, 2012e). There are nine state forests, including the Kettle Moraine State Forest with six separate units (Table 17.1.8-4). These forests contain rivers, wildlife, and hardwood forest (DNR, 2015aw).[121]

[121] For specific information related to each of the forests, see Wisconsin's DNR's 'Find a Park' site: http://dnr.wi.gov/topic/parks/findapark.html.

Wisconsin also has a State Natural Areas (SNAs) Program to "protect outstanding examples of Wisconsin's native landscape of natural communities, significant geological formations and archeological sites". There are 675 natural areas in the state, which comprise over 380,000 acres. (DNR, 2015ay). Many of these areas are within other national or state designated parks and forests. For additional information and to find an SNA, see Wisconsin's DNR's 'State natural areas by alphabetical listing' site: http://dnr.wi.gov/topic/Lands/NaturalAreas/alpha.html.

Rivers Designated as National Wild, Scenic or Recreational

National Wild, Scenic, or Recreational Rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. Wisconsin has two national wild and scenic rivers (Figure 17.1.8-3), the St. Croix River and the Wolf River, with a combined 276 miles of river segments designated (National Wild and Scenic Rivers System, 2015c). Additionally, the state has one NPS-designated National Scenic Riverway, the Saint Croix. This riverway includes both the St. Croix and Namekagon Rivers and is shared with the state of Minnesota. The river corridor's visual resources include scenic views, wildlife, wooded bluffs and historic towns (NPS, 2015g).

Wisconsin authorized its own wild rivers program with the enactment of Subchapter 26, Wild Rivers to Chapter 30: Navigable Waters, Harbors and Navigation of the Wisconsin Statutes. The program was established "in order to afford the people of the state an opportunity to enjoy natural streams, to attract out-of-state visitors and assure the well-being of our tourist industry, and to preserve some rivers in a free flowing condition and protect them from development". Under this statute, Wisconsin designated four rivers, or portions thereof, as wild: Pike River (Figure 17.1.8-5), Pine-Popple Rivers, Martin Hanson Wild River, and the Totagatic River. The statute includes rules for maintenance and recreational use of the rivers to "preserve the wild and scenic qualities of the river[s]" (DNR, 2015ap).

Figure 17.1.8-5: Pike Wild River

Source: (DNR, 2015ap)

National Lakeshore

National Lakeshores are administered by the NPS to protect the natural and recreational significance of the area. Wisconsin contains one National Lakeshore, the Apostle Islands. The

Apostle Islands National Lakeshore (Figure 17.1.8-3) shoreline along Lake Superior is home to visual resources such as wilderness areas, beaches, cliffs, and lighthouses (NPS, 2015f).

National Wildlife Refuges and State Wildlife Management Areas

National Wildlife Refuges (NWRs) are a network of lands and waters managed by the USFWS. These lands and waters are "set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats" (USFWS, 2015ah). There are 11 NWRs, nine of which are wholly in Wisconsin (Figure 17.1.8-3) and two of which are shared among other states (USFWS, 2015ai). Of the nine within the state is the Green Bay NWR, comprised of 330 acres across the islands of Hog Island, Plum Island, and Pilot Island, to preserve native and migratory bird species (USFWS, 2015aj). Visual resources within the Green Bay NWR include bay water vistas, a variety of bird species, historic lighthouse structures, and on Plum Island, northern mesic forests of aspen, sugar maple, and basswood trees (USFWS, 2012e). The two NWRs shared with other states are the Upper Mississippi River National Wildlife and Fish Refuge, also in Illinois, Iowa, and Minnesota, and the Hackmatack NWR, which is shared with Illinois (USFWS, 2015ai).

The Wisconsin DNR manages almost 200 wildlife and conservation areas "to provide many opportunities and public spaces…to hunt, fish, trap, hike, canoe or watch and photograph wildlife" (DNR, 2015ba).

Table 17.1.8-6: Wisconsin National Wildlife Refuges

National Wildlife Refuge Name	
Fox River NWR	Leopold Wetland Management District (WMD)[122]
Gravel Island NWR	St. Croix WMD
Green Bay NWR	Trempealeau NWR
Hackmatack NWR	Upper Mississippi River Fish and NWR
Horicon NWR	Whittlesey Creek NWR
Necedah NWR	

Source: (USFWS, 2015ai)

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, 2014c). These landmarks may be considered visual resources or visually sensitive. In Wisconsin, there are 18 NNLs (Table 17.1.8-7 and Figure 17.1.8-3). Some of the natural features within these areas include hardwood forests, bogs, dunes, swale communities and mountain ranges. The Avoca River-Bottom Prairie (Figure 17.1.8-6) is the "largest intact prairie in Wisconsin… a nearly full complement of plant species" (NPS, 2012b).

[122] A Wetland Management District is an administrative organization that manages all the waterfowl production areas in a multi-county area (USFWS, 2008b).

Figure 17.1.8-6: Avoca River-Bottom Prairie

Source: (NPS, 2012c)

Table 17.1.8-7: Wisconsin National Natural Landmarks

Abraham's Woods	Flambeau River Hemlock-Hardwood Forest
Avoca River-Bottom Prairie	Kakagon Sloughs
Baraboo Range	Kickapoo River Natural Area
Bose Lake Hemlock Hardwoods	Moquah Barrens Research Natural Area
Cave of the Mounds	Point Beach Ridges
Cedarburg Bog	Ridges Sanctuary Toft's Point Mud Lake Area
Chippewa River Bottoms	Spruce Lake Bog
Chiwaukee Prairie	Summerton Bog
Finnerud Forest Scientific Area	Wyalusing Hardwood Forest

Source: (NPS, 2012b)

17.1.8.7. Additional Areas

State and National Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. The National Scenic Byways Program is managed by the U.S. Department of Transportation, Federal Highway Administration. Wisconsin has one designated National Scenic Byway; the Great River Road (Figure 17.1.8-3), 2,069 miles, 250 are in Wisconsin, follows the Mississippi River through Wisconsin and multiple states. Additionally, the U.S. Forest Service designates scenic byways, of which there are two in Wisconsin: Great Divide Scenic Byway (29 miles) and Heritage Drive Scenic Byway (15 miles) (USDOT, 2015b) (WisDOT, 2016).

Similar to National Scenic Byways, the Wisconsin Department of Transportation administers a state scenic byways program. There are four State Byways (Figure 17.1.7-3 in Section 17.1.7, Land Use, Recreation, and Airspace), including the Door County Coastal Byway (66 miles), Great River Road (2,069 miles), Lower Wisconsin River Road (100 miles), and Wisconsin Lake Superior Scenic Byway (70 miles) (WisDOT, 2015b).

17.1.9. Socioeconomics

17.1.9.1. 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 (U.S. Bureau Land Management, 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 17.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use, recreation, and airspace (Section 17.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 17.1.1, Infrastructure), and aesthetic considerations (Section 17.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the Census Bureau[123] and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data

[123] 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-

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

The remainder of this section addresses the following subjects: regulatory considerations specific to socioeconomics in the state, communities and populations, economic activity, housing, property values, and taxes.

17.1.9.2. 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.

17.1.9.3. Communities and Populations

This section discusses the population and major communities of Wisconsin (WI) and includes the following topics:

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

Statewide Population and Population Growth

Table 17.1.9-1 presents the 2014 estimated population and population density of Wisconsin in comparison to the Central region[124] and the nation. The estimated population of Wisconsin in

---

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.

[124] The Central region comprises the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, South Dakota, Utah, Wisconsin, and Wyoming. Throughout the socioeconomics

2014 was 5,757,564. The population density was 106 persons per square mile (sq. mi.), which was considerably higher than the population density of both the region (66 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Wisconsin was the 20th largest state by estimated population among the 50 states and the District of Columbia, 25th largest by land area, and had the 25th greatest population density (U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015g).

Table 17.1.9-1: Land Area, Estimated Population, and Population Density of Wisconsin

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Wisconsin	54,158	5,757,564	88
Central Region	1,178,973	77,651,608	66
United States	3,531,905	318,857,056	90

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

Estimated population growth is an important subject for this PEIS given FirstNet's mission. Table 17.1.9-2 presents the population growth trends of Wisconsin from 2000 to 2014 in comparison to the Central region and the nation. The state's annual growth decreased, from 0.59 percent to 0.31 percent, in the 2010 to 2014 period compared to 2000 to 2010. The growth rate of Wisconsin in the latter period was lower than the rate of the both region (0.45 percent) and the nation (0.81 percent).

Table 17.1.9-2: Recent Population Growth of Wisconsin

Geography	Estimated Population			Numerical stimated Population Change		Rate of Estimated Population Change (AARC)[a]	
	2000	2010	2014	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Wisconsin	5,363,675	5,686,986	5,757,564	323,311	70,578	0.59%	0.31%
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, 2015h; U.S. Census Bureau, 2015f)

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 17.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia's Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis

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.

service (U.S. Census Bureau, 2015q) (UVA Weldon Cooper Center, 2015). The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates Wisconsin's estimated population will increase by approximately 527,253 people, or 9.2 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.55 percent, which is higher than the historical growth rate from 2010 to 2014 of 0.31 percent and similar to the historical growth rate from 2000 to 2000 of 0.59 percent. The projected growth rate of the state is similar to that of the region (0.60 percent) and lower than the nation's rate (0.80 percent).

Table 17.1.9-3: Projected Estimated Population Growth of Wisconsin

Geography	Estimated Population 2014	Projected 2030 Estimated Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) 2014 to 2030
Wisconsin	5,757,564	6,296,359	6,273,275	6,284,817	527,253	9.2%	0.55%
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, 2015f; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)

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

Population Distribution and Communities

Figure 17.1.9-1 presents the distribution and relative density of the estimated population of Wisconsin. 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, 2015j).

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, 2012a; U.S. Census Bureau, 2015s). 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 northern region of Wisconsin, the Northern Highland region, is the least populated part of the state. For more information about the Northern Highland, see Section 17.1.7, Land Use, Recreation, and Airspace.

Table 17.1.9-4 provides the populations of the 10 largest population concentrations in Wisconsin, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[125] In 2010, the largest population concentration was the Milwaukee area, which had 1,376,476 people. The state had no other population concentrations over 500,000. The smallest of these 10 population concentrations was the Oshkosh area, with a 2010 population of 74,495. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Madison area with an annual growth rate of 2.00 percent.

Table 17.1.9-4 also shows that the top 10 population concentrations in Wisconsin accounted for 49.3 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 73.4 percent of the entire state's growth.

Table 17.1.9-4: Population of the 10 Largest Population Concentrations in Wisconsin

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Appleton	187,683	216,154	217,926	3	28,471	1.42%
Eau Claire	91,393	102,852	103,768	7	11,459	1.19%
Green Bay	187,316	206,520	208,913	4	19,204	0.98%
Kenosha (WI/IL) (WI Portion)	110,942	124,060	124,686	6	13,118	1.12%
La Crosse (WI/MN) (WI Portion)	84,230	95,510	95,881	8	11,280	1.26%
Madison	329,533	401,661	407,966	2	72,128	2.00%
Milwaukee	1,308,913	1,376,476	1,380,543	1	67,563	0.50%
Oshkosh	71,070	74,495	75,209	10	3,425	0.47%
Racine	129,545	133,700	133,143	5	4,155	0.32%
Wausau	68,221	74,632	74,142	9	6,411	0.90%
Total for Top 10 Population Concentrations	**2,568,846**	**2,806,060**	**2,822,177**	**NA**	**237,214**	**0.89%**
Wisconsin (statewide)	**5,363,675**	**5,686,986**	**5,706,871**	**NA**	**323,311**	**0.59%**
Top 10 Total as Percentage of State	**47.9%**	**49.3%**	**49.5%**	**NA**	**73.4%**	**NA**

Sources: (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015ai; U.S. Census Bureau, 2015l)

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

17.1.9.4. 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.

125 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.

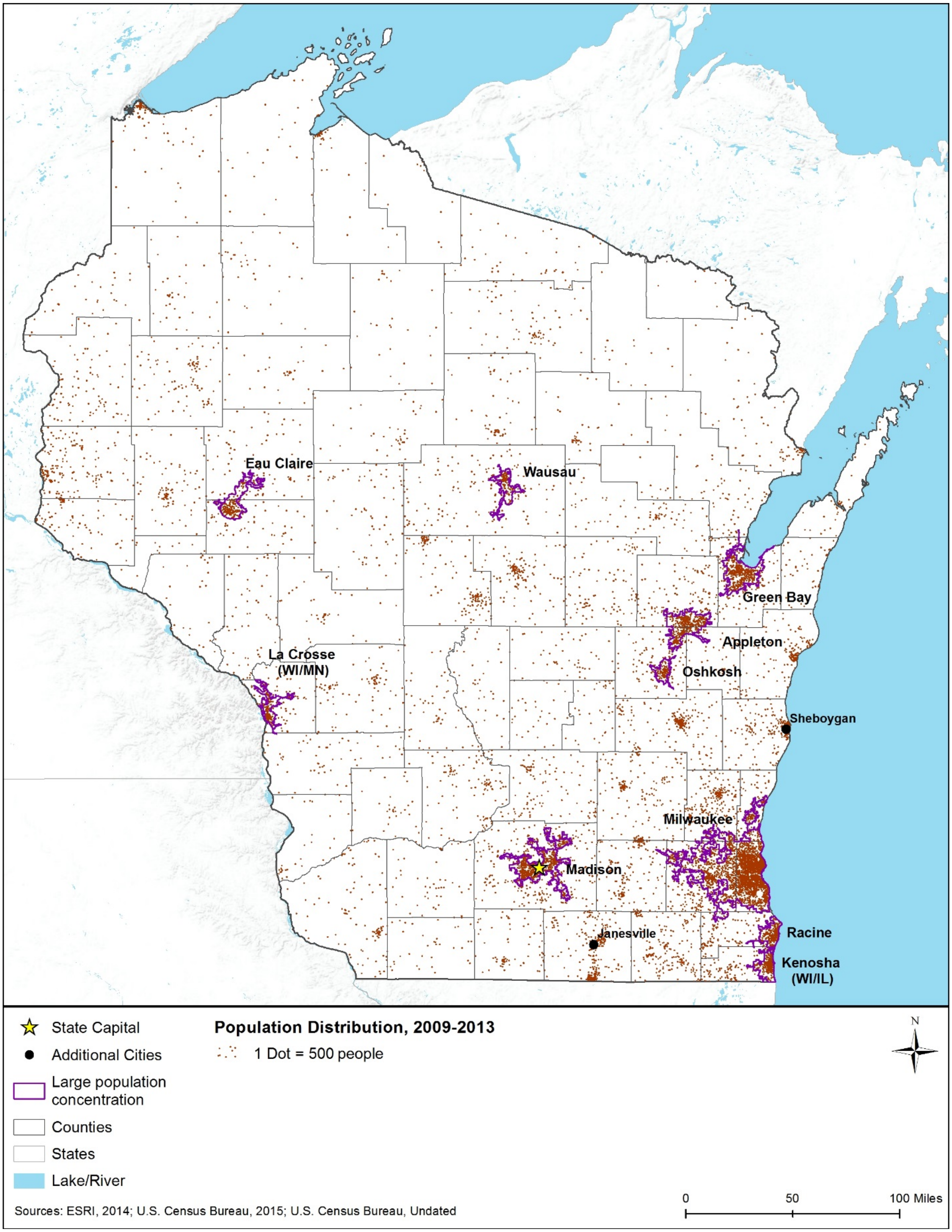


Figure 17.1.9-1: Estimated Population Distribution in Wisconsin, 2009–2013

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

Economic Activity

Table 17.1.9-5 compares several economic indicators for Wisconsin to the Central region and the nation. The table presents two indicators of income[126] – 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 17.1.9-5, the per capita income in Wisconsin in 2013 ($27,448) was slightly lower ($80) than that of the region ($27,528), and $736 lower than that of the nation ($28,184) (Bureau of Labor Statistics, 2015b) (U.S. Census Bureau, 2015m) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o).

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 17.1.9-5 shows that in 2013, the MHI in Wisconsin ($51,474) was $571 lower than that of the region ($52,045), and $776 lower than that of the nation ($52,250) (Bureau of Labor Statistics, 2015b) (U.S. Census Bureau, 2015m) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o).

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 17.1.9-5 compares the unemployment rate in Wisconsin to the Central region and the nation. In 2014, Wisconsin's statewide unemployment rate of 5.5 percent was somewhat lower than the rate for the region (5.7 percent) and the rate for the nation (6.2 percent) (Bureau of Labor Statistics, 2015b) (U.S. Census Bureau, 2015m) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o).[127]

[126] 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, 2015ag)

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

Table 17.1.9-5: Selected Economic Indicators for Wisconsin

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Wisconsin	$27,448	$51,474	5.5%
Central Region	$27,528	$52,045	5.7%
United States	$28,184	$52,250	6.2%

Sources: (U.S. Census Bureau, 2015p; U.S. Census Bureau, 2015q; U.S. Census Bureau, 2015r) (Bureau of Labor Statistics, 2015b)

Figure 17.1.9-2 and Figure 17.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015p) and unemployment in 2014 (Bureau of Labor Statistics, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 17.1.9-1 (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015s). Following these two maps, Table 17.1.9-6 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 Wisconsin.

Figure 17.1.9-2 shows that the majority of counties in the northern and central portions of Wisconsin have a MHI below the national median. Most counties with MHI levels above the national median are in the southeastern part of the state, surrounding seven of the top 10 population concentrations. Table 17.1.9-6 shows that MHI in the Appleton ($55,918) and Madison ($58,568) areas was above the state average ($52,413). MHI in all other population concentrations was below the state average. MHI was lowest in the Oshkosh area ($45,641).

Figure 17.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that the majority of counties in Wisconsin had unemployment rates below the national average (that is, better employment performance). Most counties with unemployment rates above the national average were in the northern part of the state, north of Eau Claire and Wausau, plus a few counties in the southern half of the state. The 2009–2013 unemployment rate in the population concentrations ranged widely, from 5.6 percent in the Appleton area to 12.0 percent in the Wisconsin portion of the Kenosha area, compared to the state average of 7.8 percent.

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 17.1.9-7 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers was somewhat higher in Wisconsin than in the Central region and the nation. The percentage of government workers and self-employed workers was slightly lower in the state than in the region and nation.

By industry, Wisconsin has a mixed economic base and some notable figures in the table are as follows. Wisconsin in 2013 had a considerably higher percentage (more than two percentage points different) of persons working in “manufacturing” than did the region or the nation. It had a considerably lower percentage of workers in “professional, scientific, management, administrative, and waste management services” than the nation. Employment shares for all other industries in Wisconsin were within two percentage points of the regional and national figures.

Table 17.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Wisconsin, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Appleton	$55,918	5.6%
Eau Claire	$45,681	6.9%
Green Bay	$50,526	7.9%
Kenosha (WI/IL) (WI Portion)	$51,934	12.0%
La Crosse (WI/MN) (WI Portion)	$47,725	6.0%
Madison	$58,568	5.8%
Milwaukee	$51,317	9.3%
Oshkosh	$45,641	6.8%
Racine	$48,904	11.6%
Wausau	$47,266	8.3%
Wisconsin (statewide)	$52,413	7.8%

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

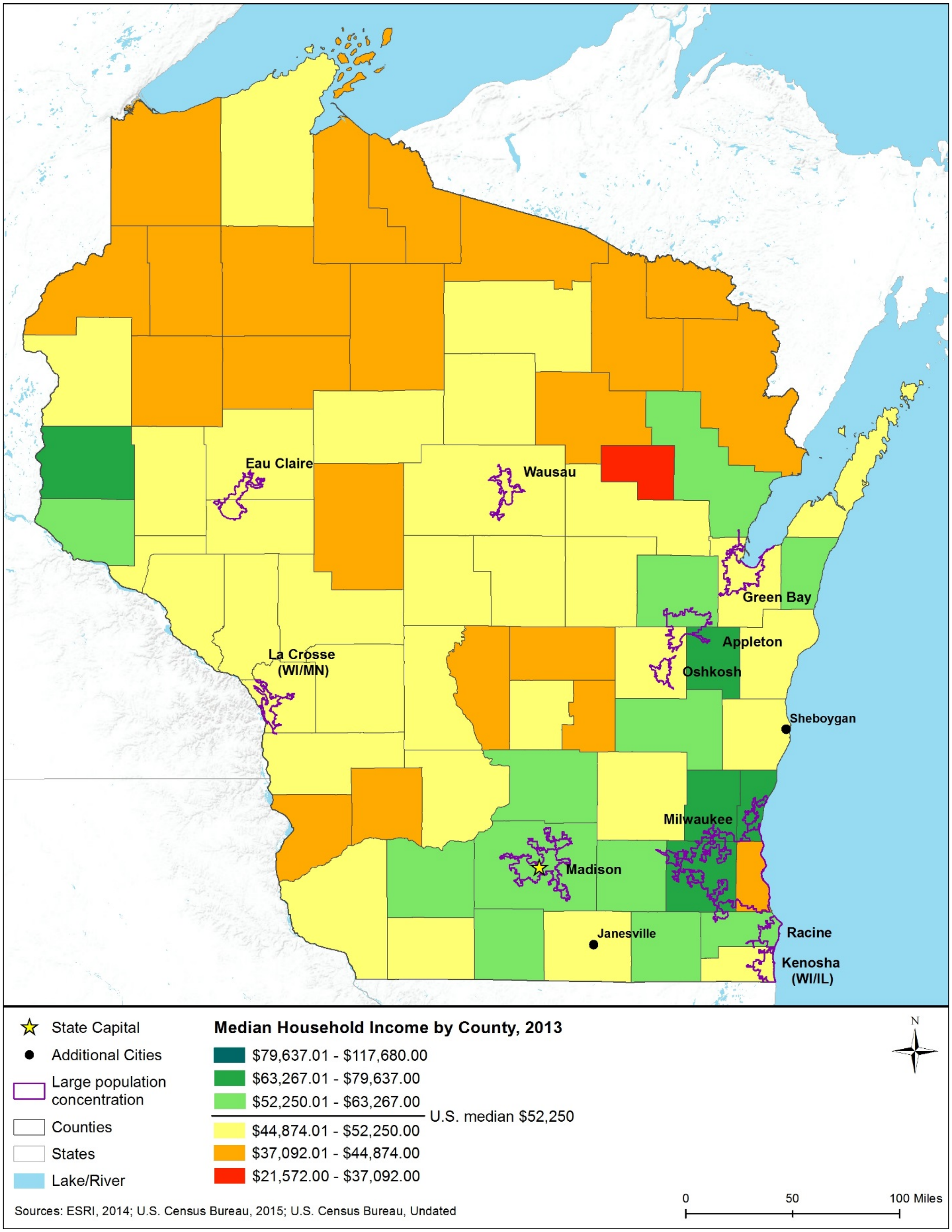


Figure 17.1.9-2: Median Household Income in Wisconsin, by County, 2013

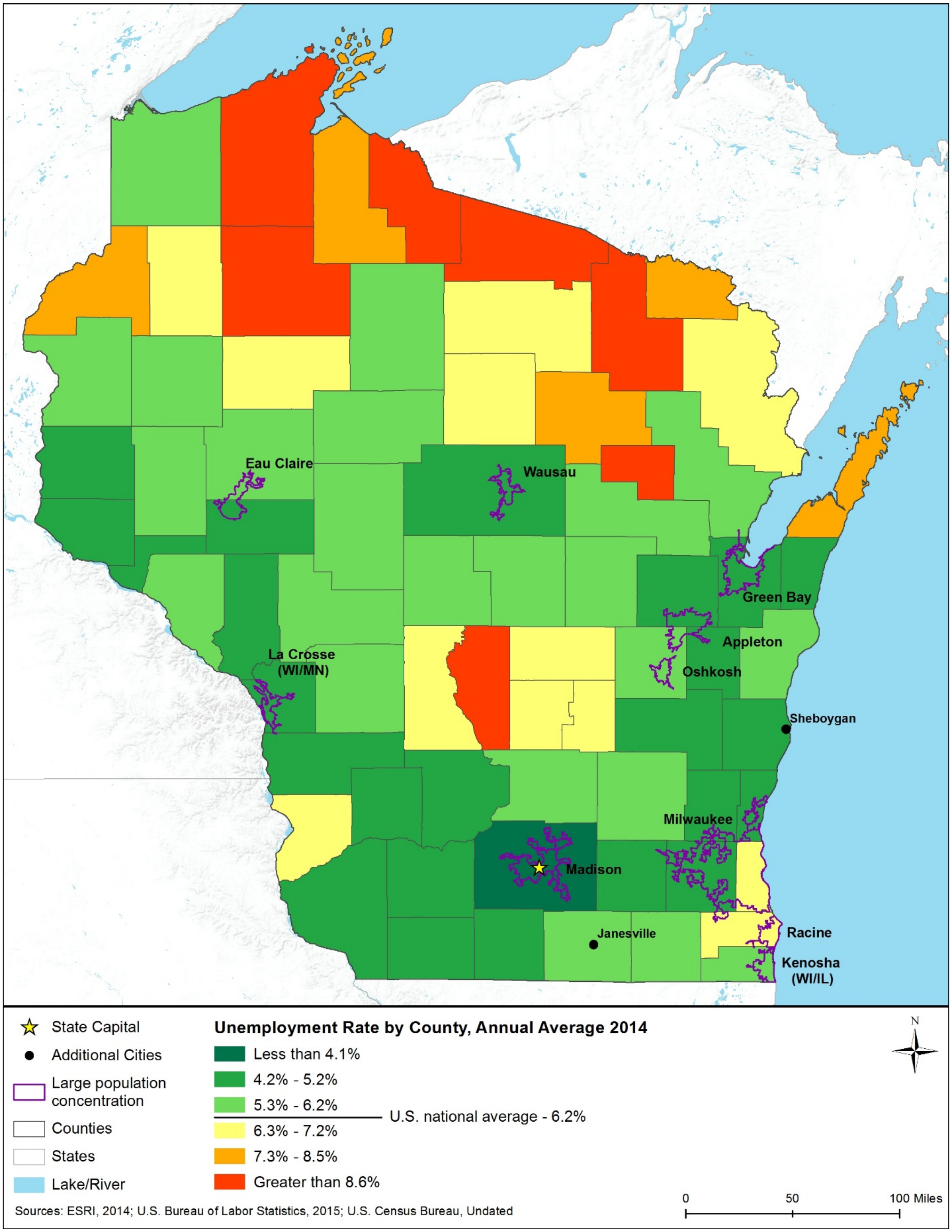


Figure 17.1.9-3: Unemployment Rates in Wisconsin, by County, 2014

Table 17.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Wisconsin	Central Region	United States
Civilian Employed Population 16 Years and Over	2,873,231	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	82.6%	81.7%	79.7%
Government workers	12.2%	12.8%	14.1%
Self-employed in own not incorporated business workers	5.0%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	2.6%	2.2%	2.0%
Construction	5.1%	5.6%	6.2%
Manufacturing	18.6%	14.0%	10.5%
Wholesale trade	2.6%	2.7%	2.7%
Retail trade	11.6%	11.5%	11.6%
Transportation and warehousing, and utilities	4.2%	4.9%	4.9%
Information	1.7%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	6.2%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	8.1%	9.7%	11.1%
Educational services, and health care and social assistance	22.9%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.7%	9.1%	9.7%
Other services, except public administration	4.3%	4.6%	5.0%
Public administration	3.5%	3.9%	4.7%

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

Table 17.1.9-8 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 17.1.9-7 for 2013.

Table 17.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Wisconsin, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Appleton	4.8%	3.7%	1.8%	9.2%
Eau Claire	4.1%	3.6%	1.6%	6.9%
Green Bay	4.3%	6.4%	2.0%	7.6%
Kenosha (WI/IL) (WI Portion)	4.9%	4.6%	1.7%	7.2%

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
La Crosse (WI/MN) (WI Portion)	4.0%	3.9%	2.4%	6.2%
Madison	3.3%	2.7%	2.7%	12.9%
Milwaukee	3.8%	4.2%	1.9%	10.5%
Oshkosh	2.4%	3.3%	1.5%	7.5%
Racine	4.6%	5.2%	1.4%	8.4%
Wausau	4.0%	4.2%	1.4%	6.0%
Wisconsin (statewide)	5.3%	4.4%	1.7%	7.9%

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

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 17.1.9-9 compares Wisconsin to the Central region and nation on several common housing indicators.

As shown in Table 17.1.9-9, in 2013 Wisconsin had a slightly lower percentage of housing units that were occupied (86.9 percent) than the region (88.4 percent) and the nation (87.6 percent). Of the occupied units, Wisconsin had a similar percentage of owner-occupied units (67.2 percent) to the region (67.6 percent) and a slightly higher percentage than the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Wisconsin in 2013 was 66.5 percent, slightly lower than the region (67.7 percent) and higher than the nation (61.5 percent). The homeowner vacancy rate in Wisconsin (1.8 percent) matched the rate for the region and was slightly lower than the nation's rate (1.9 percent). This rate reflects "vacant units that are 'for sale only'" (U.S. Census Bureau, 2015u). The vacancy rate among rental units was slightly lower in Wisconsin (5.2 percent) than in the region (6.0 percent) and the nation (6.5 percent).

Table 17.1.9-9: Selected Housing Indicators for Wisconsin, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Wisconsin	2,633,420	86.9%	67.2%	1.8%	5.2%	66.5%
Central Region	33,580,411	88.4%	67.6%	1.8%	6.0%	67.7%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

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

Table 17.1.9-10 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 17.1.9-10 shows that during this period, the percentage of occupied housing units exceeded the state average of 87.1 percent in all areas, ranging from 90.6 percent in the Wausau area to 95.4 percent in the Madison area.

Table 17.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Wisconsin, 2009–2013

Area	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Appleton	92,418	94.4%	68.4%	2.1%	5.2%	66.6%
Eau Claire	44,897	94.2%	58.7%	1.1%	3.5%	59.3%
Green Bay	88,566	94.2%	62.7%	1.8%	5.7%	60.1%
Kenosha (WI/IL) (WI Portion)	50,759	91.9%	62.0%	2.1%	7.7%	60.7%
La Crosse (WI/MN) (WI Portion)	40,872	94.5%	60.7%	2.2%	3.9%	57.3%
Madison	181,592	95.4%	55.0%	1.4%	3.9%	47.6%
Milwaukee	596,718	92.2%	58.8%	1.3%	4.0%	52.5%
Oshkosh	31,446	93.0%	59.2%	2.2%	6.6%	60.3%
Racine	56,901	91.3%	65.9%	1.5%	7.8%	63.6%
Wausau	33,685	90.6%	64.1%	3.3%	6.6%	64.7%
Wisconsin (statewide)	2,626,142	87.1%	68.1%	1.9%	5.5%	66.5%

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

Property Values

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

Table 17.1.9-11 provides indicators of residential property values for Wisconsin 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, 2015u).

The table shows that the median value of owner-occupied units in Wisconsin in 2013 ($163,000) was higher than the corresponding value for the Central region ($151,200) and lower than the nation's value ($173,900).

Table 17.1.9-11: Residential Property Values in Wisconsin, 2013

Geography	Median Value of Owner-Occupied Units
Wisconsin	$163,000
Central Region	$151,200
United States	$173,900

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

Table 17.1.9-12 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 in the top 10 population concentrations exceeded the state value of $167,100 only in the Milwaukee area ($190,400) and the Madison area ($224,300). The lowest value occurred in the area – Oshkosh – that had the lowest median household income (Table 17.1.9-6).

Table 17.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Wisconsin, 2009–2013

Area	Median Value of Owner-Occupied Units
Appleton	$147,100
Eau Claire	$143,200
Green Bay	$152,300
Kenosha (WI/IL) (WI Portion)	$159,800
La Crosse (WI/MN) (WI Portion)	$146,700
Madison	$224,300
Milwaukee	$190,400
Oshkosh	$126,300
Racine	$147,000
Wausau	$127,200
Wisconsin (statewide)	$167,100

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

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[128] are

[128] 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. Bureau of the Census 2006).

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 17.1.9-13 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 17.1.9-13 shows that the state government in Wisconsin received more total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation, while Wisconsin local governments obtained more total revenue per capita than counterparts in the region and less than counterparts in the nation. The Wisconsin state and local governments had similar levels per capita of intergovernmental revenues from the federal government[129] compared to their counterparts. The state government in Wisconsin obtained lower levels of property taxes per capita than its counterparts in the region and nation. Local governments in Wisconsin obtained considerably higher levels of property taxes, per capita, than local governments in the region and nation. The Wisconsin state and local governments reported similar or lower per capita revenue from general sales taxes than their counterparts in the region and nation. The Wisconsin state government reported higher revenue from selective sales taxes, and public utility taxes specifically, on a per capita basis than its counterparts in the region and nation. Local governments in Wisconsin reported considerably lower per capita levels of selective sales taxes revenues than did local governments in the region and the nation. Local governments in Wisconsin did not report any public utility taxes revenue. The state government in Wisconsin reported higher levels of individual and corporate income tax revenues, on a per capita basis, than its counterparts in the region and nation. Local governments in Wisconsin did not report any individual or corporate income tax revenues.

Table 17.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue		Wisconsin		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	($M)	$35,881	$27,375	$463,192	$231,980	$1,907,027	$1,615,194
Per capita		$6,266	$4,780	$6,020	$3,015	$6,075	$5,145

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

Type of Revenue	Wisconsin		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Intergovernmental from Federal ($M)	$8,855	$665	$125,394	$9,383	$514,139	$70,360
Per capita	$1,546	$116	$1,630	$122	$1,638	$224
Intergovernmental from State ($M)	$0	$9,869	$0	$76,288	$0	$469,147
Per capita	$0	$1,723	$0	$992	$0	$1,495
Intergovernmental from Local ($M)	$233	$0	$2,721	$0	$19,518	$0
Per capita	$41	$0	$35	$0	$62	$0
Property Taxes ($M)	$156	$9,895	$3,626	$61,015	$13,111	$432,989
Per capita	$27	$1,728	$47	$793	$42	$1,379
General Sales Taxes ($M)	$4,289	$337	$58,236	$6,920	$245,446	$69,350
Per capita	$749	$59	$757	$90	$782	$221
Selective Sales Taxes ($M)	$2,719	$91	$33,313	$2,191	$133,098	$28,553
Per capita	$475	$16	$433	$28	$424	$91
Public Utilities Taxes ($M)	$388	$0	$3,627	$1,153	$14,564	$14,105
Per capita	$68	$0	$47	$15	$46	$45
Individual Income Taxes ($M)	$6,762	$0	$72,545	$5,148	$280,693	$26,642
Per capita	$1,181	$0	$943	$67	$894	$85
Corporate Income Taxes ($M)	$934	$0	$9,649	$310	$41,821	$7,210
Per capita	$163	$0	$125	$4	$133	$23

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

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

17.1.10. Environmental Justice

17.1.10.1. 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 Appendix C, Environmental Laws and Regulations). The fundamental principle of environmental justice as stated in the EO is, “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2015c). 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, 2015c) offers guidance on Environmental Justice issues and provides an "environmental justice screening and mapping tool," EJSCREEN (USEPA, 2015d).

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 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).

17.1.10.2. Specific Regulatory Considerations

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to environmental justice for this PEIS. However, the Wisconsin Department of Transportation (WisDOT), in coordination with the Federal Transit Administration (FTA) and Federal Highway Administration (FHWA), works to implement Executive Order (EO) 12898 and associated federal policies/orders (State of Wisconsin Department of Transportation, 2015).

WisDOT aims at implementing the following three basic principles of environmental justice at all stages of the planning process for its projects:

- "To avoid, minimize or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects on minority populations and low-income populations;
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and
- To prevent the denial of, reduction of or significant delay in the receipt of benefits by minority and low-income populations" (State of Wisconsin Department of Transportation, 2015).

17.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 17.1.10-1 presents 2013 data on the composition of Wisconsin'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 (6.2 percent), Asian (2.5 percent), or Some Other Race (1.7 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; for Asian, 2.8 percent and 5.1 percent respectively; and for Some Other Race, 2.4 percent and 4.7 percent respectively. The state's estimated population of persons identifying as White (86.6 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 Wisconsin that identifies as Hispanic (6.3 percent) is smaller than in the Central region (8.5 percent) and considerably smaller than in the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin.

The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Wisconsin's All Minorities estimated population percentage (17.5 percent) is considerably lower than the percentages for both the Central region (23.8 percent) and the nation (37.6 percent).

Table 17.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Wisconsin (13.5 percent) is lower than the figures for both the Central region (14.7 percent) and the nation (15.8 percent).

Table 17.1.10-1: 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		
Wisconsin	5,742,713	86.6%	6.2%	0.9%	2.5%	0.0%	1.7%	2.1%	6.3%	17.5%
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, 2015i)

"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 17.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Wisconsin	13.5%
Central Region	14.7%
United States	15.8%

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

17.1.10.4. 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 17.1.10-1 visually portrays the results of the environmental justice population screening analysis for Wisconsin. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015ab; U.S. Census Bureau, 2015ac; U.S. Census Bureau, 2015ad; U.S. Census Bureau, 2015ae) and Census Bureau urban classification data (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015af).

Figure 17.1.10-1 shows that Wisconsin has many areas with high and moderate potential for environmental justice populations. The distribution of both the high and moderate potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations.

It is important to understand how the data behind Figure 17.1.10-1 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 17.1.10-1 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 17.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

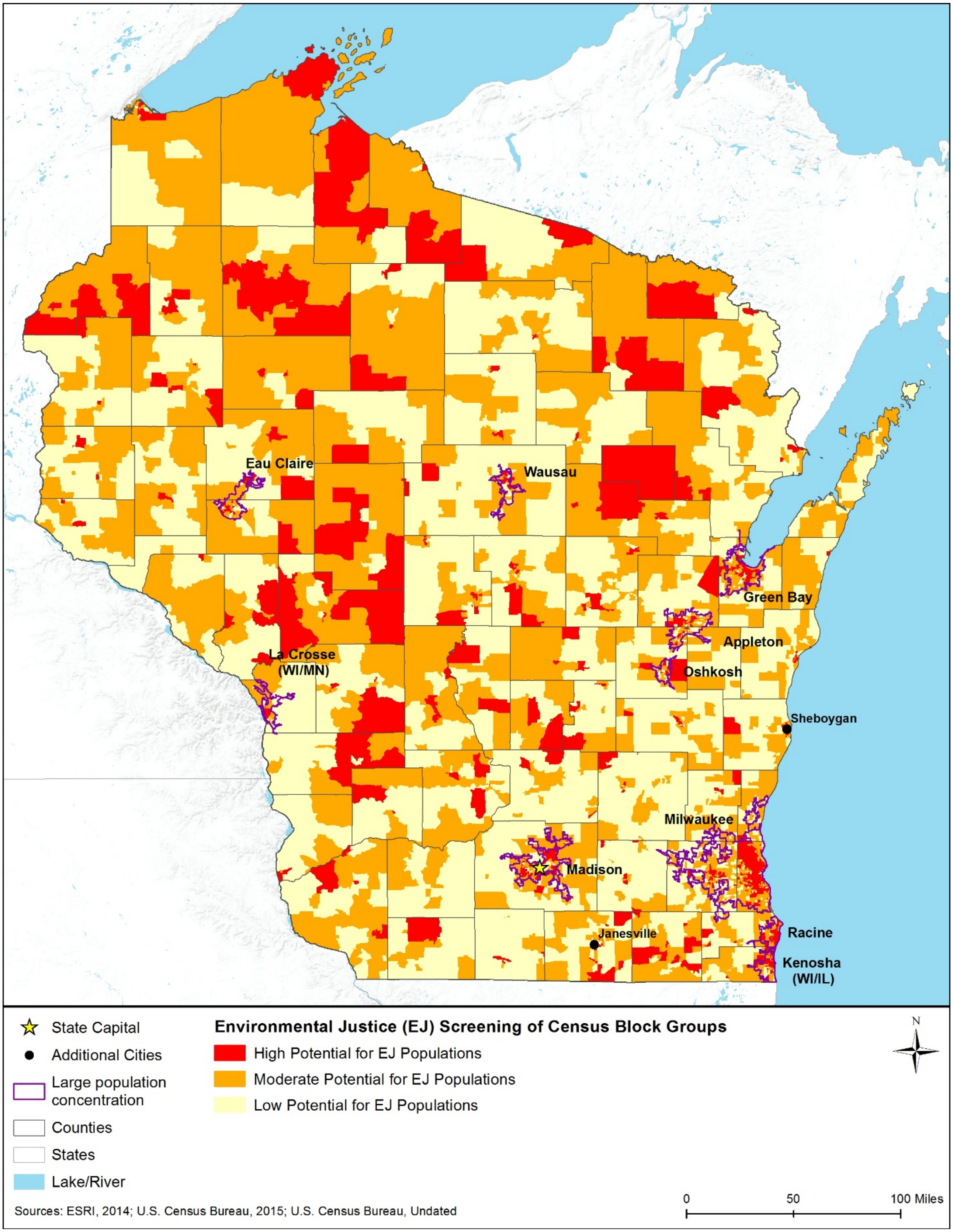


Figure 17.1.10-1: Potential for Environmental Justice Populations in Wisconsin, 2009–2013

17.1.11. Cultural Resources

17.1.11.1. Definition of Resource

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

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

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

- Statutory language and implementing regulations for Section 106 of the NHPA, as amended, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS's program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015j); and
- 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).

17.1.11.2. Specific Regulatory Considerations

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

Wisconsin has state regulations that are similar to the NHPA (refer to Table 17.1.11-1). However, federal regulations supersede these regulations. 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 17.1.11-1: Relevant Wisconsin Cultural Resources Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Wisconsin Act 395 (adopted 1987)	Wisconsin State Historic Preservation Office (SHPO)	This Act mirrors the NHPA for state actions, requiring agencies to consult with SHPO regarding potential impacts to historic properties.

17.1.11.3. Cultural and Natural Setting

Human beings have inhabited the state of Wisconsin for some 12,000 years (Haynes, Johnson, & Stafford, 1999; Pauketat, 2012; Davis, 2010). The majority of Wisconsin's early human habitation evidence comes from the study of archeological sites of pre-European contact and historic populations. In addition to the hundreds of archaeological sites listed in the state's inventory, there are 250 archaeological site listed on the NRHP (NPS, 2015a).

Archaeologists typically divide large study areas into regions. As shown in Figure 17.1.3-1, Wisconsin occupies two physiographic regions: Interior Plains and Laurentian Upland each with one province that comprises them. The Laurentian Upland region contains the Superior Upland province and spans the nearly the entire northern area of the state except for a small parcel to the west. The Interior Plains region contains the Central Lowland province and covers the majority of the state encompassing the entire eastern coast and most of the land westward.

Evidence at most archeological sites in Wisconsin are in relatively shallow deposits, either on the surface or within one to two feet of the surface. However, in some cases, natural factors have buried sites beneath multiple layers of sediment or organic materials, such as in floodplain deposits found along streams and rivers or peat deposits in wetlands. In Wisconsin, hundreds of sites are located across the state along riverbanks and streams, in wetlands and bogs, on hilltops, and submerged underwater (Wisconsin Historical Society, 2015e).

The following sections provide additional detail about Wisconsin's prehistoric periods (approximately 10000 B.C. – A.D. 1600) and the historic period since European contact in the 1600s. Section 17.14.4 presents an overview of the initial human habitation in Wisconsin and the cultural development that occurred before European contact. Section 17.14.5 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 17.14.6 provides a current list of significant archaeological sites in Montana and tools that the state has developed to ensure their preservation. Section 17.14.7 document the historic context of the state since European contact, and Section 17.14.8 summarizes the architectural context of the state during the historic period.

17.1.11.4. Prehistoric Setting

Archaeologists divide Wisconsin's prehistoric past into three periods: The Paleoindian Period (10000 – 7000 B.C.), Archaic (7000 – 1000 B.C.), and Woodland (1000 B.C – A.D. 1600) (Wisconsin Archaeological Society, 2014a). Figure 17.1.11-1 shows a timeline representing these periods of early human habitation of present day Wisconsin. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation is prevalent in each of Wisconsin's physiographic regions. Due to advancements in techniques and associating artifacts discovered with similar ones previously assigned to a particular range of the archaeological record, the periods associated with a particular time in North American human development continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).

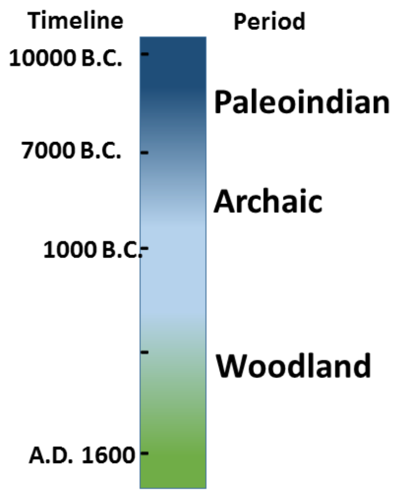


Figure 17.1.11-1: Timeline of Prehistoric Human Occupation

Sources: (Institute of Maritime History, 2015; Wisconsin Archaeological Society, 2014a)

Paleoindian (10,000 – 7,000 B.C.)

The Paleoindian Period represents the earliest human habitation Wisconsin. The earliest people to occupy the state were small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear points, also referred to as the Clovis fluted point (Hill M. G., 1994). Studies show that that such technology was prevalent in northeastern Asia, the Arabian Peninsula and Spain prior to human arrival into North America (Charpentier, Inizan, & Feblot-Augustins, 2002).

Most of the oldest known evidence of human settlement in Wisconsin is attributed to the discovery of fluted points found in surface and shallow deposits throughout the state. Archaeologists hypothesize that the people of this period ranged across the state in small bands that followed migratory game, such as mammoth and bison. Early Paleoindian settlers used the Clovis fluted point technology to hunt this large game. In west-central Wisconsin there is evidence of Paleoindian tool manufacturing. The area was heavily foraged by these early people. Many of the tools that have been discovered in this area are at various stages of production; the tools were discarded, and then refinished and used again. For the most part, they used local raw materials to manufacture tools (Hill M. G., 1994).

These bands established seasonal camps, some of which likely became permanent settlements. They were related to people who migrated to North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (Schroeder, 2007).

Around ten to seven thousand years ago, there was gradual warming trend in this region, and the Folsom culture replaced the Clovis culture. The Folsom people had more advanced methods for hunting bison, which lead to overhunting in the region. As hypothesized, their sophisticated hunting methods—along with the climatological changes that were occurring at the time—may have led to the distinction of the gradual extinction of the mammoth and other large animals (Schroeder, 2007; Carr & Boszhardt, 2003).

Archaic (7,000 – 1,000 B.C.)

Towards the end of the last ice age, the temperatures in Wisconsin became warmer. Along with temperature increase, there was a shift in the economy of the culture. A diversification in the subsistence patterns of the people in response to this new dryer climate was beginning to take hold during this period. "Early Archaic peoples employed a generalized foraging strategy, utilizing a broad range of animal species from a wide array of environmental settings. This new archaeological evidence is utilized in conjunction with detailed paleo-environmental data and information from cultural ecological studies to develop a model of Late Paleoindian-Early Archaic subsistence behavior for the Western Great Lakes" (Kuehn, 1998).

Early Archaic people employed a variety of subsistence strategies to exploit the variety of flora and faunal species that were available. Lakes, rivers, streams and wetlands were also heavily exploited for their food sources. As time moved forward in the Archaic, the people continued to exploit a larger array of flora and fauna in the region, especially as they became more specialized in their hunting and gathering practices (Kuehn, 1998).

By the late Archaic, there is evidence that copper exploitation was occurring in the eastern and east-central region of Wisconsin. Copper artifacts in northern Wisconsin and the Upper Peninsula are dated in the Middle Archaic period. The copper material was extracted from local sources and there is no indication that it was being mined from other areas (Hill M. A., 2012).

Evidence suggest that the people maintained a lifestyle of hunting and gathering throughout the Archaic period in Wisconsin. During the Middle and Late Archaic, the inhabitants of Saginaw Valley and Upper Great Lakes region of Wisconsin were exploiting small mammals such as raccoons, birds, aquatic resources, and gathering nuts, fruits and berries as a means for subsistence (Egan, 1988). Crude forms of pottery were being produced as well, but it was not until the Formative Period that this was being produced on a substantial scale. Furthermore, it is hypothesized that the pottery that was being produced in Archaic was not related to later forms, and that Woodland varieties were being influenced by people from the south and east of Wisconsin (Mehrer, 1998).

Woodland Period (1,000 B.C. – A.D. 1,600)

Pottery became widespread during the Woodland period in Wisconsin. Pottery is the defining material that separates how the people differed from those of the Archaic period. Pottery is an indication that people were beginning to settle down and become more sedentary. There are examples of extensive pottery use in the southern parts of Wisconsin, but not in the north (Mehrer, 1998). It is now evident that the harvesting of wild rice throughout Wisconsin was prevalent throughout the Woodland Period. Wild rice became an important part of the

Woodland people's diet and it supplemented their already diverse and mixed economy (Arzigian, 2000).

The Effigy Mound culture emerged during the late Woodland period in southern Wisconsin. In the Driftless area of southwest Wisconsin, a number of examples of effigy mound forms have been discovered. Projectile points, lithic raw materials, ceramics are unique to this region. The shape of the mounds are unlike those found anywhere else in North America. Some of the mounds were constructed in the shape of a panther, lizard or turtle (Boszhardt & Goetz, 2000).

17.1.11.5. Federally Recognized Tribes of Wisconsin

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are 12 federally recognized Tribes in Wisconsin; the Bad River Band of the Lake Superior, the Tribe of Chippewa Indians, the Forest County Potawatomi Community, the Ho-Chunk Nation of Wisconsin, the Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin, the Lac du Flambeau Band of Lake Superior Chippewa Indians of the Lac du Flambeau, the Reservation of Wisconsin, the Menominee Indian Tribe of Wisconsin, the Oneida Tribe of Indians of Wisconsin, the Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin, the St. Croix Chippewa Indians of Wisconsin, the Sokaogon Chippewa Community, and the Stockbridge Munsee Community (NRCS, 2015d; Government Publishing Office, 2015). The location of federally recognized tribes are shown in Figure 17.1.11-2. There are several other tribes depicted on the figure below that once lived in Wisconsin, but do not retain federal reservation or trust lands here any longer.

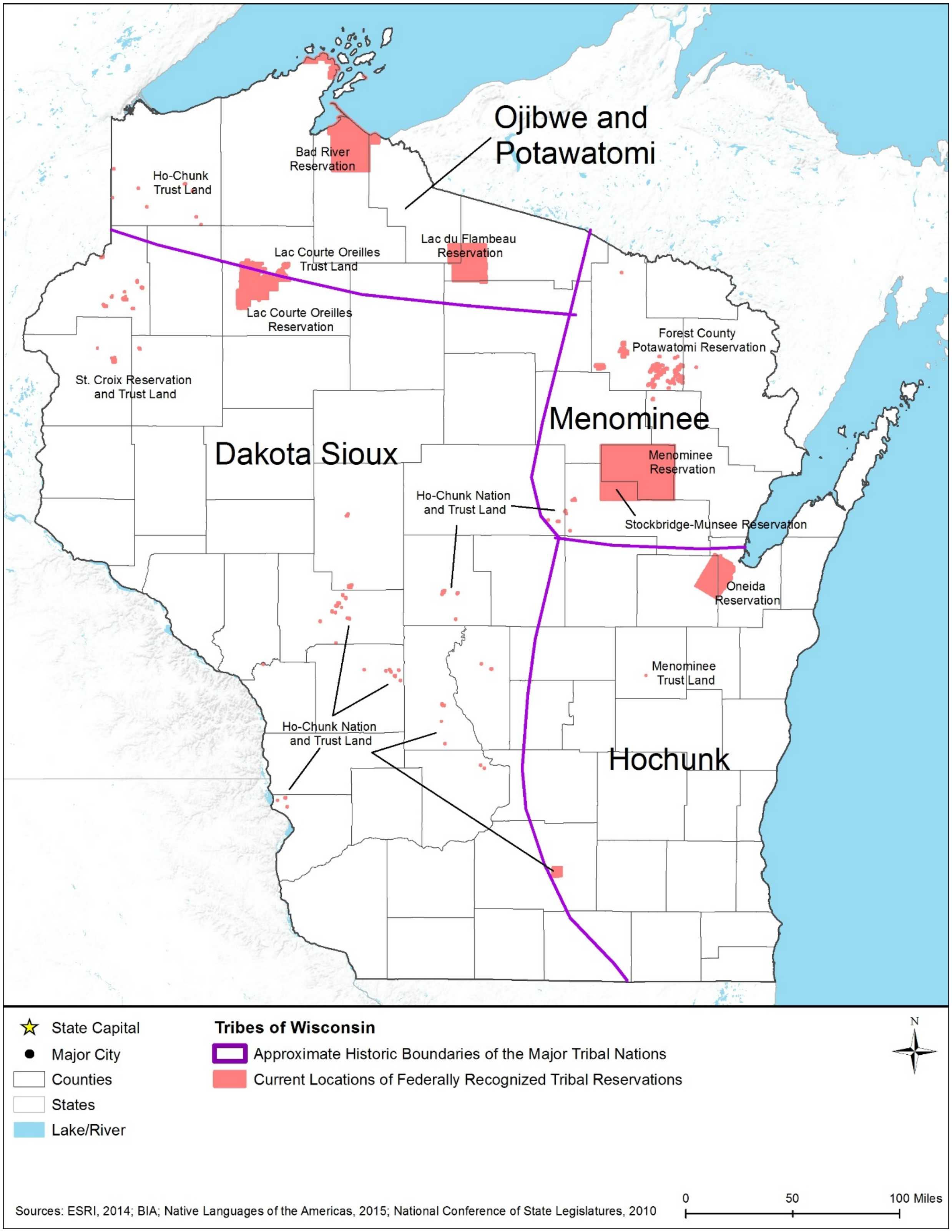


Figure 17.1.11-2: Approximate Historic Boundaries of Tribes in Wisconsin

17.1.11.6. Significant Archaeological Sites of Wisconsin

As previously mentioned in Section 17.1.11.3 there are 250 archaeological sites in Wisconsin listed on the NRHP. Table 17.1.11-2 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/ (NOAA, 2015b).

Wisconsin State Cultural Resources Database and Tools

Wisconsin Historical Society

The Wisconsin Historical Society acts as the State Historic Preservation Office (SHPO) for Wisconsin. The Society provides numerous resources on their websites including educational materials for instructors, access to the Wisconsin Magazine of History, and multiple public collections. Their website (http://www.wisconsinhistory.org/) also hosts the Wisconsin Historic Preservation Database (WHPD), which is further subdivided into three distinct collections. Users cannot access the system online without purchasing a license from the department, though qualified individuals can access it free of charge through state operated access terminals (Wisconsin Historical Society, 2015a).

Wisconsin Archaeological Society

The Wisconsin Archaeological Society is a non-profit organization which seeks to promote regional archaeology publications, research, education, and volunteering. The association's website (http://wiarcheologicalsociety.org/) provides users with preservation news, educational videos, and information on purchasing their biannual publication, The Wisconsin Archaeologist. The journal has the distinction of being the longest continuously published archaeological journal in North America (Wisconsin Archaeological Society, 2014b).

Table 17.1.11-2: Archaeological Sites on the National Register of Historic Places in Wisconsin

Closest City	Site Name	Type of Site
Alma Center	Silver Mound Archeological District	Prehistoric
Arena	Sawle Mound Group Archeological District	Prehistoric
Arpin	Skunk Hill (Tah-qua-kik) Ceremonial Community	Historic - Aboriginal
Aztalan	Pioneer Aztalan Site	Prehistoric
Bagley	Wyalusing State Park Mounds Archeological District	Prehistoric
Baileys Harbor	CHRISTINA NILSSON (shipwreck)	Shipwreck
Barneveld	Rainbow Cave	Prehistoric
Barre Mills	Samuels' Cave	Prehistoric
Bayfield	Morty Site (47AS40)	Prehistoric
Bayfield	P-Flat Site (47AS47)	Historic - Aboriginal, Prehistoric

Closest City	Site Name	Type of Site
Bayfield	PRETORIA (schooner--barge) Shipwreck Site	Shipwreck
Bayfield	Trout Point Logging Camp	Historic
Bayfield	SEVONA (Bulk Carrier) Shipwreck Site	Shipwreck
Belgium	NIAGARA (steamer)	Shipwreck
Berlin	Hamilton-Brooks Site	Historic, Historic - Aboriginal, Prehistoric
Big Bend	Big Bend Mound Group No. 2	Prehistoric
Big Bend	Dewey Mound Group	Prehistoric
Big Bend	Goodwin-McBean Site (47WK184)	Prehistoric
Big Bend	Peterson Site (47WK199)	Prehistoric
Black River Falls	Gullickson's Glen	Prehistoric
Blue Mounds	Fort Blue Mounds	Prehistoric
Boydtown	Unpleasant Ridge	Prehistoric
Brazeau	White Potato Lake Garden Beds Site	Prehistoric
Brigham	Archeological Site No. 47IA167	Prehistoric
Brigham	Archeological Site No. 47IA168	Prehistoric
Brigham	Carden Rockshelter	Prehistoric
Brigham	DNR #4 Rockshelter	Prehistoric
Brigham	DNR No. 5 Archeological Site	Prehistoric
Brigham	Hole-in-the-Wall #1 Cave	Prehistoric
Brokaw	Maine Site (47MR22)	Prehistoric
Busseyville	Carcajou Point Site (Boundary Increase II)	Historic - Aboriginal, Prehistoric
Busseyville	Carcajou Point (47JE2)	Historic - Aboriginal, Prehistoric
Carlton	AMERICA (canaller) Shipwreck	Shipwreck
Castle Rock	Bode--Wad--Mi Rockshelter	Prehistoric
Cataract	Walczak--Wontor Quarry Pit Workshop	Prehistoric
Centerville	GALLINIPPER Shipwreck (Schooner)	Shipwreck
Centerville	HOME Shipwreck (Schooner)	Shipwreck
Chilton	Aebischer Site (47CT30)	Prehistoric
Chilton	Ridge Group	Prehistoric
Clayton	Tainter Cave	Prehistoric
Delavan	Mile Long Site	Prehistoric
Delton	Hulbert Creek Garden Beds	Prehistoric
Diamond Bluff	Diamond Bluff Site-Mero Mound Group	Prehistoric
Diamond Bluff	Mero Archeological District (Boundary Increase)	Prehistoric
Dodgeville	Mayland Cave	Prehistoric
Doty	Boulder Lake Site	Historic, Prehistoric
Drummond	Lake Owen Archeological District	Historic
Dunn	Bram Mound Group	Prehistoric
Dunn	Lower Mud Lake Archeological Complex	Historic, Historic - Aboriginal, Prehistoric

Closest City	Site Name	Type of Site
Dunn	Moore Mound Group	Prehistoric
Eagle	Clipped Wing Eagle Mound	Prehistoric
Eagle	Eagle Township Mound Group	Prehistoric
Eagle	Hunting Eagle Mound	Prehistoric
Eagle Township	Shadewald I Mound Group	Prehistoric
Eastman	Larsen Cave	Prehistoric
Eaton	Island Village Site	Historic - Aboriginal, Prehistoric
Edgerton	Crab Apple Point Site	Historic - Aboriginal, Prehistoric
Edgerton	Kinney Farmstead-Tay-e-he-Dah Site	Historic - Aboriginal
Eureka	Carpenter Site (47WN246)	Historic - Aboriginal, Prehistoric
Evansville	Cooksville Mill and Mill Pond Site	Historic
Flambeau	Deadman Slough	Prehistoric
Fond du Lac	Pipe Site	Prehistoric
Fort Atkinson	Haight Creek Mound Group (47JE38)	Prehistoric
Fort Atkinson	Highsmith Site	Prehistoric
Fort Atkinson	Hoard Mound Group (47JE33)	Prehistoric
Fort Atkinson	Panther Intaglio Effigy Mound	Prehistoric
Fox Lake	Indian Point Site	Prehistoric
Fremont	Sanders Site (47WP26 and 47WP70)	Prehistoric
Friendship	Roche-a-Cri Petroglyphs	Prehistoric
Fulton	Mouth of the Yahara Archeological District	Historic - Aboriginal, Prehistoric
Gardner	Claflin Point Site	Shipwreck
Glen Haven	Eagle Valley Mound District	Prehistoric
Grantsburg	Sandrock Cliffs	Prehistoric
Hancock	Whistler Mound Group	Prehistoric
Harmony	Tollackson Mound Group	Prehistoric
Harmony	Tollackson Mound Group (Boundary Increase)	Prehistoric
Hertel	Altern Site	Prehistoric
Highland	Gottschall Site (47IA80)	Historic - Aboriginal, Prehistoric
Hilbert	Calumet County Park Group	Prehistoric
Hiles	Butternut--Franklin Lakes Archeological District	Prehistoric
Holmen	Midway Village Site	Prehistoric
Jacksonport	Jacksonport Wharf Archeological District	Historic, Shipwreck
Jefferson	Pitzner Site (47JE676)	Prehistoric
Kaukauna	Osprey Site	Prehistoric
Kekoskee	Kekoskee Archeological District	Prehistoric
Kenosha	Barnes Creek Site	Prehistoric
Kenosha	Chesrow Site	Prehistoric

Closest City	Site Name	Type of Site
Kenosha	WISCONSIN shipwreck (iron steamer)	Shipwreck
Kickapoo Center	Viola Rockshelter (47VE640)	Prehistoric
Kildare	Lemonweir Glyphs	Prehistoric
La Crosse	Overhead Site	Prehistoric
La Farge	Upper Kickapoo Valley Prehistoric Archeological District	Prehistoric
La Pointe	BIG BAY SLOOP shipwreck (sloop)	Shipwreck
La Pointe	LUCERNE (Shipwreck)	Shipwreck
La Pointe	Marina Site	Historic - Aboriginal, Prehistoric
La Pointe	MARQUETTE (shipwreck)	Shipwreck
La Pointe	MOONLIGHT shipwreck	Shipwreck
La Pointe	NOQUEBAY (Schooner--Barge) Shipwreck Site	Shipwreck
La Pointe	R. G. STEWART (Shipwreck)	Shipwreck
La Pointe	T. H. Camp (shipwreck)	Shipwreck
La Pointe	Winston--Cadotte Site	Historic, Historic - Aboriginal
Lac du Flambeau	Strawberry Island Site	Historic, Historic - Aboriginal
Lake Michigan	OCEAN WAVE (Shipwreck)	Shipwreck
Lake Michigan	DANIEL LYONS (Shipwreck)	Shipwreck
Lake Michigan	ROUSE SIMMONS (Shipwreck)	Shipwreck
Lake Mills	Bean Lake Islands Archeological District	Prehistoric
Lake Tomahawk	Lake Tomahawk Site	Prehistoric
Lake Tomahawk	Tom 2 Site	Prehistoric
Lancaster	Bass Site (47GT25)	Prehistoric
Leland	Durst-Bloedau Site	Prehistoric
Leland	Raddatz Rockshelter	Prehistoric
Liberty Grove	Bohjanen's Door Bluff Pictographs	Prehistoric
Liberty Grove	FLEETWING (shipwreck)	Shipwreck
Long Lake	Fay Outlet Site (47FL13)	Prehistoric
Lynne	McCord Village	Historic - Aboriginal
Lynne	McCord Village (Boundary Increase)	Historic - Aboriginal
Lynxville	Foley Mound Group	Prehistoric
Lynxville	Wall-Smethurst Mound Group	Prehistoric
Madison	Blackhawk Country Club Mound Group (47DA131)	Prehistoric
Madison	Brown, Charles E., Indian Mounds	Prehistoric
Madison	Burrows Park Effigy Mound and Campsite	Prehistoric
Madison	Edgewood College Mound Group Archeological District	Prehistoric
Madison	Elmside Park Mounds	Prehistoric
Madison	Farwell's Point Mound Group	Prehistoric
Madison	Forest Hill Cemetery Mound Group	Prehistoric
Madison	Halvorson Mound Group	Prehistoric
Madison	Lake Farms Archeological District	Prehistoric

Closest City	Site Name	Type of Site
Madison	Mendota State Hospital Mound Group	Prehistoric
Madison	Merrill Springs Mound Group II Archeological District	Prehistoric
Madison	Mills Woods Mound	Prehistoric
Madison	Observatory Hill Mound Group	Prehistoric
Madison	Phlaum--McWilliams Mound Group	Prehistoric
Madison	Spring Harbor Mound Group	Prehistoric
Madison	Vilas Circle Bear Effigy Mound and the Curtis Mounds	Prehistoric
Madison	Vilas Park Mound Group	Prehistoric
Manitowoc	FRANCIS HINTON (steamer)	Shipwreck
Marinette	Chautauqua Grounds Site	Historic - Aboriginal, Prehistoric
McFarland	Lewis Mound Group (47DA74)	Prehistoric
McFarland	Siggelkow Park Mound Group (47DA504)	Prehistoric
McFarland	Sure Johnson Mound Group	Prehistoric
Medary	Valley View Site	Prehistoric
Menasha	Doty Island (47WN30)	Historic - Aboriginal, Prehistoric
Menasha	Menasha Lock Site	Historic - Aboriginal, Prehistoric
Menomonie	Upper Wakanda Park Mound Group	Prehistoric
Mequon	ISLAND CITY (schooner) Shipwreck	Shipwreck
Middleton	Heim Mound	Prehistoric
Middleton	Stricker Pond I Site (47DA424)	Prehistoric
Milford	Telfer Site	Prehistoric
Milwaukee	EMBA (self-unloading barge) Shipwreck	Shipwreck
Milwaukee	LIGHT VESSEL No. 57 (Shipwreck)	Shipwreck
Milwaukee	Milwaukee River Parkway	Historic
Milwaukee	Spring Grove Site	Prehistoric
Mindoro	Bell Coulee Shelter	Prehistoric
Minocqua	Fishers Island	Prehistoric
Monona	Monona Mound (47DA275)	Prehistoric
Moscow	McCoy Rock Art Site	Prehistoric
Mosel	SILVER LAKE (scow-schooner) Shipwreck	Shipwreck
Mosel	WALTER B. ALLEN (canaller) Shipwreck	Shipwreck
Mukwonago	Barfoth-Blood Mound Group (47WK63)	Prehistoric
Necedah National Wildlife Refuge	Cranberry Creek Archeological District	Prehistoric
Neenah	Brainerd Site	Prehistoric
Neenah	Doty Island Village Site	Historic, Prehistoric
New Lisbon	Gee's Slough Mound Group	Prehistoric
Newbold	Little St. Germain Creek Site	Prehistoric

Closest City	Site Name	Type of Site
Newton	Cade Archeological District	Prehistoric
North Bay	FRANK O'CONNOR (bulk carrier)	Shipwreck
Northport	Porte des Morts Site	Historic, Historic - Aboriginal, Prehistoric
Oak Creek	LUMBERMAN shipwreck (schooner)	Shipwreck
Oconto	Arndt's Pensaukee Sawmill Complex	Historic
Oconto	Oconto Site	Prehistoric
Onalaska	Sand Lake Archeological District	Prehistoric
Onalaska	Sand Lake Site (47LC44)	Prehistoric
Onalaska	Swennes Archaeological District	Prehistoric
Ontario	Hay Valley Archeological District	Prehistoric
Ontario	Rockton Archeological District	Prehistoric
Oostburg	Byron (schooner) Shipwreck	Shipwreck
Oshkosh	Overton Archeological District	Historic, Historic - Aboriginal, Prehistoric
Perkinstown	Big Indian Farms	Historic - Aboriginal
Petersburg	Carved Cave	Prehistoric
Petersburg	Crow Hollow Site	Prehistoric
Phelps	Wallila Farm	Historic
Pleasant Prairie	Lucas Site	Prehistoric
Port Washington	TENNIE AND LAURA (Shipwreck)	Shipwreck
Portage	Fort Winnebago Site	Historic, Military
Portage	Fox-Wisconsin Portage Site	Historic - Aboriginal
Potosi	Hog Hollow Site	Prehistoric
Potosi	Potosi Badger Huts Site	Historic
Prairie du Chien	Pedretti III	Prehistoric
Prairie du Chien	Reed, Alfred, Mound Group (47CR311)	Prehistoric
Pulaski	Shiprock Rockshelter	Prehistoric
Rice Lake	Barron County Pipestone Quarry	Historic - Aboriginal, Prehistoric
Rice Lake	Rice Lake Mounds (47BN90)	Historic - Aboriginal, Prehistoric
Rice Lake	Wajiwan ji Mashkode Archeological District	Historic - Aboriginal, Prehistoric
Richland	Syttende Mai Site	Prehistoric
Richland Center	Richland Center Archeological District	Prehistoric
Rockton	B. Lawrence Site I	Prehistoric
Rockton	Markee Site	Prehistoric
Roxbury	Hornung Mound Group	Prehistoric
Russell	OTTAWA (Tug) Shipwreck Site	Shipwreck
Sauk City	Wisconsin Heights Battlefield	Military
Seneca	Olson Mound Group	Prehistoric
Sevastopol	AUSTRALASIA (wooden bulk carrier) Shipwreck	Shipwreck

Closest City	Site Name	Type of Site
Sevastopol	GREEN BAY shipwreck (sloop)	Shipwreck
Sevastopol	Whitefish Dunes--Bay View Site	Prehistoric
Sheboygan	HETTY TAYLOR (shipwreck)	Shipwreck
Sheboygan	Kletzien Mound Group (47SB61)	Prehistoric
Sherwood	High Cliff Mounds	Prehistoric
Shorewood	APPOMATTOX (Shipwreck)	Shipwreck
Shorewood	APPOMATTOX (shipwreck) Boundary Increase	Shipwreck
Siren	Fickle Site (47BT25)	Prehistoric
Sister Bay	MERIDIAN (schooner) Shipwreck Site	Shipwreck
Springvale	Raube Road Site	Historic
St. Croix Falls	Dalles Bluff Site	Prehistoric
St. Germain	Archeological Site No. 47VI197	Prehistoric
Sterling	Archeological Site No. 47VE881	Prehistoric
Stevenstown	Agger Rockshelter	Prehistoric
Stockbridge	Stockbridge Harbor	Prehistoric
Stoddard	Goose Island Archeological Site VE502	Prehistoric
Sturgeon Bay	Bullhead Point Historical and Archeological District	Historic, Shipwreck
Sturgeon Bay	Cardy Site	Prehistoric
Sturgeon Bay	JOYS (Shipwreck)	Shipwreck
Sumner	Carcajou Point Site (Boundary Increase)	Historic - Aboriginal, Prehistoric
Town of Eagle	Shadewald II Mound Group	Prehistoric
Town of Grafton	NORTHERNER Shipwreck (Schooner)	Shipwreck
Town of Newport	Kingsley Bend Mound Group Boundary Increase	Prehistoric
Townsend	Archibald Lake Mound Group	Prehistoric
Trempealeau	Melchior Hotel and Brewery Ruins	Historic
Trempealeau	Schwert Mound Group	Prehistoric
Trempealeau	Trempealeau Platform Mounds Site	Prehistoric
Two Rivers	CONTINENTAL shipwreck (bulk carrier)	Shipwreck
Viola	Hanson Petroglyphs	Prehistoric
Washington	IRIS (Shipwreck)	Shipwreck
Washington	LOUISIANA (Shipwreck)	Shipwreck
Washington	Pilot Island NW Site	Shipwreck
Washington Island	Little Lake Archeological District	Shipwreck
Waukesha	Cutler Mound Group	Prehistoric
Waupun	Horicon Site	Prehistoric
Wauzeka	Cipra Wayside Mound Group	Prehistoric
Webster	Northwest and XY Company Trading Post Sites	Historic
Webster	Yellow River Swamp Site 47BT36	Prehistoric
West Bend	Washington County “Island” Effigy Mound District	Prehistoric
Westby	Larson Cave	Prehistoric
Wheatland	Wehmhoff Mound (47KN15)	Prehistoric

Closest City	Site Name	Type of Site
Whitewater	Maples Mound Group	Prehistoric
Wind Point	KATE KELLY (Shipwreck)	Shipwreck
Winneconne	Kamrath Site	Prehistoric
Winneconne	Lasley's Point Site	Prehistoric
Wisconsin Dells	Kingsley Bend Mound Group	Prehistoric
Wolf	Metzig Garden Site (47WN283)	Prehistoric
Yellow Lake	Ebert Mound Group (47BT28)	Prehistoric

Source: (NPS, 2016e)

17.1.11.7. Historic Context

The French were the first Europeans to explore present-day Wisconsin, with the first documented landing being made by Jean Nicolet, near Green Bay, in 1634, though Etienne Brule likely preceded him in 1622 or 1623. Wisconsin was rich with furs, and the Indians provided furs to Europeans in exchange for trade goods. Missionary work was undertaken as well; however, the fur trade dominated Wisconsin throughout the 17th and 18th centuries. Fortified trading posts were established in order to protect trade routes. The French and Indian War (1755 to 1763), which was fought over continental control, related heavily to fur trading, and resulted in France losing nearly all of their North American territory. Wisconsin's first settlements were trading outposts, and Milwaukee and Green Bay are two examples. By the second quarter of the 19th century fur trading had ended due to overhunting (Wisconsin Historical Society, 2015f).

Wisconsin was minimally affected by the American Revolution, as it was removed from most of the action. Despite technically becoming part of the U.S. following the American Revolution, Wisconsin remained under British control, particularly with respect to the fur trade, until the end of the War of 1812. U.S. settlement increased as the British left following the War of 1812, and while the fur trading industry had begun to decline, lead mining would soon be a major industry for the region. "By 1829, more than 4,000 miners were producing 13 million pounds of lead a year" (Wisconsin Historical Society, 2015g).

Wisconsin experienced a great deal of immigration during the 19th century, both from within the U.S. and from Europe. Many immigrants were Germans; however, other cultures, such as Scandinavians, were present as well. Beginning in 1847, trains began to spread across the state, and on May 29, 1848, Wisconsin joined the Union as the 30th state. Farming was important, with dairy farming increasing after wheat crops were destroyed by insects in the 1860s. Logging, mining, and industrial activities also remained important during the 19th century (Wisconsin Historical Society, 2015h). During the Civil War, Wisconsin fought on the side of the Union, and thousands of Wisconsin men enlisted. Many of these soldiers completed training at Camp Randall, which is now the location of the University of Wisconsin's football stadium.

During the late 19th and early 20th centuries, Wisconsin became more industrialized and more progressive. Progressive Era politics grew in response to the increase in industry and permeated many aspects of life, with socialist public officials being elected. World War I (WWI) was initially opposed within Wisconsin due to the state's significant German population; however, residents came to support the conflict and volunteered to fight. During the 1920s, Wisconsin's economy suffered as Prohibition resulted in the closure of breweries, which had been a major contributor to the economy of the state (Wisconsin Historical Society, 2015i).

During the Great Depression, industrial workers and farmers in Wisconsin suffered. Wisconsin residents pushed for dramatic and progressive social changes, with extremists gaining followers and strikes and protests being common. Wisconsin residents participated in New Deal work programs, with the Civilian Conservation Corps (CCC) employing as many as 92,000 Wisconsin men (Wisconsin Historical Society, 2015j). During World War II (WWII), Wisconsin supported the war effort by producing ships, submarines, ammunition, and food (Wisconsin Historical Society, 2015k).

Wisconsin has 2,316 NRHP listed sites, as well as 42 NHLs (NPS, 2015a). Wisconsin does not contain any National Heritage Areas (NPS, 2015h). Figure 17.1.11-3 shows the location of NRHP sites within the state of Wisconsin.[130]

17.1.11.8. Architectural Context

While many of Wisconsin's original settlements still exist, such as Green Bay and Milwaukee, there are few surviving buildings that predate the second quarter of the 19th century. Early buildings were built of logs, both squared and round, as lumber was abundant and these building types were familiar to the immigrants moving into the region. Depending on the ethnicity of the builders, such as English, German, or Scandinavian, log structures might feature different design choices. "Of the small one-room cabins marking this early pioneer period, one of the finest survivals is the Goodrich cabin at Milton, Rock County" (Historic American Buildings Survey, 1965). "Stovewood" structures are another variety of log buildings, in which small sections of logs resembling firewood were stacked in a similar fashion to a wood pile, with the spaces in between being filled in with masonry. The Mecikalski Stovewood Saloon and Boarding-house in Lennox is an example of this method of construction (Perrin, 1967).

[130] See Section 17.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

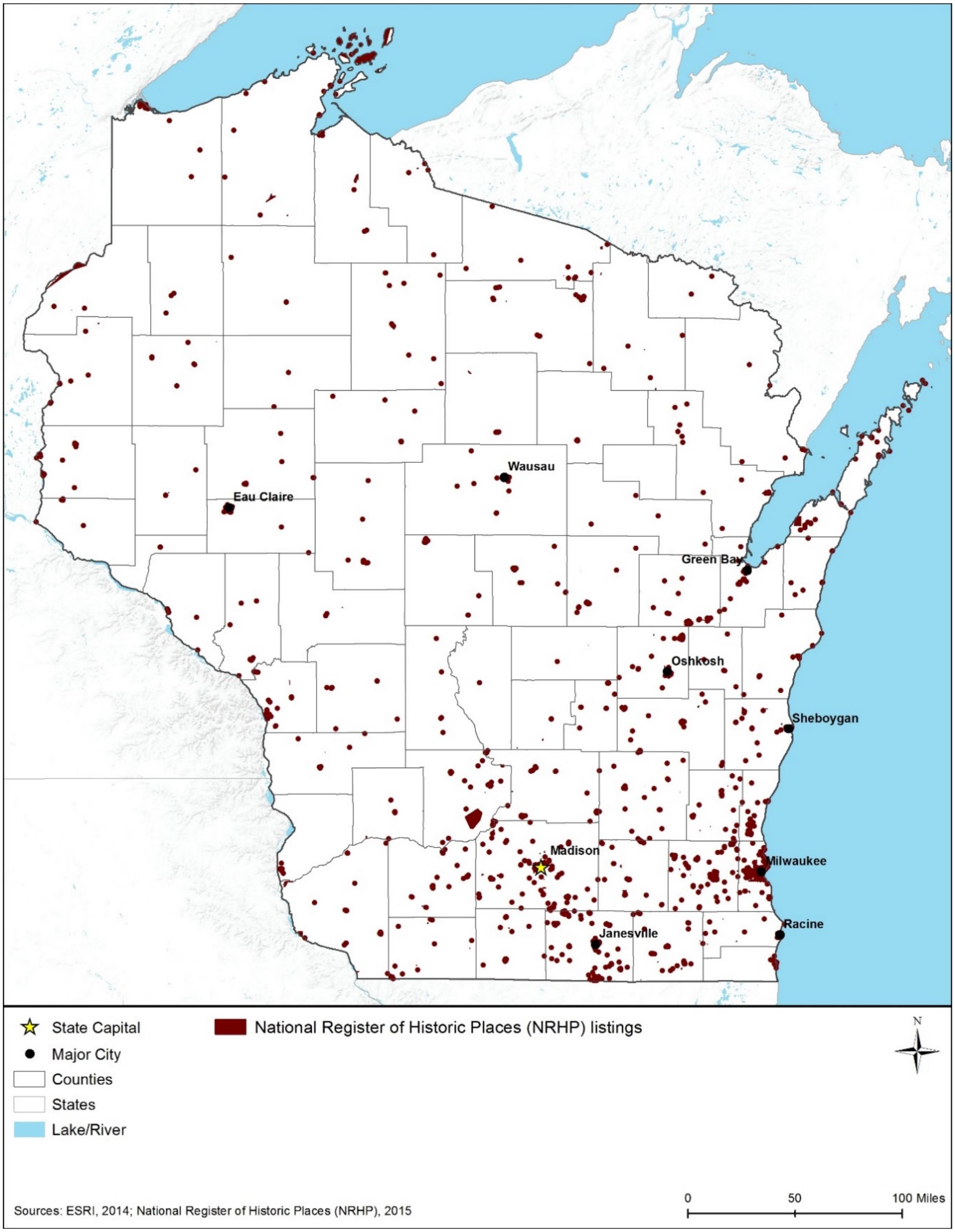


Figure 17.1.11-3: National Register of Historic Places (NRHP) Sites in Wisconsin[131]

[131] The oddly shaped polygons in this figure are artifacts of available data of NRHP district listings. The accuracy of the location data for these resources varies, resulting in variations in the appearance of each resource.

Half-timber construction was also common during the 19th century in areas with heavy German populations. Heavy timber-frames were erected and then in-filled with bricks and masonry. The Koepsell House in Jackson is an example of a half-timbering. While none are known to have survived, half-timbering is also known to have been used for the construction of churches and mills. Standard heavy-timber framing was also common, lasting through the first three quarters of the 19th century for houses, and continuing into the 20th century for barn construction. As milled lumber became more common, "balloon-framing" became standard.[132] Balloon-framing was popular in urban areas prior to rural areas due to the availability of milled lumber. Masonry construction was common as well, with fieldstone construction being popular during late 19th century. Brick construction was also employed, especially with bricks made from the cream colored clay mined around Milwaukee (Historic American Buildings Survey, 1965)

Popular building styles include the Federal style in early buildings, with Greek Revival becoming popular after the first quarter of the 19th century. In Wisconsin, Greek Revival details often appeared on buildings that still demonstrated characteristics of the Federal style. It was also popular in institutional architecture, as the territory/state was growing considerably during that time; courthouses and jails are examples of these. Gothic Revival became popular during the middle of the 19th century, particularly in church architecture, and Victorian Era and Colonial Revival architecture became popular during the late 19th and early 20th centuries. St. Luke's Episcopal Church in Racine is an example of high-style Gothic Revival, which was common in church architecture. During the 20th century, bungalows, Foursquares, and revival houses were built, with the Craftsman, Prairie, and Colonial and Tudor Revival styles being common. Following World War II, minimal traditional houses and ranch houses were built. (Historic American Buildings Survey, 1965)

Additional building types in Wisconsin include mills, which were built in great number during the 19th century. While few of these now exist, many were built in the Greek Revival style. One example that does still exist is the Cedarburg Mill (1855), on Cedar Creek and built of stone; wood was generally more common, but featured a lower rate of survivability. Stagecoach stops with inns and saloons were common, and many Greek Revival examples were built during the 19th century. Breweries were also common and are linked strongly to Wisconsin's Germanic heritage. "One of the best surviving examples of brewery architecture is the Mineral Springs Brewery at Mineral Point. The two-story building with two square towers was built in 1850. The walls are made of local buff- and gray limestone of excellent texture" (Historic American Buildings Survey, 1965). Milwaukee contains a variety of historic architecture relating to the brewing industry; however, many breweries closed during Prohibition. Wisconsin also contains a collection of round and polygonal buildings, both houses and barns. Octagon structures were popular for a short time during the late 19th century; however, barns with as many as twelve or fourteen sides were built (Perrin, 1967).

[132] "Balloon-framing" relied on a system of milled lumber and machine cut nails, instead of using heavy timber held together with mortise and tenon joints. Balloon framing is essentially how houses are constructed today.

Figure 17.1.11-4: Representative Architectural Styles of Wisconsin

Top Left – Pabst Brewery (Milwaukee, WI) – (Detroit Publishing Company, 1890)
Top Right – Appleton Paper Mills (Appleton, WI) – (Detroit Photographic Company, 1898)
Bottom Left – Koepsell House (Eagle, WI) – (Highsmith, 1980)
Bottom Center – Cedarburg Mill (Cedarburg, WI) – (Historic American Buildings Survey, 1933a)
Bottom Right – Log Cabin (Milton, WI) – (Historic American Buildings Survey, 1933b)

17.1.12. Air Quality

17.1.12.1. 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[133] 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)[134] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[135] This section discusses the existing air quality in Wisconsin. The USEPA designates areas within the United States as attainment,[136] nonattainment,[137] maintenance,[138] or unclassifiable[139] depending on the concentration of air

[133] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[134] Equivalent to 1 milligram per liter (mg/L).
[135] 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, 2015p).
[136] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015q).
[137] 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, 2015q).
[138] 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, 2015q).
[139] 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, 2015q).

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.

17.1.12.2. 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[140] or secondary,[141] 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, 2016b). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health.

In conjunction with the federal NAAQS, Wisconsin maintains its own air quality standards, the Wisconsin Ambient Air Quality Standards WIAAQS). Table 17.1.12-1 presents an overview of the WIAAQS as defined by the Wisconsin DNR.

Table 17.1.12-1: Wisconsin Ambient Air Quality Standards (WIAAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	
CO	8-hour	10	9	Same as Primary		Not to be exceeded more than once per year
	1-hour	40	35	Same as Primary		Not to be exceeded more than once per year
Lead	3-month	1.5	-	Same as Primary		Maximum arithmetic mean
	3-month	0.15	-	Same as Primary		Maximum arithmetic 3-month mean concentration for a 3-year period is less than or equal to 0.15 $\mu g/m^3$

[140] 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, 2014e).
[141] 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, 2014e).

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m³	ppm	μg/m³	ppm	
NO_2	Annual	100	0.053	Same as Primary		Annual arithmetic mean
PM_{10}	24-hour	150	-	Same as Primary		Maximum 24-hour average concertation
$PM_{2.5}$	Annual	15.0	-	Same as Primary		Annual arithmetic mean concentration
	24-hour	35	-	Same as Primary		24-hour average concentration
O_3	1-hour	235	0.12	Same as Primary		Maximum 1-hour concentration
	8-hour	-	0.08	Same as Primary		Maximum 8-hour concentration
	8-hour	-	0.075	Same as Primary		The 3-year average of the annual fourth−highest daily maximum 8−hour average ozone concentration is less than or equal to 0.075 pp
SO_2	3-hour	-	-	-	0.5	Not to be exceeded more than once per year
	24-hour	-	0.14	-	-	Not to be exceeded more than once per year
	Annual	-	0.030	-	-	Annual arithmetic mean

Source: (Wisconsin State Legislature, 2015e)

Title V Operating Permits/State Operating Permits

Wisconsin 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, 2015e). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015e). Wisconsin's Administrative Code NR 407 [Operation Permits] describes the applicability of Title V operating permits. Wisconsin 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 17.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 17.1.12-2: Major Air Pollutant Source Thresholds

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

Source: (USEPA, 2014c)

Exempt Activities

Select activities, as defined by NR 407.03 [Exemptions from Operation Permit Requirements], are exempt from the registration and permitting provisions of NR 407.01 [Applicability; Purpose] for Wisconsin operation permits. The following sources are exempt from operation permitting requirements:

- "…Emergency electric generators powered by internal combustion engines which are fueled by gaseous fuels, gasoline or distillate fuel oil with an electric output of less than 3,000 kilowatts…;
- …Any source that is not a part 70 source[142] or an affected source[143] and all of the following requirements are met:
    - The maximum theoretical emissions from the source for SO_2 or CO do not exceed 9.0 pounds per hour for each air contaminant;
    - The maximum theoretical emissions from the source for PM, NO_2 or Volatile Organic Compounds (VOCs) do not exceed 5.7 pounds per hour for each air contaminant;
    - The maximum theoretical emissions from the source for $PM_{2.5}$ do not exceed 2.2 pounds per hour;
    - The maximum theoretical emissions from the source for lead do not exceed 0.13 pounds per hour." (Wisconsin State Legislature, 2015f)
- "Any source that will not emit at a rate greater than the following applicable emission rates listed in NR 405.02 (27) (a) [Pollutant and Emissions Rate]:
    - CO: 100 tons per year (tpy)
    - NO_2: 40 tpy
    - SO_2: 40 tpy
    - PM: 25 tpy
    - PM_{10}: 15 tpy
    - $PM_{2.5}$: 10 tpy, also 40 tpy of NO_2 or 40 tpy of SO_2
    - O_3: 40 tpy of VOCs
    - Lead: 0.60 tpy
    - Municipal solid waste landfill emissions (measured as nonmethane organic compounds): 50 tpy
    - Fluorides: 3.0 tpy
    - Sulfuric acid mist: 7.0 tpy
    - Hydrogen sulfide (H2S): 10 tpy
    - Total reduced sulfur (including H2S): 10 tpy
    - Reduced sulfur compounds (including H2S): 10 tpy

[142] Part 70 source: A stationary source required to have an operating permit pursuant to NR 407 [Operating Permits] that may contain one or more emission units (Wisconsin State Legislature, 2015f).
[143] Affected unit: "A stationary source that includes one or more affected units that are subject to an emissions reduction requirement or emissions limitation under the acid rain program" (DNR, 2015at).

  - Municipal waste combustor (MWC) acid gases (measured as total sulfur dioxide and hydrogen chloride): 40 tpy
  - MWC metals (measured as particulate matter): 15 tpy
  - MWC organics (measured as total tetra- through octa- chlorinated dibenzo-p-dioxins and dibenzofurans): 3.5× 10-6 tpy…”. (Wisconsin State Legislature, 2015g)
- “Any source whose maximum theoretical emissions from the source for any hazardous air contaminant listed in NR 445.07 **[**Emission thresholds, standards, control requirements and exemptions] do not exceed the emission rate listed in the table for the hazardous air contaminant for the respective stack height;
- A source that will not have maximum theoretical emissions of any single hazardous air pollutant listed under section 112 of the CAA [Hazardous Air Pollutants] that equal or exceed 10 tons per year or cumulative maximum theoretical emissions of all the hazardous air pollutants listed under section 112 of the CAA [Hazardous Air Pollutants] that equal or exceed 25 tons per year;
- The source is not subject to any standard or regulation under section 111 of the CAA [Standards of performance for new stationary sources];
- The source is not subject to any standard or regulation under section 112 of the CAA [Hazardous Air Pollutants], excluding section 112(d)(5) **[**Alternative standard for area sources] or (r) [Prevention of accidental releases].” (Wisconsin State Legislature, 2015f)

Temporary Emissions Sources Permits

Wisconsin does not have regulations for temporary emission source permitting. Any temporary emission sources should review stationary source requirements, or contact the state for additional assistance.

State Preconstruction Permits

The Wisconsin DNR issues waivers under regulation NR 406.03 (2) (a) “in order to commence construction, reconstruction, replacement, relocation or modification of an air pollution source prior to the department issuing a construction permit to the source under NR 406 [Construction Permits].” The department may not issue waivers for sources that require operation permits or sources within 10 kilometers of a Class I area (Wisconsin State Legislature, 2015h).

General Conformity

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

The estimated pollutant emissions are compared to *de minimis* levels.[144] These values are the minimum thresholds for which a conformity determination must be performed (see Table 17.1.12-3).

Table 17.1.12-3: *De Minimis* Levels

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

Source: (Government Publishing Office, 2010a).

If an action does not result in an emissions increase above the de minimis levels in Table 17.1.12-3, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the de minimis levels in Table 17.1.12-3, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity,[145] 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

[144] 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, 2016e).
[145] 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 Requirements

The Wisconsin SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Wisconsin's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Wisconsin's SIP actions are codified under 40 CFR Part 52 Subpart YY. A list of all SIP requirements for designated areas for all six criteria pollutants can be found on the USEPA's website (http://www3.epa.gov/airquality/urbanair/sipstatus/reports/wi_areabypoll.html#co__1971_).

17.1.12.3. 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 17.1.12-1 and Table 17.1.12-4, below, present the nonattainment areas in Wisconsin 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. Unlike Table 17.1.12-4, Figure 17.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

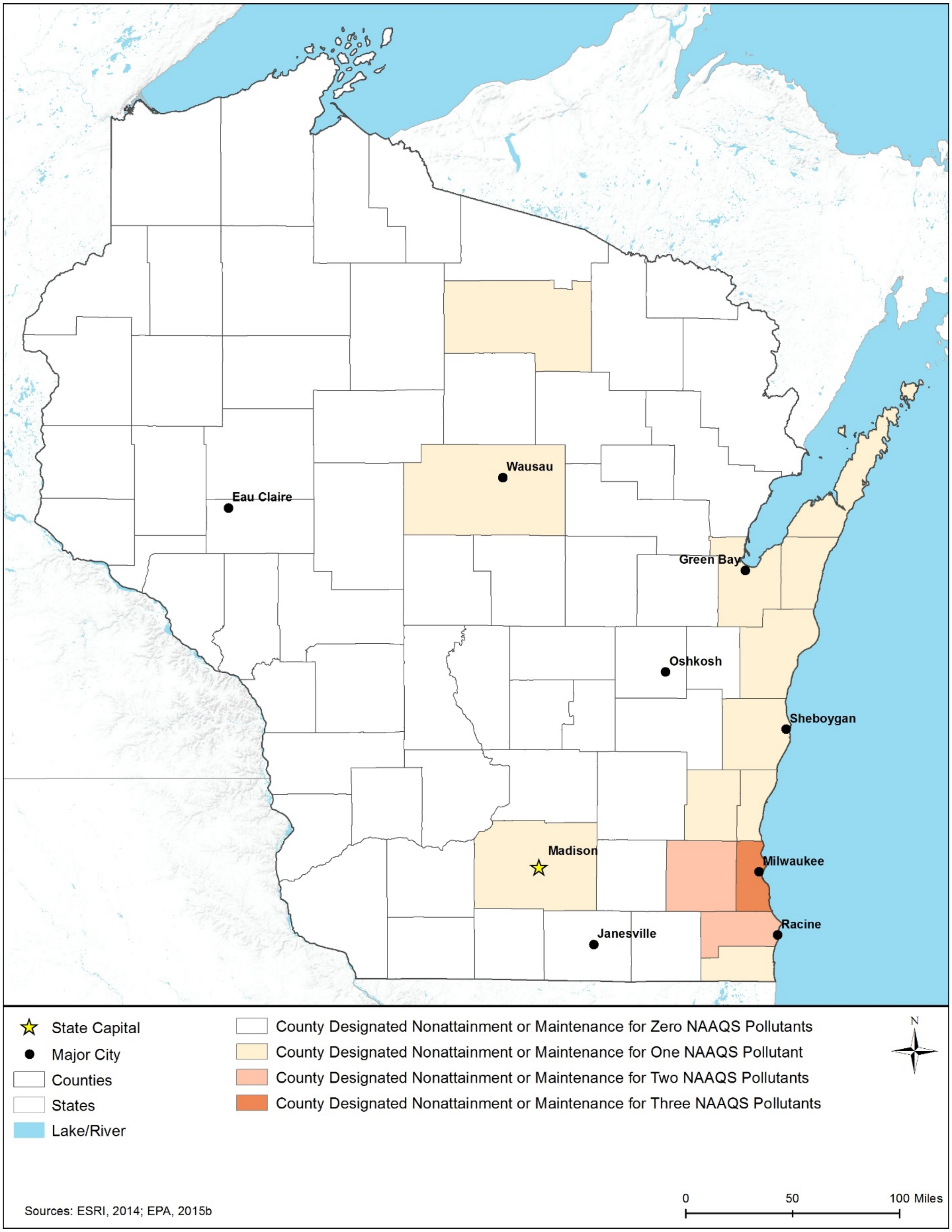


Figure 17.1.12-1: Nonattainment and Maintenance Counties in Wisconsin

Table 17.1.12-4: Wisconsin 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
Brown										M	
Dane										M	
Door								M			
Kenosha								M	X-5		
Kewaunee								M			
Manitowoc								M			
Marathon										M	
Milwaukee							M	M		M	
Oneida										M	X-6
Ozaukee								M			
Racine							M	M			
Sheboygan								X-4	X-5		
Washington								M			
Waukesha							M	M			

Source: (USEPA, 2015f)
X-1 = Nonattainment Area (Extreme)
X-2 = Nonattainment Area (Severe)
X-3 = Nonattainment Area (Serious)
X-4 = Nonattainment Area (Moderate)
X-5 = Marginal Nonattainment Area
X-6 = Unclassified Nonattainment Area
M = Maintenance Area

Air Quality Monitoring and Reporting

The Wisconsin DNR measures air pollutants at 42 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (DNR, 2015bb). Annual Wisconsin State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region (DNR, 2015bb). The Wisconsin DNR reports real-time pollution levels of O_3, $PM_{2.5}$, and PM_{10} on the AirNOW.[146]

Throughout 2014, O_3 measurements exceeded the federal standard of 0.075 ppm at stations across Kenosha County and the Sheboygan area. A portion of Oneida County was in nonattainment for SO_2 and exceeded the 2010 primary federal standard of 0.075 ppm (DNR, 2015bc).

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

[146] AirNow is a government website that posts daily Air Quality Index for more than 400 cities.

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

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. "Historically, the USEPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers[148] (the normal useful range of USEPA-approved Gaussian plume models" (USEPA, 1992).

Wisconsin contains one Federal Class I area; all other land within the state is classified as Class II (USEPA, 2012a). If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source (USEPA, 1992). No other adjacent states have Class I lands within 100-kilometers of the Wisconsin border. Figure 17.1.12-2 provides a map of Wisconsin highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses.

Figure 17.1.12-2 corresponds to the numbers and Class I areas listed in Table 17.1.12-5.

Table 17.1.12-5: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Rainbow Lake Wilderness Area	6,583	WI

Source: (USEPA, 2012a)
[a] The numbers correspond to the shaded regions in Figure 17.1.12-2.

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

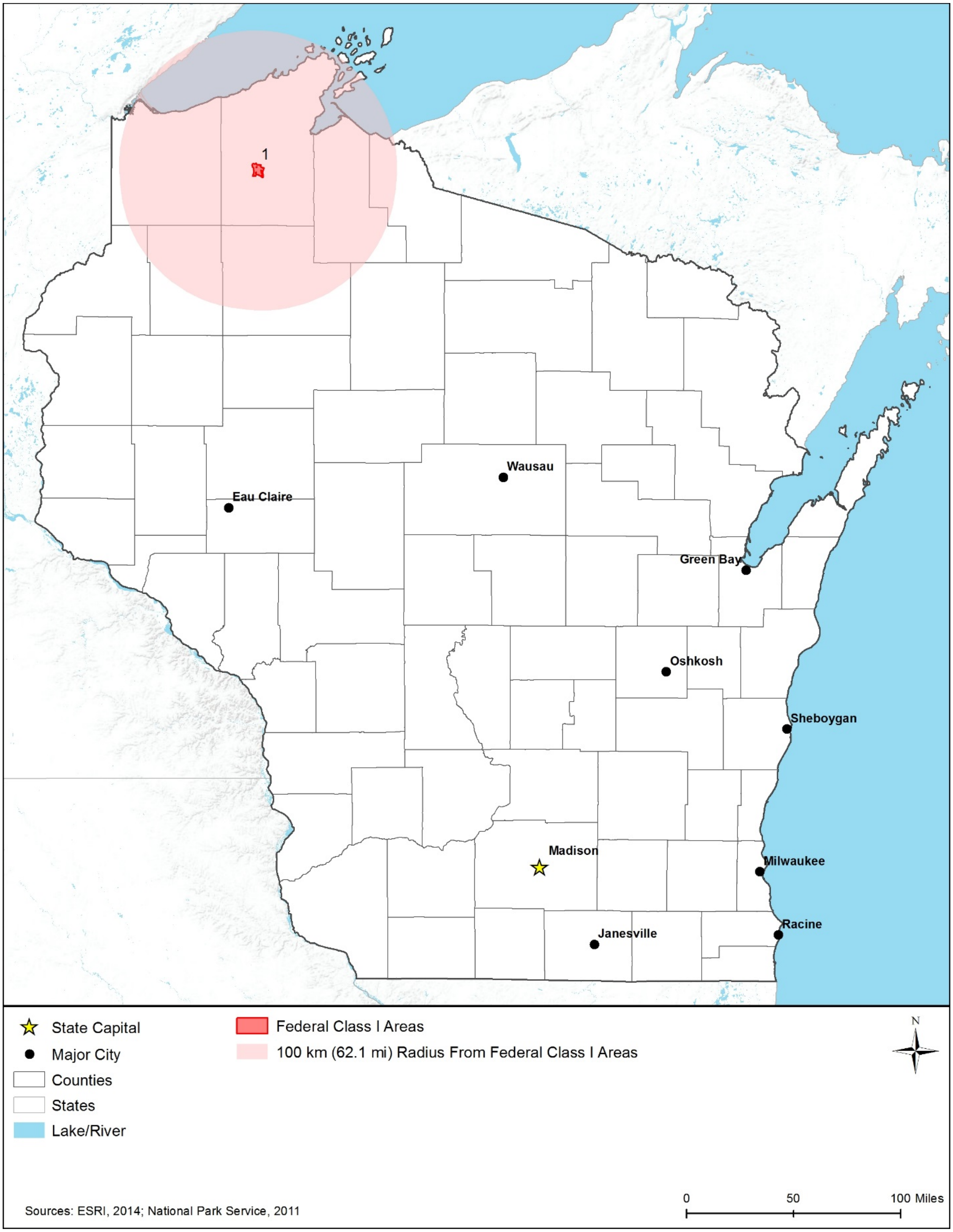


Figure 17.1.12-2: Federal Class I Areas with Implications for Wisconsin

17.1.13. Noise

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

17.1.13.1. Definition of the Resource

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

The effects of noise can be classified into three categories:

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

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”) (OSHA, 2016a). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (FTA, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015f). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA, 2016a).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (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 17.1.13-1 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.

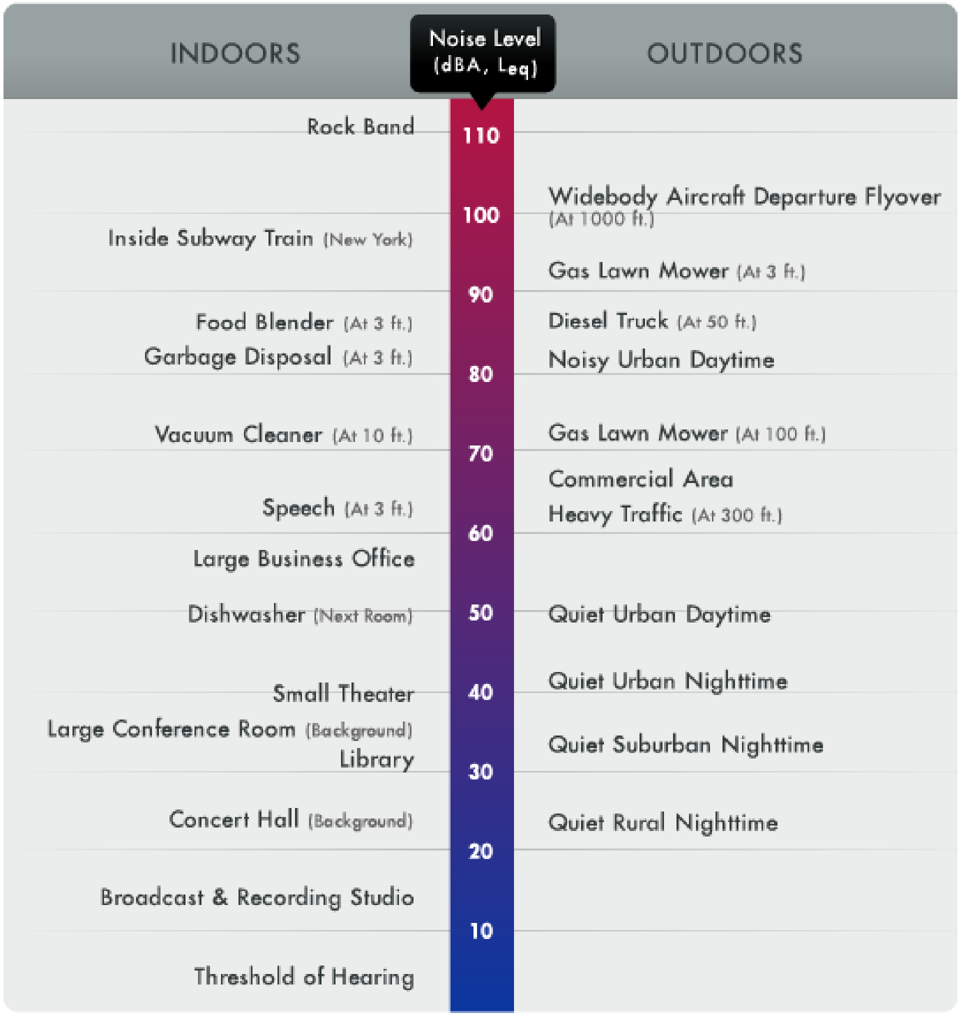


Figure 17.1.13-1: Sound Levels of Typical Sounds

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

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

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

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

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

17.1.13.2. 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.

Wisconsin has several statewide noise regulations written into the Wisconsin Statutes and Annotations. They mainly apply to motor vehicle functions such as mufflers. Table 17.1.13-1 provides a brief summary of these regulations.

Table 17.1.13-1: Relevant Wisconsin Noise Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
Wisconsin Statute 347.39	Wisconsin State Legislature	Requires motor vehicles operating on highways to use a muffler.

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

17.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Wisconsin varies widely based on the area and environment of the area. The population of Wisconsin can choose to live and interact in areas that are large cities, rural or suburban communities, small towns, and national and state parks. Figure 17.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Wisconsin may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Wisconsin. As such, this section describes the areas where the population of Wisconsin can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of

Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are Milwaukee and Madison because they are the most populated areas.

- **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 Wisconsin, General Mitchell International Airport (MKE) has annual operations of more than 108,000 flights (FAA, 2015g). These operations result in increased ambient noise levels in the surrounding communities. See Section 17.1.7, Land Use, Recreation, and Airspace, and Table 17.1.7-8 for more information about airports in the state.
- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (DOT, 2015). 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 (DOT, 2015). See Section 17.1.1, Infrastructure, and Figure 17.1.1-1 for more information about the major highways in the state.
- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (Federal Transit Authority, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (DOT, 2015). Wisconsin has two passenger rail corridors with high levels of commercial and commuter rail traffic (WisDOT, 2015c). The Hiawatha Service links Milwaukee and Chicago (IL). The Wisconsin section of the Empire Builder service extends from Milwaukee to La Crosse. See Section 17.1.1, Infrastructure, and Figure 17.1.1-1 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, 2014d). Wisconsin has two national parks and 18 National Natural Landmarks (NPS, 2015a). Visitors to these areas expect lower ambient noise conditions than the

surrounding urban areas. See Section 17.1.8, Visual Resources, and Figure 17.1.8-3 for more information about national and state parks for Wisconsin.

17.1.13.4. 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 Wisconsin 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 Wisconsin.

17.1.14. Climate Change

17.1.14.1. 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, 2012d). 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[149]), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in million metric tons (MMT) CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" with "Atmospheric concentrations of CO_2 increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005" (IPCC, 2007). The atmospheric concentration of CH_4 and N_2O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

[149] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents ($MMTCO_2e$). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_2E$ = (million metric tons of a gas) * (GWP of the gas)" (USEPA 2015).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see Section 17.2, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation; 3) sea level; and 4) severe weather events.

17.1.14.2. 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. Wisconsin has not established goals and regulations to reduce GHG emissions to combat climate change.

While Wisconsin has not adopted any state-wide policies or specific goals for GHG emissions or climate change, in 2007 a partnership between the Wisconsin Department of Natural Resources and the University of Wisconsin–Madison's Nelson Institute for Environmental Studies formed the Wisconsin Initiative on Climate Change Impacts (WICCI). The goal of WICCI is to assess and anticipate climate change impacts on Wisconsin's natural resources, ecosystems, regions and industries) and develop and recommend adaptation strategies that can be implemented by relevant stakeholders. (DNR, 2012f)

However, in 2015 a separate agency, the Board of Commissioners of Public Lands (BCPL) passed a vote that forbade its employees from discussing climate change at work. The restriction, approved by a 2-1 vote, prevents the staff members at the BCPL from communicating about climate change, including about its potential impacts on 77,000 acres of state timberland. (Lehman, 2015)

17.1.14.3. Greenhouse Gas Emissions

Estimates of Wisconsin 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 CH4 and nitrous oxide (NOx), but not at the state level (EIA, 2015d). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015g). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

For the purposes of this PEIS, the EIA data on CO2 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 CH4, they are described and cited.

According to the EIA, Wisconsin emitted a total of 99.5 MMT of CO_2 in 2013 from fossil fuels, a more than 10 percent increase over 2012. The largest-emitting sector was electric power, consisting almost entirely of emissions from coal at 43.3 MMT. The transportation sector was the next highest at 26.7 MMT of emissions almost entirely from petroleum products (Table 17.1.14-1) (EIA, 2015e). Annual emissions between 1980 and 2013 are presented in Table 17.1.14-1. Wisconsin's CO_2 emissions increased between 1980 and 2005 from 81.7 MMT to

110.5 MMT, or 35 percent. Emissions then declined to almost their 1980 levels, but increased against in 2013. Increases and decreases were caused mostly between changes in emissions from coal and petroleum products, with natural gas emissions remaining relatively constant (EIA, 2015e). Wisconsin ranked 19th in total CO_2 emissions among the 50 states and the District of Columbia in 2013, and was ranked 24th in per capita emissions (EIA, 2015f).

Table 17.1.14-1: Wisconsin CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2013

Fuel Type (MMT)		Source (MMT)	
Coal	42.9	Residential	9.8
Petroleum Products	32.7	Commercial	5.8
Natural Gas	23.9	Industrial	14.0
		Transportation	26.7
		Electric Power	43.3
TOTAL	**99.5**	**TOTAL**	**99.5**

Source: (EIA, 2015e)

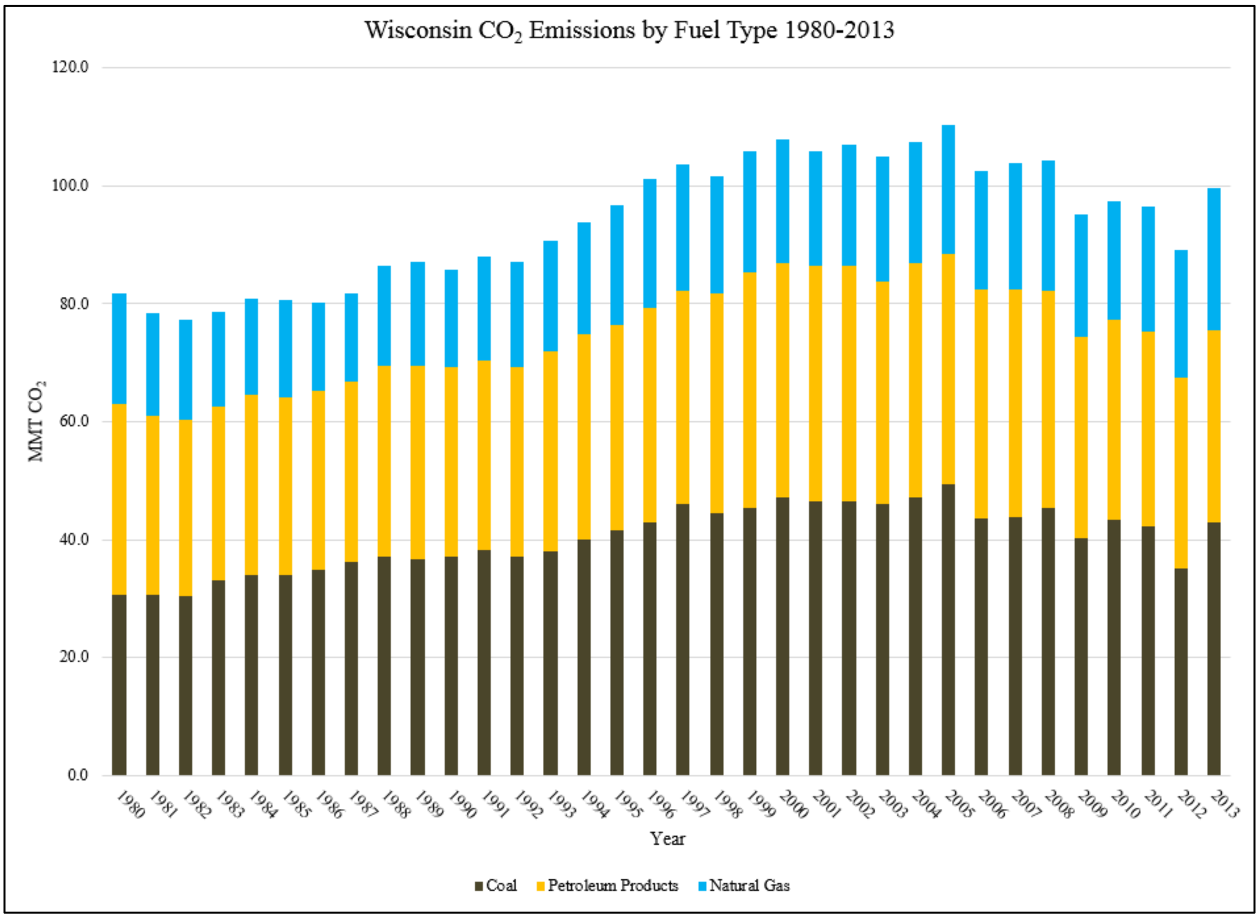


Figure 17.1.14-1: Wisconsin CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015e)

The Wisconsin IDNR commissioned the World Resources Institute in 2007 to prepare a state-level GHG emissions inventory (DNR, 2007b). The majority of Wisconsin's GHG emissions is CO_2. These emissions are the result of fossil fuel combustion for the purpose of producing energy, mostly petroleum products from electric power generating facilities and coal-fired power plants. Other major GHGs emitted in Wisconsin are CH_4, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF_6) and perfluorocarbons (PFCs) (DNR, 2007b). The report includes an estimate of 2003 GHG emissions for the state by sector and GHG. In 2003, Wisconsin emitted 123.1 MMT CO2e, or 23 MT per person, and 1.8% of the estimated U.S. total that year. Wisconsin was estimated to be the 21st-largest emitter among the 50 states. Of this amount, 105.5 MMT was CO_2, 9.1 MMT CO_2e was CH_4, and 6.3 MMT CO_2e was N_2O. Energy utilities were the largest overall emitter (DNR, 2007b).

The overall trend in Wisconsin's GHG emissions between 1990 and 2003 was a 16.3 percent increase, faster than the U.S. average, although since 2000, emissions had decreased. The report attributes major disturbances in the overall trend to an unusually warm winter in 1998-1999, and the economic recession that began in 2001 (DNR, 2007b).

A majority of Wisconsin's energy consumption is by heavy energy-consuming industries such as manufacturing machinery, metals, beer, and cheese (EIA, 2015g). Wisconsin's oil production sector is quite small. A majority of petroleum comes from the Lakehead Pipeline System and several other pipelines and is used in the transportation sector. Wisconsin does not produce coal or natural gas, instead coal is shipped from states along the Mississippi River and the Great Lakes and natural gas is supplied by pipeline from Oklahoma, Texas, Louisiana, Kansas and Canada (EIA, 2015g).

Previously, a portion of electricity used in Wisconsin came from the Kewaunee Nuclear Power Plant that shut down in May 2013. Since then, Wisconsin became a net importer. About three-fifths of electricity is now generated by coal. Because roughly two-thirds of homes use natural gas for heat homes during the long, snowy winters, a majority of natural gas is consumed from the residential and industrial sector. (EIA, 2015g)

17.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "reoccurring average weather found in any particular place" (NWS, 2011a). The widely-accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2011a). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly characteristics (NWS, 2011a).

The entirety of Wisconsin falls into climate group (D) (see Figure 17.1.14-2). Climates classified as (D) are "moist, continental, mid-latitudinal climates," with "warm to cool summers and cold winters" (NWS, 2011a). In (D) climates, the "average temperature of the warmest month is greater than 50 degrees Fahrenheit (°F), while the coldest month is less than negative 22 °F" (NWS, 2011a). Winter months in (D) climate zones are cold and severe with "snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses" (NWS, 2011a). Wisconsin has two sub-climate categories, which are described in the following paragraphs.

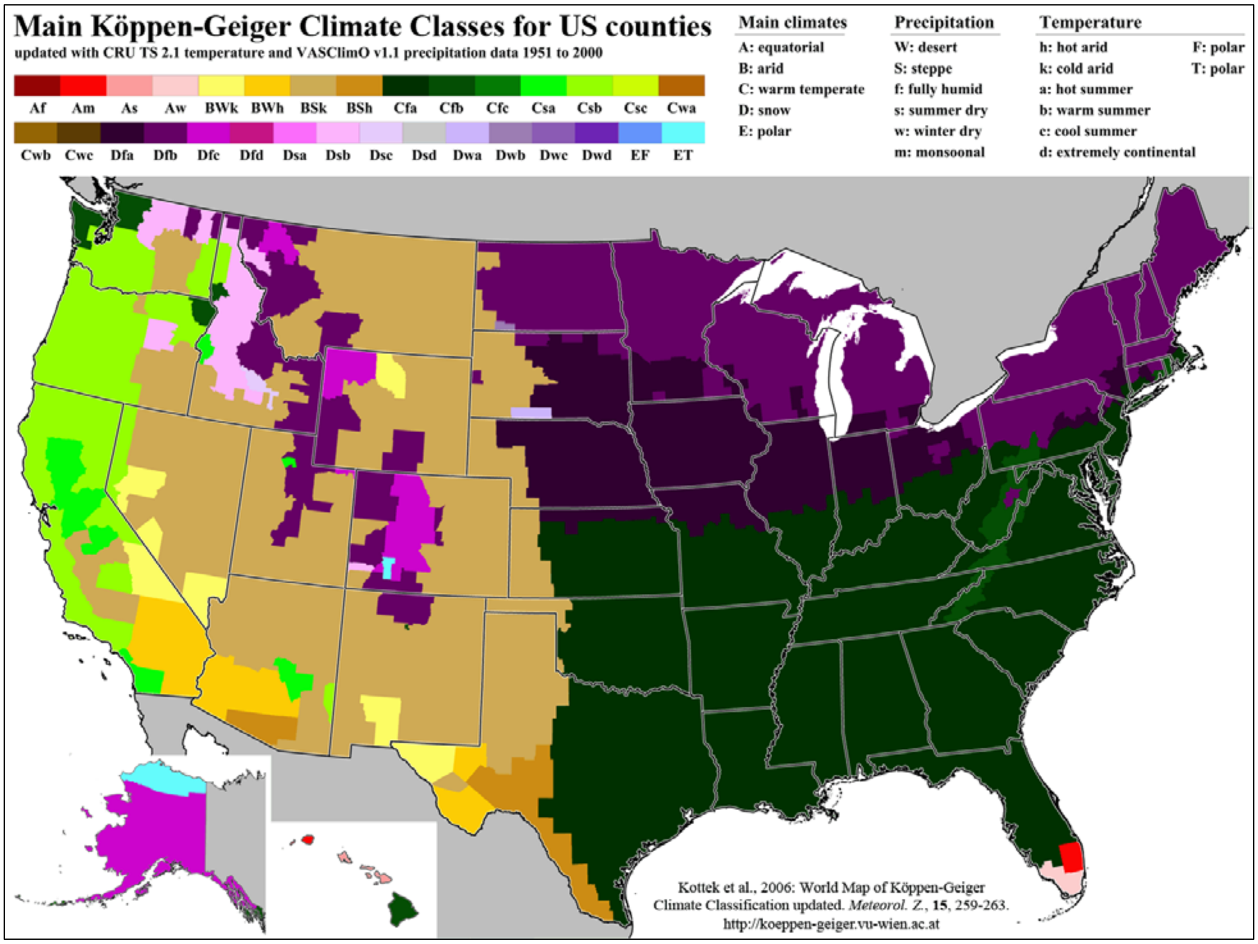


Figure 17.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Dfa – The Köppen-Geiger climate classification system classifies confined regions of southern Wisconsin as Dfa. Climates classified as Dfa are generally warm, with humid temperatures, hot summers, snowy winters, and precipitation year-round. The secondary climate classification in this zone (f) indicates substantial precipitation during all seasons. The tertiary climate classification in this zone (a) indicates hot summer months. (NWS, 2011a) (NWS, 2011b)

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

17.1.15. Human Health and Safety

17.1.15.1. Definition of the Resource

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the deployment, operation, and maintenance of towers, antennas, cables, utilities, and other equipment and infrastructure at existing and potential FirstNet telecommunication sites. There are two human populations of interest within the existing environment of health and safety, (1) telecommunication occupational workers and (2) the general public near telecommunication sites. Each of these populations could experience different degrees of exposure to hazards as a result of their relative access to FirstNet telecommunication sites and their function throughout the deployment of the FirstNet telecommunication network infrastructure.

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and manmade or natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency (RF) radiation or vehicle traffic. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 17.1.1, Infrastructure.

17.1.15.2. Specific Regulatory Considerations

Federal organizations, such as OSHA, USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Wisconsin, this resource area is regulated by the Wisconsin Department of Workforce Development (WDWD), the DNR, and the Wisconsin Department of Health Services (WDHS), Division of Public Health, Bureau of Environmental and Occupational Health (BEOH). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Wisconsin does not have an OSHA-approved "State Plan." Therefore, private and public sector occupational safety and health programs in Wisconsin are enforced by OSHA. Environmental compliance and cleanup requirements are, as well as mine lands are administered by DNR. Occupational and public safety regarding environmental health are regulated by BEOH.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations. Table 17.1.15-1 below summarizes the major Wisconsin laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 17.1.15-1: Relevant Wisconsin Human Health and Safety Laws and Regulations

State Law and Regulation	Regulatory Agency	Applicability
Wisconsin Administrative Code (WAC): Natural Resources (NR), Chapters NR 100-860	DNR	Identifies requirements for the prevention and control of environmental contamination at major facilities, including transportation facilities and hazardous waste generators.
Wisconsin Statutes: Section 101.58-101.595	Wisconsin Department of Workforce Development (WDWD)	Identifies requirements and protections for worker and community right to know, communication of chemical hazards, and non-retaliatory provisions for filing claims.

17.1.15.3. Environmental Setting: Existing Telecommunication Sites

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

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

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes[150] are examples of when trenching or confined space work is necessary. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width) would occur. Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics.

Heavy equipment and machinery – New and replacement facility deployment and maintenance can involve the use of heavy equipment and machinery. During the lifecycle of a

[150] 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.

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

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

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

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 17.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area.

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

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

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

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, 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 3,450 telecommunication equipment installers and repairers, and 710 telecommunication line installers and repairers (Figure 17.1.15-1) working in Wisconsin (Bureau of Labor Statistics, 2015c). In 2013, the most recent year data are available, Wisconsin had 3.1 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (Bureau of Labor Statistics, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (Bureau of Labor Statistics, 2013b).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; and 7 due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (Bureau of Labor Statistics, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Wisconsin has not had any fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available. In the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 73 fatalities in Wisconsin between 2003 and 2014, with the highest fatality years being 2011 and 2013, with 9 fatalities each of those years (Bureau of Labor Statistics, 2015d).

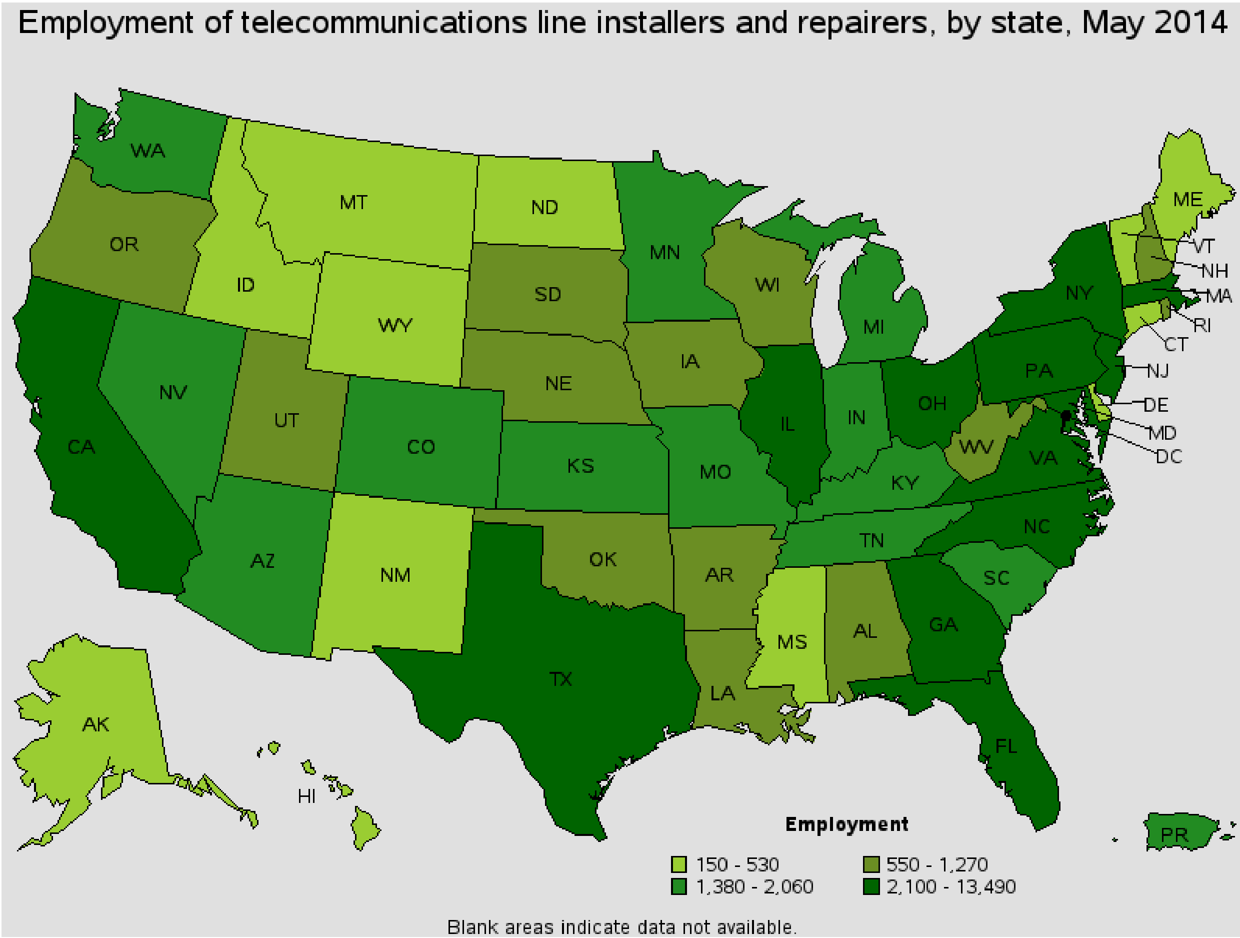


Figure 17.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (Bureau of Labor Statistics, 2015e)

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. The WDHS Division of Public Health collects injury surveillance and fatality data among the general public through the Wisconsin Interactive Statistics on Health (WISH). While WISH cannot be searched for cases specific to telecommunication sites, there are available injury categories consistent with risks present at telecommunication sites. For example, between 2000 and 2013, there were 12,310 deaths from falls in the Wisconsin (Centers for Disease Control and Prevention, 2015a). Other potential injury and death risks, such as being caught between objects, or electrocution are not individually reported. Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

Environmental Setting: Contaminated Properties at or near Telecommunication Sites

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

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[151] 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.

Wisconsin's Superfund program is overseen by the Remediation and Redevelopment Program, managed by the WNDR (DNR, 2015bd). As of September 2015, Wisconsin had 126 RCRA Corrective Action sites,[152] 653 brownfield sites, and 39 proposed or final Superfund/NPL sites (USEPA, 2015h). Based on a October 2015 search of USEPA's Cleanups in My Community (CIMC) database, two Superfund sites still exist in Wisconsin where contamination has been detected at an unsafe level, or a reasonable human exposure risk exists (Fox River, near Green Bay, WI; and Sheboygan Harbor & River, near Sheboygan, WI) (USEPA, 2015i).

Brownfield sites in Wisconsin are offered a variety of financial and liability tools available through the DNR Remediation and Restoration program for site cleanup (DNR, 2014g). One example of a brownfield site is the 30th Street Industrial Corridor in Madison, WI. The site consists of 50 former industrial properties, stretching 5 miles north and south of Madison, WI. DNR worked with USEPA to complete Phase I and Phase II site assessments for the properties establishing the first step in working toward redevelopment of a neglected portion of the city (DNR, 2012g).

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling

[151] 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)

[152] Data gathered using USEPA's CIMC search on October 27, 2015, for all sites in Wisconsin, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (NPS, 2004).

facilities). As of October 2015, Wisconsin had 872 TRI reporting facilities. According to the USEPA, in 2013, the most recent data available, Wisconsin released 36.2 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases. This accounted for 0.88 percent of nationwide TRI releases, ranking Wisconsin 33 of 56 U.S. states and territories based on total releases per square mile (USEPA, 2015j).

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 October 15, 2015, Wisconsin had 120 NPDES permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015k).

The National Institute of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to "visually explore data from the USEPA's TRI and Superfund Program" (National Institute of Health, 2015). Figure 17.1.15-2 provides an overview of potentially hazardous sites in Wisconsin.

In addition to hazardous waste contamination, another health and safety hazard includes surface and subterranean mines. Health and safety hazards known to be present at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015a). Gradual settling or sudden sinking of the Earth's surface, also known as subsidence, presents additional risks and is further discussed in Section 17.1.3, Geology. In 2014, the Wisconsin mining industry ranked 5th for non-fuel minerals (primarily sand and gravel, stone, and lime) generating a value of $3.6B (USGS, 2016a). According to DNR, 200 acres have been affected by mining activities statewide (Federal Mining Dialogue, 2015b). As of May 2015, there were no high priority AMLs (sites posing health and safety hazards) in Wisconsin (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015).

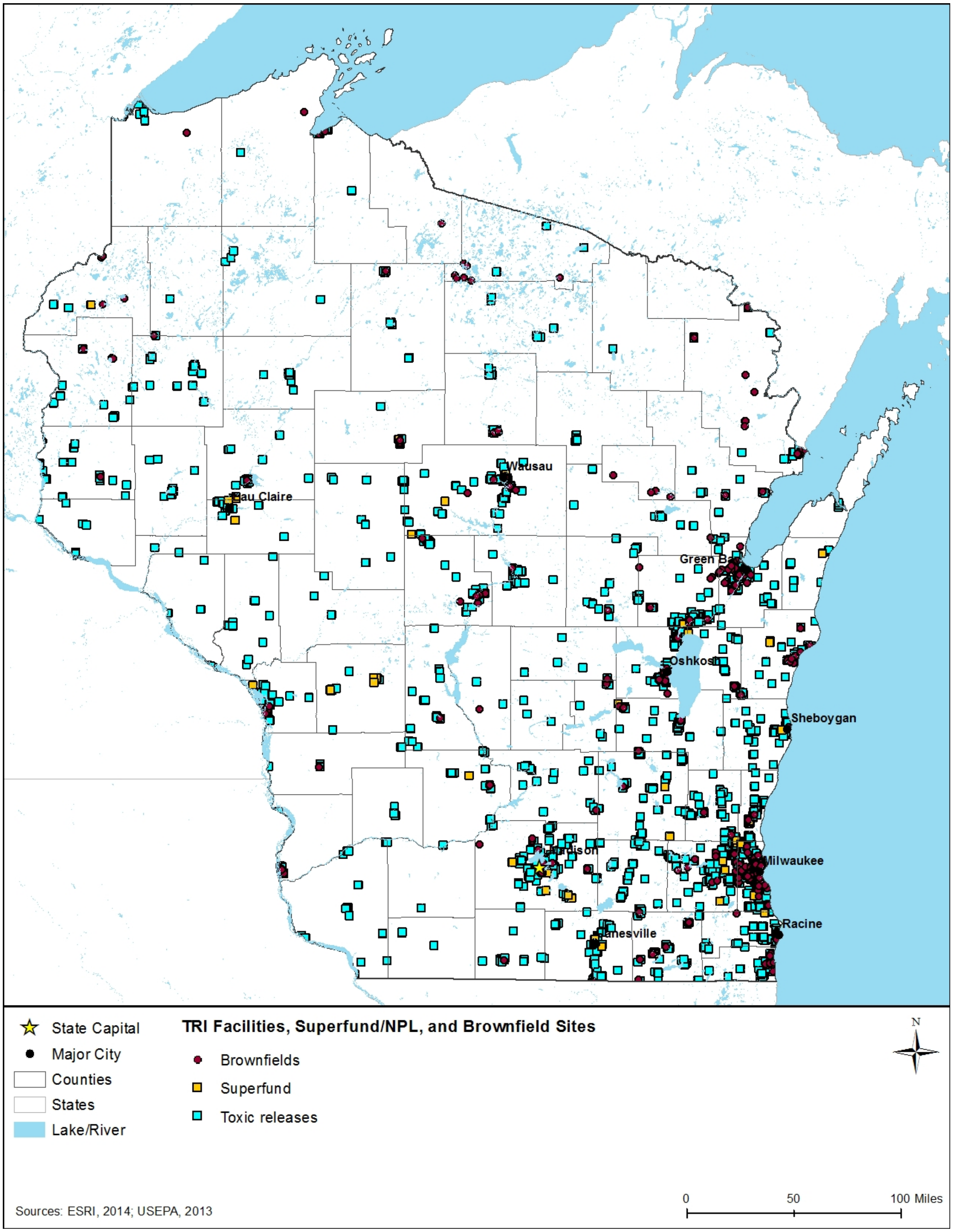


Figure 17.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Wisconsin (2013)

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may 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 four USEPA-regulated telecommunications sites in Wisconsin (USEPA, 2015l). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS, Wisconsin had three occupational fatalities each in 2003 and 2011 within the installation, maintenance, and repair occupations (SOC code 49-0000) from exposure to "harmful substances or environments," although these were not specific to telecommunications (Bureau of Labor Statistics, 2015d). By comparison, the BLS reported three fatalities in 2011 and three fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments. (Bureau of Labor Statistics, 2015f). In 2014, BLS also reported four fatalities within the telecommunications line installers and repairers occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (Bureau of Labor Statistics, 2014).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors.

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. The Wisconsin Department of Health and Family Services partners with the federal Agency for Toxic Substance and Disease Registry (ATSDR) and USEPA to provide public 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 available through the ATSDR website (Centers for Disease Control and Prevention, 2015b). In 2011, the most recent year data are available, Wisconsin reported 238 acute toxic substance release incidents, at a rate of one injury or fatality due to reported releases per 100,000 population (Centers for Disease Control and Prevention, 2015c).

Spotlight on Wisconsin Superfund Sites: Lemberger Transport and Recycling

The 16-acre Lemberger Transport and Recycling site in Franklin Township, WI (Manitowoc County) operated as an unlined landfill from 1970 until 1976, and received industrial waste such as tar, paint sludge, PCBs, and aluminum dust. USEPA added the site to the NPL in 1984 after finding groundwater contamination from volatile organic compounds (VOCs) extending 1.5 miles from the site, and affecting a number of residential wells in the area.

Site cleanup began in 1985 when DNR installed seven deep replacement wells (250 feet below ground surface) for residential drinking water. Following the installation of the new drinking water wells, USEPA conducted a Remedial Investigation/Feasibility Study (RI/FS) from 1987 through 1993 to determine the nature and extent of contamination at the site, and to identify cleanup alternatives. (USEPA, 2014f)

In 1992, Lemberger Transport and Recycling entered into a consent decree with USEPA to implement cleanup actions, including a groundwater pump-and-treat system (Figure 17.1.15-3), drum removal, soil capping with a vapor extraction system, site perimeter fencing, and other land use controls. By 1994, more than 1,380 drums and 180 jars of waste had been excavated and disposed. In 1995 and 1996, the pump-and-treat system and site cover were installed, with the pump-and-treat system operating until August 2006. Despite cleanup efforts, numerous chemical exposure risks are still present at the site including petroleum hydrocarbons, VOCs, and metals. Exposure risks (including to telecommunications workers) are present in future industrial development at or near the site through ingestion and dermal contact with groundwater and soil, or inhalation of dust. (USEPA, 2014f)

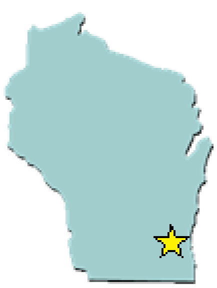


Figure 17.1.15-3 Example of a Groundwater Pump-and-Treat System

Source: (National Science Foundation, 2015)

17.1.15.4. Environmental Setting: Natural & Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the public. Telecommunications, including public safety communications, can be unavailable (temporarily or permanently) during disaster events (Bureau of Labor Statistics, 2015g). Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). Hazardous chemicals and sanitary wastes often contaminate floodwaters, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003).

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

Telecommunication Worker Occupational Health and Safety

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

Currently, the WDWD 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 117 NRC-reported incidents for Wisconsin in 2015 with known causes, all were attributed to manmade disasters (primarily equipment failure and operator error) (U.S. Coast Guard, 2015). For example, in April 2015, a mechanical soil auger struck an underground natural gas pipeline during a monitoring well installation, causing an explosion that caught the auger and nearby pick-up truck on fire in downtown Medford, WI (U.S. Coast Guard, 2015). Such incidents present unique, hazardous challenges to telecommunication workers responding during manmade and natural 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, Wisconsin reported 15 weather-related fatalities (10 due to cold temperatures, 2 due to wind, and 3 of unknown causes) and 8 non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (National Weather Service, 2015).

Spotlight on Wisconsin Natural Disaster Site: Severe Winter Storm and Snowstorm

Between January 31, 2011, and February 3, 2011, a severe winter storm caused extreme statewide snowfall in Wisconsin (Figure 17.1.15-4). Nationwide, the winter storm affected 100 million Americans as it moved from the southwest United States and across the upper Midwest. The heavy snow and ice accumulation downed trees and caused widespread power and utility outages. The deep snow hindered recovery and support services, including first responder deployment. Wisconsin governor, Scott Walker declared a state of emergency to assess and rebuild the estimated $8.14M in damages. (NPS, 2011b)

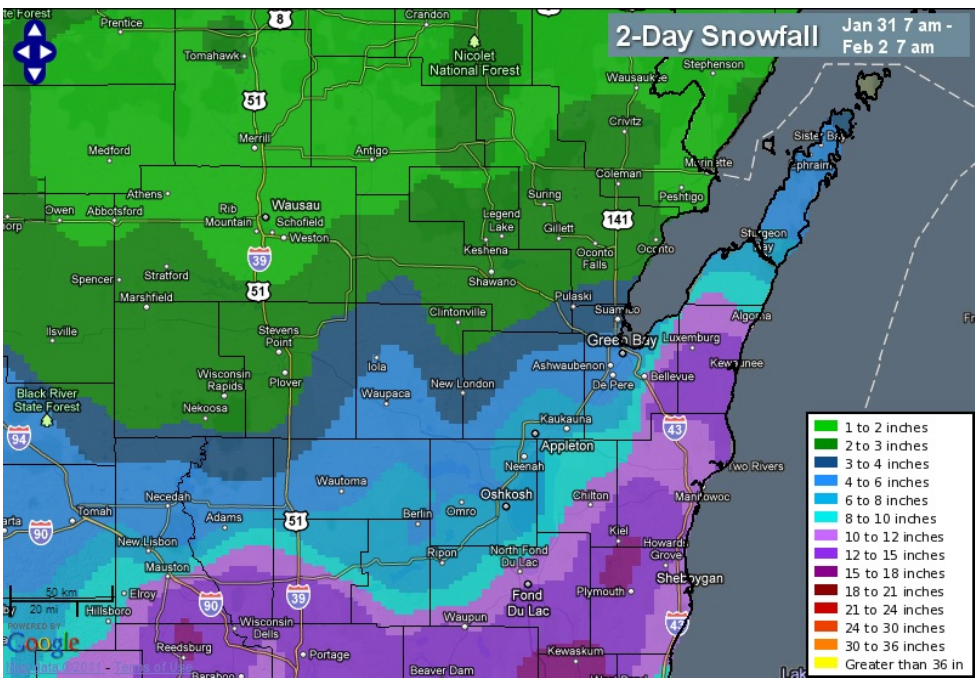


Figure 17.1.15-4 Wisconsin Snowfall Accumulation during 2011 Winter Storm

Source: (NPS, 2012d)

17.2. ENVIRONMENTAL CONSEQUENCES

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

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

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

17.2.1. Infrastructure

17.2.1.1. Introduction

This section describes potential impacts to infrastructure in Wisconsin associated with construction, deployment, and operation of the Proposed Action and alternatives. Chapter 19, Best Management Practices 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.

17.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 17.2.1-1. 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 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.

17.2.1.3. 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., Wisconsin Department of Roads, airport authorities, and railway companies) to ensure proper coordination during deployment.

Based on the impact significance criteria presented in Table 17.2.1-1, 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.

Table 17.2.1-1: Impact Significance Rating Criteria for Infrastructure

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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	local/city, county/region, or state/territory.		local/city, county/region, or state/territory.	local/city, county/region, or state/territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is potentially significant, but with mitigation is less than significant.	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	local/city, county/region, or state/territory.		local/city, county/region, or state/territory.	local/city, county/region, or state/territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system (“brownouts”). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is potentially significant, but with mitigation is less than significant.	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	local/city, county/region, or state/territory.		local/city, county/region, or state/territory.	local/city, county/region, or state/territory.
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

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

The capacity of local health, public safety, and emergency response services would experience less than significant impacts during deployment or operation phases. During deployment and system optimization, existing services would remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare – and that is if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of first responders through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 17.2.1-1, potential negative impacts would be less than significant. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 17.2.1-1, any potential impacts would be less than significant during deployment. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of the deployment activities.

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

Commercial telecommunication systems, communications, or level of service would experience no impacts, as such commercial assets would likely be using a different spectrum for communications. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.[153] Anticipated impacts would be less than significant due to the limited extent and temporary nature of the deployment.Commercial telecommunication systems, communications, or level of service are anticipated to be less than significant, per the impact significance criteria presented in Table 17.2.1-1.

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

The Wisconsin PSC regulates private investor-owned public utilities such as electric, water, and sewage companies. 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 exact project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

17.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit

[153] 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.

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 on infrastructure resources.

Activities with the Potential to Have Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase, however, it is anticipated that this tie-in would cause less than significant impacts as the activity would be temporary and minor.

- New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing telecommunications poles.
- Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to infrastructure resources as mentioned above, installation of new associated huts or equipment, if required, could impact infrastructure resources, depending on the exact siting of such installation activities.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that 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. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site specific plans.

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

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

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the above mentioned 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.

17.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[154]

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.

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to 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 to avoid any negative impacts to such resources. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. 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 of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure from development as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 17.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

17.2.2. Soils

17.2.2.1. Introduction

This section describes potential impacts to soil resources in Wisconsin 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.

17.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 17.2.2-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.2-1: 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

17.2.2.3. 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 Wisconsin 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). Soils with medium to high erosion potential in Wisconsin include those in the Aqualfs, Aquents, Aquepts, Aquods, Aquolls, Fluvents, Hemists, Orthents, Orthods, Psamments, Saprists, Udalfs, Udepts, and Udolls suborders, which are found throughout the state (see Section 17.1.2.6, Soil Erosion and Figure 17.1.2-2).

Based on the impact significance criteria presented in Table 17.2.2-1, building of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades. Furthermore, deployment sites that are large-scale or adjacent to other construction sites (i.e., cumulatively large-scale sites) could result in long-term erosion that might not be reversed for several years.

To the extent practicable, FirstNet would 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 (see Chapter 19) to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind.

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 17.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet project sites, , minimal topsoil mixing is anticipated. Potential impacts could be further minimized by implementing BMPs and Mitigation Measures (see Chapter 19).

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 17.1.2.4, Soil Suborders). Soils with the highest potential for compaction and rutting in Wisconsin include those in the Aqualfs, Aquents, Aquepts, Aquods, Aquolls, Hemists, and Saprists suborders (Figure 17.1.2-2). These soils are constitute approximately 17.41 percent of Wisconsin's land area. 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 17.2.2-1, 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).

17.2.2.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and POP structures and would not impact soil resources because it would not produce perceptible changes to soil resources.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, with no impacts to soil resources. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, would not impact soil resources because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have no impact on soil resources.

Activities with the Potential to Have Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
  - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
  - New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in or near bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy

equipment use during these activities depending on the duration of the construction activity.

- o 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 points of presence 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
  - o 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.
  - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures are needed they may require ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
  - o Deployable Technologies: Implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas. Where technologies such as COWs, COLTs, and SOWs are deployed on existing paved surfaces, there would be no impacts to soil resources because there would be no ground disturbance.

In general, the above mentioned 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, discusses 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 above mentioned 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 because there would be no ground disturbance. 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.2.5. 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, discusses 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 the deployable assets, assuming that the same access roads used for deployment are also used for inspections as the activity would likely be short term and localized to the deployment locations. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, less than significant soil compaction and rutting impacts could result as previously explained above. Finally, if deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in minimal soil erosion. However, it is anticipated that the potential soil erosion would result in less than significant impacts as described above. Chapter 19, BMPs and Mitigation Measures, discusses 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 17.1.2, Soils.

17.2.3. Geology

17.2.3.1. Introduction

This section describes potential impacts to Wisconsin geology resources associated with deployment and operation of the Proposed Action and alternatives. 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.

17.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 17.2.3-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.3-1: 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
Potential Paleontological	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.

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

NA = Not Applicable

17.2.3.3. 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 and landslides, 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

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 17.1.3.8, Wisconsin is not at risk to significant earthquake events. As shown in Figure 17.1.3-4, areas of greatest seismicity in Wisconsin are concentrated in the southern portions of the state, including Racine. Based on the impact significance criteria presented in Table 17.2.3-1, 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 zones with higher risks for earthquakes. Given the potential for minor earthquakes in or near Wisconsin, 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 Wisconsin, as they do not occur in Wisconsin; therefore, volcanoes do not present a hazard to the state.

Landslides

Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 17.1.3.8, portions of Wisconsin are highly susceptible to, or demonstrate high incidence of, landslides. Based on the impact significance criteria presented in Table 17.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have less than significant impacts as it is likely that the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas in which landslides are highly prevalent. Anthropogenic[155] disturbances to the landscape, snow melt, or heavy precipitation events increase the likelihood of landslide events in Wisconsin. Where infrastructure is subject to landslide hazards, BMPs and mitigation measures, as discussed in Chapter 19, could help avoid or minimize the potential impacts.

[155] 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, 2016f).

Land Subsidence

As discussed in Section 17.1.3.8, portions of Wisconsin are vulnerable to land subsidence due primarily to karst topography. Based on the impact significance criteria presented in Table 17.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have less than significant impacts; however, subsidence impacts to the Proposed Action could be potentially significant to the Proposed Action if FirstNet's deployment locations were within areas at high risk to karst topography or located in mining areas. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography is subject to misalignment, alteration, or, in extreme cases, destruction. 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 land subsidence, BMPs and mitigation measures, as discussed in Chapter 19, could help avoid or minimize the potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

There are no fossil fuel resource production sites in Wisconsin. Equipment deployment near mineral resources is 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 17.2.3-1, impacts to mineral 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 resources. To the extent practicable, FirstNet would likely avoid construction in areas where these resources exist. 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 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 17.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 17.1.3.6., marine fossils are found throughout the state in with an abundance found in the Green River Formation (State of Wisconsin 2015a). 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 17.2.3-1, impacts could be potentially significant if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and less than significant, as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures (see Chapter 19) could be implemented to help avoid or minimize the potential impacts.

17.2.3.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

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

vehicle would be very unlikely to impact geologic resources, it is anticipated that this activity would have no impact on geologic resources.

Activities with the Potential to Have Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water is not expected to impact geologic 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 the on-site delivery of additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. Where deployable technologies would be implemented on existing paved surfaces, there would be no impacts to/from geologic resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: In most cases, the installation of permanent equipment on existing structures, 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 above mentioned 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. Due to their small-scale nature, these potential impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures, discusses 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 above mentioned 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 because there would be no ground disturbance associated with those activities.

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

17.2.3.5. Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be less than significant due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative as deployment would be temporary and no ground disturbance would be associated with routine maintenance and inspections.

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 were subject to increased seismic activity, landslides, and land subsidence. Chapter 19, BMPs and Mitigation Measures, discusses 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 17.1.3, Geology.

17.2.4. Water Resources

17.2.4.1. Introduction

This section describes potential impacts to water resources in Wisconsin 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.

17.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 17.2.4-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.4-1: 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	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Floodplain degradation*	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with mitigation is less than significant.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		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

17.2.4.3. 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 1703(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.

Almost all of Wisconsin's assessed rivers, streams, lakes, reservoirs, and ponds meet their designated uses and are in good condition. Designated uses include agriculture water supply, and aquatic life (USFWS, 2015b). Groundwater quality within the state is generally good for most domestic uses (USEPA, 2016c).

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 DNR Construction Site Storm Water Runoff General Permit would be required. As part of the permit application, erosion control and stormwater management plans would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the state water quality standards 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. (DNR, 2016h)

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, and Safe Drinking Water Act), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 17.2.4-1, water quality impacts would likely be less than significant, and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. Groundwater contamination may exist in areas directly within or near the project area. If trenching[156] 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 Wisconsin dewatering requirements. Any groundwater extracted during dewatering activities or as required by a dewatering permit would be treated prior to discharge or disposed of at a wastewater treatment facility.

There is little potential for groundwater contamination within a watershed or multiple watersheds. As a result, it is unlikely that the majority of FirstNet's deployment locations would substantially degrade groundwater quality or aquifer. Thus, based on the impact significance criteria presented in Table 17.2.4-1, there would likely be less than significant impacts on groundwater quality within most of the state. In areas where groundwater is close to the surface, then site-specific analysis, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on humans, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 17.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would occur inside the 500-year floodplain, would use minimal fill, would not substantially increase impervious surfaces, 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, [157] or occur only during an emergency.

Examples of activities that would have less than significant impacts include:

[156] 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).
[157] A water year is defined as "the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months" (USGS, 2016c).

- Construction of any structure in the 500-year floodplain that 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 could further reduce the risk of impacts to floodplain degradation (see Chapter 19).

Drainage Pattern Alteration

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

According to the significance criteria in Table 17.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered less than significant.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Activities designed so that stormwater is contained on site and does not flow to or impact surface waterbodies offsite on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term, therefore impacts to drainage patterns would be less than significant. BMPs, mitigation measures, and avoidance could be implemented to further reduce any 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 the discharge or stage of a waterbody (stream height) are not anticipated to have an impact on flow, according to Table 17.2.4-1. 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 projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed 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 17.1.4.7, approximately 70 percent of Wisconsin residents use groundwater for their drinking water. Generally, the water quality of Wisconsin’s aquifers is suitable for drinking and daily water needs (Moody, Carr, Chase, & Paulson, 1986). 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, as practicable and feasible, be considered to avoid areas that would extract groundwater from potable groundwater sources in the area. 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.

17.2.4.4. 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, Proposed Action Infrastructure, the following are likely to have no impacts to water resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to water resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to water resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance.

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

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment would be required to shoreline environments prior to installation to fully assess potential impacts to lake or river coastal environments.
    - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids; groundwater impacts from trenching activities are not expected. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
    - Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance that could cause impacts to water quality from increased suspended solids.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected,

installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to water resources. However, if the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance, impacts to water resources could occur, including increased suspended solids leading to impaired water quality and impacts to groundwater from excavation.
  - Deployable Technologies: Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could further reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be no impacts to water resources because there would be no ground disturbance.
  - Deployment of drones, balloons, blimps, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters. In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; installation of security/safety lighting and fencing; and

deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure could include water quality impacts, but are expected to be less than significant. See Chapter 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.

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 existing roads and utility rights-of-way. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.4.5. 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 if there is any runoff into the surface water. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. 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. Chapter 19, BMPs and Mitigation Measures, discusses 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 vary, depending 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 because there would be no ground disturbance. 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 as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 17.1.4, Water Resources.

17.2.5. Wetlands

17.2.5.1. Introduction

This section describes potential impacts to wetlands in Wisconsin 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.

17.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 17.2.4-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.5-1: 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 1704 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Indirect Effects: [2] Change in Function(s)[3] Change in Wetland Type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[1] "Magnitude" is defined based on the type of wetland impacted, using USACE wetland categories (USACE 2014). Category 1 are the highest quality, highest functioning wetlands

[2] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type

[3] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

NA = Not Applicable

17.2.5.3. 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 small amount of land disturbance associated with the likely proposed individual sites (generally less than an acre) and any temporary loss may be reversed with revegetation. 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).

In Wisconsin, palustrine (freshwater) wetlands found on river and lake floodplains across the state are the main type of wetlands, as shown in Figure 17.1.5-1 and Table 17.1.5-2. Wisconsin has over 5,000,000 acres of palustrine wetlands alone (USFWS, 2015b), as shown in Table 17.1.5-2.

Based on the impact significance criteria presented in Table 17.2.5 1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, the deployment activities would not violate applicable federal, state, and local regulations. In Iowa, as discussed in Section 17.1.5.4, Wetlands, there are no regulated high quality wetlands.

As discussed in Wetlands, Section 17.1.5.4, wetlands of special concern include ridge and swale complexes, and the Lake Superior NERR. If any of the proposed deployment activities were to occur in these high quality wetlands, potentially significant impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would be required, in addition to BMPs and mitigation measures to avoid potentially significant impacts to wetlands. BMPs and mitigation measures could be implemented to reduce and avoidance could help mitigate potentially significant impacts.

Potential Other Direct Effects

Other 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, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through mechanical or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 17.2.4-1, construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) could cause potentially significant impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds could be potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with likely proposed individual sites (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of activities that could have other direct effects to wetlands in Wisconsin include:

- Vegetation Clearing: removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- Ground Disturbance: Increased amounts of stormwater runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- Direct Hydrologic Changes (flooding or draining): Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- Direct Soil Changes: Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameters.
- Water Quality Degradation (spills or sedimentation): The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[158] Change in Function(s)[159] or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to both high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of functions related to wetlands in Wisconsin that could potentially be impacted from construction-related deployment activities include:

- Flood Attenuation: Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they could lower flood peaks by providing detention of storm flows.
- Bank Stabilization: By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- Water Quality: Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- Nutrient Processing: Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- Wildlife Habitat: Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding can harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- 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 17.2.4-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that

[158] 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.
[159] 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.

are already impaired or impacted by human activity), would be considered potentially less than significant. Since the majority of wetlands in Wisconsin 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.

17.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations could be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.

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

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and/or indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal environments.
  - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near

wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, or blimps, piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands. Implementing BMPs and mitigation measures (see Chapter 19) could reduce impact intensity.

In general, the above mentioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. 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 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, discusses 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 above mentioned construction impacts. It is anticipated that there could be ongoing other potential direct impacts to wetlands if heavy equipment is used for routine operations and maintenance application of herbicides occurs to control vegetation along all ROWs and near structures, depending on the proximity to wetlands. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are not expected to be significant due to the limited nature of deployment activities, as it is anticipated that such herbicide applications would be intermittent and use a minimal amount of herbicides. It is also anticipated that routine maintenance activities would be conducted on existing roads and utility ROW. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.5.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and/or indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be less than significant due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, discusses 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 above mentioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

It is anticipated that there would be less than significant impacts to wetlands associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility rights-of-way would be utilized for maintenance and inspection activities. Site maintenance, including mowing or herbicides, is anticipated to result in less than significant effects to wetlands, depending on the proximity to, wetland type, and amount of herbicides used, due to the limited nature of site maintenance activities, including mowing and application of herbicides. Chapter 19, BMPs and Mitigation Measures provides a listing of 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 17.1.5, Wetlands.

17.2.6.Biological Resources

17.2.6.1. Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Wisconsin associated with deployment and operation of the Proposed Action and its 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.

17.2.6.2. 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 17.2.6-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 17.2.6.3, 17.2.6.4, and 17.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 17.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Wisconsin.

Table 17.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury /mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods Violation of various regulations including: MBTA and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Wisconsin for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Wisconsin for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Wisconsin for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Wisconsin for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Wisconsin for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Wisconsin.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

NA = Not Applicable

17.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Wisconsin 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. 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. Based on the impact significance criteria presented in Table 4.2.6-1, significant direct injury or mortality impacts would only occur if potentially significant population-level or sub-population effects if they are observed for at least one species depending on the distribution and the management of the subject species. This includes large scale mortality or injury events that may impact sensitive endemic species. Large-scale mortality or injury events are not likely to occur. 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.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. Areas near Madison, Green Bay, and Milwaukee, have experienced land use changes from urbanization. However, a large portion of the state remains relatively unfragmented.

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. 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.

Indirect Injury/Mortality

"Indirect effects" are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality can include stress related to disturbance. The alteration of soils or hydrology within a localized area 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. 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.

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. The Wisconsin Invasive Species Identification, Classification, and Control Rule, or "Invasive Species Rule" (NR 40) stipulates that it is illegal to possess, transport, transfer, or introduce certain invasive species in Wisconsin without a permit (DNR, 2015be). The Invasive Species Rule covers over 128 species (DNR, 2015bf).

When non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. Natural or native community species evolve together into an ecosystem with many checks and balances that limit the population growth of any one species. These checks and balances include such things as: predators, herbivores, diseases, parasites, and other organisms competing for the same resources and limiting environmental factors. However, when an organism is introduced into an ecosystem in which it did not evolve naturally, those limits may not exist and its numbers could sometimes dramatically increase. The unnaturally large population numbers could then have severe impacts to the environment, local economy, and human health. Invasive species could out-compete the native species for food and habitats and sometimes even cause their extinction. Three plant species occur on the Federal Noxious Weed List within Wisconsin: Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), and multiflora rose (*Rosa multiflora*) (USDA, 2014a). Even if natives are not completely eliminated, the ecosystem often becomes much less diverse (USFWS, 2012f).

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. 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 Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, the same type of Proposed Action infrastructure could result in a range impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology,[160] and the nature as well as the extent of the habitats affected.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to terrestrial vegetation because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch

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

vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on terrestrial vegetation.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects if BMPs and mitigation measures are not implemented.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects, if BMPs and mitigation measures are not implemented.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cables 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 launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the above mentioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. These impacts are expected to be less than significant due to the small scale of expected deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of 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 above mentioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be no 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.[161]

Deployable Technologies Alternative

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

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

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 could vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 17.1.6.3, Terrestrial Vegetation.

17.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Wisconsin (i.e., less than two miles from the edge of the coast) are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 17.2.6-1, less than significant impacts would be anticipated given the anticipated small size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Wisconsin. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, preferred vegetation along roadways, areas of insect relief, and ease of travel along road corridors (FHWA, 2015d). Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur.

Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

If bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small and would be dependent on the location and type of deployment activity, and tree removal. Site avoidance measures could be implemented to help avoid disturbance to bats. 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.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and could violate MBTA and BGEPA. Generally, collision events occur to night-migrating birds, "poor" fliers (e.g., ducks), 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 nesting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997). Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small scale of likely FirstNet actions.

Direct mortality and injury to birds of Wisconsin 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. 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.

Reptiles and Amphibians

Very few species of reptiles and amphibians are widespread throughout Wisconsin, and are instead more commonly found in areas near bodies of water, along sandy banks or open sandy soils, and within ponds and wetland areas, as turtles, frogs, and salamanders are attracted to these types of habitats. 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. 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.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Wisconsin are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat, and impeding access to resources and mates. Areas near Madison, Green Bay, and Milwaukee, have experienced land use changes from urbanization. However, a large portion of the state remains relatively unfragmented.

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 Wisconsin's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Wisconsin and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bear, elk) 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, squirrels, beaver) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. 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.

Birds

The direct removal of migratory bird nests are prohibited under the MBTA. The USFWS and the Wisconsin DNR provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitat.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[162] 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). 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.

Reptiles and Amphibians

Important habitats for Wisconsin's amphibians and reptiles typically consist of wetlands and, in some cases the surrounding upland forest. Impacts are expected to be less than significant. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Filling or draining of wetland breeding habitat (see Section 17.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Wisconsin amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[163]

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

[162]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.
[163] See Chapter 19, Wetlands, for a discussion of BMPs for wetlands.

and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 17.2.6.6, 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. 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.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur result to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would be unlikely to occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would be unlikely to 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 Wisconsin's amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

Large game animals (e.g., elk) have well-defined migratory routes. Route knowledge is passed on from one generation to the next and includes important feeding and calving areas. Small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[164]

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, but are generally expected to be less than significant given the short-term nature and limited geographic scope for individual 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.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, as a group, shorebirds migrating through Wisconsin undertake some of the longest-distance migrations of all animals. Wisconsin is located within the Mississippi Flyway. The Mississippi Flyway covers the entire state of Wisconsin and spans from the coast of the Gulf of Mexico in the south to the Canadian border to the north. Wisconsin has 91 IBAs, which cover approximately 3.2 million acres are widely distributed throughout the state, although the largest concentration of IBAs are located in the central and north-central regions of the state, along river corridors and the Great Lakes shorelines (National Audubon Society, 2015). Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be less than significant given the short-term nature and limited geographic scope for individual 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.

Reptiles and Amphibians

Several species of mole salamanders and the wood frog are known to seasonally migrate in Wisconsin. These amphibians often travel by the hundreds on their migration pathway that often

[164] A location chosen by an animal for hibernation.

crosses roadways. Mole salamanders are typically found in burrows in the forest floor including forests with sandy soils (DNR, 2016i). Wood frogs use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, Atwood, Dunkle, & Karr, 2010). However, Berven and Grudzien (*1990*) found that a small percentage of juvenile wood frogs could migrate over 1.5 miles from natal ponds, suggesting juveniles may be capable of migrating relatively long distances. Mortality and barriers to movement could occur as a result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be less than significant given the short-term nature and limited geographic scope for individual 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.

<u>Terrestrial Invertebrates</u>

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Wisconsin'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.

<u>Terrestrial Mammals</u>

Restricted access to important winter hibernacula or summer maternity roosts for bats and calving grounds for large mammals, such as the elk, has the potential to negatively affect body condition and reproductive success of mammals in Wisconsin. For example, elk use certain types of habitats that allow for more effective defense of their calves from predators.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small scale and impacts are expected to be less than significant. 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.

<u>Birds</u>

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages. The majority of FirstNet deployment or operation activities are likely to be small scale in nature. 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.

Reptiles and Amphibians

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

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, alter water quality through sediment infiltration, or obstruction of natural water flow to pools. 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.

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. The Wisconsin Invasive Species Identification, Classification, and Control Rule, or “Invasive Species Rule” (NR 40) stipulates that it is illegal to possess, transport, transfer, or introduce certain invasive species in Wisconsin without a permit (WAC, 2015d). The Invasive Species Rule covers over 128 species (DNR, 2015bf).

FirstNet deployment activities or operations 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 Wisconsin’s wildlife are described below.

Terrestrial Mammals

In Wisconsin, feral pigs adversely impact several native large and small mammals, including turkey, waterfowl, and deer (DNR, 2005a). They compete for food with birds and mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans.

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. 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.

Birds

Invasive plant and pest species directly alter the landscape or habitat to a condition that is more favorable for an invasive species, and less favorable for native species and their habitats. For example, in Wisconsin, 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 water quality from increased fecal coliform loading in the water, and declines in submerged aquatic vegetation that support native fish and other wildlife (Swift, Clarke, Holevinski, & Cooper, 2013). Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites; these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities.

Reptiles and Amphibians

The red-eared slider (*Trachemys scripta elegans*) (a turtle species) is an invasive species in Wisconsin. This species is highly adaptable and could threaten native wildlife by competing for food sources and spread disease (USGS, 2015d). Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites as part of the deployment activities. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers.

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects in particular pose a large threat to forest and agricultural resources (USDA Forest Service, 2015). Species such as the gypsy moth, hemlock woolly adelgid, and emerald ash borer are of particular concern in Wisconsin and are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. 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 Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wildlife resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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 on wildlife resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g. reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects if BMPs and mitigation measures are not implemented.
    - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individual species as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
    - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife (see Section 17.2.4, Water Resources, for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality; habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical time periods, effects to migratory patterns as well as reproductive effects and indirect injury/ mortality could occur.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation;

effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and/or indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant given the small scale of likely individual FirstNet projects; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species’ phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews. 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. Site maintenance would be infrequent, including mowing or limited application of herbicides, may result in less than significant effects to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms.

Wildlife resources could be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and therefore would likely be less than significant given the short-term nature and limited geographic scope for individual 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 wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. 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 17.1.6.4, Terrestrial Wildlife.

17.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Wisconsin 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, 2012e).

Based on the impact significance criteria presented in Table 17.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although measurable but minimal for some FirstNet projects, individual behavior of fish species would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location, depending on the nature of the deployment activity. Additionally, deployment activities with the potential for impacts to sensitive aquatic habitats 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. These impacts are expected to be less than significant, and BMPs and mitigation measures to protect water resources (see Section 17.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts are expected to be less than significant, and are anticipated to be localized and at a small scale, and would vary depending on the species, time of year, and duration of deployment. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are expected to be less than significant. 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.

Invasive Species Effects

The potential to introduce invasive plants within construction zones could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet deployment activities could result in short-term or temporary changes to specific project sites although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers, therefore impacts are expected to be less than significant. 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 Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to fisheries would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to fisheries and aquatic habitats because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats if those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have no impact on the aquatic environment.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support

fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects if BMPs and mitigation measures are not implemented.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g. mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites (some fish). Disturbance, including noise, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats.

However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.
- Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less than significant due to the small scale of deployment activities and the limited number of aquatic species expected to be impacted. 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. Site maintenance near fish habitat may result in less than significant effects to fisheries and aquatic habitats, due to accidental spills from maintenance equipment or pesticide runoff.

Fisheries and aquatic habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. 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 associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts from habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant due to the limited nature of expected deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. The impacts could vary greatly among species and geographic region but they are still expected to remain less than significant. 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 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 17.1.6.5, Fisheries and Aquatic Habitats.

17.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Wisconsin's environment associated with deployment and operation of the Proposed Action and alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 17.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as may affect, likely to adversely affect; may affect, not likely to adversely affect; and no effect. Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 17.2.6-2: 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.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large-scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
	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 17.2.6-2, 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, invertebrates, and plants with known occurrence in Wisconsin are described below.

<u>Terrestrial Mammals</u>

Direct mortality or injury to the federally listed Northern long-eared bat (*Myotis septentrionalis*) could occur if tree clearing activities occurred during the roosting season (i.e., approximately April-November) and bats were present, and from collisions or electrocutions with manmade cables and wires, or vehicle strikes. Impacts would likely be isolated, individual events. While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around hibernacula when bats are present could lead to adverse effects to these species; when disturbed by noise or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 2015h).

The Canada lynx (*Lynx canadensis*), a federally threatened species, and gray wolf (*Canis lupus*), a federally endangered species, are both found in the northern regions of Wisconsin. Direct mortality or injury to the Canada lynx and gray wolf could occur from vehicle strikes as both species could be found along transportation corridors. Impacts would likely be isolated, individual events. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

Three federally listed birds are known to occur within the Great Lakes region of Wisconsin; they include the piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and Kirtland’s warbler (*Setophaga kirtlandii*). 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. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Fish

There are no federally listed fish found in Wisconsin. Therefore, no direct injury or mortality of federally threatened and endangered fish species is expected as a result of the Proposed Action.

Reptiles and Amphibian

There are no federally listed reptiles and amphibians found in Wisconsin. Therefore, no direct injury or mortality of federally threatened and endangered reptiles and amphibian species is expected as a result of the Proposed Action.

Invertebrates

There are eight endangered invertebrate species that are federally listed and known to occur in the state of Wisconsin; they include the Higgin's eye pearlymussel (*Lampsilis higginsii*), Hine's emerald dragonfly (*Somatochlora hineana*), 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 these species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. The five mussel species are primarily found within the western regions of the state in the St. Croix and Wisconsin Rivers. The two butterflies and one dragonfly species are generally found within the middle and eastern areas of Wisconsin. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Plants

Seven threatened plant species are federally listed and known to occur in the state of Wisconsin. The species include dwarf lake iris (*Iris lacustris*), Eastern prairie fringed orchid (*Platanthera leucophaea*), Fassett's locoweed (*Oxytropis campestris var. chartacea*), Mead's milkweed (*Asclepias meadii*), Northern wild monkshood (*Aconitum noveboracense*), Pitcher's thistle (*Cirsium pitcher*), and prairie bush-clover (*Lespedeza leptostachya*). 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. The seven plant species listed all have different ranges throughout the state of Wisconsin that range from the St. Croix River and southwestern regions to northeastern areas along Lake Michigan. In general, distribution of these species is very limited throughout the state. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, 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, invertebrates, and plants with known occurrence in Wisconsin are described below.

Terrestrial Mammals

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

The piping plover (*Charadrius melodus*) and Kirtland’s warbler (*Setophaga kirtlandii*) are the only federally listed bird species that are known to nest in Wisconsin. The piping plover nests on open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers (USFWS, 1988). The Kirtland’s warbler nests in young jack pine stands (USFWS, 2016). The majority of FirstNet deployment activities would not occur in nesting areas; therefore, impacts to these bird species are not anticipated. Noise, light, or human disturbance within nesting areas could cause listed birds to abandon their nests, relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Fish

There are no federally listed fish found in Wisconsin. Therefore, no reproductive effects to federally threatened and endangered fish species is expected as a result of the Proposed Action.

Reptiles and Amphibian

There are no federally listed reptiles and amphibians found in Wisconsin. Therefore, no reproductive effects to federally threatened and endangered reptile and amphibian species is expected as a result of the Proposed Action.

Invertebrates

Changes in water quality from ground disturbing activities could cause stress resulting in lower productivity for federally listed mollusks and the Hine's emerald dragonfly (*Somatochlora* *hineana*) known to occur in Wisconsin. Impacts to wild lupine, the staple food for Karner blue butterflies (*Lycaeides melissa samuelis*) when they are caterpillars (USFWS, 2008a), could result in reduced survival and reproduction. Deployment activities are not expected to cause changes to water quality or wild lupine that could result in impacts. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Plants

No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially significant. Potential effects to federally listed terrestrial mammals, birds, reptiles, invertebrates, and plants with known occurrence in Wisconsin are described below.

Mammals

Noise associated with the installation of cables could affect mammal migration patterns, though impacts are likely to be short-term. It is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, the red knot has been found to fly up to 9,300 miles from their breeding and wintering sites and often return to the same stopover sites year and after year in Wisconsin. Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result in adverse effects to federally listed birds. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Fish

There are no federally listed fish found in Wisconsin. Therefore, no behaviorial effects to federally threatened and endangered fish species is expected as a result of the Proposed Action.

Reptiles and Amphibians

There are no federally listed reptiles and amphibians found in Wisconsin. Therefore, no behavioral changes to federally threatened and endangered reptile and amphibian species is expected as a result of the Proposed Action.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mollusks and the Hine's emerald dragonfly (*Somatochlora hineana*) resulting in lower productivity. Disturbances to wild lupine, especially during the breeding season, in areas known to have Karner blue butterflies could impact survival. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. FirstNet activities are generally expected to be small-scale in nature, therefore large-scale impacts are not expected; however, it is possible that small-scale changes could lead to potentially significant adverse effects for certain species. For example, impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically.

Terrestrial Mammals

There is no designated critical habitat for terrestrial mammals in Wisconsin. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

There is no designated critical habitat for birds in Wisconsin. 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

There is no designated critical habitat for fish in Wisconsin. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles and Amphibians

There are no federally listed reptiles and amphibians in Wisconsin, There are no designated critical habitats for reptile or amphibians in Wisconsin. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Invertebrates

Critical habitat for the Hine's emerald dragonfly (*Somatochlora hineana*) has been established in various locations along Wisconsin's Lake Michigan coastline. One site is located in the Cedarburg Bog State Natural Area approximately 25 miles north of Milwaukee, and another range of sites in northeastern Door County (USFWS, 2015r). Critical habitat for the Poweshiek skipperling (*Oarisma poweshiek*) has been designated in the eastern region of Wisconsin in prairie ferns and tallgrass. Green Lake County and Waukesha County within Wisconsin are believed to support the species (USFWS, 2015ak). Land clearing, excavation activities, and other ground disturbing activities in this region of Wisconsin could lead to habitat loss or degradation, which could potentially affect the Hine's emerald dragonfly or the Poweshiek skipperling depending on the duration, location, and spatial scale of the associated activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

There is no designated critical habitat for plants in Wisconsin. 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 affect to may affect but not likely to adversely affect depending on the deployment scenario or site-specific conditions. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

Activities Likely to Have No Effect

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no effect on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened or endangered species because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have no impact on protected species.

Activities with the Potential to Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g. mollusks, small mammals, and young), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat if BMPs and mitigation measures are not implemented.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact threatened and endangered species and their habitat, particularly aquatic species (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. If activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no impacts to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects,

behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.

- Wireless Projects
    - New Wireless Communication Towers: : Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
    - Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. These impacts may affect, but are not likely adversely affect protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

It is anticipated that operational impacts may affect, but are not likely to adversely affect threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, may affect, but are not likely to adversely affect threatened and endangered species, as they would be conducted infrequently and in compliance with BMPs and mitigation measures developed through consultation with the appropriate resource agency.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. Listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species may be affected, but are not likely to be adversely affected, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that activities may affect, but are not likely to adversely affect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effects to threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 17.1.6.6, Threatened and Endangered Species and Species of Concern.

17.2.7. Land Use, Recreation, and Airspace

17.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Wisconsin associated with deployment and operation of the Proposed Action and Alternatives.

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.

17.2.7.2. 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 17.2.7-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is potentially significant, but with mitigation is less than significant.	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is potentially significant, but with mitigation is less than significant.	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is potentially significant, but with mitigation is less than significant.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is potentially significant, but with mitigation is less than significant.	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

17.2.7.3. 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 aboveground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 17.2.7-1, 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 aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 17.2.7-1, less than significant impacts would be anticipated as any new land use would be small scale; only short-term impacts during the construction phase would be expected.

Loss of Access to Public or Private Recreation Land or Activities

Access to public or private recreation land or activities could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of ROW or easement. Localized, short-term accessibility to recreation land or activities could be impacted by the deployment and maintenance of structures, towers, roads, and other permanent features. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 17.2.7-1, 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 17.2.7-1, 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 17.2.7-1, 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.

17.2.7.4. 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 17.1.7.5 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 17.1.7.5 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 or near bodies of water and the constructing landings and/or facilities on shores or the banks of water bodies that accept the submarine cable.
  - Land Use: See Activities Likely to Have Impacts below.
  - Recreation: See Activities Likely to Have Impacts below.
  - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 17.1.7.5 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 17.1.7.5 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 AGL or do not trigger any of the other FAA obstruction to airspace criteria.

- Satellites and Other Technologies

- Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
  - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
  - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
  - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact to land use, it is anticipated that this activity would have no impact on land use.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - Airspace: No impacts are anticipated – see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.

- Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.
- Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
- Airspace: No impacts are anticipated – see previous section.

- New Build – Submarine Fiber Optic Plant: Installing cables in or near bodies of water and the constructing landings and/or facilities on shores or the banks of water bodies that accept the submarine cable.
  - Land Use: Deployment activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shores or the banks of water bodies could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
  - Recreation: Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
  - Airspace: No impacts are anticipated – see previous section.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
  - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
  - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
  - Airspace: No impacts are anticipated – see previous section.

- Wireless Projects

- New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
  - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
  - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
  - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets the other criteria listed in Section 17.1.7.5 Obstructions to Airspace Considerations. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of Wisconsin's airports.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
  - Land Use: No impacts are anticipated – see previous section.
  - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
  - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.

- Deployable Technologies
  - *Deployable Technologies*: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: No impacts are anticipated – see previous section.
    - Recreation: No impacts are anticipated – see previous section.

    - Airspace: Implementation of Deployable Aerial Communications Architecture could result in temporary or intermittent potential impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Wisconsin airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).

- Satellites and Other Technologies
  - *Satellite-Enabled Devices and Equipment*: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - 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. 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. 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, discusses 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 above mentioned 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 are used. 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 17.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. The use of deployable aerial communications architecture could temporarily add new air traffic or aerial navigation hazards. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. See Chapter 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.

17.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use if deployment occurs in areas with compatible land uses. While a single deployable technology may have an imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be less than significant due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used. 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, discusses 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 17.1.7, Land Use, Recreation, and Airspace.

17.2.8. Visual Resources

17.2.8.1. Introduction

This section describes potential impacts to visual resources in Wisconsin associated with deployment and operation of the Proposed Action and alternatives. 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.

17.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 17.2.8-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact.

Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.8-1: 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.

17.2.8.3. 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 Wisconsin, residents and visitors travel to visit the Apostle Islands National Lakeshore and other areas around the state for scenic vistas and recreational activities. 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 17.2.8-1, 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 could be considered potentially significant.

Based on the impact significance criteria presented in Table 17.2.8 1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term could 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.

17.2.8.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting and pole replacement would be limited.
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources since those activities would not require ground disturbance or vegetation removal.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of the project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development 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 or near bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the

aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a national park unit or other sensitive area. If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if the on-site delivery of additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal, areas of surface disturbance, or additional nighttime lightning.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant due to the temporary and small-scale nature of deployment activities, although certain discrete locations could have potentially greater impacts to night skies or as a result of new towers. Chapter 19, BMPs and Mitigation Measures, discusses 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 above mentioned 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas. If staging or landing areas (depending on the type of technology) require surface disturbance or vegetation clearing, or if these areas were within scenic landscapes or required new nighttime lighting, impacts could occur to the aesthetic character of scenic resources or viewsheds. These impacts are expected to be less than significant as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be less than significant. These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to visual resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 17.1.8, Visual Resources.

17.2.9. Socioeconomics

17.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Wisconsin associated with deployment and operation of the Proposed Action and alternatives. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 17.2.9-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.9-1: 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

17.2.9.3. 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;
- 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 Existing Environment, property values vary considerably across Wisconsin. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $224,000 in the greater Madison area, to just over $127,000 in the Wausau 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) (Bond, Sims, & Dent, 2013).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and partners make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). 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 Wisconsin. The average unemployment rate in 2014 was 5.5 percent, which is lower than the national rate of 6.2 percent. The majority of counties in Wisconsin had unemployment rates below the national average (that is, better employment performance). Most counties with unemployment rates above the national average were in the northern part of the state, north of Eau Claire and Wausau, plus a few counties in the southern half of the state. (BLS, 2016)

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 17.2.9-1 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.

17.2.9.4. 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 17.2.9-1.

Activities Likely to Have No Impacts

- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch

vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have no impact on socioeconomic resources.

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below indicates which of the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near 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., parked vehicles in new parking lots), equipment maintenance activities at such facilities may generate noise, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be less than significant.
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:

- Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

In general, the abovementioned activities would have less than significant beneficial socioeconomic impacts. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be less than significant, as described above. Chapter 19, BMPs and Mitigation Measures, discusses 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 sites within the region and state. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity, and therefore less than significant based on the significance criteria table.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. These potential impacts are anticipated to be less than significant as described above. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be less than significant.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be less than significant as they would be limited to a relatively small number of sites within the region and Wisconsin. 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.

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 17.1.9, Socioeconomics.

17.2.10. Environmental Justice

17.2.10.1. Introduction

This section describes potential impacts to environmental justice in Wisconsin associated with deployment and operation of the Proposed Action and alternatives. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 17.2.10-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.10-1: 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

17.2.10.3. 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 Existing Environment (Section 17.1.10.4) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 17.1.10.3, Wisconsin's population has lower percentages of minorities than the region and considerably lower percentages than the nation. The state has a lower poverty rate than the region or nation. Wisconsin has many areas with high and moderate Potential for environmental justice populations, but a lower proportion of its area in these categories compared with many states. The distribution of both the high and moderate potential areas is fairly even across the state. These areas occur both within and outside of the 10 largest population concentrations. Further analysis using the data developed for the screening analysis in Section 17.1.10.4, 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, 2015d; USEPA, 2014d).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts can use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

17.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any

surrounding communities. Therefore, they would not affect environmental justice communities.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have no impacts to environmental justice. If physical access is required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice communities, it is anticipated that this activity would have no impact on environmental justice issues.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as

staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise and dust could be temporarily generated, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be less than significant, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. 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

Activities to Have No Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons.

Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the above mentioned deployment activities that involve construction.

Impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.10.5. 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. Chapter 19, BMPs and Mitigation Measures, discusses 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, discusses 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 17.1.10, Environmental Justice.

17.2.11. Cultural Resources

17.2.11.1. Introduction

This section describes potential impacts to cultural resources in Wisconsin associated with deployment and operation of the Proposed Action and alternatives. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.11.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 17.2.11-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.11-1: 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 Areas of Potential Effects (APE).		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e. visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect**[1]	**Effect, but Not Adverse**	**No Effect**
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[1] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is “Less than Significant with Mitigation Incorporated,” historic properties are considered to be “non-renewable resources,” given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[2] Per NHPA, a “historic property” is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project’s APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian Tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

17.2.11.3. 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 17.2.11-1, 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 Wisconsin, some deployment activities may be in these areas, in which case BMPs (see Chapter 19) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs (see Chapter 19).

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of significant impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to Native Americans. It is anticipated that FirstNet would identify potential impacts to such areas by conducting research on particular areas and through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

17.2.11.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to cultural resources. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact on cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could impact cultural resources where there potential to contain archaeological sites. Impacts to cultural resources could also 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, which could result in the disturbance of archaeological sites (archaeological deposits tend to be associated with bodies of water and have high probabilities for archaeological deposits), 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 Milwaukee 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 affect, but not adversely affect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment sites. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally, as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, discusses 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 above mentioned deployment impacts. It is anticipated that there would be no effects to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 016 of the NHPA. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.11.5. Alternatives Impact Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, discusses 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, discusses 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 17.1.11, Cultural Resources.

17.2.12. Air Quality

17.2.12.1. Introduction

This section describes potential impacts to Wisconsin's air quality from deployment and operation of the Proposed Action and alternatives. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Wisconsin's air quality were evaluated using the significance criteria presented in Table 17.2.12-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to Wisconsin's air quality addressed in this section are presented as a range of possible impacts.

Table 17.2.12-1: 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

17.2.12.3. 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 and Wisconsin Ambient Air Quality Standards. Areas exist in Wisconsin that are in maintenance or nonattainment for one or more of the following pollutants: $PM_{2.5}$, O_3, and SO_2 (Table 17.1.12-4 and Figure 17.1.12-1) (See Section 17.1.12, Air Quality).

Based on the significance criteria presented in Table 17.2.12-1, air emission impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. Less than significant emissions could occur for any of the criteria pollutants within attainment areas in Wisconsin; however, NAAQS and Wisconsin Ambient Air Quality Standards exceedances are not anticipated. Given that nonattainment areas are present throughout Wisconsin (Figure 17.1.12-1), 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.

17.2.12.4. Potential Impacts of the Preferred Alternative

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

Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points, however this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create no new sources of emissions.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to no impact on ambient air quality concentrations.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have no impact on those resources.

Activities with 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 or near bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
- Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.

- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If the on-site delivery of additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
  - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved

versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the above mentioned 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, discusses 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 above mentioned 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

17.2.13. Noise

17.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and alternatives in Wisconsin. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 17.2.13-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 17.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

17.2.13.3. 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 17.2.13-1, 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.

17.2.13.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise impacts and while others would not.

In addition, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.

  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise levels from the use of heavy equipment and machinery.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable could result in short-term and temporary 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 above mentioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be less than significant due to the temporary duration of deployment activities. Additionally, pre-existing noise levels achieved after some months (typically less than a year but could be a few hours for linear activitis such as pole construction). Chapter 19, BMPs and Mitigation Measures, discusses 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 above mentioned 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.13.5. 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 Noise 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the above mentioned 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, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

17.2.14. Climate Change

17.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Wisconsin associated with deployment and operation of the Proposed Action and alternatives. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.14.2. 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 17.2.14-1. As described in Section 17.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or alternatives. The second is the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 MMT in 2013 (USEPA, 2015m), 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 17.2.14-1: Impact Significance Rating Criteria for Climate

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with BMPs and Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent	Global impacts observed.		Global impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

17.2.14.3. 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 Wisconsin depending on the region of the state (USGCRP, 2014a). 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 Wisconsin, the frost-free season under a high emissions scenario may extend greater than 25 days longer than the baseline years (USGCRP, 2016).

Wisconsin is surrounded by two great lakes, Lake Michigan and 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 17.2.14-1 and Figure 17.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Wisconsin from a 1969 to 1971 baseline.

Dfa – Figure 17.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the Dfa region of Wisconsin under a low emissions scenario would increase by approximately 4 °F or 5 °F depending on the section of the region, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Wisconsin would increase by approximately 6° F. (USGCRP, 2009)

Figure 17.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5 °F. Under a high emissions scenario for the period (2080 to 2099) in the Dfa region of Wisconsin, temperatures would increase by approximately 10° F. (USGCRP, 2009)

Dfb – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Dfa region under both low and high emissions scenarios.

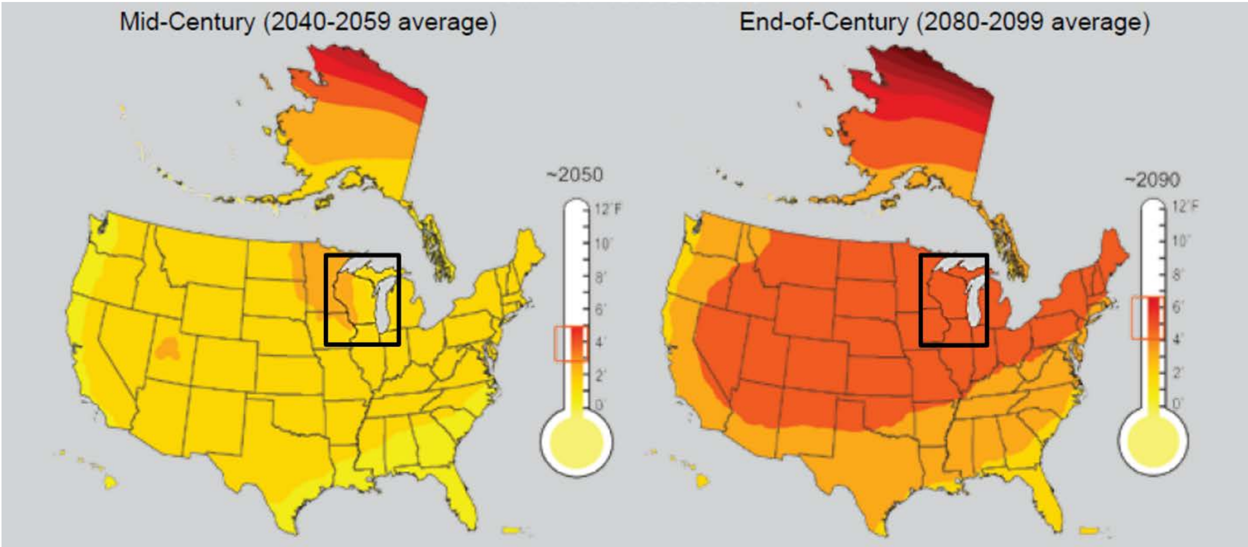


Figure 17.2.14-1: Wisconsin Low Emission Scenario Projected Temperature Change

Source: (USCRP, 2009b)

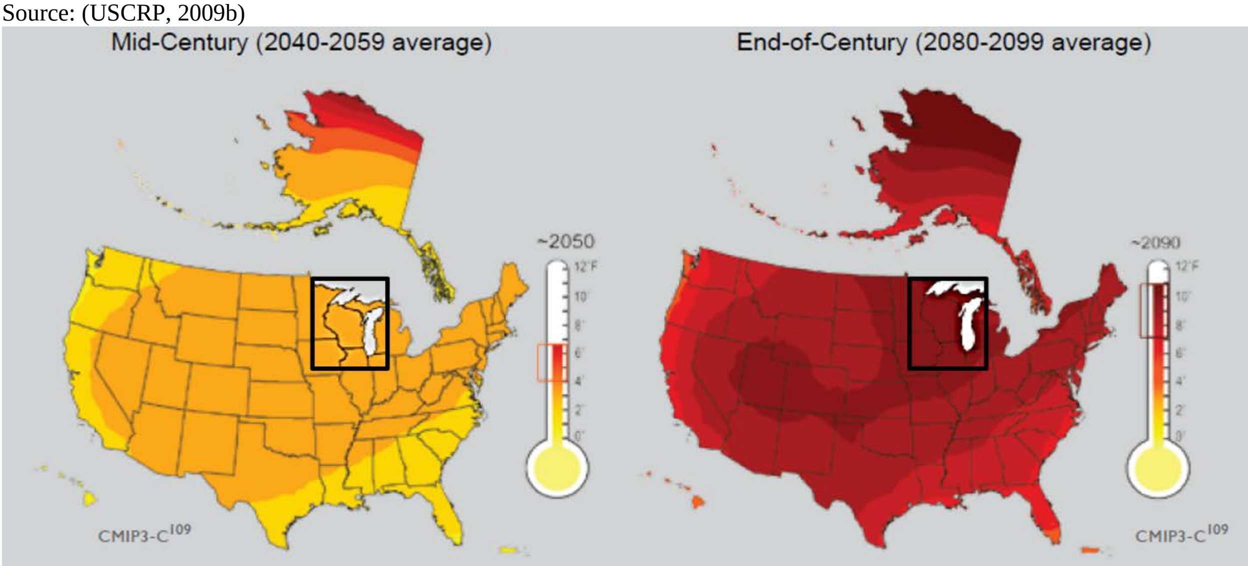


Figure 17.2.14-2: Wisconsin High Emission Scenario Projected Temperature Change

Source: (EIA, 2015c)

Precipitation

Precipitation in the Midwest is greatest in the east, declining towards the west. Precipitation occurs about once every seven days in the western part of the region and once every three days in the southeastern part. The 10 rainiest days could contribute as much as 40 percent of total precipitation in a given year. Annual precipitation increased in the Midwest during the past century, with much of the increase driven by intensification of the heaviest rainfalls. This tendency towards more intense precipitation events is projected to continue in the future. (USGCRP, 2014a)

Snowfall varies across the region, comprising less than 10 percent of total precipitation in the southern portion of the Midwest, to more than half in the northern portion of the Midwest, with as much as two inches of water available in the snowpack at the beginning of spring melt in the northern reaches of the river basins. When this amount of snowmelt is combined with heavy rainfall, catastrophic, widespread flooding could occur. Trends towards a decline in the frequency of high magnitude snowfall, but an increase in lake effect snowfall have been observed. These divergent trends and their inverse relationships with air temperatures make overall projections of regional impacts of the associated snowmelt extremely difficult. Flooding could also occur due to extreme precipitation in the absence of snowmelt. These warm-season events are also projected to increase in magnitude in the future. (USGCRP, 2014a)

Figure 17.2.14-3 and Figure 17.2.14-4 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 17.2.14-1 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 17.2.14-2 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 17.2.14-3 shows that in a rapid emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in winter and spring for the entire state of Wisconsin. However, there are no expected increases in precipitation in summer other than fluctuations due to natural variability. (USGCRP, 2014b)

Figure 17.2.14-4 shows that if emissions continue to increase, winter and spring precipitation is projected to 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 approximately 10 percent over the same period. (USGCRP, 2014b)

Dfb – In fall, precipitation is expected to increase up to 10 percent in Wisconsin depending on the area of the state, and in other areas there are no expected changes in fall precipitation. Precipitation changes for the Dfb region are consistent with projected changes for the Dfa region of Wisconsin in both low and high emissions scenarios.

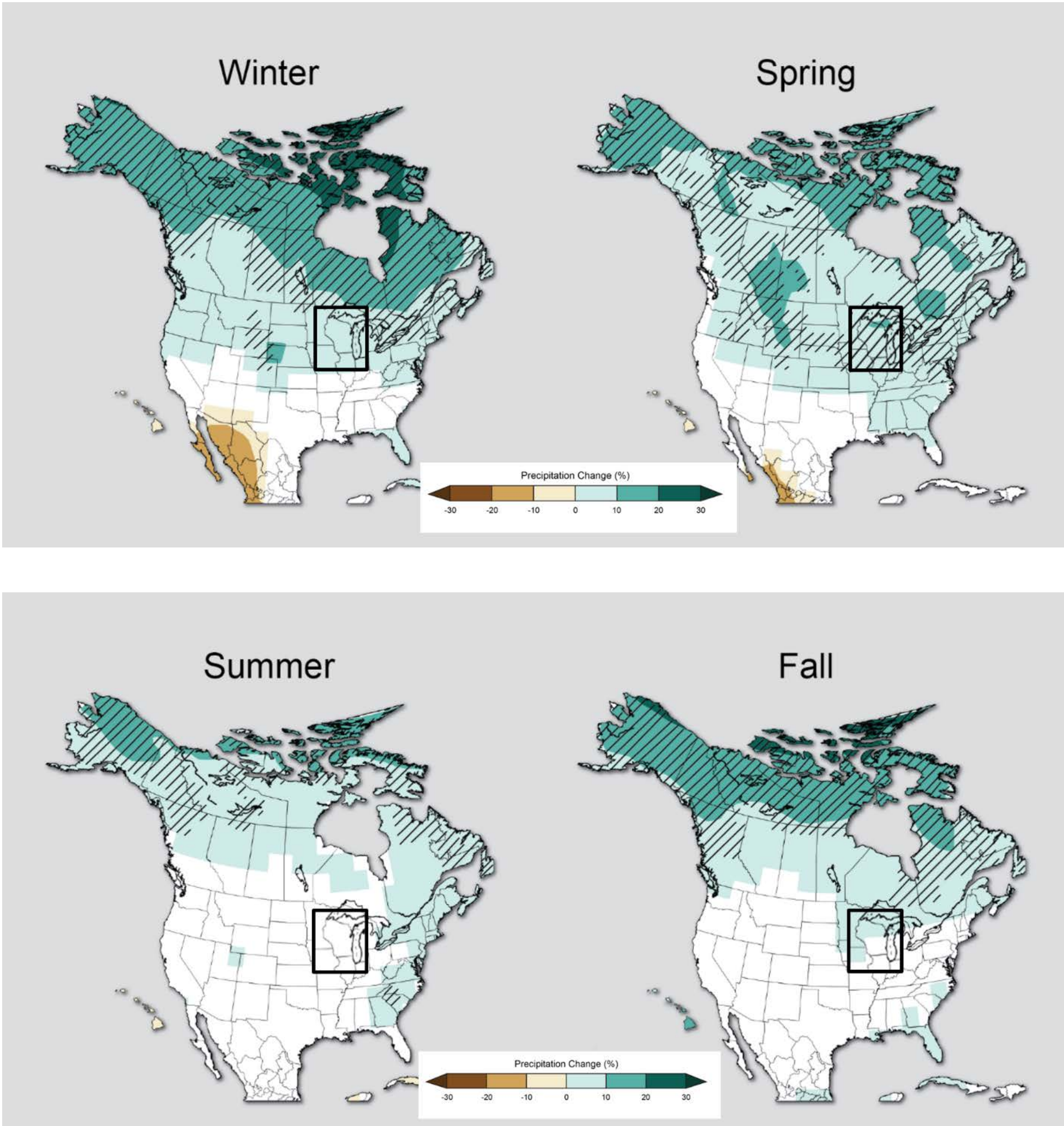


Figure 17.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

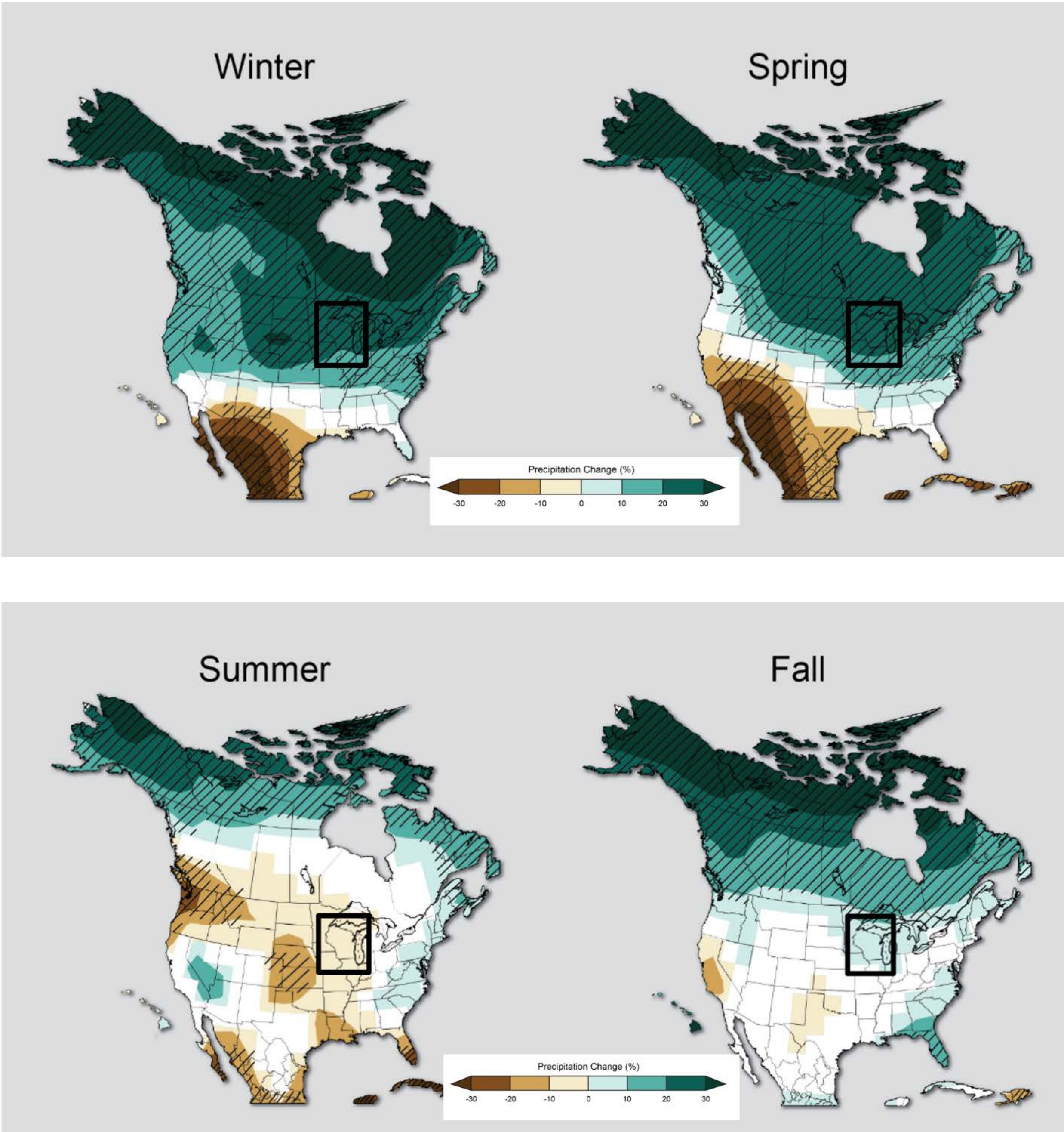


Figure 17.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

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, 2014e)

17.2.14.4. 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 17.2.14-1, 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, 2015h). 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, 2015n), the same transmitter would be responsible for approximately 271 MT of CO_2 per year running continuously. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated. Therefore, this scenario is a "worst-case" for GHG emissions. If the system deployment resulted in the operation of more than 50 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters (Vereecken, et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Impact of Climate Change on Project-Related Resource Effects

Climate change may impact 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.

Climate change may negatively impact water quality in the Great Lakes (Lake Superior and Lake Michigan in the case of Wisconsin) through increased sedimentation from extreme rainfall events and also more harmful algal blooms and other types of contamination resulting from warmer water temperatures (USGCRP, 2014d). Climate change may expose areas of Wisconsin to increased intensity and duration of heat waves (USGCRP, 2014c) particularly in population centers with the significant paved areas, contributing to urban heat islands in cities such as Milwaukee, which greatly magnify the heat effects. These effects would vary from state to state depending on the resources in question and their relationship to climate change. These impacts will be considered fully in Chapter 18, Cumulative Impacts. No BMPs will be described for this aspect of the resource.

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.

For areas of Wisconsin at risk for flooding, climate change is projected to increase the frequency and severity of torrential downpours which in turn may increase the potential for flash floods (USGCRP, 2014c) and damage to FirstNet infrastructure. Extended periods of extreme heat may increase general demand on the electric grid in the Midwest (DOE, 2015), impede the operation of the grid, and overwhelm the capacity on-site equipment needed to keep microwave and other transmitters cool.

17.2.14.5. 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 Wisconsin, including deployment and operation activities.

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed

Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
    - Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because these activities.

Activities with the Potential to Have Impacts

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wired Projects
    - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
    - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include

construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.

- Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities. .
- New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small aquatic sources would contribute to GHGs.
- Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.

- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction as construction would not take place. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
- Deployable Technologies
  - COWs, COLTs, or SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts in excess of 25,000 MT if operated in large numbers over the long-term. However this would be highly dependent on their size, number, and the frequency and duration of their use. Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of piloted or unmanned aircraft were used for a sustained period of time (i.e. months to years). Emissions would depend on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Emissions occurring as a result of soil disturbance and loss of vegetation are expected to be less than significant due to the limited and localized nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, discusses 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 from the project, including adaptation, which refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

Climate change’s anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

17.2.14.6. 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.

Potential Operations Impacts

Implementing land-based deployable technologies (COW, COLT, SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. These activities are expected to be less than significant due to the limited duration of deployment activities.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. Climate change effects have the most noticeable impacts over a long period of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 17.1.14, Climate Change.

17.2.15. Human Health and Safety

17.2.15.1. Introduction

This section describes potential impacts to human health and safety in Wisconsin associated with deployment of the Proposed Action and alternatives. Chapter 19, BMPs and Mitigation Measures, discusses BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.15.2. 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 17.2.15-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to human health and safety addressed in this section are presented as a range of possible impacts.

Table 17.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	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
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

17.2.15.3. 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 17.2.15-1, 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, 2015b).

- Engineering controls,
- Work practice controls,
- Administrative controls, and then
- Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes[165], 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

[165] 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, 2015b). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet project sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2015b). Administrative controls may take the form of limiting the number of hours an employee is allowed to work per day, requiring daily safety meetings before starting work, utilizing the buddy system for dangerous tasks, and any other similar activity or process that is designed to identify and mitigate unnecessary exposure to hazards. When engineering controls, work practice controls, and administrative controls are not feasible or do not provide sufficient protection, employers must also provide appropriate PPE to their employees and ensure its proper use. PPE is the common term used to refer to the equipment worn by employees to minimize exposure to chemical and physical hazards. Examples of PPE include gloves, protective footwear, eye protection, protective hearing devices (earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure.

The WDWD, the Wisconsin Department of Natural Resources (DNR), and the WDHS, Division of Public Health, BEOH regulate state programs to oversee employee safety in public or private sector workplaces. Therefore, these agencies defer all regulatory authority and enforcement for occupational safety relating to FirstNet site work to the leadership and interpretation of OSHA.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. 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 17.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned or active mine lands. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior's Abandoned Mine Lands inventory, through the Wisconsin Department of Environmental Quality, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment 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 Wisconsin 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, Wisconsin 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 17.2.15-1, 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.

17.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: The pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be no impacts to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or

releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in or near bodies of water requires workers to operate over aquatic environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at

proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site

preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, historic and environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Infrastructure could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure and release of hazardous chemicals and hazardous waste, and release of historic contamination to the surrounding environment. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, discusses 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. See Chapter 19, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

17.2.15.5. 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. See Chapter 19, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety associated with routine inspections of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, PPE or other mitigation measures may be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be less than significant because of the small scale of likely FirstNet activities; activities associated would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. See Chapter 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.

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 17.1.15, Human Health and Safety.

WI APPENDIX A – COMMUNITIES OF CONCERN

Table A1: S1 Ranked Terrestrial Communities of Concern in Wisconsin

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Mesic Cedar Forest	Northern Lakes and Forests	Rare upland forest community containing mesic[166] sites. This community type is characterized by white cedar (*Thuja occidentalis*), and other trees including hemlock (*Tsuga Canadensis*), white spruce (*Abies balsamea*), yellow birch (*Betula alleghanensis*), and white pine (*Pinus strobes*). The herb layer in this forest community may consist of Canada mayflower (*Maianthemum canadense*), twinflower (*Linnaea borealis*), clubmosses (*Lycopodium* spp.).	This community occurs mainly at mesic sites in northern Wisconsin.
Great Lakes Barrens	Northern Lakes and Forests, North Central Hardwood Forests	A variant of the pine barrens community and known to occur at sandspits and dunes in the Apostle Islands and along the Great Lakes shorelines; this community type has a limited distribution. The Lake Superior occurrences lack representation of prairie species, and the ground layer is mainly composted of lichens, fungi, grasses, sedges, ericaceous (i.e., acidic soil) shrubs and sub-shrubs, and a limited number of flowering herbs. The dominant trees consist of scattered red pine that exhibit exposure to wind and fire conditions. Eastern white pine and jack pine may also be present. The community also exhibits extremely xeric site conditions due to past wildfires.	Occurrences are limited to sandspits and dunes along the Great Lakes shorelines and within the Apostle Islands in Lake Superior in northern Wisconsin.
Oak Opening	Driftless Area, Southeastern Wisconsin Till Plains	An oak-dominated savanna community that contains less than 50% tree canopy coverage. Historically, this community was abundant and occurred in wet-mesic and dry site conditions, however there are few communities remaining today. The few remaining communities occur on dry sites, as the mesic and wet-mesic oak openings have been impacted by agricultural and residential development, as well as the encroachment of other plants due to fire suppression. Common vegetation consists of bur oak (*Quercus marcocarpa*), white oak (*Quercus alba*), and black oak (*Quercus veluntina*) trees. These oak trees are typically located in large, open areas. Shagbark hickory (*Carya ovata*) is also present.	Limited to southern Wisconsin and a small portion of central-western Wisconsin near the Mississippi River.

[166] Mesic: "A soil condition that is medium-wet" (USEPA, 2015r).

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Oak Woodland	Driftless Area, Southeastern Wisconsin Till Plains	A natural community similar to oak savannas and oak forests. Oak woodland differs from oak savannas by the limb structures of the trees and greater crown closure (range of 50% to 95%). There are few intact oak woodland communities because the community has been subject to frequent low-intensity wildfires, lacks dense woody understory characteristic of most oak forests, and has relatively low canopy closure compared to an oak forest.	Intact communities occur in central and southern Wisconsin.
Mesic Prairie	Western Corn Belt Plains, Northern Central Hardwood Forests, Driftless Area	Historically, a common grassland community that occurs on rich, moist, well-drained sites and level to gently rolling terrain. The dominant plant type consists of tall grass and big bluestem (*Andropogon gerardii*). Less dominant plant species include little bluestem (*Andropogon scoparius*), Indian grass (*Sorghastrum nutans*), porcupine grass (*Stipa spartea*), prairie dropseed (*Sporobolus heterolepis*), and tall switchgrass (*Panicum virgatum*).	A limited distribution of this community occurs on no more than 100 acres of tallgrass prairie in southern Wisconsin and in a small portion of western Wisconsin near River Falls. Small sites also occur in Ipswich Prairie State Natural Area in Grant-Lafayette counties, Military Prairie Heritage Area in Iowa County, and in Scuppernong Grasslands in Waukesha County.
Coastal Plain Marsh	North Central Hardwood Forests, Driftless Area	Sandy to peaty-mucky lakeshores, pond shores, depressions, and ditches in and around the bed of extinct glacial Lake Wisconsin. There is often a well-defined concentric zonation of vegetation. Historically, the surrounding vegetation consisted of oak and pine barrens; dry acidic forests composted of oaks and pines; sand prairie, and peatland communities.	The distribution is limited to a few sites within central Wisconsin that occur on sandy beds or margins of extinct glacial lakes. All known occurrences are small to medium in size and occur on glacial outwash lands and in glacial tunnel channels.
Interdunal Wetland	Northern Lakes and Forests, North Central Hardwood Forests, Southeastern Wisconsin Till Plains	Occupy wind-created hollows that intersect with the water table within active dune fields along the Great Lake shorelines. The community may also occur where sand encroaches on nearby wetlands. The areas may be colonized by wetland plants, including common species known to occur near Lake Superior, such as twig-rush (*Cladium mariscoides*), rush species (*Juncus balticus*), pipewort (*Eriocaulon septangulare*), sedge (*Carex viridula*), ladies-tress orchids (*Spiranthes* spp.), and bladderworts (*Utricularis cornuta* and *U. respuninata*).	Distributed at dune fields along the Great Lake (i.e., Lake Superior) shorelines. Documented known occurrences are at East Bay Peshtigo Harbor and the western tip of Long Island in the Apostle Islands in Ashland County.

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Algific Talus Slope	Driftless Area	Small and isolated slopes that tend to occur on steep north- or east-facing slopes with a substrate of fractured limestone bedrock that retains ice and emits cold air throughout the growing season. The cold microhabitat allows northern species, such as northern monkshood (*Aconitum noveboracense*) and rare terrestrial snails to persist.	Known to primarily occur in the southwestern corner of Wisconsin's Driftless area (southwest Wisconsin). Known occurrences are located on a north-facing bluff near the Mississippi River.
Alvar	North Central Hardwood Forests, Southeastern Wisconsin Till Plains	This community consists of think discontinuous soil overlying horizontal beds of limestone or dolomite near the Great Lake shorelines. Characterized by relatively low tree cover, the community contains distinctive and unusual biota, such as prairie, savanna, and boreal forests. Small coniferous and deciduous trees, such as cedar, fir, pine, oak, aspen and birch can occur in this community among big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian-grass (*Sorghastrum nutans*),	Occurs near the Great Lake shorelines near Green Bay, specifically at Red Banks Alvar State Natural Area.
Talus Forest	North Central Hardwood Forests	Develops on a substrate of quartzite, sandstone, dolomite, rhyolite, and other rock types. Canopy cover ranges from sparse to moderately dense; tree dominance can be variable. Tree cover includes white pine (*Pinus strobes*), red cedar (*Juniperus virginiana*), paper birch (*Betula papyrifera*), northern white cedar (*Thuja occidentalis*), and red pine (*Pinus resinosa*).	Rib Mountain Talus Forest supports rare plant species among quartzite rocks on the south side of Rib Mountain.
Patterned Peatland	Northern Lakes and Forests	Very rare wetland community characterized by herb- and shrub-dominated minerotrophic peatland (soils and vegetation that receive main water supply from streams and springs) with alternating moss and sedge-dominated peat ridges and saturated and inundated hollows. Within patterned peatland, the peat "landforms" differ in nutrient availability and pH level. The flora may also be diverse and include sedges, ericads, sundews, orchids, arrowgrasses (*Triglochin spp.*) and calciphilic shrubs, such as bog birch (*Betula pumila*), and shrubby cinquefoil (*Potentilla fruticosa*).	Found in some peatlands located in northern Wisconsin.

Note: Natural community descriptions for "Lake – Deep, Soft, Drainage" and "Lake – Meromictic" were not available. % = percent, in. = inches, ft. = feet

Sources: (EPA 2015g; Wisconsin NHIP 2015)

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council On Historic Preservation
ACS	American Community Survey
AGL	Above Ground Level
AIRFA	American Indian Religious Freedom Act
AML	Abandoned Mine Lands
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act of 1979
AS	Audubon Society
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
ATSDR	Agency For Toxic Substance and Disease Registry
ATV	All-Terrain Vehicle
BCPL	Board of Commissioners of Public Lands
BEOH	Bureau of Environmental and Occupational Health
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	Best Management Practice
BOA	Bureau of Aeronautics
BYA	Billion Years Ago
CAA	Clean Air Act
CCC	Civilian Conservation Corps
CEQ	Council on Environmental Quality
CFA	Controlled Firing Area
CFR	Code of Federal Regulations
CGP	Construction General Permit
CIMC	Cleanups In My Community
CIO	Chief Information Officer
CO	Carbon Monoxide
CRS	Community Rating System
CWA	Clean Water Act
DNR	Department of Natural Resources
DOE	Department of Energy
DOT	Department of Transportation

Acronym	Definition
EFH	Essential Fish Habitat
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
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FLM	Federal Land Manager
FRA	Federal Railroad Administration
FSDO	Flight Standards District Offices
FSS	Flight Service Station
FTA	Federal Transit Administration
GAO	Government Accountability Office
GHG	Greenhouse Gas
GNIS	Geographic Names Information System
HAP	Hazardous Air Pollutants
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
ITU-T	Telecommunication Standardization Sector of the International Telecommunication Union
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LMR	Land Mobile Radio
LRR	Land Resource Region
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MC	Municipal Community System
MFWP	Montana Fish, Wildlife, and Parks
MHI	Median Household Income
MKE	Mitchell International Airport
MLRA	Major Land Resource Areas
MMT	Million Metric Tons
MNHP	Montana National Heritaga Program

Acronym	Definition
MSL	Mean Sea Level
MWC	Municipal Waste Combustor
MYA	Million Years Ago
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NASAO	National Association of State Aviation Officials
NCED	National Conservation Easement Database
NEPA	National Environmental Policy Act
NERR	National Estuarine Research Reserve
NFIP	National Flood Insurance Program
NHIP	Natural Heritage Inventory Program
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NN	Non-transient Non-community Systems
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notices To Airmen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NR	Natural Resources
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NT	Transient Non-Community Systems
NTIA	National Telecommunications and Information Administration
NTFI	National Task Force on Interoperability
NWI	National Wetlands Inventory
NWS	National Weather Service
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OSHA	Occupational Safety and Health Administration
OTM	Other Than Municipal Community Systems
PADUS	Protected Areas Database of the United States
PGA	Peak Ground Acceleration
PPE	Personal Protective Equipment

Acronym	Definition
PSC	Public Service Commission
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SIREN	Sustained Interoperable Radio For Emergency Notification
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SPL	Sound Pressure Level
SUA	Special Use Airspace
SWPPP	Storm Water Pollution Prevention Plan
TIA	Telecommunications Industry Association
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
UVA	University of Virginia
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compound
WAC	Wisconsin Administrative Code
WAP	Wildlife Action Plan
WCMP	Wisconsin Coastal Management Program

Acronym	Definition
WPCA	Wisconsin Commercial Ports Association
WCS	Wetlands Classification Standard
WDHS	Wisconsin Department of Health Services
WDWD	Wisconsin Department of Workforce Development
WEPA	Wisconsin Environmental Policy Act
WHEPP	Wisconsin Hospital Emergency Preparedness Program
WIAAQS	Wisconsin Ambient Air Quality Standards
WICCI	Wisconsin Initiative On Climate Change Impacts
WISCOM	Wisconsin Interoperable System For Communications
WISH	Wisconsin Interactive Statistics on Health
WMD	Wetland Management District
WPDES	Wisconsin Pollutant Discharge Elimination System
WSL	Wisconsin State Legislature
WSP	Wisconsin State Patrol
WWI	World War I
WWII	World War II

REFERENCES

The citations in this Draft PEIS reflect the most recent information on the referenced site at the time the document was written. If the site was updated after that point, the more recent information will be incorporated into the final document, as feasible.

40 CFR 230.3(t). (1993, August 25). *Clean Water Act-Guidelines for Specification of Disposal Sites for Dredged or Fill Material*. Retrieved April 6, 2015, from http://www.ecfr.gov/cgi-bin/text-idx?SID=7977290449ab243f2865159951305a77&node=40:25.0.1.3.24&rgn=div5

ACHP. (2004, August 5). *36 CFR Part 800 - Protection of Historic Properties.* Retrieved July 21, 2015, from Advisory Council on Historic Preservation: http://www.achp.gov/regs-rev04.pdf

American Trails. (2015a, August 14). *National Trails Training Partnership*. Retrieved September 15, 2015, from http://www.americantrails.org/resources/feds/NatTrSysOverview.html

American Trails. (2015b). *National Recreation Trails Database*. Retrieved September 22, 2015, from http://www.americantrails.org/NRTDatabase/trailList.php?pageNum_rsTrails=0&usrTrailName=&usrTrailState=WI&usrTrailCounty=&usrTrailUse=&usrSortOrder=TrailName&usrTrailUse2=&usrAgency=&usrYearDesignated=&usrTrailSystem=&usrTrailLength=0

American Trails. (2015c). *Nelson-Trevino Canoe Trail*. Retrieved September 22, 2015, from http://www.americantrails.org/NRTDatabase/trailDetail.php?recordID=3784

Amtrak. (2015a, October). *Empire Builder*. Retrieved October 16, 2015, from http://www.amtrak.com/empire-builder-train

Amtrak. (2015b, October). *Hiawatha*. Retrieved October 16, 2015, from http://www.amtrak.com/hiawatha-train

Amtrak. (2015c, October). *Midwest Train Routes*. Retrieved October 16, 2015, from Amtrak: http://www.amtrak.com/midwest-train-routes

Arzigian, C. (2000). *Middle Woodland and Oneota Contexts for Wild Rice Exploitation in Southwestern Wisconsin.* Retrieved October 2015, from http://www.jstor.org/stable/20708136

Balshe, W. (2011). *Power System Considerations for Cell Tower Applications.* Cummins Power Generation. Retrieved from https://www.cumminspower.com/www/literature/technicalpapers/PT-9019-Cell-Tower-Applications-en.pdf

Berven, K., & Grudzien, T. (1990). Dispersal in the wood frog (Rana sylvatica): implications for genetic population structure. *Evolution, Volume 44*(Issue 8), 2047-2056. Retrieved from http://www.jstor.org/stable/2409614?seq=1#page_scan_tab_contents

BLM. (1984). *Manual 8400 - Visual Resource Management.* Washington: Department of the Interior, Bureau of Land Management.

BLM. (2014, August). *DRECP Noise and Vibration*. Retrieved 07 22, 2015, from http://www.blm.gov/style/medialib/blm/ca/pdf/pa/energy/drecp/draft_drecp.Par.37401.File.dat/III.21%20Noise%20and%20Vibration.pdf

BLS. (2016). *Local Area Unemployment Statistics Map*. Retrieved August 28, 2016, from http://data.bls.gov/map/MapToolServlet

Bond, S., Sims, S., & Dent, P. (Eds.). (2013). *Towers, Turbines, and Transmission Lines: Impacts on Property Value.* Chichester, West Sussex, United Kingdom: Wiley-Blackwell.

Boszhardt, R. F., & Goetz, N. (2000). *An Apparent Late Woodland Boundary in western Wisconsin.* Retrieved October 2015, from http://www.jstor.org/stable/20708137

Bureau of Labor Statistics. (2013a). *Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2013 (Wisconsin).* Retrieved October 27, 2015, from http://www.bls.gov/iif/oshwc/osh/os/pr136wi.pdf

Bureau of Labor Statistics. (2013b). *Incidence rate and number of nonfatal occupational injuries by industry and ownership, 2013 (U.S.).* Retrieved September 22, 2015, from http://www.bls.gov/iif/oshwc/osh/os/ostb3966.pdf

Bureau of Labor Statistics. (2013c). *Fatal occupational injuries to private sector wage and salary workers, government workers, and self-employed workers by industry, all United States, 2013.* Retrieved September 22, 2015, from http://www.bls.gov/iif/oshwc/cfoi/cftb0279.pdf

Bureau of Labor Statistics. (2014). *Table A-5. Fatal occupational injuries by occupation and event or exposure, all United States, 2014.* Retrieved September 29, 2015, from 2014 Census of Fatal Occupational Injuries (preliminary data): http://www.bls.gov/iif/oshwc/cfoi/cftb0290.pdf

Bureau of Labor Statistics. (2015a, May). *U.S. Bureau of Labor Statistics*. Retrieved from May 2015 State Occupational Employment and Wage Estimates Wisconsin: http://www.bls.gov/oes/current/oes_wi.htm

Bureau of Labor Statistics. (2015b). *Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages.*

Bureau of Labor Statistics. (2015c, March). *Wisconsin*. Retrieved May 2015, from Occupational Employment Statistics: http://www.bls.gov/oes/current/oes_wi.htm#49-0000

Bureau of Labor Statistics. (2015d, April 22). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved October 27, 2015, from Injuries, Illnesses, and Fatalities: http://www.bls.gov/iif/state_archive.htm#WI

Bureau of Labor Statistics. (2015e, March 25). *Occupational Employment and Wages, May 2014: 49-9052 Telecommunications Line Installers and Repairers*. Retrieved September 25, 2015, from Occupational Employment Statistics: http://www.bls.gov/oes/current/oes499052.htm

Bureau of Labor Statistics. (2015f, September 21). *Census of Fatal Occupational Injuries (2011 forward)*. Retrieved September 18, 2015, from Census of Fatal Occupational Injuries (2011 forward): http://data.bls.gov/pdq/SurveyOutputServlet;jsessionid=D50AB7BE7C7731D5A8549E2E0212D1CD.tc_instance4

Bureau of Labor Statistics. (2015g, November 19). *Schedule of upcoming releases and access to archived news releases*. Retrieved February 16, 2016, from http://www.bls.gov/iif/osh_nwrl.htm

Calhoun, A., & DeMaynadier, P. (2007). Science and conservation of vernal pools in northeastern North America: ecology and conservation of seasonal wetlands in northeastern North America. *Science and conservation of vernal pools in northeastern North America: ecology and conservation of seasonal wetlands in northeastern North America*. Retrieved from http://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/Ch12_ScienceConservationofVernalPools.pdf

Carr, D. H., & Boszhardt, R. F. (2003). The Kriesel Cache: A Late Paleoindian Biface Cache from Western Wisconsin. *Plains Anthropologist, 48*(187), 225-235. Retrieved October 2015, from http://www.jstor.org/stable/25669842

Centers for Disease Control and Prevention. (2015a, December 1). *CDC WONDER: Underlying Cause of Death, 1999-2013 Results*. Retrieved December 1, 2015, from http://wonder.cdc.gov/

Centers for Disease Control and Prevention. (2015b, August 13). *Public Health Assessments & Health Consultations (Wisconsin)*. Retrieved October 26, 2015, from Agency for Toxic Substances & Disease Registry: http://www.atsdr.cdc.gov/hac/pha/HCPHA.asp?State=WI

Centers for Disease Control and Prevention. (2015c, September 25). *National Environmental Public Health Tracking Network*. Retrieved October 27, 2015, from http://ephtracking.cdc.gov/showHome.action

CEQ. (1997, December). *Environmental Justice: Guidance Under the National Environmental Policy Act.* Retrieved April 2015, from http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf

CEQ. (2014). *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*. Retrieved June 2014, from https://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa/ghg-guidance

Charpentier, V., Inizan, M. L., & Feblot-Augustins, J. (2002). *Fluting in the Old World: The Neolithic Projectile Points of Arabia.* Retrieved August 2015, from http://www.jstor.org/stable/23273456

CIO Council. (2015). *Data Center Consolidation and Optimization*. Retrieved from https://cio.gov/drivingvalue/data-center-consolidation/

City of Lincoln. (2015). *What are Saline Wetlands?* Retrieved July 2015, from http://lincoln.ne.gov/city/parks/parksfacilities/wetlands/wetlandsinfo.htm

Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of wetlands and deepwater habitats of the United States, FWS/OBS-79/31.* Retrieved April 5, 2015, from http://www.fws.gov/wetlands/Documents/classwet/index.html

CSC. (2007, March). Retrieved from Telecommunications Facilities: An Illustrated Primer on the Siting of Facilities within Connecticut and Throughout the Nation: http://www.ct.gov/csc/lib/csc/csc_tower_3_07.pdf

Davis, L. B. (2010). *Precontact Archaeology and Prehistory of the Central Montana High Plains.* Billings, Montana: Bureau of Land Management.

Department of Defense. (2014). *Base Structure Report - Fiscal Year 2014 Baseline; A Summary of the Real Property Inventory.* Retrieved September 2015, from http://www.acq.osd.mil/eie/

Detroit Photographic Company. (1898). Wisconsin. Appleton Paper Mills. *Library of Congress Prints and Photographs Online Collection*. Appleton, Wisconsin: Library of Congress. Retrieved October 2015, from http://www.loc.gov/resource/ppmsca.18045/

Detroit Publishing Company. (1890). Pabst Brewery, Milwaukee. *Library of Congress Prints and Photographs Online Collection*. Milwaukee, Wisconsin: Library of Congress. Retrieved October 2015, from http://www.loc.gov/resource/det.4a08082/

Di Gregorio, A., & Jansen, L. J. (1998). *Land Cover Classification System (LCCS): Classification Concepts and User Manual.* Rome: Food and Agriculture Organization of the United Nations.

Diesel Service & Supply. (2016, June). *Approximate Diesel Fuel Consumption Chart*. Retrieved from http://www.dieselserviceandsupply.com/Diesel_Fuel_Consumption.aspx

DNR. (2004). *Wisconsin's amphibian and reptile regulations*. Retrieved from http://dnr.wi.gov/files/pdf/pubs/er/er0102.pdf

DNR. (2005a). *Wisconsin Strategy for Wildlife Species of Greatest Conservation Need.* Retrieved June 2016, from http://dnr.wi.gov/files/PDF/pubs/er/ER0641.pdf

DNR. (2005b). *Planning for the future.* Madison, Wisconsin. Retrieved from http://dnr.wi.gov/topic/wildlifehabitat/wap10year.html

DNR. (2005c). *Michigan's Wildlife Action Plan.* Retrieved November 2015, from https://www.michigan.gov/documents/dnr/A0_Executive_Summary_and_TOC_319782_7.pdf

DNR. (2007a). *Mute Swans in Wisconsin.* Retrieved June 2016, from http://dnr.wi.gov/files/pdf/pubs/wm/wm0473.pdf

DNR. (2007b, June 25). *Wisconsin greenhouse gas emissions inventory and projections (June 25, 2007).* Retrieved February 28, 2016, from Wisconsin Digital Archives: http://www.wistatedocuments.org/cdm/ref/collection/p267601coll4/id/1737

DNR. (2008a). *Lake Sturgeon (Acipenser fulvescens).* Retrieved from Fishes of Wisconsin: http://dnr.wi.gov/topic/fishing/documents/species/lakesturgeon.pdf

DNR. (2008b). *Brook Trout (Salvelinus fontinalis).* Retrieved June 2016, from Fishes of Wisconsin - Trout and Salmon: http://dnr.wi.gov/topic/fishing/documents/species/brooktrout.pdf

DNR. (2011a). *General Permit to Discharge Under the Wisconsin Pollutant Discharge Elimination System*. Retrieved October 23, 2015, from http://dnr.wi.gov/topic/stormwater/documents/construction_permit_S067831-4.pdf

DNR. (2011b, May). *Division of Forestry Strategic Direction*. Retrieved October 2015, from http://dnr.wi.gov/topic/ForestPlanning/documents/SD_NRB_May2011_Final.pdf

DNR. (2012a). *Rapid Ecological Assessment for Driftless Area Study Streams.* Retrieved October 2015, from http://dnr.wi.gov/files/pdf/pubs/er/er0836_ext.pdf

DNR. (2012b). *Lake Michigan LaMP: Wisconsin Stories*. Retrieved November 2015, from http://dnr.wi.gov/topic/greatlakes/documents/LakeMichFactSheetFinal.pdf

DNR. (2012c). *Bluegill.* Retrieved June 2016, from Fishing Wisconsin Game fishes of Wisconsin: http://dnr.wi.gov/topic/fishing/species/bluegill.html

DNR. (2012d). *Yellow perch.* Retrieved June 2016, from Fishing Wisconsin Game fishes of Wisconsin: http://dnr.wi.gov/topic/fishing/species/yperch.html

DNR. (2012e, September 18). *Sustainable forestry*. Retrieved September 22, 2015, from http://dnr.wi.gov/topic/TimberSales/benefits.html

DNR. (2012f). *Wisconsin Initiative on Climate Change Impacts*. Retrieved 2015, from http://dnr.wi.gov/climatechange/

DNR. (2012g, December). *30th Street Industrial Corridor.* Retrieved October 27, 2015, from Remediation and Redevelopment Program: http://dnr.wi.gov/files/PDF/pubs/rr/RR928.pdf

DNR. (2013a). *Water Quality Certification.* Retrieved from http://docs.legis.wisconsin.gov/code/admin_code/nr/200/299.pdf

DNR. (2013b). *Outstanding and Exceptional Resource Waters*. Retrieved November 2015, from http://dnr.wi.gov/topic/surfacewater/orwerw.html

DNR. (2013c). *Small game hunting.* Tech. rep., Wisconsin Department of Natural Resource, Bureau of Wildlife Management.

DNR. (2014a, July). *2014 Annual Drinking Water Report Wisconsin's Public Water System*. Retrieved October 2015, from Department of Natural Resources: http://dnr.wi.gov/files/PDF/pubs/DG/DG0045.pdf

DNR. (2014b). *Clean Water Act Integrated Report 2014*. Retrieved November 2015, from http://dnr.wi.gov/topic/SurfaceWater/IR2014.html

DNR. (2014c). *Wisconsin's 2014 Water Quality Report to Congress*. Retrieved November 2015, from http://dnr.wi.gov/topic/SurfaceWater/documents/2014/Wisconsin%202014%20IR%20Executive%20Summary.pdf

DNR. (2014d). *Game Species in Wisconsin*. Retrieved from http://dnr.wi.gov/topic/wildlifeHabitat/game.html

DNR. (2014e). *Wisconsin's amphibians and reptiles*. Retrieved from http://dnr.wi.gov/topic/wildlifehabitat/herps.asp

DNR. (2014f, October 17). *Wisconsin State Park System: Hiking trails*. Retrieved September 22, 2015, from http://dnr.wi.gov/topic/parks/activities/hike.html

DNR. (2014g, October 31). *Brownfields: redeveloping contaminated property*. Retrieved October 27, 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/Brownfields/Brownfields.html

DNR. (2015a, October). *Wastewater Treatment in Wisconsin*. Retrieved October 2015, from Department of Natural Resources: http://dnr.wi.gov/topic/wastewater/

DNR. (2015aa). *Interdunal Wetland*. Retrieved November 2015, from http://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=detail&Code=CPHER068WI

DNR. (2015ab). *Great Lakes Ridge and Swale*. Retrieved November 2015, from http://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=detail&Code=CCCOM102WI

DNR. (2015ac). *Wildlife Areas*. Retrieved November 2015, from http://dnr.wi.gov/topic/lands/WildlifeAreas/

DNR. (2015ad). *Chapter NR 40: The Invasive Species Rule, Summary and Reference Guide.* Tech. rep.

DNR. (2015ae). *Wisconsin CH. NR 40 Invasive Species List*. Retrieved from http://dnr.wi.gov/topic/Invasives/documents/nr40lists.pdf

DNR. (2015af). *Wisconsin's rare birds*. Retrieved from http://dnr.wi.gov/topic/endangeredresources/Animals.asp?mode=list&Grp=7&sort=SGCN

DNR. (2015ag). *Invertebrate Species of Greatest Conservation Need*. Retrieved from http://dnr.wi.gov/topic/wildlifehabitat/profiles.asp?taxa=Invertebrate

DNR. (2015ah). *Gypsy moth*. Retrieved June 2016, from http://dnr.wi.gov/topic/foresthealth/gypsymoth.html

DNR. (2015ai). *Hemlock wooly adelgid*. Retrieved June 2016, from http://dnr.wi.gov/topic/foresthealth/adelgid.html

DNR. (2015aj). *Emerald ash borer*. Retrieved June 2016, from http://dnr.wi.gov/topic/foresthealth/emeraldashborer.html

DNR. (2015ak). *Fishing Wisconsin - trout and salmon fishing*. Retrieved from http://dnr.wi.gov/topic/fishing/trout/

DNR. (2015al). *Fishes of Wisconsin*. Retrieved from http://dnr.wi.gov/topic/fishing/species/

DNR. (2015am). *Sea lamprey and control efforts in Wisconsin*. Retrieved June 2016, from http://dnr.wi.gov/topic/fishing/lakesuperior/lampreybarrier.html

DNR. (2015an). *Mussels*. Retrieved from http://dnr.wi.gov/news/features/feature.asp?id=2&article=9

DNR. (2015ao). *Regulated aquatic invasive plants in Wisconsin*. Retrieved from http://dnr.wi.gov/topic/invasives/documents/nr40aquatics.pdf

DNR. (2015ap, June 16). *Wild Rivers*. Retrieved September 22, 2015, from http://dnr.wi.gov/topic/Lands/wildrivers/

DNR. (2015aq). *Wisconsin Department of Natural Resources*. Retrieved October 2015, from http://dnr.wi.gov/topic/

DNR. (2015ar). *Travel Wisconsin - Visitor Activity Guide*. Retrieved October 2015, from http://www.travelwisconsin.com/pdf/2015_state_parks_guide.pdf

DNR. (2015as). *Northern Highland-American Legion State Forest Visitor's Guide 2015*. Retrieved October 2015, from http://dnr.wi.gov/topic/StateForests/nhal/documents/visitorGuide.pdf

DNR. (2015at). *Flambeau River State Forest*. Retrieved October 2015, from http://dnr.wi.gov/topic/StateForests/flambeauRiver/

DNR. (2015au, September 10). *Chapter 2: Assessment of Current Conditions.* Retrieved September 22, 2015, from Ecological Landscapes of Wisconsin: http://dnr.wi.gov/topic/landscapes/documents/1805Ch2.pdf

DNR. (2015av, August 24). *Glacial Heritage Area*. Retrieved September 22, 2015, from http://dnr.wi.gov/topic/Lands/Other/GlacialHeritageArea.html

DNR. (2015aw, August 6). *Find a park*. Retrieved September 22, 2015, from http://dnr.wi.gov/topic/parks/findapark.html

DNR. (2015ax, July 21). *Wisconsin State Parks and Forests: Governor Knowles State Forest*. Retrieved from http://dnr.wi.gov/topic/StateForests/govKnowles/

DNR. (2015ay, August 6). *State Natural Areas Program*. Retrieved September 22, 2015, from http://dnr.wi.gov/topic/Lands/naturalareas/

DNR. (2015b, October). *WPDES Permits*. Retrieved October 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/wastewater/permits.html

DNR. (2015ba, March 31). *Wildlife Areas*. Retrieved September 21, 2015, from http://dnr.wi.gov/topic/lands/wildlifeareas/

DNR. (2015bb, June). *Final 2016 Monitoring Network Plan.* Retrieved October 21, 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/AirQuality/documents/2016NetworkPlanFinal.pdf

DNR. (2015bc, April). *2015 Wisconsin Air Quality Trends.* Retrieved October 21, 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/files/PDF/pubs/am/AM526.pdf

DNR. (2015bd, September 11). *Superfund*. Retrieved September 25, 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/brownfields/superfund.html

DNR. (2015be). *Chapter NR 40 Invasive Species Identification, Classification and Control*. Retrieved from http://dnr.wi.gov/topic/invasives/classification.html

DNR. (2015bf). *Invasive species*. Retrieved from http://dnr.wi.gov/topic/invasives/

DNR. (2015bg). *Calcareous Fen*. Retrieved from WDNR Calcareous Fens: http://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=detail&Code=CPHER064WI

DNR. (2015c, October). *Wastewater Operator Certification*. Retrieved October 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/regulations/opcert/wastewater.html

DNR. (2015d, October). *Solid Waste Management In Wisconsin*. Retrieved October 2015, from Department of Natural Resources of Wisconsin: http://dnr.wi.gov/topic/waste/solid.html

DNR. (2015e, October). *Solid Waste Landfills Licensed in Wisconsin Licensed for Year 2016*. Retrieved October 2015, from Wisconsin Department of Natrual Resources: http://dnr.wi.gov/topic/Waste/documents/faclists/WisLic_SWLandfills.pdf

DNR. (2015f, October). *Landfills*. Retrieved October 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/Landfills/

DNR. (2015g, June). *Municipal & Industrial Waste Landfills 2014*. Retrieved October 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/Landfills/documents/reports/2014tonnage.pdf

DNR. (2015h, October). *Recyling and Composting*. Retrieved October 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/Recycling/

DNR. (2015i, October). *Recyclable Materials Collected by Wisconsin Responsible Units (in tons)*. Retrieved October 2015, from Wisconsin Department of Natural Resources: http://dnr.wi.gov/topic/Recycling/documents/table1forweb.pdf

DNR. (2015k, October). *Wisconsin State Fossil*. Retrieved from http://dnr.wi.gov/eek/nature/state/fossil.htm

DNR. (2015m). *Lake Superior Basin*. Retrieved November 2015, from http://dnr.wi.gov/water/basin/superior/

DNR. (2015n). *Upper Green Bay Basin*. Retrieved November 2015, from http://dnr.wi.gov/water/basin/upgb/

DNR. (2015o). *Lower Wisconsin River Basin*. Retrieved November 2015, from http://dnr.wi.gov/water/basin/lowerwis/

DNR. (2015p). *River Facts*. Retrieved November 2015, from http://dnr.wi.gov/topic/rivers/riverfacts.html

DNR. (2015q). *Water Atlas Data, Webinars & Reports*. Retrieved November 2015, from http://dnr.wi.gov/topic/SurfaceWater/atlas.html

DNR. (2015r). *Lake Winnebago*. Retrieved November 2015, from http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=131100

DNR. (2015s). *Lake Superior*. Retrieved November 2015, from http://dnr.wi.gov/org/caer/ce/eek/nature/habitat/lakesuperior.htm

DNR. (2015t). *Lake Superior Basin*. Retrieved November 2015, from http://dnr.wi.gov/water/basin/superior/

DNR. (2015u). *Lake Michigan*. Retrieved November 2015, from http://dnr.wi.gov/topic/endangeredresources/communities.asp?mode=detail&code=c9

DNR. (2015v). *Wild Rivers*. Retrieved November 2015, from http://dnr.wi.gov/topic/Lands/WildRivers/

DNR. (2015w). *Waterway Protection Wetland Disturbance*. Retrieved October 19, 2015, from http://dnr.wi.gov/topic/waterways/construction/wetlands.html

DNR. (2015x). *Wetland Types*. Retrieved November 2015, from http://dnr.wi.gov/topic/wetlands/types.html

DNR. (2015y). *Wetland Communities of Wisconsin*. Retrieved November 2015, from http://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=group&Type=Wetland

DNR. (2015z). *Coastal Wetlands of Wisconsin's Great Lakes*. Retrieved November 2015, from http://dnr.wi.gov/topic/wetlands/coastal/

DNR. (2016a). *Water Permit Applications*. Retrieved June 2016, from http://dnr.wi.gov/permits/water/

DNR. (2016b, May 19). *Wisconsin natural heritage working list*. Retrieved from http://dnr.wi.gov/topic/NHI/WList.html

DNR. (2016c). *Wisconsin Fish Species List.* Retrieved June 2016, from http://dnr.wi.gov/topic/fishing/documents/species/wifish.pdf

DNR. (2016d). *Wisconsin's rare fishes*. Retrieved June 2016, from http://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=list&Grp=13

DNR. (2016e). *Shovelnose Sturgeon - Identification.* Retrieved June 2016, from http://dnr.wi.gov/topic/fishing/sturgeon/shovelnosesturgeonidentification.html

DNR. (2016f). *Paddlefish (Polydon spathula).* Retrieved June 2016, from http://dnr.wi.gov/topic/endangeredresources/animals.asp?mode=detail&speccode=afcab01010

DNR. (2016g). *Bullheads.* Retrieved June 2016, from Game fishes of Wisconsin: http://dnr.wi.gov/topic/fishing/documents/species/bullheads.pdf

DNR. (2016h). *General Permit to Discharge Under the Wisconsin Pollutant Discharge Elimination System.* Retrieved June 2016, from http://dnr.wi.gov/topic/stormwater/documents/construction_permit_S067831-4.pdf

DNR. (2016i). *Spotted Salamander (Ambystoma maculatum)*. Retrieved from http://dnr.wi.gov/topic/wildlifehabitat/herps.asp?mode=detail&spec=aaaaa01090

DOE. (2015). *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions.* Washington, DC: Department of Energy. Retrieved December 15, 2015

DOE. (2016, May 19). *Glossary of Hydropower Terms*. Retrieved from http://energy.gov/eere/water/glossary-hydropower-terms

DOT. (2015, 05 28). *Highway Traffic Noise*. Retrieved 07 22, 2015, from http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm

DOT, F. (2015). *Federal Railroad Administration Horn Noise FAQ*. Retrieved 07 22, 2015, from https://www.fra.dot.gov/Page/P0599

DuluthPort. (2015a, October). *Mid-America's gateway to the world*. Retrieved October 2015, from Port of Duluth-Superior: http://www.duluthport.com/port-area-map.php

DuluthPort. (2015b, October). *Overview*. Retrieved October 2015, from Port of Duluth-Superior: http://www.duluthport.com/port.php

eBird. (2015a). *eBird range map--bald eagle*. Retrieved from http://ebird.org/ebird/map/baleag?bmo=1&emo=12&byr=2011&eyr=2015&__hstc=75100365.64b7254677ac8cc5c8f21aa17c0b9689.1442877327577.1442877327577.144287732

7577.1&__hssc=75100365.4.1442877327577&__hsfp=3470679313#_ga=1.21938685.790432658.1442877326

eBird. (2015b). *eBird range map--golden eagle*. Retrieved from http://ebird.org/ebird/map/goleag?bmo=1&emo=12&byr=2011&eyr=2015#_ga=1.21938685.790432658.1442877326

Egan, K. C. (1988). *Middle and Late Archaic Phytogeography and Floral Exploitation in the Upper Great Lakes.* Retrieved October 2015, from http://www.jstor.org/stable/20708267

EIA. (2015a, October). *Wisconsin Profile Overview*. Retrieved October 2015, from U.S. Energy Information Administration: http://www.eia.gov/state/?sid=WI

EIA. (2015b, October). *Electricity Data Browser*. Retrieved October 2015, from U.S. Energy Information Administration: http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvo&geo=00001&sec=g&linechart=ELEC.GEN.ALL-WI-99.A&columnchart=ELEC.GEN.ALL-WI-99.A&map=ELEC.GEN.ALL-WI-99.A&freq=A&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0

EIA. (2015c, July). *Wisconsin*. Retrieved July 2015, from U.S. Energy Information Administration: http://www.eia.gov/state/?sid=WI

EIA. (2015d, July). *Greenhouse Gas Emissions Overview*. Retrieved 07 28, 2015, from Emissions of Greenhouse Gases in the United States: http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm

EIA. (2015e, October 26). *State Carbon Dioxide Emissions*. Retrieved February 11, 2016, from http://www.eia.gov/environment/emissions/state/

EIA. (2015f, October 26). *Energy-Related CO2 Emissions at the State Level, 2000-2013*. Retrieved February 11, 2016, from http://www.eia.gov/environment/emissions/state/analysis/

EIA. (2015g, February 19). *Wisconsin - State Profile and Energy Estimates*. Retrieved 9 17, 2015, from http://199.36.140.204/state/?sid=WI

EIA. (2015h, July 7). *How much carbon dioxide is produced by burning gasoline and diesel fuel?* Retrieved September 21, 2015, from http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11

EIA. (2016). *Glossary - Electricity*. Retrieved from U.S. Energy Information Administration: https://www.eia.gov/tools/glossary/?id=electricity

Executive Office of the President. (1994, February). *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Retrieved April 2015, from 59 Federal Register 7629: https://federalregister.gov/a/94-3685

FAA. (2007, August 26). *Hearing and Noise in Aviation*. Retrieved 07 22, 2015, from https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing_brochure.pdf

FAA. (2008). *Chapter 14 Airspace.* Retrieved June 2015, from Pilot's Handbook of Aeronautical Knowledge: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2014.pdf

FAA. (2012a, April 05). *Advisory Circular AC 36-3H*. Retrieved 07 22, 2015, from http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC36-3H%20Chg%201.pdf

FAA. (2012b). *Evaluation for new obstruction lighting techniques to reduce avian fatalities.* Technical Circular, Federal Aviation Administration. Retrieved from http://www.tc.faa.gov/its/worldpac/techrpt/tctn12-9.pdf

FAA. (2013). *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap.* Washington D.C.: U.S. Department of Transportation Federal Aviation Administration.

FAA. (2014, January). *Federal Aviation Administration, Air Traffic Organization*. Retrieved June 2015, from http://www.faa.gov/about/office_org/headquarters_offices/ato/

FAA. (2015a, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from http://www.faa.gov/about/office_org/field_offices/fsdo/

FAA. (2015b). *Aeronatical Information Manual.* Retrieved from http://www.faa.gov/air_traffic/publications/media/aim.pdf

FAA. (2015c). *Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)*. Retrieved July 2015, from Federal Aviation Administration: https://oeaaa.faa.gov/oeaaa/external/portal.jsp

FAA. (2015d, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from http://www.faa.gov/about/office_org/field_offices/fsdo/

FAA. (2015e). *FAA Air Traffic Organization Policy JO 7400.9Z Airspace Designations and Reporting Points*. Retrieved March 2016, from Marcellus Shale: http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.list/parentTopicID/10

FAA. (2015f, August). *FAA Pilot Safety Brochure - Hearing and Noise in Aviation.* Retrieved 08 05, 2015, from FAA.gov: https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing_brochure.pdf

FAA. (2015g). *Aviation System Performance Metrics (ASPM) Database*. Retrieved 07 22, 2015, from https://aspm.faa.gov/apm/sys/AnalysisAP.asp

FAA. (2016a, June). *Airport Data and Contact Information*. Retrieved March 2016, from http://www.faa.gov/airports/airport_safety/airportdata_5010/

FAA. (2016b). *FAA Order JO 7400.8Y, Special Use Airspace*. Retrieved March 2016, from http://www.faa.gov/documentLibrary/media/Order/7400.8Y_(2016).pdf

FAA. (2016c). *Wisconsin TFT List*. Retrieved March 2016, from Federal Aviation Administration - Graphic TFR's: http://tfr.faa.gov/tfr2/list.jsp

FCC. (2000, August). *Deployment of Advanced Telecommunications Capability: Second Report.* Retrieved Nov 16, 2015, from https://transition.fcc.gov/Bureaus/Common_Carrier/Orders/2000/fcc00290.pdf

FCC. (2012, March 13). *Final Programmatic Environmental Assessement for the Antenna Structure Registration Program.* Retrieved from https://apps.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf

FCC. (2014a). *Internet Access Servies: Status as of December 31, 2013.* Industry Analysis and Technology Division Wireline Competition Bureau. Federal Communications Commission.

FCC. (2014b). *Local Telephone Competition: Status as of December 31, 2013.* Industry Analysis and Technology Division Wireline Competition Bureau.

FCC. (2015a). *Master PSAP Registry, V 2.0.* PSAP Registry Data Report.

FCC. (2015b, June 17). *Antenna Structure Registration*. Retrieved June 17, 2015, from Federal Communications Commission: http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp

FCC. (2016, February 1). *Tower and Antenna Siting*. Retrieved February 10, 2016, from https://www.fcc.gov/general/tower-and-antenna-siting

FCC. (2016c, June). *Detail - Microwave*. Retrieved from Application Search Help: http://wireless2.fcc.gov/helpfiles/applicationSearch/ad_microwave.html

Federal Mining Dialogue. (2015a, January 6). *Abandoned Mine Lands Portal - Staying Safe*. Retrieved September 29, 2015, from http://www.abandonedmines.gov/ss.html

Federal Mining Dialogue. (2015b, May 7). *Abandoned Mine Lands Portal*. Retrieved from http://www.abandonedmines.gov/

Federal Transit Authority. (2006). *Transit Noise and Vibration Impact Assessment.* FTA.

FEMA. (2000). *44 CFR Section 59.1 of the National Flood Insurance Program (NFIP) Regulations: Definitions of NFIP Terms.* Retrieved May 2015, from http://www.fema.gov/media-library/assets/documents/12437?id=3064

FEMA. (2010, March). *Guidelines for Estimation of Percolation losses for NFIP Studies.* Retrieved August 2015, from FEMA: http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl_perc.pdf

FEMA. (2013). *Unit 3: NFIP Flood Studies and Maps*. Retrieved May 2015, from http://www.fema.gov/media-library-data/20130726-1539-20490-0241/nfip_sg_unit_3.pdf

FEMA. (2014, June). Retrieved from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communites_May_1_2014.pdf

FEMA. (2014a, May). *Chapter 8: Floodplain Natural Resources and Functions*. Retrieved May 2015, from https://training.fema.gov/hiedu/docs/fmc/chapter%208%20-%20floodplain%20natural%20resources%20and%20functions.pdf

FEMA. (2014b, May). *Chapter 2: Types of Floods and Floodplains*. Retrieved May 2015, from http://training.fema.gov/hiedu/docs/fmc/chapter%202%20-%20types%20of%20floods%20and%20floodplains.pdf

FEMA. (2014c, May). *The National Flood Insurance Program Community Status Book*. Retrieved May 2015, from http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book

FEMA. (2014d, May). *Community Rating System*. Retrieved May 2015, from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communites_May_1_2014.pdf

FEMA. (2015, April). *Floodplain Management Fact Sheet*. Retrieved May 2015, from https://www.fema.gov/floodplain-management-fact-sheet

Fenneman, N. (1916). *Physiographic Subdivision of the United States.* Retrieved April 2015, from http://www.pnas.org/content/3/1/17.full.pdf?ck=nck

FGDC. (2013, August). *Classification of Wetlands and Deepwater Habitats of the United States.* Retrieved April 17, 2015, from FGDC Subcommittee on Wetlands Data: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013

FHWA. (2011, July 14). *Highway Traffic and Construction Noise*. Retrieved from fhwa.dot.gov: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix

FHWA. (2013, September 3). *National Scenic Byways Program - Intrinsic Qualities: Identification and Distinctions*. Retrieved May 2016, from http://www.fhwa.dot.gov/hep/scenic_byways/byway_quality/analysis/iq_identification.cfm

FHWA. (2014a, October 21). *Public Road Length*. Retrieved October 16, 2015, from http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm10.cfm

FHWA. (2014b, October 1). *National Scenic Byways Program*. Retrieved April 8, 2015, from http://www.fhwa.dot.gov/hep/scenic_byways/

FHWA. (2015a, May 28). *Bridges by State and County 2014*. Retrieved October 16, 2015, from http://www.fhwa.dot.gov/bridge/nbi/no10/county14e.cfm#wi

FHWA. (2015b). *Route Log and Finder List*. Retrieved October 16, 2015, from Federal Highway Administration: http://www.fhwa.dot.gov/reports/routefinder/#s09

FHWA. (2015c, October). *Wisconsin*. Retrieved October 16, 2015, from http://www.fhwa.dot.gov/byways/states/WI

FHWA. (2015d). *Wildlife vehicle collision reduction study*. Retrieved from https://www.environment.fhwa.dot.gov/ecosystems/wvc/ch4.asp#top

Fiber Optic Association. (2010). *Guide to Fiber Optics & Premises Cabling*. Retrieved September 21, 2015, from Safety in Fiber Optic Installations: http://www.thefoa.org/tech/safety.htm

GAO. (2013). *Data Center Consolidation: Strengthened Oversight Needed to Achieve Billions of Dollars in Savings*. Retrieved from http://www.gao.gov/products/GAO-13-627T

Gehring, J., Kerlinger, P., & Manville., A. M. (2011). The role of tower height and guy wires on avian collisions with communication towers. *The Journal of Wildlife Management, 75*, 848-855. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/jwmg.99/abstract

Government Publishing Office. (2010a, April 5). *Title 40 Code of Federal Regulations Part 93.153*. Retrieved July 20, 2015, from http://www.ecfr.gov/cgi-bin/text-idx?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93_1153&rgn=div8

Government Publishing Office. (2011). *Title 7, Agriculture, Chapter 104 - Plant Protection*. Retrieved from https://www.gpo.gov/fdsys/pkg/USCODE-2011-title7/pdf/USCODE-2011-title7-chap104.pdf

Government Publishing Office. (2015, June). *Electronic Code of Federal Regulations.* Retrieved June 2015, from U.S. Government Publishing Office: http://www.ecfr.gov/cgi-bin/text-idx?SID=6095c0db6bb5edb10c850334725dae34&mc=true&tpl=/ecfrbrowse/Title36/36tab_02.tpl

Haynes, C. V., Donahue, D., Jull, A., & Zabel, T. (1984). Application of Accelerator Dating to Fluted Point Paleoindian Sites. *Archaeology of Eastern North America, 12*, 184-191. Retrieved September 2015, from http://www.jstor.org/stable/40914238

Haynes, V. T., Johnson, E., & Stafford, T. W. (1999). AMS Radiocarbon Dating of the Type Plainview and Firstview (Paleoindian) Assemblages: The Agony and the Ecstasy. *American Antiquity, 64*(3), 444-454. Retrieved September 2015, from http://www.jstor.org/stable/2694144

Highsmith, C. M. (1980). *[Historic interpretor harvesting radishes at Old World Wisconsin, The State Historical Society's outdoor museum in Eagle Wisconsin]*. Retrieved October 2015, from http://www.loc.gov/resource/highsm.15104/

Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R., & Treweek, J. (1997). Bird Disturbance: Improving the Quality and Utility of Disturbance Research. *Journal of Applied Ecology,* 34(2): 275-288. Retrieved from http://obpa-nc.org/DOI-AdminRecord/0048804-0048817.pdf

Hill, M. A. (2012, April). *Tracing Social Interaction: Perspectives on Archaic Copper Exchange from the Upper Great Lakes.* Retrieved October 2015, from http://www.jstor.org/stable/23486062

Hill, M. G. (1994). *Paleoindian Projectile Points from the Vicinity of Silver Mound (47JA21), Jackson County, Wisconsin.* Retrieved October 2015, from http://www.jstor.org/stable/20708365

Historic American Buildings Survey. (1933a). *Cedarburg Mill, 215 East Columbia Avenue, Cedarburg, Ozaukee County, WI.* Retrieved October 2015, from http://www.loc.gov/resource/hhh.wi0053.photos/?sp=1

Historic American Buildings Survey. (1933b). *Pioneer Log Cabin, Public Square Vicinity, Milton, Rock County, WI.* Retrieved October 2015, from http://www.loc.gov/pictures/search/?q=Photograph:%20wi0107&fi=number&op=PHRASE&va=exact&co%20=hh&st=gallery&sg%20=%20true

Historic American Buildings Survey. (1965). *Wisconsin Architecture A Catalog of Buildings Represented in the Library of Congress, With Illustrations From Mesred Drawings.* Washington, D.C.: Government Printing Office.

Homan, R., Atwood, M., Dunkle, A., & Karr, S. (2010). Movement orientation by adult and juvenile wood frogs (Rana sylvatica) and American toads (Bufo americanus) over multiple years. *Herptelogical Conservation and Biology, 5*, 64-72. Retrieved from http://www.herpconbio.org/Volume_5/Issue_1/Homan_etal_2010.pdf

Idaho State University. (2000). *Environmental Geology*. Retrieved March 20, 2016, from http://geology.isu.edu/wapi/EnvGeo/EG4_mass_wasting/EG_module_4.htm

Illinois DNR. (2015). *Regional Assessment of the Wisconsin Driftless Natural Division.* Retrieved October 2015, from http://www.dnr.illinois.gov/conservation/IWAP/Documents/NaturalDivisions/WisconsinDriftless.pdf

Institute of Maritime History. (2015, August). *Rainsford Island Archaeological Survey*. Retrieved August 2015, from http://www.maritimehistory.org/content/rainsford-island-archaeological-survey

International Finance Corporation. (2007a, April 30). *Environmental, Health, and Safety Guidelines for Telecommunications*. Retrieved from http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final+-+Telecommunications.pdf?MOD=AJPERES&id=1323152343828

International Finance Corporation. (2007b, April 30). *Environmental, Health, and Safety Guidelines for Telecommunications*. Retrieved from http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final+-+Telecommunications.pdf?MOD=AJPERES&id=1323152343828

IPCC. (2007). *Climate Change 2007: Synthesis Report.* Retrieved October 2013, from Intergovernmental Panel on Climate Change: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

IPCC. (2013). *Climate Change 2013: The Physical Science Basis.* Intergovernmental Panel on Climate Change. Retrieved from https://www.ipcc.ch/report/ar5/wg1/

Kirtland's Warbler Recovery Team. (1985). *Kirtland's warbler recovery plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/850930.pdf

Kottek, M. (2006). *World Map of the Köppen-Geiger Climate Classification.* Offenbach, Germany and Vienna, Austria: Gebrüder Borntraeger.

Kuehn, S. R. (1998, July). *New Evidence for Late Paleoindian-Early Archaic Subsistence Behavior in the Western Great.* Retrieved October 2015, from http://www.jstor.org/stable/2694630

Lehman, E. (2015). *Wisconsin Agency Bans Talk of Climate Change*. Retrieved 2015, from Scientific American: http://www.scientificamerican.com/article/wisconsin-agency-bans-talk-of-climate-change/

Mehrer, M. W. (1998, June). *Early Pottery in Midwestern North America.* Retrieved October 2015, from http://www.jstor.org/stable/27768404

Merriam Webster Dictionary. (2015a). *Airspace*. Retrieved June 2015, from Merriam Webster Dictionary: http://www.merriam-webster.com/dictionary/airspace

Merriam Webster Dictionary. (2015b). *Sea Level*. Retrieved from http://www.merriam-webster.com/dictionary/sea%20level

Metra. (2015, May 13). *About the Metra System*. Retrieved October 16, 2015, from http://metrarail.com/content/dam/metra/documents/Planning/System_Profile_20150513.pdf

MFWP. (2015a). *Prohibited Species*. Retrieved August 2015, from http://fwp.mt.gov/fishAndWildlife/species/exotics/prohibited.html#mam

MFWP. (2015b). *Controlled Species*. Retrieved August 2015, from http://fwp.mt.gov/fishAndWildlife/licenses/controlled.html

MFWP and MNHP. (2015). *Montana field guide*. Retrieved from http://fieldguide.mt.gov/displayES_LCLU.aspx

Michigan Department of Natural Resources. (2015). *Kirtland's warbler (Dendroica kirtlandii)*. Retrieved from http://www.michigan.gov/dnr/0,1607,7-153-10370_12145_12202-32591--,00.html

MKE. (2014, December). *Air Traffic Report*. Retrieved October 16, 2015, from http://www.mitchellairport.com/files/1214/2291/3782/December_ATRPT.pdf

MKE. (2015). *Master Plan Update Chapter 2*. Retrieved October 16, 2015, from http://www.mitchellairport.com/files/1713/0988/7841/MKE_Chp_2.pdf

Moody, D. W., Carr, J., Chase, E. B., & Paulson, R. W. (1986). *National Water Summary 1986 -- Hydrologic Events and Ground-Water Quality.* Retrieved April 5, 2015, from http://pubs.er.usgs.gov/publication/wsp2325

NASA. (2013, July). Final Environmental Impact Statement: Sounding Rockets Program at Poker Flat Research Range. Wallops Island, VA. Retrieved July 1, 2016, from http://netspublic.grc.nasa.gov/main/NASA%20SRP%20at%20PFRR%20FEIS%20Volume%20I.pdf

National Association of State Aviation Officials. (2015). *Resources NASAO National Association of State Aviation Officials*. Retrieved July 2015, from NASAO National Association of State Aviation Officials: http://www.nasao.org/resources/state-system-plan-library/

National Audubon Society. (2015). *Important Bird Areas in Wisconsin*. Retrieved from http://netapp.audubon.org/IBA/State/US-WI

National Institute of Health. (2015, June). *What is TOXMAP?* Retrieved from http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html

National Science Foundation. (2015). *Can Marcellus Shale Gas Development and Healthy Waterways Sustainably Coexist?* Retrieved August 2015, from https://www.nsf.gov/discoveries/disc_images.jsp?cntn_id=122543&org=NSF

National Weather Service. (2015, June 10). *Office of Climate, Water, and Weather Services*. Retrieved October 27, 2015, from 2014 Summary of Hazardous Weather Fatalities, Injuries, and Damage by State: http://www.nws.noaa.gov/om/hazstats/state14.pdf

National Wild and Scenic Rivers System. (2015a). *St. Croix River, Minnesota, Wisconsin*. Retrieved November 2015, from http://www.rivers.gov/rivers/st-croix.php

National Wild and Scenic Rivers System. (2015b). *Wolf River, Wisconsin*. Retrieved November 2015, from http://www.rivers.gov/rivers/wolf.php

National Wild and Scenic Rivers System. (2015c). *Wisconsin*. Retrieved September 22, 2015, from http://www.rivers.gov/wisconsin.php

National Wildlife Federation. (2015). *Ecoregions*. Retrieved from http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecoregions.aspx

NCED. (2015). *State of Wisconsin and All Easements*. Retrieved November 2015, from National Conservation Easement Database: http://conservationeasement.us/reports/easements?report_state=Wisconsin&report_type=All

Nehm, R., & Bemis, B. (2002). *Common Paleozoic Fossils of Wisconsin.* Retrieved October 2015, from Common Paleozoic Fossils of Wisconsin: http://wgnhs.uwex.edu/pubs/download_es045/

New Hampshire Department of Environmental Services. (2014). *Geologic Mapping Program.* Retrieved August 2015, from http://des.nh.gov/organization/commissioner/gsu/gmp/categories/overview.htm

NIST. (2015, March). *Nationwide Public Safety Broadband Network Deployment: Network Parameter Sensitivity Analysis.* U.S. Department of Commerce. National Institute of Standards and Technology (NIST), Wireless Networks Division, Communications Technology Laboratory. Retrieved from http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8039.pdf

NOAA. (2010). *NOAA and Wisconsin Officials Designate the Lake Superior National Estuarine Research Reserve*. Retrieved November 2015, from National Climatic Data Center: http://oceanservice.noaa.gov/news/weeklynews/oct10/wisconsin_nerr.html

NOAA. (2015a). *Lake Superior National Estuarine Research Reserve*. Retrieved November 2015, from http://nerrs.noaa.gov/reserves/lake-superior.html

NOAA. (2015b). *National Oceanic and Atmospheric Administration*. Retrieved from National Centers of Environmental Information: http://www.ncdc.noaa.gov/cag/time-series/us

NPS. (1995a, July 12). *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes.* Retrieved September 4, 2015, from National Park Service: http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm

NPS. (1995b). *The Secretary of the Interior's Standards for the Treatment of Historic Properties + Guidelines for the Treatment of Cultural Landscapes*. Retrieved March 2016, from http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/

NPS. (2000). *Geologic Glossary*. Retrieved August 2015, from https://www.nature.nps.gov/geology/usgsnps/misc/glossaryDtoI.html#G

NPS. (2004). *Rocky Mountain National Park.* U.S. Department of Interior. Retrieved September 1, 2015, from http://www.nps.gov/romo/learn/management/upload/romo_geo_overview.pdf

NPS. (2011a, May 19). *Connecting with Native Americans*. Retrieved April 12, 2015, from http://www.nps.gov/history/tribes/Heritage_Areas.htm

NPS. (2011b, July 26). *Class I Area Locations*. Retrieved April 21, 2015, from http://www.nature.nps.gov/air/maps/classiloc.cfm

NPS. (2012a, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from http://nature.nps.gov/nnl/index.cfm

NPS. (2012b, June 28). *National Natural Landmarks Program*. Retrieved September 21, 2015, from http://www.nature.nps.gov/nnl/state.cfm?State=WI

NPS. (2012c, June 28). *National Natural Landmarks Program: Avoca River-Bottom Prairie*. Retrieved September 21, 2015, from http://www.nature.nps.gov/nnl/site.cfm?Site=AVRI-WI

NPS. (2012d, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from http://www.nps.gov/nts/legislation.html

NPS. (2013, December 10). *Geologic Hazards*. Retrieved September 1, 2015, from Geologic, Energy, and Mineral Resources: http://www.nature.nps.gov/geology/hazards/

NPS. (2014a). *Earth Science Concepts - Geology by Region.* Retrieved October 2015, from https://www.nature.nps.gov/geology/education/concepts/concepts_regional_geology.cfm

NPS. (2014b). *Earth Science Concepts - Superior Upland Province*. Retrieved October 2015, from http://www.nature.nps.gov/geology/education/concepts/concepts_superiorupland.cfm

NPS. (2014c, October 22). *National Natural Landmarks Program*. Retrieved April 21, 2015, from http://nature.nps.gov/nnl/index.cfm

NPS. (2014d, 06 16). *National Park Service Science of Sound*. Retrieved 07 22, 2015, from http://www.nature.nps.gov/sound/science.cfm

NPS. (2015a). *Wisconsin*. Retrieved November 2015, from National Natural Landmarks Program: http://www.nature.nps.gov/nnl/state.cfm?State=WI

NPS. (2015b). *North Country National Scenic Trail*. Retrieved October 2015, from http://www.nps.gov/noco/planyourvisit/index.htm

NPS. (2015c, Sept). *National Heritage Areas*. Retrieved Sept 2015, from http://www.nps.gov/heritageareas/

NPS. (2015d). *Saint Croix National Scenic Riverway*. Retrieved October 2015, from http://www.nps.gov/sacn/index.htm

NPS. (2015e). *National Historic Landmarks Survey*. Retrieved September 22, 2015, from Listing of National Historic Landmarks by State: Wisconsin: http://www.nps.gov/nhl/find/statelists/wi/WI.pdf

NPS. (2015f, September 10). *Apostle Islands National Lakeshore*. Retrieved September 22, 2015, from http://www.nps.gov/apis/index.htm

NPS. (2015g, September 21). *Saint Croix National Scenic Riverway*. Retrieved September 22, 2015, from http://www.nps.gov/sacn/index.htm

NPS. (2015h). *National Heritage Areas: A Map of All the National Heritage Areas*. Retrieved May 2015, from National Park Service: http://www.nps.gov/maps/full.html?mapId=01a03739-ab0c-40eb-bc3d-6791d3bb67fa

NPS. (2015i, February 18). *National Historic Landmarks Program.* Retrieved May 2016, from https://www.nps.gov/nhl/

NPS. (2015j). *National Register of Historic Places Program: Fundamentals*. Retrieved September 23, 2015, from http://www.nps.gov/nr/national_register_fundamentals.htm

NPS. (2016a). *Apostle Islands National Lakeshore*. Retrieved March 2016, from http://www.nps.gov/state/wi/index.htm

NPS. (2016b). *Mainland Sea Caves - Ice Caves*. Retrieved March 2016, from http://www.nps.gov/apis/mainland-caves-winter.htm

NPS. (2016c). *National Register of Historic Places Program: Research*. Retrieved March 2016, from http://www.nps.gov/nr/research/

NPS. (2016d, June). *National Historic Landmarks Program*. Retrieved from https://www.nps.gov/nhl/learn/intro.htm

NPS. (2016e). *NPGallery Digital Asset Search*. Retrieved June 2016, from http://npgallery.nps.gov/nrhp/

NPS. (2016f, May 19). *Wisconsin*. Retrieved October 14, 2015, from http://www.nps.gov/state/wi/index.htm

NRCS. (1996a). *Soil Quality Resource Concerns: Soil Erosion*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051278.pdf

NRCS. (1996b). *Soil Quality Resource Concerns: Compaction*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051594.pdf

NRCS. (1999). *Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys.* Retrieved from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf

NRCS. (2000, March). *Soil Quality - Urban Technical Note No. 1.* Retrieved from Erosion and Sedimentation on Construction Sites: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053285.pdf

NRCS. (2003). *Soil Compaction: Detection, Prevention, and Alleviation*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053258.pdf

NRCS. (2006). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* Retrieved May 2015, from Major Land Resource Area: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf

NRCS. (2009). *Protecting pollinators*. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/newsroom/photos/?cid=nrcs144p2_057907

NRCS. (2015a). *What is Soil?* Retrieved June 2015, from Soil Education: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054280

NRCS. (2015b). *Twelve Orders of Soil Taxonomy*. Retrieved August 2015, from Soils: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053588

NRCS. (2015c). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved July 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf

NRCS. (2015d). *STATSGO2 Database.* Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053629

NRCS. (2015e). *Hydric Soils -- Introduction.* Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961

NRCS. (2015f). *Erosion*. Retrieved September 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/erosion/

NTFI. (2005). *Why Can't We Talk? Working Together to Bridge the Communications Gap to Save Lives: A Guide for Public Officials.* U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. National Task Force on Interoperability (NTFI). Retrieved from https://www.ncjrs.gov/pdffiles1/nij/204348.pdf

NTIA. (2005, October). *Interference Protection Criteria Phase 1 - Compilation from Existing Sources.* Retrieved January 6, 2016, from NTIA Report 05-432: https://www.ntia.doc.gov/files/ntia/publications/ipc_phase_1_report.pdf

NTIA. (2014). *Download Data.* Retrieved from National Broadband Map: http://www.broadbandmap.gov/data-download

NWS. (2011a, October 21). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Adminisration: http://www.srh.noaa.gov/jetstream//global/climate.htm#map

NWS. (2011b, October 21). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration: http://www.srh.noaa.gov/jetstream//global/climate_max.htm

Omernik, J., Chapman, S., Lilllie, R., & Dumke, R. (2008, May). *Ecoregions of Wisconsin*. Retrieved June 2016, from http://dnr.wi.gov/topic/SurfaceWater/datasets/omernik_eco/

Oregon Department of Geology. (2015). *Earthquake Hazards in the Pacific Northwest*. Retrieved March 2015, from http://www.oregongeology.org/sub/earthquakes/EQs.htm

OSHA. (2002). *Occupational Safety & Health Administration We Can Help*. Retrieved from Hearing Conservation: https://www.osha.gov/Publications/OSHA3074/osha3074.html

OSHA. (2003). *Fact Sheets on Natural Disaster Recovery: Flood Cleanup.* Retrieved December 2013, from https://www.osha.gov/OshDoc/data_Hurricane_Facts/Bulletin2.pdf

OSHA. (2015a). *Communication Towers*. Retrieved from https://www.osha.gov/doc/topics/communicationtower/index.html

OSHA. (2015b). *Occupational Safety & Health Administration We Can Help*. (S. L. OSHA Directorate of Technical Support and Emergency Management, & U. Salt Lake City, Editors) Retrieved September 22, 2015, from Safety & Health Managment System Tools: https://www.osha.gov/SLTC/etools/safetyhealth/comp3.html#Safe Work Practices

OSHA. (2016a). *OSHA Technical Manual: Noise.* Retrieved May 2016, from Section III: Chapter 5: https://www.osha.gov/dts/osta/otm/new_noise/

OSHA. (2016b, May 29). *Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring*. Retrieved from https://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html

Page, S. D. (2012, October 15). Timely Processing of Prevention of Significant Deterioration (PSD) Permits when EPA or a PSD-Delegated Air Agency Issues the Permit. Retrieved April 21, 2015, from https://www.epa.gov/nsr/timely-processing-prevention-significant-deterioration-psd-permits-when-epa-or-psd-delegated-air

Paleontology Portal. (2015). *Wisconsin*. Retrieved October 2015, from http://paleoportal.org/index.php?globalnav=time_space&sectionnav=state&state_id=48

Pauketat, T. R. (2012). *The Oxford Handbook of North American Archaeology.* New York, New York: Oxford University Press, Inc.

Perrin, R. W. (1967). *The Architecture of Wisconsin.* Madison: The State Historical Society of Wisconsin.

Peterson, R., & McKenny, M. (1968). *A field guide to the wildflowers, northeastern and northcentral North America.* Tech. rep., Houghton Mifflin Co.

Port of Green Bay. (2015a, October). *History*. Retrieved October 2015, from Port of Green Bay: http://www.portofgreenbay.com/business-opportunities/benefits

Port of Green Bay. (2015b, October). *Home*. Retrieved October 2015, from Port of Green Bay: http://www.portofgreenbay.com/

Port of Milwaukee. (2015, October). *Location*. Retrieved October 2015, from Port of Milwaukee: http://city.milwaukee.gov/Directory/Port/About-Us.htm#.ViYYon6rTrc

Project 25.org. (2015, August 28). *P25 Phase1 FDMA System in Service (June 2015)*. Retrieved August 28, 2015, from http://www.Project25.org/images/stories/ptig/docs/P25_Phase_1_FDMA_Systems_REV_2_update_June_2015.pdf

ProximityOne. (2015). *State Population Projections, Outlook 2030*. Retrieved March 2015, from https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/

PSC. (2015a, October). *PSC Overview*. Retrieved October 2015, from Public Service Commission of Wisconsin: https://psc.wi.gov/aboutUs/organization/PSCoverview.htm

PSC. (2015b, October). *Electric Industry Overview*. Retrieved October 2015, from Public Service Commission of Wisoncsin: https://psc.wi.gov/utilityInfo/electric/index-electric.htm

PSC. (2015c, October). *Wisconsin 2015 Electric Service Territories*. Retrieved October 2015, from Public Service Commission of Wisconsin: https://psc.wi.gov/utilityInfo/maps/documents/medElectricMap.pdf

PSC. (2015d, October). *Water Industry Overview*. Retrieved October 2015, from Public Service Commission of Nevada: https://www.psc.wi.gov/water/index.htm

PSCR. (2015). *Location-Based Services R&D Roadmap.* U.S. Department of Commerce, National Institute of Standards and Technology (NIST), Public Safety Communications Research (PSCR).

Purdue University. (2015). *Hydrologic Soil Groups.* Retrieved June 2015, from https://engineering.purdue.edu/mapserve/LTHIA7/documentation/hsg.html

Purdue University Consumer Horticulture. (2006). *What is Loam?* Retrieved May 19, 2016, from https://hort.purdue.edu/ext/loam.html

RadioReference.com. (2015a, October 19). *Wsconsin Interoperable System for Communications*. Retrieved October 19, 2015, from http://www.radioreference.com/apps/db/?sid=6364

RadioReference.com. (2015b, October 19). *Wisconsin State Patrol*. Retrieved October 19, 2015, from http://www.radioreference.com/apps/db/?aid=599

RadioReference.com. (2015c, October 19). *Department of Health Services*. Retrieved October 19, 2015, from http://www.radioreference.com/apps/db/?aid=7210

RadioReference.com. (2015d, October 19). *Sustained Interoperable Radio for Emergency Communiction Notification*. Retrieved October 19, 2015, from http://www.radioreference.com/apps/db/?sid=7511

RadioReference.com. (2015e, October 19). *Milwaukee County Public Safety*. Retrieved October 19, 2015, from http://www.radioreference.com/apps/db/?sid=254

RadioReference.com. (2015f, October 19). *Barron County Wisconsin*. Retrieved October 19, 2015, from http://www.radioreference.com/apps/db/?ctid=3054

Recreation.gov. (2015). *Spotlight: Ice Age National Scenic Trail*. Retrieved October 2015, from http://www.recreation.gov/marketing.do?goto=acm%2FExplore_And_More%2FexploreArticles%2FSpotlight__Ice_Age_National_Scenic_Trail.htm&type=_article_

Rogers, D. J., Olshansky, R., & Rogers, B. R. (2004). *Damage to Foundations From Expansive Soils.* Retrieved March 23, 2015, from http://web.mst.edu/~rogersda/expansive_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf

Sacramento County Airport System. (2015). *Sacramento County Airport System Noise Page*. Retrieved 6 10, 2015, from http://www.sacramento.aero/scas/environment/noise/noise_101/

Schroeder, S. (2007, February). *Evidence for Paleoindians in Wisconsin and at the Skare Site.* Retrieved October 2015, from http://www.jstor.org/stable/25670930

Sims, P. (1993). *The Great Lakes Tectonic Zone - Revisited.* Retrieved December 15, 2015, from USGS Publications Warehouse: http://pubs.usgs.gov/bul/1904s/report.pdf

SkiCentral. (2015). *Wisconsin Ski Resorts*. Retrieved October 2015, from http://www.skicentral.com/wisconsin.html

Smithsonian Institution. (2016). *Glossary -- Courtesy of the Department of Paleobiology, National Museum of Natural History, Washington, DC*. Retrieved May 2016, from http://paleobiology.si.edu/geotime/main/glossary.html

Sperling. (2009). *Whats the buzz about bees.* Retrieved from http://www.xerces.org/wp-content/uploads/2009/06/whatsthebuzarticle2.pdf

State of Wisconsin. (2015). *Chapter NR 216 Storm Water Discharge Permits*. Retrieved November 2015, from http://docs.legis.wisconsin.gov/code/admin_code/nr/200/216.pdf

State of Wisconsin Department of Transportation. (2015). *State of Wisconsin Department of Transportation Environmental Justice*. Retrieved October 2015, from http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/environment/Environmental-justice.aspx

Stern. (1990). *An illustrated key to the freshwater mussels of Wisconsin*. Retrieved from http://epapers.uwsp.edu/Museum/RMNH%2020a.pdf

Swift, B., Clarke, K., Holevinski, R., & Cooper, E. (2013). *Status and ecology of mute swans in New York State.* Retrieved from http://www.dec.ny.gov/docs/wildlife_pdf/muteswanreport.pdf

Symons, B. (2014). Project25 User's Perspective: WyoLink. *Project 25 User's Perspective (IWCE).* Las Vegas: IWCE.

Thompson, W. (2015). *Surficial Geology Handbook for Southern Maine.* Retrieved July 2015, from http://www.maine.gov/dacf/mgs/explore/surficial/sghandbook/surficial_geology_handbook_for_southern_maine.pdf

U.S. Bureau Land Management. (2005). *Land Use Planning Handbook.* Retrieved from http://www.blm.gov/style/medialib/blm/ak/aktest/planning/planning_general.Par.65225.File.dat/blm_lup_handbook.pdf

U.S. Bureau of Justice Statistics. (2011, July 26). *Census of State and Local Law Enforcement Agencies*. Retrieved from http://www.bjs.gov/index.cfm?ty=pbdetail&iid=2216

U.S. Census Bureau. (2006). *Government Finance and Employment Classification Manual.* 2006_classification_manual. Retrieved July 2015, from http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf

U.S. Census Bureau. (2012a). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas first sorted by state FIPS code, then sorted by UACE code. Retrieved June 2015, from http://www2.census.gov/geo/docs/reference/ua/ua_st_list_all.xls

U.S. Census Bureau. (2012b). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas first sorted by state FIPS code, then sorted by UACE code. Retrieved June 2015, from http://www2.census.gov/geo/docs/reference/ua/ua_st_list_all.xls

U.S. Census Bureau. (2012c). *Wisconsin: 2010 Population and Housing Unit Counts CPH-2-51*. U.S. Census. Retrieved May 19, 2016, from https://www.census.gov/prod/cen2010/cph-2-51.pdf

U.S. Census Bureau. (2015a, May 28). *U.S. Census Bureau*. Retrieved May 21, 2015, from State and County Quickfacts: http://www.census.gov/quickfacts/table/LND110210/55

U.S. Census Bureau. (2015aa). *American Community Survey, 2013 1-Year Estimates, Table S1701: Poverty Status in the Past 12 Months*. (Obtained via Census Bureau online American FactFinder tool) Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1701&prodType=table

U.S. Census Bureau. (2015ab). *American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race*. (Obtained via Census Bureau online DataFerrett tool) Retrieved April 2015, from http://dataferrett.census.gov/

U.S. Census Bureau. (2015ac). *American Community Survey, 2009-2013 5-Year Summary File, Table B03002, Hispanic or Latino Origin by Race*. (Obtained via Census Bureau online DataFerrett tool) Retrieved April 2015, from http://dataferrett.census.gov

U.S. Census Bureau. (2015ad). *American Community Survey, 2009-2013 5-Year Summary File, Table B17021, Poverty Status of Individuals in the Past 12 Months by Living Arrangement*. (Obtained via Census Bureau online DataFerrett tool) Retrieved April 2015, from http://dataferrett.census.gov

U.S. Census Bureau. (2015ae). *American Community Survey, 2009-2013 5-Year Summary File, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months*. (Obtained via Census Bureau online DataFerrett tool) Retrieved May 2015, from http://dataferrett.census.gov

U.S. Census Bureau. (2015af). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Other Census Urban Area Information - Maps, Shapefiles & References. Retrieved June 2015, from http://www.census.gov/geo/reference/ua/urban-rural-2010.html

U.S. Census Bureau. (2015ag). *American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions*. 2013_ACSSubjectDefinitions. Retrieved April 2015, from http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf

U.S. Census Bureau. (2015ah, May 28). *Wisconsin Quick Facts*. Retrieved May 21, 2015, from State and County Quickfacts: http://quickfacts.census.gov/qfd/states/55000.html

U.S. Census Bureau. (2015ai). *Census 2000 Summary File 1 (SF 1), Table P001, Total Population*. (Obtained via Census Bureau online American FactFinder tool) Retrieved

July 2015, from http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

U.S. Census Bureau. (2015b). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014.* Washington, D.C.: US. Census Bureau, Population Division.

U.S. Census Bureau. (2015c, March 11). *Foreign Trade*. Retrieved March 2015, from United States Census Bureau: http://www.census.gov/foreign-trade/Press-Release/2013pr/12/ft920/index.html

U.S. Census Bureau. (2015d). *American Community Survey, 2013 1-year Estimates, Table DP03, Selected economic characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP03&prodType=table

U.S. Census Bureau. (2015e). *2010 Census Urban and Rural Classification and Urban Area Criteria.* Retrieved June 2015, from Other Census Urban Area Information - Maps, Shapefiles & References: http://www.census.gov/geo/reference/ua/urban-rural-2010.html

U.S. Census Bureau. (2015f). *Population Estimates Program, 2010-2014 Data*. Retrieved March 2015, from http://www.census.gov/popest/data/national/totals/2014/NST-EST2014-alldata.html

U.S. Census Bureau. (2015g). *2010 Census Summary File 1, Table GCT-PH1, Population, Housing Units, Area, and Density*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_GCTPH1.US01PR&prodType=table

U.S. Census Bureau. (2015h). *Resident Population of the 50 States, the District of Columbia, and Puerto Rico: Census 2000.* File tab02.xls. Retrieved March 2015, from https://www.census.gov/population/www/cen2000/maps/respop.html

U.S. Census Bureau. (2015i). *American Community Survey, 2013 1-Year Estimates, Table DP05, Demographic and Housing Estimates*. (Obtained via Census Bureau online American FactFinder tool) Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP05&prodType=table

U.S. Census Bureau. (2015j). *American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race*. (Obtained via Census Bureau online Dataferrett tool) Retrieved April 2015, from http://dataferrett.census.gov/

U.S. Census Bureau. (2015k). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014*. Retrieved March 2016, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

U.S. Census Bureau. (2015l). *American Community Survey, 2009-2013 5-Year Estimates, Table DP05, Demographic and Housing Estimates*. (Obtained via Census Bureau online American FactFinder tool) Retrieved August 2015, from http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

U.S. Census Bureau. (2015m). *Small Area Income and Poverty Estimates (SAIPE), 2013.*

U.S. Census Bureau. (2015n). *American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics*. Retrieved from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table

U.S. Census Bureau. (2015o). *American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars).* Retrieved from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table

U.S. Census Bureau. (2015p). *Small Area Income and Poverty Estimates (SAIPE), 2013.* Retrieved March 2015, from http://www.census.gov/did/www/saipe/data/statecounty/data/2013.html

U.S. Census Bureau. (2015q). *American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table

U.S. Census Bureau. (2015r). *American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars).* (Obtained via Census Bureau online American FactFinder tool) Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table

U.S. Census Bureau. (2015s). *2010 Census Urban and Rural Classification and Urban Area Criteria.* Other Census Urban Area Information - Maps, Shapefiles & References. Retrieved June 2015, from http://www.census.gov/geo/reference/ua/urban-rural-2010.html

U.S. Census Bureau. (2015t). *2009-2013 American Community Survey 5-Year Estimates, Table DP03: Selected economic characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April, July 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table

U.S. Census Bureau. (2015u). *American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions.* 2013_ACSSubjectDefinitions. Retrieved April 2015, from http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf

U.S. Census Bureau. (2015v). *American Community Survey, 2013 1-Year Estimates, Table DP04, Selected housing characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP04&prodType=table

U.S. Census Bureau. (2015w). *American Community Survey, 2009-2013 5-year Estimates, Table DP04, Selected housing characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April, July 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP04&prodType=table

U.S. Census Bureau. (2015x). *2012 Census of Governments: Finance – Surveys of State and Local Government Finances, Table LGF001*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=COG_2012_LGF001&prodType=table

U.S. Census Bureau. (2015y). *American Community Survey, 2012 1-Year Estimates, Table B01003: Total Population*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B01003&prodType=table

U.S. Census Bureau. (2015z). *American Community Survey, 2013 1-year Estimates, Table DP03, Selected economic characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP03&prodType=table

U.S. Census Bureau. (2016). *American Community Survey*. Retrieved from http://www.census.gov/programs-surveys/acs/

U.S. Coast Guard. (2015, December 31). *National Response Center*. Retrieved March 24, 2016, from http://www.nrc.uscg.mil/FOIAFiles/CY15.xlsx

U.S. Department of Commerce. (2013, February 21). *Department of Commerce Environmental Justice Strategy*. Retrieved July 2015, from http://open.commerce.gov/sites/default/files/DOC_Environmental_Justice_Strategy.pdf

U.S. Department of Interior. (2008). *Navajo Reservoir RMP/FEA Appendix E Noise*. Retrieved 07 22, 2015, from https://www.usbr.gov/uc/envdocs/ea/navajo/appdx-E.pdf

U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. (2015, May 26). Abandoned Mine Land Inventory System (e-AMLIS) State and Tribal Summary. Retrieved October 29, 2015, from http://amlis.osmre.gov/Summaries.aspx

U.S. Fire Administration. (2015, June 11). *National Fire Department Census*. Retrieved from http://apps.usfa.fema.gov/census-download/main/download

University of Minnesota. (2001). *Soils and Landscapes of Minnesota*. Retrieved July 2015, from http://www.extension.umn.edu/agriculture/tillage/soils-and-landscapes-of-minnesota/

University of Wisconsin. (2015). *Wisconsin spring bee guide*. Retrieved from https://energy.wisc.edu/bee-guide/WI-Spring-Bee-Guide.pdf

University of Wisconsin-Extension. (2005). *Bedrock Geology of Wisconsin*. Retrieved October 2015, from http://wgnhs.uwex.edu/pubs/M067/

USACE. (1997, July 1). *Planning and Gudiance Letter #97-09: Scenic and Aesthetic Considerations*. Retrieved October 15, 2015, from http://planning.usace.army.mil/toolbox/library/MemosandLetters/pgl97-09.pdf

USACE. (2011). *Issuance of Regional General Permit GP-002WI in the state of Wisconsin Except Within the Exterior Boundaries of Indian Reservations*. Retrieved October 19, 2015, from http://www.mvp.usace.army.mil/Portals/57/docs/regulatory/2010004712PN.pdf

USACE. (2015). *Corps Lakes Gateway: Wisconsin*. Retrieved March 2016, from http://corpslakes.usace.army.mil/visitors/states.cfm?state=WI

USCRP. (2009b). *Global Climate Change Impacts in the United States*. New York: U.S. Global Change Research Program. Retrieved April 27, 2015

USDA. (2014). *2012 Census of Agriculture, Wisconsin*. Retrieved October 2015, from http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Wisconsin/

USDA. (2014a). *Wisconsin State Noxious Weeds List*. Retrieved from http://plants.usda.gov/java/noxious?rptType=State&statefips=55

USDA. (2014b). *Federal noxious weed list*. Retrieved from https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist.pdf

USDA. (2014c). *2014 State Agriculture Overview, Wisconsin.* Retrieved October 2015, from http://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=Wisconsin

USDA. (2015). *Ecoregions of the United States*. Retrieved from http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/

USDA Forest Service. (2015, Nov 9). *Invasive Species*. Retrieved Dec 4, 2015, from http://www.nrs.fs.fed.us/disturbance/invasive_species/

USDOT. (2015a). *National Transportation Atlas Database*. Retrieved July 2015, from Bureau of Transportation Statistics National Transportation Atlas Database: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html

USDOT. (2015b). *America's Byways: Great River Road*. Retrieved September 21, 2015, from http://www.fhwa.dot.gov/byways/byways/2279

USEPA. (1973, July 27). *USEPA.gov*. Retrieved August 5, 2015, from National Service Center for Environmental Publications - Impact Characterization of Noise. (NTID 73.4): o http://nepis.epa.gov/Exe/ZyNET.exe/9101DPQN.TXT?ZyActionD=ZyDocument&Client=EPA&Index=Prior+to+1976&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=

USEPA. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.* Washington, D.C.: USEPA.

USEPA. (1979, March 19). Notification to Federal Land Manager Under Section 165(d) of the Clean Air Act. Retrieved April 21, 2015, from http://www.epa.gov/sites/production/files/2015-07/documents/fdlndmgr.pdf

USEPA. (1992, October 19). *Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts, U.S. Environmental Protection Agency*. (J. S. Seitz, Ed.) Retrieved April 21, 2015, from http://www.epa.gov/sites/production/files/2015-07/documents/class1.pdf

USEPA. (1995). *America's wetlands: Our vital link between land and water*. Retrieved April 21, 2015, from U.S. Environmental Protection Agency, EPA843-K-95-001: http://water.epa.gov/type/wetlands/fish.cfm

USEPA. (2010, March 24). *Revisions to the General Conformity Regulations*. Retrieved April 20, 2015, from https://www.epa.gov/general-conformity/final-revisions-general-conformity-regulations

USEPA. (2011, December 12). *CERCLA Overview*. Retrieved from EPA Superfund: http://www.epa.gov/superfund/policy/cercla.htm

USEPA. (2012a, May). *List of 156 Mandatory Class I Federal Areas*. Retrieved April 20, 2015, from Visibility: http://www3.epa.gov/airquality/visibility/class1.html

USEPA. (2012c, July 16). *Noise Pollution*. Retrieved August 4, 2015, from http://www.epa.gov/air/noise.html

USEPA. (2012d). *Climate Change Indicators in the United States 2012.* Retrieved October 2013, from http://www.epa.gov/climatechange/pdfs/climateindicators-full-2012.pdf

USEPA. (2012e, November 01). *Fact Sheet - Managing Ozone Air Quality: Findings on Failure to Submit Elements of 1997 Ozone NAAQS State Implementation Plan*. Retrieved July 21, 2015, from http://www.epa.gov/groundlevelozone/fs20080317.html

USEPA. (2013a). *Lake Winnebago Watershed*. Retrieved from https://wiki.epa.gov/watershed2/index.php/Lake_Winnebago_Watershed

USEPA. (2013b, August 13). *General Conformity*. Retrieved April 20, 2015, from https://www.epa.gov/general-conformity

USEPA. (2014a). *Lake Michigan Lakewide Action and Management Plan*. Retrieved November 2015, from https://binational.net/wp-content/uploads/2015/04/LM-2014-AR.pdf

USEPA. (2014b, October 28). *Who Has to Obtain a Title V Permit*. Retrieved April 20, 2015, from https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit

USEPA. (2014c, October 28). *Who Has to Obtain a Title V Permit*. Retrieved April 20, 2015, from http://www.epa.gov/airquality/permits/obtain.html

USEPA. (2014e, October 21). *National Ambient Air Quality Standards (NAAQS)*. Retrieved April 20, 2015, from http://www.epa.gov/air/criteria.html

USEPA. (2014f). *Grants and Programs*. Retrieved July 2015, from http://www.epa.gov/compliance/environmentaljustice/grants/index.html

USEPA. (2015a, January). *Chesapeake Bay Glossary*. Retrieved July 15, 2015, from http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Chesapeake%20Bay%20Glossary

USEPA. (2015b). *About the National Health and Environmental Effects Research Laboratory (NHEERL)*. Retrieved August 2015, from http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm

USEPA. (2015c). *Environmental Justice*. Retrieved July 2015, from http://www.epa.gov/compliance/environmentaljustice/index.html

USEPA. (2015d). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved July 2015, from http://www2.epa.gov/ejscreen

USEPA. (2015e, July 14). *Air Permit Programs*. Retrieved April 20, 2015, from Air Quality Planning and Standards: http://www3.epa.gov/airquality/permjmp.html

USEPA. (2015f, April 21). *The Green Book Nonattainment Areas for Criteria Pollutants*. Retrieved April 21, 2015, from http://www.epa.gov/airquality/greenbook/

USEPA. (2015g, July). *U.S. Greenhouse Gas Inventory Report 1990-2013*. Retrieved 07 28, 2015, from Greenhouse Gas Emissions: http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#data

USEPA. (2015h, April 7). *Cleanups in my Community.* Retrieved October 27, 2015, from http://ofmpub.epa.gov/apex/cimc/f?p=cimc:73::::71:P71_WELSEARCH:WI|State|WI|||true|true|true|true|true|true||-1|sites|N|basic

USEPA. (2015i). *Cleanups in My Community List Results*. Retrieved October 27, 2015, from http://ofmpub.epa.gov/apex/cimc/f?p=102:35:3326861783394:::35:P35_State_code,P35_ADV_QUERY:WI,((SF_EI_HE_CODE=%27N%27))

USEPA. (2015j, March). *2013 TRI Analysis: State - Wisconsin*. Retrieved from http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?&pstate=WI&pyear=2013&pDataSet=TRIQ1

USEPA. (2015k, October 15). *Envirofacts - PCS-ICIS*. Retrieved from http://www3.epa.gov/enviro/facts/pcs-icis/search.html

USEPA. (2015l, October 27). *Envirofacts Search Results*. Retrieved October 27, 2015, from http://www3.epa.gov/enviro/facts/multisystem.html

USEPA. (2015m, June). *U.S. Greenhouse Gas Emissions*. Retrieved September 22, 2015, from http://www3.epa.gov/climatechange/science/indicators/ghg/us-ghg-emissions.html

USEPA. (2015n, October 8). *Emissions & Generation Resource Integrated Database (eGRID) Summary Table 1*. Retrieved March 10, 2016, from http://www.epa.gov/energy/egrid-2012-summary-tables

USEPA. (2015o). *Terms and Acronyms Search page*. (U.S. Environmental Protection Agency) Retrieved July 28, 2015, from https://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do

USEPA. (2015p, July 17). *Technology Transfer Network - Basic Information*. Retrieved July 17, 2015, from http://cfpub.epa.gov/oarweb/mkb/basic_information.cfm

USEPA. (2015q, January 30). *Designations*. Retrieved April 20, 2015, from http://www.epa.gov/airquality/greenbook/define.html

USEPA. (2015r). *Terminology Services.* United States Environmental Protection Agency.

USEPA. (2015s). *Wisconsin Impaired Waters and TMDL Information*. Retrieved November 2015, from Watershed Assessment, Tracking & Environmental Results System: http://ofmpub.epa.gov/tmdl_waters10/attains_state.control?p_state=WI#causes_303d

USEPA. (2016a, February 21). *Ecoregions of North America*. Retrieved from Western Ecology Division: https://archive.epa.gov/wed/ecoregions/web/html/na_eco.html

USEPA. (2016b, May 18). *Hazardous Air Pollutants*. Retrieved May 25, 2016, from https://www.epa.gov/haps

USEPA. (2016c). *Wisconsin Impaired Waters and TDML Information*. Retrieved June 2016, from https://iaspub.epa.gov/tmdl_waters10/attains_state.control?p_state=WI#total_assessed_waters

USEPA. (2016d, May 28). *Waste and Cleanup Risk Assessment Glossary*. Retrieved from Vocabulary Catalog: https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Waste%20and%20Cleanup%20Risk%20Assess

USEPA. (2016e, May 19). *De Minimis Levels*. Retrieved from https://www3.epa.gov/airquality/genconform/deminimis.html

USEPA. (2016f, May 29). *Glossary of Climate Change Terms*. Retrieved from https://www3.epa.gov/climatechange/glossary.html

USFS. (2009, Sept 30). *Chapter 90 Communiations Site Management.* Retrieved Nov 16, 2015, from Forest Service Handbook 2709.11 - Special Uses Handbook: http://www.fs.fed.us/specialuses/documents/Comm_Use_Policy_2709.11_90.doc

USFS. (2009). *Soil-Disturbance Field Guide.* USDA. Retrieved from http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf

USFS. (2009). *Soil-Disturbance Field Guide*. Retrieved September 2015, from http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf

USFS. (2012, August). *Wisconsin's Forests, 2009*. Retrieved October 2015, from http://www.treesearch.fs.fed.us/pubs/41698

USFS. (2015). *Chequamegon-Nicolet National Forest*. Retrieved September 21, 2015, from http://www.fs.usda.gov/cnnf

USFS. (2015). *Chequamegon-Nicolet National Forest: Special Places*. Retrieved September 22, 2015, from http://www.fs.usda.gov/attmain/cnnf/specialplaces

USFS. (2016a, May 19). *National Forest Locator Map*. Retrieved from http://www.fs.fed.us/locatormap/index.php?lat=45.708&long=-90.728&zoom=8

USFS. (2016b). *Chequamegon-Nicolet National Forest*. Retrieved March 2016, from http://www.fs.usda.gov/cnnf

USFWS. (1983). *National recovery plan for northern monkshood (Acinotum noveboracense).* Retrieved from http://ecos.fws.gov/docs/recovery_plan/830923.pdf

USFWS. (1988). *Great lakes & northern great plains piping plover recovery plan*. Retrieved from http://www.nwk.usace.army.mil/Portals/29/docs/regulatory/ksdredging/GreatLakesRecoveryPlan-May1988.pdf

USFWS. (1991). *Fassett's locoweed recovery plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/910329.pdf

USFWS. (2002). *Recovery plan for the Pitcher's thistle (Cirsium pitcheri)*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/020920b.pdf

USFWS. (2003). *Fassett's locoweed fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/plants/fassetts/fassetts.html

USFWS. (2004). *Higgins eye pearlymussel recovery plan: first revision*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/040714.pdf

USFWS. (2005a). *Canada lynx recovery outline*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/final%20draft%20Lynx%20Recovery%20Outline%209-05.pdf

USFWS. (2005b). *Red knot fact sheet*. Retrieved from http://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf

USFWS. (2005c). *Mead's milkweed fact sheet*. Retrieved from http://www.fws.gov/Midwest/endangered/plants/meads/meadsmil.html

USFWS. (2008a). *Karner blue butterfly (Lycaeides melissa samuelis)*. Retrieved from http://www.fws.gov/midwest/endangered/insects/kbb/pdf/kbbFactSheet.pdf

USFWS. (2008b). *Small Wetlands Program.* Retrieved March 2016, from https://boozallen-my.sharepoint.com/personal/029155_bah_com/_layouts/15/guestaccess.aspx?guestaccesstoken=Jh%2bBdhh6NdMr%2bIp2IWx2fDhX%2bdHDJOKj0S%2bHrF7M8nI%3d&docid=2_1bacb2d333b5345e78c208fe0bda2698c

USFWS. (2010). *Mexican gray wolf conservation assessment*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/100505_Mexican%20Wollf%20Conservation%20Assessment_Final.pdf

USFWS. (2012a). *Sheepnose fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/clams/sheepnose/SheepnoseFactSheetMarch2012.html

USFWS. (2012b). *Snuffbox fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/clams/snuffbox/SnuffboxFactSheet.html

USFWS. (2012c). *Spectaclecase (Cumberlandia monodonta) fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/clams/spectaclecase/SpectaclecaseFactSheetMarch2012.html

USFWS. (2012d). *Eastern prairie fringed orchid (Platanthera leucophaea)*. Retrieved from http://www.fws.gov/mainefieldoffice/Eastern_prairie_fringed_orchid.html

USFWS. (2012e, December 20). *Green Bay National Wildlife Refuge: Wildlife & Habitat*. Retrieved September 21, 2015, from http://www.fws.gov/refuge/Green_Bay/wildlife_and_habitat/index.html

USFWS. (2012f). *Frequently asked questions about invasive species*. Retrieved from http://www.fws.gov/invasives/faq.html

USFWS. (2013a). *Birds protected by the migratory bird treaty act*. Retrieved from http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtintro.html

USFWS. (2013b). *Canada lynx (Lynx candensis)*. Retrieved from http://www.fws.gov/mountain-prairie/species/mammals/lynx/CandaLynxFactSheet_091613.pdf

USFWS. (2013c). *Dwarf lake iris (Iris lacustris) recovery plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/DLI%20RP%20FINAL%20AUG2013_1.pdf

USFWS. (2014a). *Northern Long-eared Bat Interim Conference and Planning Guidance*. Retrieved from http://www.fws.gov/northeast/virginiafield/pdf/NLEBinterimGuidance6Jan2014.pdf

USFWS. (2014b). *Rufa red knot background information and threats assessment*. Retrieved from http://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FINAL.pdf

USFWS. (2014c). *Poweshiek skipperling fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/insects/posk/PoweshiekSkipperlingFactSheet.html

USFWS. (2015a, January 26). *Wetlands Mapper Legend Categories*. Retrieved April 20, 2015, from National Wetland Inventory: http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html

USFWS. (2015aa). *Species profile for eastern prairie fringed orchid (Platanthera leucophaea)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2GG

USFWS. (2015ab). *Species profile for Fassett's locoweed (Oxytropis campestris var. chartacea)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2EM

USFWS. (2015ac). *Species profile for Mead's milkweed (Asclepias meadii)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q1T6

USFWS. (2015ad). *Species profile for northern wild monkshood (Aconitum noveboracense)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q1SN

USFWS. (2015ae). *Species profile for Pitcher's thistle (Cirsium pitcheri)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q276

USFWS. (2015af). *Prairie bush clover fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/plants/prairieb.html

USFWS. (2015ag). *Wisconsin, U.S. Fish and Wildlife Service*. Retrieved September 2015, from http://www.fws.gov/midwest/news/wisconsin.html

USFWS. (2015ah, April). *National Wildlife Refuge System*. Retrieved April 17, 2015, from http://www.fws.gov/refuges/

USFWS. (2015ai). *Wisconsin Wildlife Refuges*. Retrieved September 21, 2015, from http://www.fws.gov/refuges/refugeLocatorMaps/Wisconsin.html

USFWS. (2015aj, September 11). *Green Bay National Wildlife Refuge*. Retrieved September 21, 2015, from http://www.fws.gov/refuge/Green_Bay/about.html

USFWS. (2015ak). *Designation of critical habitat for the Dakota skipper and Poweshiek skipperling*. Retrieved from https://www.gpo.gov/fdsys/pkg/FR-2015-10-01/pdf/2015-24184.pdf

USFWS. (2015al). *Species profile for prairie bush-clover (Lespedeza leptostachya)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2CB

USFWS. (2015b, January 26). *Wetlands Mapper Legend Categories*. Retrieved April 20, 2015, from National Wetland Inventory: http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html

USFWS. (2015c, January 26). *Data Limitations, Exclusions and Precautions*. Retrieved May 11, 2015, from http://www.fws.gov/wetlands/Data/Limitations.html

USFWS. (2015d). *Listed species believed to or known to occur in Wisconsin*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=WI&status=listed

USFWS. (2015e). *Critical Habitat Portal - Wisconsin*. Retrieved from http://ecos.fws.gov/crithab/

USFWS. (2015f). *Species profile for Canada lynx (Lynx canadensis)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A073#crithab

USFWS. (2015g). *Species profile for gray wolf (Canis lupus)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A00D

USFWS. (2015h). *Northern long-eared bat fact sheet*. Retrieved from http://www.fws.gov/midwest/endangered/mammals/nleb/nlebFactSheet.html

USFWS. (2015i). *Species profile for northern long-eared bat*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JE

USFWS. (2015j). *Species profile for Kirtland's warbler (Setophaga kirtlandii)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=B03I

USFWS. (2015k). *Species profile for piping plover (Charadrius melodus)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079#recovery

USFWS. (2015l). *Summary of the final determination of critical habitat for the Great Lakes breeding population of the piping plover*. Retrieved from http://www.fws.gov/midwest/endangered/pipingplover/pdf/summary.pdf

USFWS. (2015m). *Piping plover (Charadrius melodus)*. Retrieved from http://www.fws.gov/charleston/pdf/PIPL_page.pdf

USFWS. (2015n). *Piping plover, Atlantic Coast population*. Retrieved from http://www.fws.gov/northeast/pipingplover/overview.html

USFWS. (2015o). *Species profile for red knot (Calidris canutus rufa)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0DM

USFWS. (2015p). *Eastern Massasauga Rattlesnake*. Retrieved June 2016, from http://www.fws.gov/midwest/endangered/reptiles/eama/conserve.html

USFWS. (2015q). *Species profile for Higgins eye (Lampsilis higginsii)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=F009

USFWS. (2015r). *Species profile for Hine's emerald dragonfly (Somatochlora hineana)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=I06P

USFWS. (2015s). *Species profile for Karner blue butterfly (Lycaeides melissa samuelis)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=I00F

USFWS. (2015t). *Species profile for Poweshiek skipperling (Oarisma poweshiek)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=I0W1

USFWS. (2015u). *Species profile for sheepnose mussel (Plethobasus cyphyus)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F046

USFWS. (2015v). *Species profile for snuffbox mussel (Epioblasma triquetra)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F03J

USFWS. (2015w). *Species profile for spectaclecase (mussel) (Cumberlandia monodonta)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=F00X

USFWS. (2015x). *Winged mapleleaf*. Retrieved from http://www.fws.gov/Midwest//TwinCities/ArtContest/WingedMapleleaf.html

USFWS. (2015y). *Species profile for winged mapleleaf (Quadrula fragosa)*. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=F00C

USFWS. (2015z). *Species profile for dwarf lake iris (Iris lacustris)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2BS

USFWS. (2016, 2 2). *Kirtland's warbler (Setophaga kirtlandii) [=Dendroica kirtlandii]*. Retrieved 3 1, 2016, from http://www.fws.gov/midwest/endangered/birds/Kirtland/

USGCRP. (2009). *Global Climate Change Impacts in the United States.* Retrieved March 2016, from https://nca2009.globalchange.gov/national-climate-change/index.html

USGCRP. (2014a). *National Climate Assessment: Midwest*. Retrieved from U.S. Global Change Research Program: http://nca2014.globalchange.gov/report/regions/midwest#statement-16934

USGCRP. (2014b). *U.S. Global Change Research Program: Precipitation Change*. Retrieved from National Climate Assessment: http://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change

USGCRP. (2014c). *National Climate Assessment - Extreme Weather.* Retrieved October 6, 2015, from http://nca2014.globalchange.gov/report/our-changing-climate/extreme-weather#intro-section-2

USGCRP. (2014d). *2014 National Assessment - Midwest.* Retrieved November 17, 2015, from http://nca2014.globalchange.gov/report/regions/midwest#intro-section-2

USGCRP. (2014e). *National Climate Assessment: Changes in Storms*. Retrieved July September, 2015, from U.S. Global Change Research Program: http://nca2014.globalchange.gov/report/our-changing-climate/changes-storms

USGCRP. (2016). *Frost-Free Season*. Retrieved March 2016, from http://nca2014.globalchange.gov/report/our-changing-climate/frost-free-season

USGS. (1999). *How Ground Water Occurs*. Retrieved February 12, 2013, from U.S. Geological Survey General Interest Publication: http://pubs.usgs.gov/gip/gw/how_a.html

USGS. (2000). *Land Subsidence in the United States (Fact Sheet 165-00)*. Retrieved September 2013, from http://water.usgs.gov/ogw/pubs/fs00165/SubsidenceFS.v7.PDF

USGS. (2001). *Elevations and Distances in the United States*. Retrieved March 2016, from http://pubs.usgs.gov/gip/Elevations-Distances/elvadist.html#Highest

USGS. (2003). *National Landslide Hazards Mitigation Strategy – A Framework for Loss Reduction*. Retrieved September 2013, from http://pubs.usgs.gov/circ/c1244/c1244.pdf

USGS. (2005). *Atlas of Water Resources in the Black Hills Area, South Dakota.* Retrieved August 2015, from http://pubs.usgs.gov/ha/ha747/

USGS. (2008). *A Tapestry of Time and Terrain: The Union of Two Maps, Geology and Topography*. Retrieved September 2013, from http://pubs.usgs.gov/imap/i2720/i2720_pamphlet.pdf

USGS. (2010). *What is "Peak Acceleration" or "Peak Ground Acceleration" (PGA)?* Retrieved April 2015, from http://geohazards.usgs.gov/deaggint/2002/documentation/parm.php

USGS. (2011, August). *Gap Analysis Program (GAP).* Retrieved from National Land Cover, Version 2: http://gapanalysis.usgs.gov/gaplandcover/data/

USGS. (2012a). *Earthquake Glossary - Earthquake.* Retrieved July 2015, from http://earthquake.usgs.gov/learn/glossary/?term=earthquake

USGS. (2012b, December). *The USGS Land Cover Institute*. Retrieved August 2015, from http://landcover.usgs.gov/classes.php/

USGS. (2012c, October 13). *Nebraska Land Cover*. Retrieved October 13, 2015, from http://landcover.usgs.gov/nebraska.php

USGS. (2012d, November). *Gap Analysis Program (GAP).* Retrieved from Protected Areas Database of the United States (PADUS), version 1.3 Fee: http://gapanalysis.usgs.gov/padus/

USGS. (2013a). *Land Subsidence from Ground-water Pumping*. Retrieved September 2013, from http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/

USGS. (2013b). *Types of Glaciers Glossary*. Retrieved October 2015, from http://pubs.usgs.gov/of/2004/1216/d/d.html

USGS. (2013c). *Glossary of Glacier Terminology*. Retrieved August 2015, from http://pubs.usgs.gov/of/2004/1216/text.html#tz

USGS. (2014a). *Geologic Provinces of the United States - Interior Plain Province.* Retrieved October 2015, from http://geomaps.wr.usgs.gov/parks/province/intplain.html

USGS. (2014b). *Geologic Provinces of the United States: Laurentian Upland Province - Superior Upland*. Retrieved October 2015, from http://geomaps.wr.usgs.gov/parks/province/laurent.html

USGS. (2014c). *Wisconsin Seismicity Map (1973-March 2012).* Retrieved October 2015, from http://earthquake.usgs.gov/earthquakes/states/wisconsin/seismicity.php

USGS. (2014d, November). *Water Resources of the United States*. Retrieved July 2015, from http://www.usgs.gov/water/

USGS. (2014e). *National Atlas of the United States*. Retrieved Septmeber 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html

USGS. (2014f). *Sedimentary Rocks.* Retrieved July 2015, from http://geomaps.wr.usgs.gov/parks/rxmin/rock2.html

USGS. (2014g). *Measuring the Size of an Earthquake.* Retrieved July 2015, from http://earthquake.usgs.gov/learn/topics/measure.php

USGS. (2014h). *Landslide Overview Map of the Conterminous United States.* Retrieved June 2015, from http://landslides.usgs.gov/hazards/nationalmap/

USGS. (2015a). *Structural Geology*. Retrieved July 2015, from http://www2.usgs.gov/science/science.php?thcode=2&code=1117

USGS. (2015b). *About U.S. Volcanoes.* Retrieved August 2015, from http://volcanoes.usgs.gov/about/volcanoes/

USGS. (2015c). *Wisconsin Earthquake History*. Retrieved October 2015, from http://earthquake.usgs.gov/earthquakes/states/wisconsin/history.php

USGS. (2015d). *African Clawed Frog (Xenopus laevis) - Fact Sheet.* Retrieved from http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=67

USGS. (2015e). *Water Science Glossary of Terms.* Retrieved June 2015, from http://water.usgs.gov/edu/dictionary.html#B

USGS. (2015f). *Paleontology.* Retrieved July 2015, from http://www.usgs.gov/science/science.php?term=861

USGS. (2015g). *Geologic Glossary.* Retrieved October 2015, from http://geomaps.wr.usgs.gov/parks/misc/glossarya.html

USGS. (2016a). *Mineral Commodity Summaries.* Retrieved from http://minerals.usgs.gov/minerals/pubs/mcs/

USGS. (2016b). *Tectonic Processes*. Retrieved from http://www.usgs.gov/science/science.php?code=1145&thcode=2

USGS. (2016c, February 10). *Explanations for the National Water Conditions*. Retrieved from Water Resources of the United States: http://water.usgs.gov/nwc/explain_data.html

UVA Weldon Cooper Center. (2015). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040.* Projections for the 50 States and D.C., one-click download of all files, file USProjections_2020to2040_all_data_udpated_noshapefile.zip. Retrieved March 2015, from http://www.coopercenter.org/demographics/national-population-projections

Vaughan, P. W. (1997). *Winged mapleleaf mussel recovery plan.* Retrieved from http://ecos.fws.gov/docs/recovery_plan/970625.pdf

Vereecken, W., Heddeghem, W. V., Deruyck, M., Puype, B., Lannoo, B., & Joseph, W. (2011, July). Power Consumption in Telecommunications Networks: Overview and Reduction Strategies. *IEEE Communications Magazine*, pp. 62-69. Retrieved Septembe 22, 2015, from http://www.researchgate.net/publication/228774201

WAC. (2015a). *Wisconsin Administrative Code and Register.* Wisconsin State Legislature.

WAC. (2015b). *Chapter NR 27. Endangered and Threatened Species.* Retrieved October 12, 2015, from http://docs.legis.wisconsin.gov/code/admin_code/nr/001/27.pdf.

WAC. (2015c). *Chapter NR 29 Endangered Resources Information Fees.* Retrieved October 12, 2015, from http://docs.legis.wisconsin.gov/code/admin_code/nr/001/29.pdf.

WAC. (2015d). *Chapter NR 40 Invasive Species Identification, Classification and Control. 35.93, Wisconsin Statutes, Legislative Reference Bureau.*

WCPA. (2015, October). *Wisconsin Ports*. Retrieved October 2015, from Wisconsin Commercial Ports Association: http://www.wcpaports.org/ports

Wilderness.net. (2015a). *Wilderness Data Search Results*. Retrieved September 27, 2015, from http://www.wilderness.net/NWPS/stateView?state=WI

Wilderness.net. (2015b). *The Wilderness Act of 1964*. Retrieved September 17, 2015, from http://www.wilderness.net/nwps/legisact

Wisconsin Archaeological Society. (2014a). *Wisconsin Archaeology Overview*. Retrieved October 2015, from http://wiarcheologicalsociety.org/educational-resources/

Wisconsin Archaeological Society. (2014b). *Wisconsin Archaeological Society Home*. Retrieved October 2015, from Wisconsin Archaeological Society: http://wiarcheologicalsociety.org/

Wisconsin Commercial Ports Association. (2016). *Wisconsin Ports*. Retrieved from Wisconsin Ports: http://www.wcpaports.org/ports

Wisconsin Dells Visitor and Convention Bureau. (2015). Retrieved October 2015, from http://www.wisdells.com/wisconsin-dells-water-parks.htm

Wisconsin Department of Administration. (2005, June). *Land Use Resource Guide.* Retrieved October 2015, from http://www.uwsp.edu/cnr-ap/clue/Documents/Comprehensive_Planning/Land_Use_Resource_Guide.pdf

Wisconsin Department of Health Services. (2016, May 19). *American Indians in Wisconsin - History*. Retrieved from https://www.dhs.wisconsin.gov/minority-health/population/amind-pophistory.htm

Wisconsin Department of Military Affairs. (2011). *State of Wisconsin Hazard Mitigation Plan*. Retrieved November 2015, from http://emergencymanagement.wi.gov/mitigation/docs/HazardMitigationPlan/Risk_Assessment.pdf

Wisconsin Department of Tourism. (2013a). *Travel Wisconsin Activity Guide*. Retrieved October 2015, from http://www.travelwisconsin.com/pdf/2013%20activity%20guide.pdf

Wisconsin Department of Tourism. (2013b). *Travel Wisconsin Activity Guide - Apostle Islands National Seashore (p.47)*. Retrieved October 2015, from http://www.travelwisconsin.com/pdf/2013%20activity%20guide.pdf

Wisconsin Department of Tourism. (2013c). *Chequamegon/Nicolet National Forest (p. 48)*. Retrieved October 2015, from http://www.travelwisconsin.com/pdf/2013%20activity%20guide.pdf

Wisconsin Department of Tourism. (2015a). *Welcome to Wisconsin - Cities and Regions*. Retrieved October 2015, from http://www.travelwisconsin.com/cities-regions

Wisconsin Department of Tourism. (2015b). *Southwest Region*. Retrieved October 2015, from http://www.travelwisconsin.com/southwest

Wisconsin Department of Tourism. (2015c). *South Central Region*. Retrieved October 2015, from http://www.travelwisconsin.com/south-central

Wisconsin Department of Tourism. (2015d). *Southeast Region*. Retrieved October 2015, from http://www.travelwisconsin.com/southeast

Wisconsin Department of Tourism. (2016). *Cranberry Highway*. Retrieved March 2016, from http://www.travelwisconsin.com/history-heritage/cranberry-highway-198552

Wisconsin DOT. (2014). WDOT WISCOM Update. *Statewide System Management Group Meeting* (pp. 1-10). WDOT.

Wisconsin Geological & Natural History Survey. (2011). *Wisconsin's Geologic Past.* Retrieved October 2015, from http://wgnhs.uwex.edu/pubs/m502/

Wisconsin Geological & Natural History Survey. (2013a). *Drumlins of the southern Green Bay Lobe.* Retrieved October 2015, from http://wgnhs.uwex.edu/wisconsin-geology/major-landscape-features/drumlins/

Wisconsin Geological & Natural History Survey. (2013b). *Kettle Moraine*. Retrieved October 2015, from http://wgnhs.uwex.edu/wisconsin-geology/major-landscape-features/kettle-moraine/

Wisconsin Geological & Natural History Survey. (2013c). *Northern Highlands*. Retrieved October 2015, from http://wgnhs.uwex.edu/wisconsin-geology/major-landscape-features/northern-highlands/

Wisconsin Geological & Natural History Survey. (2013d). *Ice Age geology.* Retrieved October 2015, from http://wgnhs.uwex.edu/wisconsin-geology/ice-age/

Wisconsin Geological & Natural History Survey. (2013e). *Karst and Sinkholes*. Retrieved October 2015, from http://wgnhs.uwex.edu/water-environment/karst-sinkholes/

Wisconsin Geological & Natural History Survey. (2013f). *Karst and Sinkholes*. Retrieved March 2016, from https://wgnhs.uwex.edu/water-environment/karst-sinkholes/

Wisconsin Government. (2013, September). *Wisconsin Bureau of Aeronauticsof Aeronautics, Doing Business With Us.* Retrieved October 2015, from State of Wisconsin Department of Transportation: http://wisconsindot.gov/Documents/doing-bus/aeronautics/resources/aero-gtkus.pdf

Wisconsin Government. (2016). *State of Wisconsin Department of Transportation, Airport Information*. Retrieved March 2016, from http://wisconsindot.gov/Pages/travel/air/airport-info/default.aspx

Wisconsin Historical Society. (2015a). *Wisconsin: A Very Brief History*. Retrieved from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsNavOnly=N:1127&dsRecordDetails=R:CS2909

Wisconsin Historical Society. (2015b). *About the National Register and State Register of Historic Places*. Retrieved September 22, 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsRecordDetails=R:CS2836

Wisconsin Historical Society. (2015c). *Wisconsin Historic Properties.* Retrieved September 22, 2015, from Wisconsin Historic Properties: http://www.wisconsinhistory.org/pdfs/nr.pdf

Wisconsin Historical Society. (2015d). *About the Division of Museums and Historic Sites*. Retrieved September 22, 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsNavOnly=N:1080&dsRecordDetails=R:CS3562

Wisconsin Historical Society. (2015e). *Information for Preservation Consultants and Archaeologists*. Retrieved October 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:1215

Wisconsin Historical Society. (2015f, October). *A Short History of Wisconsin: The Fur Trade Era: 1650s to 1850s*. Retrieved October 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsNavOnly=N:1100&dsRecordDetails=R:CS3585

Wisconsin Historical Society. (2015g, October). *A Short History of Wisconsin: The Territorial Era: 1787-1848*. Retrieved October 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsNavOnly=N:1100&dsRecordDetails=R:CS3586

Wisconsin Historical Society. (2015h, October). *A Short History of Wisconsin: 19th-Century Immigration and Growth*. Retrieved Ocober 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsNavOnly=N:1100&dsRecordDetails=R:CS3668

Wisconsin Historical Society. (2015i, October). *A Short History of Wisconsin: The Progressive Era: 1895-1925*. Retrieved October 2015, from http://www.wisconsinhistory.org/Content.aspx?dsNav=N:4294963828-4294963805&dsNavOnly=N:1100&dsRecordDetails=R:CS3588

Wisconsin Historical Society. (2015j, October). *Depression and Unemployment*. Retrieved October 2015, from http://www.wisconsinhistory.org/turningpoints/tp-045/?action=more_essay

Wisconsin Historical Society. (2015k, October). *The World War II Military and Home Fronts*. Retrieved October 2015, from http://www.wisconsinhistory.org/turningpoints/tp-038/?action=more_essay

Wisconsin Natural Heritage Inventory Program. (2014). *Wisconsin Natural Heritage Working List.* Tech. rep., Wisconsin Natural Heritage Program, Department of Natural Resources.

Wisconsin NHIP. (2015). *Recognized natural communities - working document*. Retrieved from http://dnr.wi.gov/topic/endangeredresources/documents/communities.pdf

Wisconsin Society for Ornithology. (2015). *Annotated checklist of the birds of Wisconsin*. Retrieved from http://wsobirds.org/images/pdfs/Checklist-02212015.pdf

Wisconsin State Legislature. (2015). *http://docs.legis.wisconsin.gov/statutes/statutes/29/IX/604.* Retrieved October 12, 2015, from Wisconsin State Legislature.

Wisconsin State Legislature. (2015c). *Statutes, Chapter 114, Aeronautics and Astronautics*. Retrieved October 2015, from http://docs.legis.wisconsin.gov/statutes/statutes/114/I/001

Wisconsin State Legislature. (2015d). *Statutes, Chapter 114, Aeronautics and Astronautics*. Retrieved October 2015, from http://docs.legis.wisconsin.gov/statutes/statutes/114/I/135

Wisconsin State Legislature. (2015e, October). *Chapter NR 404 Ambient Air Quality.* Retrieved October 20, 2015, from Wisconsin State Legislature: http://docs.lhttps://docs.legis.wisconsin.gov/code/admin_code/nr/400/404

Wisconsin State Legislature. (2015f, October). *Chapter NR 407 Operation Permits.* Retrieved October 22, 2015, from Wisconsin State Legislature: https://docs.legis.wisconsin.gov/code/admin_code/nr/400/407

Wisconsin State Legislature. (2015g, October). *Chapter NR 405.* Retrieved October 28, 2015, from Wisconsin State Legislature PREVENTION OF SIGNIFICANT DETERIORATION: https://docs.legis.wisconsin.gov/code/admin_code/nr/400/405/02/27/a

Wisconsin State Legislature. (2015h, October). *Chapter NR 406 Construction Permits.* Retrieved October 28, 2015, from Wisconsin State Legislature: https://docs.legis.wisconsin.gov/code/admin_code/nr/400/406

WisDOT. (2013). *Wisconsin Scenic Byways*. Retrieved October 15, 2015, from http://wisconsindot.gov/Documents/travel/road/scenic-ways/brochure.pdf

WisDOT. (2014, August). *Moving Freight in Wisconsin*. Retrieved October 16, 2015, from http://wisconsindot.gov/Documents/doing-bus/freight/moving-freight.pdf

WisDOT. (2015a, October). *Mission Statement*. Retrieved October 16, 2015, from http://wisconsindot.gov/Pages/about-wisdot/who-we-are/dept-overview/mission-statement.aspx

WisDOT. (2015b). *Wisconsin Scenic Byways program*. Retrieved September 21, 2015, from http://wisconsindot.gov/Pages/travel/road/scenic-ways/default.aspx

WisDOT. (2015c). *Amtrak Passenger Rail Service*. Retrieved September 15, 2015, from http://wisconsindot.gov/Pages/travel/rail/amtrak.aspx

WisDOT. (2016). *Wisconsin's Scenic Byways Program - Designated Byways*. Retrieved March 2016, from http://wisconsindot.gov/Pages/travel/road/scenic-ways/byways.aspx

World Wildlife Fund Global. (2015). *What is an ecoregion?* Retrieved from http://wwf.panda.org/about_our_earth/ecoregions/about/what_is_an_ecoregion/

Zercher, D. &. (2015). *Hine's Emerald Dragonfly (Somatochlora hineana Williamson) Recovery Plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/010927.pdf

GEOGRAPHIC INFORMATION SYSTEM (GIS) REFERENCES

BIA. (2003, December). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (GIS Metadata) Retrieved August 2015, from http://sagemap.wr.usgs.gov/ftp/regional/ind3.html and http://www.arcgis.com/home/item.html?id=2e915ef3df48422283e5b2c7d89dfcba

DAFIF. (2015, June). *Land Use, Recreation, and Airspace: MTRs*. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services

DAFIF. (2015, June). *Land Use, Recreation, and Airspace: SUAs*. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services

Environmental Systems Research Institute (ESRI). (2014). *All Maps*. (GIS Metadata) Retrieved August 2015, from http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all&_ga=1.174384612.712313298.1421186728&q=rivers&t=group&start=1

FAA. (2015). *Land Use, Recreation, and Airspace: Public, Private, and Composite Airports/Facilities*. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks.: http://www.faa.gov/airports/airport_safety/airportdata_5010/

FCC. (2015, June). *Infrastructure: FCC Tower Structure Locations*. (GIS Metadata) Retrieved August 2015, from Data was obtained through a more advanced search by BAH being in direct touch with Cavell, Mertz & Associates to obtain ALL the relevant data across the country.: http://wireless2.fcc.gov/UlsApp/AsrSearch/asrAdvancedSearch.jsp

FCC. (2015). *Infrastructure: Fiber Provider Availability*. (GIS Metadata) Retrieved August 2015, from http://www.broadbandmap.gov/data-download

FCC. (2015, June). *Infrastructure: Wireless Provider Availability*. (GIS Metadata) Retrieved August 2015, from David F. LaBranche, P.E. Geospatial Information Officer (GIO) OASD (EI&E) 571-372-6768 at Defense Installations Spatial Data Infrastructure (DISDI).: http://www.broadbandmap.gov/data-download

National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). *Water Resources: Major Watersheds and Surface Waterbodies*. (GIS Metadata) Retrieved September 2015, from National Wild and Scenic Rivers Program, NPS, Department of Interior: https://www.rivers.gov/mapping-gis.php

National Audubon Society. (2015). *Biological Resources: Important Bird Areas (IBAs)*. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally: http://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_Poly/MapServer

National Conference of State Legislatures. (2010). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (GIS Metadata) Retrieved August 2016, from http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#federal

National Heritage Areas Program Office. (2011). *Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive*. (GIS Metadata) Retrieved August 2015, from Department of Interior, National Parks Service, National Heritage Areas Program Office: https://www.nps.gov/heritageareas/

National Register of Historic Places (NRHP). (2015). *Cultural Resources: National Heritage Area (NHA) and National Register of Historic Places (NHRP) Sites*. (GIS Metadata) Retrieved August 2015, from Stutts M. 2014. NRHP. National Register properties are located throughout the U.S. and their associated territories around the globe.: https://irma.nps.gov/DataStore/Reference/Profile/2210280

National Scenic Byways Program. (2015, August). *Visual Resources: Natural Areas that May be Visually Sensitive*. (GIS Metadata) Retrieved August 2015, from Data obtained by Gary A. Jensen, Research Implementation Team Leader, Office of Human Environment HEPH-30, Federal Highway Administration, 1200 New Jersey Avenue, SE Room E76-304, Washington, DC 20590, 202-366-2048, gary.je: http://www.fhwa.dot.gov/byways/

Native Languages of the Americas. (2015). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (GIS Metadata) Retrieved August 2015, from http://www.native-languages.org/states.htm

NERR. (2012). *Water Resources: Major Watersheds and Surface Waterbodies*. (GIS Metadata) Retrieved August 2015, from NOAA, Office of Coastal Management, National Estuarine Research Reserve System (NERRS): http://cdmo.baruch.sc.edu/get/gis.cfm

NPS. (2011). *Air Quality: Federal Class I Areas with Implications*. (GIS Metadata) Retrieved August 2015, from http://science.nature.nps.gov/im/gis/index.cfm

NPS. (2015). *Land Use, Recreation, and Airspace: Recreation Resources*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior: http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941

NPS. (2015). *Visual Resources: Natural Areas that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]: http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941

NPS. (2015). *Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]: http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941

NPS. (2015). *Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from United States Park, National Parks Service, Department of Interior [National Scenic and Historic trails]: https://www.nps.gov/ncrc/programs/nts/nts_trails.html

NRHP. (2015). *Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive*. (GIS Metadata) Retrieved August 2015, from Stutts M. 2014. NRHP. National Register properties are located throughout the U.S. and their associated territories around the globe.: https://irma.nps.gov/DataStore/Reference/Profile/2210280

NTAD. (2015). *Land Use, Recreation, and Airspace: Public, Private, and Composite Airports/Facilities*. (GIS Metadata) Retrieved June 2015, from Airports; derived from the FAA's National Airspace System Resource Aeronautical Data Product: http://osav.usdot.opendata.arcgis.com/

U.S. Bureau of Labor Statistics. (2015). *Socioeconomics: Unemployment Rated*. (GIS Metadata) Retrieved August 2015, from Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages.: http://www.bls.gov/lau/rdscnp16.htm

U.S. Census Bureau. (2014). *Infrastructure: Transportation Networks*. (GIS Metadata) Retrieved June 2016, from http://www.census.gov/geo/maps-data/data/tiger-data.html

U.S. Census Bureau. (2015). *Environmental Justice: Potential for Environmental Justice Populations*. (GIS Metadata) Retrieved July 2915, from U.S. Environmental Protection Agency. "EJSCREEN Environmental Justice Mapping and Screening Tool: EJSCREEN Technical Documentation.": http://www2.epa.gov/ejscreen/technical-documentation-ejscreen

U.S. Census Bureau. (2015). *Socioeconomics: Estimated Population Distribution*. (GIS Metadata) Retrieved August 2015, from American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions. 2013_ACSSubjectDefinitions: http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf

U.S. Census Bureau. (2015). *Socioeconomics: Median Household Income*. (GIS Metadata) Retrieved August 2015, from American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Obtained via Census Bureau online DataFerrett tool.: http://www.census.gov/geo/maps-data/data/tiger-data.html

U.S. Census Bureau. (Undated). *Environmental Justice: Potential for Environmental Justice Populations*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas: http://www.census.gov/geo/maps-data/data/tiger-data.html

U.S. Census Bureau. (Undated). *Socioeconomics: Estimated Population Distribution*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code, then USACE code.: http://www.census.gov/geo/maps-data/data/tiger-data.html

U.S. Census Bureau. (Undated). *Socioeconomics: Median Household Income*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas: http://www.census.gov/geo/maps-data/data/tiger-data.html

U.S. Census Bureau. (Undated). *Socioeconomics: Unemployment Rated*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code then by USACE code.: http://www.census.gov/geo/maps-data/data/tiger-data.html

U.S. DOT Bureau of Transportation Statistics NTAD. (2015). *Infrastructure: Transportation Networks*. (GIS Metadata) Retrieved August 2015, from Railroads, Major Highways data: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/2015/polyline

United States National Atlas. (2014). *Visual Resources: Natural Areas that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/

US States National Atlas. (2014). *Land Use, Recreation, and Airspace: Recreation Resources*. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/

USDA-NRCS. (2006). *Soils: Major Land Resource Area/Land Resource Region*. (GIS Metadata) Retrieved April 2015, from Both shapefiles for MLRA and LRR are created from the same zip file download: https://gdg.sc.egov.usda.gov/

USDA-NRCS STATSGO2. (2006). *Soils: Soil Taxonomy Suborders*. Retrieved April 2015, from Downloaded by state-level: https://gdg.sc.egov.usda.gov/

USEPA. (2013). *Biological Resources: USEPA Level III Ecoregions*. (GIS Metadata) Retrieved August 2015, from Level III and IV ecoregions of the continental United States. National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, Map scale 1:3,000,000: http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm

USEPA. (2013). *Human Health and Safety: TOXMAP Superfund/NPL and TRI Facilities*. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally: https://map11.epa.gov/arcgis/rest/services/NEPAssist/NEPAVELayersPublic

USEPA. (2014). *Water Resources: Section 303(d) Impaired Waters*. (GIS Metadata) Retrieved August 2015, from https://www.epa.gov/waterdata/waters-geospatial-data-downloads

USEPA. (2015b, April). *Air Quality: Nonattainment and Maintenance Counties*. (GIS Metadata) Retrieved August 2015, from The Green Book Nonattainment Areas for Criteria Pollutants: https://www3.epa.gov/airquality/greenbook/gis_download.html

USFWS. (2014). *Biological Resources: Designated Critical Habitat Map*. Retrieved September 2015, from https://www.fws.gov/gis/data/national/

USFWS. (2014). *Wetlands: Wetlands by Type*. (GIS Metadata) Retrieved August 2015, from State level data layer: https://www.fws.gov/wetlands/Data/Data-Download.html

USFWS National Wildlife Refuge System, Realty Division. (2015). *Visual Resources: Natural Areas that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e

USFWS, Realty Division. (2015). *Land Use, Recreation, and Airspace: Recreation Resources*. (GIS Metadata) Retrieved September 2015, from National Wildlife Refuge Boundaries: http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e

USGS. (2003, October). *Water Resources: Principal Aquifers*. (GIS Metadata) Retrieved August 2015, from http://water.usgs.gov/ogw/aquifer/map.html

USGS. (2010). *Geology: Generalized Surface Geology*. (GIS Metadata) Retrieved April 2015, from http://www.arcgis.com/home/item.html?id=2967ae2d1be14a8fbf5888b4ac75a01f

USGS. (2011). *Geology: Landslide Incidence and Susceptibility Hazard Map*. (GIS Metadata) Retrieved May 2015, from Web service, data is not saved locally: https://www.arcgis.com/home/item.html?id=b3fa4e3c494040b491485dbb7d038c8a

USGS. (2012). *Geology: Physiographic Regions and Provinces*. (GIS Metadata) Retrieved April 2015, from Physiographic provinces and regions are made from the same dataset; downloaded by state-level: http://services.arcgis.com/ZzrwjTRez6FJiOq4/arcgis/rest/services/US_PhysiographicProvinces/FeatureServer

USGS. (2013). *Geology: Karst Topography*. (GIS Metadata) Retrieved May 2015, from Two data layers within the same source show different varieties of Karst, and were published on different dates: http://services.arcgis.com/hoKRg7d6zCP8hwp2/arcgis/rest/services/Appalachian_Karst_Features/FeatureServer

USGS. (2014). *Geology: Seismic Hazard Map*. (GIS Metadata) Retrieved April 2015, from http://services.arcgis.com/VTyQ9soqVukalItT/arcgis/rest/services/USPGA_Seismic_Hazard/FeatureServer

USGS. (2014, November 30). *Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.: http://gapanalysis.usgs.gov/padus/data/download/

USGS Gap Analysis Program (GAP). (2011, August). *Land Use, Recreation, and Airspace: Major Land Use Distribution by Coverage Type*. (GIS Metadata) Retrieved August 2015, from USGS GAP Analysis Land Cover, Version 2, National Land Cover Dataset; Landsat 7 ETM+; Imagery provided for Spring, Summer and Fall dates between 1999 and 2001: http://gapanalysis.usgs.gov/gaplandcover/data/download/

USGS, Protected Areas of the US (PADUS v1.3). (2012, November 30). *Land Use, Recreation, and Airspace: Land Ownership Distribution*. (GIS Metadata) Retrieved August 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update: http://gapanalysis.usgs.gov/padus/data/download/

USGS, Protected Areas of the US (PADUS v1.3). (2012, November). *Land Use, Recreation, and Airspace: Recreation Resources*. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.: http://gapanalysis.usgs.gov/padus/data/download/

USGS, Protected Areas of the US (PADUS v1.3). (2012, November). *Visual Resources: Natural Areas that May be Visually Sensitive*. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.: http://gapanalysis.usgs.gov/padus/data/download/

Page Intentionally Left Blank.

FirstNet®