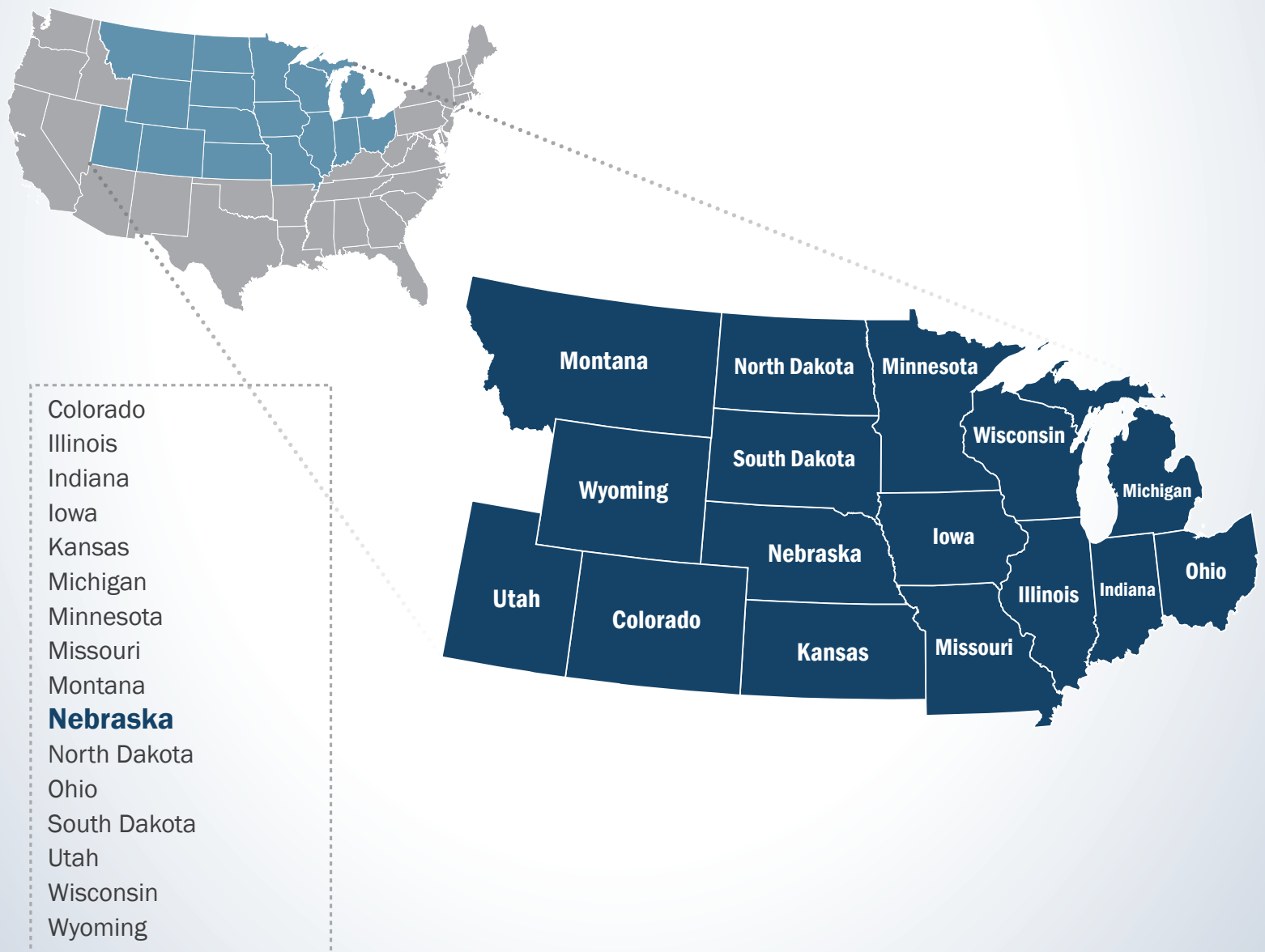




FirstNet®

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

VOLUME 10 - CHAPTER 12



First Responder Network Authority



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

VOLUME 10 - CHAPTER 12

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 Commerce—National Telecommunications and Information Administration
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

June 2017

Page Intentionally Left Blank.

Contents

12. Nebraska	12-7
12.1. Affected Environment	12-8
12.1.1. Infrastructure.....	12-8
12.1.2. Soils.....	12-35
12.1.3. Geology.....	12-47
12.1.4. Water Resources	12-63
12.1.5. Wetlands	12-74
12.1.6. Biological Resources	12-81
12.1.7. Land Use, Recreation, and Airspace.....	12-108
12.1.8. Visual Resources.....	12-134
12.1.9. Socioeconomics	12-147
12.1.10. Environmental Justice.....	12-164
12.1.11. Cultural Resources	12-169
12.1.12. Air Quality	12-184
12.1.13. Noise and Vibration	12-194
12.1.14. Climate Change.....	12-199
12.1.15. Human Health and Safety	12-206
12.2. Environmental Consequences	12-218
12.2.1. Infrastructure.....	12-218
12.2.2. Soils.....	12-230
12.2.3. Geology.....	12-237
12.2.4. Water Resources	12-249
12.2.5. Wetlands	12-262
12.2.6. Biological Resources	12-273
12.2.7. Land Use, Recreation, and Airspace.....	12-326
12.2.8. Visual Resources.....	12-339
12.2.9. Socioeconomics	12-347
12.2.10. Environmental Justice.....	12-359
12.2.11. Cultural Resources	12-367
12.2.12. Air Quality	12-376
12.2.13. Noise and Vibration	12-382
12.2.14. Climate Change.....	12-389
12.2.15. Human Health and Safety	12-402
NE Appendix A – Biological Resources	12-416
Acronyms	12-420
References.....	12-425
GIS References	12-458

List of Tables

Table 12.1.1-1: Relevant Nebraska Infrastructure Laws and Regulations	12-9
Table 12.1.1-2: Amtrak Train Routes Serving Nebraska	12-12
Table 12.1.1-3: Key Nebraska Indicators	12-13
Table 12.1.1-4: Public Safety Infrastructure in Nebraska by Type	12-13
Table 12.1.1-5: First Responder Personnel in Nebraska by Type	12-14
Table 12.1.1-6: Telecommunications Access Providers and Coverage in Nebraska as of December 31, 2013	12-19
Table 12.1.1-7: Wireless Telecommunications Coverage by Providers in Nebraska.....	12-20
Table 12.1.1-8: Number of Commercial Towers in Nebraska by Type	12-27
Table 12.1.1-9: Fiber Provider Coverage	12-30
Table 12.1.2-1: Relevant Nebraska Soil Laws and Regulations.....	12-36
Table 12.1.2-2: Characteristics of Major Land Resource Areas in Nebraska	12-39
Table 12.1.2-3: Major Characteristics of Soil Suborders Found in Nebraska, as depicted in Figure 12.1.2-3.....	12-43
Table 12.1.3-1: Relevant Nebraska Geology Laws and Regulations	12-48
Table 12.1.4-1: Relevant Nebraska Water Laws and Regulations	12-63
Table 12.1.4-2: Section 303(d) Impaired Waters of Nebraska, 2014	12-68
Table 12.1.4-3: Description of Nebraska's Principal Aquifers.....	12-72
Table 12.1.5-1: Relevant Nebraska Wetlands Laws and Regulations	12-74
Table 12.1.5-2: Nebraska Wetland Types, Descriptions, Location, and Amount, 2014	12-76
Table 12.1.6-1: Relevant Nebraska Biological Resources Laws and Regulations	12-82
Table 12.1.6-2: USEPA Level III Ecoregions of Nebraska.....	12-85
Table 12.1.6-3: Federally Listed Mammal Species of Nebraska.....	12-101
Table 12.1.6-4: Federally Listed Bird Species of Nebraska	12-102
Table 12.1.6-5: Federally Listed Fish Species of Nebraska	12-104
Table 12.1.6-6: Federally Listed Invertebrate Species of Nebraska	12-105
Table 12.1.6-7: Federally Listed Plant Species of Nebraska	12-107
Table 12.1.7-1: Relevant Nebraska Airspace Laws and Regulations.....	12-110
Table 12.1.7-2: Major Land Use in Nebraska by Coverage Type	12-110
Table 12.1.7-3: Top Five Developed Metropolitan Areas in Nebraska (2014 estimate).....	12-112
Table 12.1.7-4: Federal Land in Nebraska.....	12-114
Table 12.1.7-5: Indian Reservations and Other Tribal Land Holdings in Nebraska	12-115
Table 12.1.7-6: SUA Designations	12-123
Table 12.1.7-7: Other Airspace Designations.....	12-124
Table 12.1.7-8: Type and Number of Nebraska Airports/Facilities	12-127
Table 12.1.8-1: Relevant Nebraska Visual Resources Laws and Regulations	12-134
Table 12.1.8-2: State Historical Parks	12-140
Table 12.1.8-3: Nebraska State Parks	12-144
Table 12.1.8-4: National Natural Landmarks with Scenic Resources	12-145
Table 12.1.9-1: Land Area, Estimated Population, and Population Density of Nebraska....	12-149
Table 12.1.9-2: Recent Population Growth of Nebraska	12-150
Table 12.1.9-3: Projected Estimated Population Growth of Nebraska.....	12-151
Table 12.1.9-4: Population of the 10 Largest Population Concentrations in Nebraska.....	12-152
Table 12.1.9-5: Selected Economic Indicators for Nebraska	12-154

Table 12.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Nebraska, 2009–2013		12-158
Table 12.1.9-7: Employment by Class of Worker and by Industry, 2013		12-158
Table 12.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Nebraska, 2009–2013		12-159
Table 12.1.9-9: Selected Housing Indicators for Nebraska, 2013		12-160
Table 12.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Nebraska, 2009–2013		12-161
Table 12.1.9-11: Residential Property Values in Nebraska, 2013		12-161
Table 12.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Nebraska, 2009–2013		12-162
Table 12.1.9-13: State and Local Government Revenues, Selected Sources, 2012		12-163
Table 12.1.10-1: Estimated Population by Race and Hispanic Status, 2013		12-166
Table 12.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013.....		12-166
Table 12.1.11-1: Relevant Nebraska Cultural Resources Laws and Regulations.....		12-170
Table 12.1.11-2: Archaeological Sites on the National Register of Historic Places in Nebraska		12-177
Table 12.1.12-1: Nebraska Ambient Air Quality Standards.....		12-186
Table 12.1.12-2: Major Air Pollutant Source Thresholds.....		12-187
Table 12.1.12-3: De Minimis Levels		12-188
Table 12.1.12-4: Nebraska Nonattainment and Maintenance Areas by Pollutant Standard and County.....		12-190
Table 12.1.12-5: Relevant Federal Class I Areas		12-192
Table 12.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB).....		12-196
Table 12.1.13-2: Relevant Nebraska Noise Laws and Regulations.....		12-197
Table 12.1.14-1: Nebraska CO ₂ Emissions from Fossil Fuels by Fuel Type and Sector, 2014.....		12-201
Table 12.1.15-1: Relevant Nebraska Human Health and Safety Laws and Regulations.....		12-207
Table 12.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level.....		12-220
Table 12.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level..		12-231
Table 12.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level		12-239
Table 12.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level.....		12-250
Table 12.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level		12-263
Table 12.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level.....		12-274
Table 12.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level.....		12-312
Table 12.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level.....		12-327
Table 12.2.8-1: Impact Significance Rating Criteria for Visual Resources at the Programmatic Level.....		12-341

Table 12.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level.....	12-348
Table 12.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level.....	12-361
Table 12.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level.....	12-369
Table 12.2.12-1: Impact Significance Rating Criteria at the Programmatic Level	12-377
Table 12.2.13-1: Impact Significance Rating Criteria for Noise and Vibrations at the Programmatic Level.....	12-383
Table 12.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level.....	12-390
Table 12.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level.....	12-403
Table A-1: NNHP S1 Ranked Natural Community Types in Nebraska.....	12-416

List of Figures

Figure 12.1.1-1: Nebraska Transportation Networks	12-11
Figure 12.1.1-2: Wireless Network Configuration	12-15
Figure 12.1.1-3: AT&T and Verizon Wireless Availability in Nebraska.....	12-21
Figure 12.1.1-4: U.S. Cellular and Viera Wireless Availability in Nebraska.....	12-22
Figure 12.1.1-5: Sprint, ATCJet.Net LLC, Connecting Point, and Future Technologies Wireless Availability in Nebraska	12-23
Figure 12.1.1-6: Vistabeam, Hamilton.Net Inc., Huntel Cablevision, Telebeep Wireless, and Affordable Internet Solutions Wireless Availability in Nebraska	12-24
Figure 12.1.1-7: Other Providers Wireless availability in Nebraska	12-25
Figure 12.1.1-8: Types of Towers.....	12-26
Figure 12.1.1-9: FCC Tower Structure Locations in Nebraska	12-28
Figure 12.1.1-10: Typical Fiber Optic Network in Nebraska	12-29
Figure 12.1.1-11: Fiber Availability in Nebraska for KDSI Internet Services and Internet Nebraska Corporation	12-31
Figure 12.1.1-12: Other Providers' Fiber Availability in Nebraska	12-32
Figure 12.1.2-1: Locations of Major Land Resource Areas in Nebraska	12-38
Figure 12.1.2-2: Nebraska Sandhills.....	12-41
Figure 12.1.2-3: Nebraska Soil Taxonomy Suborders.....	12-45
Figure 12.1.3-1: Physiographic Regions and Provinces of Nebraska.....	12-49
Figure 12.1.3-2: Generalized Surface Geology for Nebraska.....	12-52
Figure 12.1.3-3: Generalized Bedrock Geology for Nebraska	12-54
Figure 12.1.3-4: Ashfall Fossil Beds State Historical Park	12-56
Figure 12.1.3-5: Nebraska 2014 Seismic Hazard Map	12-59
Figure 12.1.3-6: Nebraska Landslide Incidence and Susceptibility Hazard Map.....	12-60
Figure 12.1.3-7: Karst Topography in Nebraska	12-62
Figure 12.1.4-1: Major Nebraska Watersheds, Defined by Nebraska DNR, and Surface Waterbodies	12-66
Figure 12.1.4-2: Section 303(d) Impaired Waters of Nebraska, 2014.....	12-70
Figure 12.1.4-3: Principal Aquifers of Nebraska.....	12-73
Figure 12.1.5-1: Wetlands by Type in Western Nebraska, 2014.....	12-78

Figure 12.1.5-2: Wetlands by Type in Eastern Nebraska, 2014	12-79
Figure 12.1.6-1: USEPA Level III Ecoregions of Nebraska	12-84
Figure 12.1.6-2: Important Bird Areas in Nebraska	12-95
Figure 12.1.6-3: ESA Designated Critical Habitat in Nebraska	12-100
Figure 12.1.7-1: Major Land Use Distribution by Coverage Type.....	12-113
Figure 12.1.7-2: Land Ownership Distribution.....	12-116
Figure 12.1.7-3: Nebraska Recreation Resources.....	12-119
Figure 12.1.7-4: National Air Space Classification Profile	12-121
Figure 12.1.7-5: Nebraska Public and Private Airports/Facilities	12-128
Figure 12.1.7-6: Public Nebraska Airports/Facilities	12-129
Figure 12.1.7-7: Private Nebraska Airports/Facilities	12-130
Figure 12.1.7-8: SUAs in Nebraska.....	12-132
Figure 12.1.7-9: MTRs in Nebraska	12-133
Figure 12.1.8-1: Representative Sample of Some Historic and Cultural Areas that May Be Visually Sensitive.....	12-137
Figure 12.1.8-2: Signal Butte National Historic Landmark.....	12-138
Figure 12.1.8-3: Scenic View from the California National Historic Trail	12-139
Figure 12.1.8-4: Natural Areas that May be Visually Sensitive	12-142
Figure 12.1.8-5: Soldier Creek Wilderness within the Oglala National Grassland	12-146
Figure 12.1.9-1: Estimated Population Distribution in Nebraska, 2009–2013.....	12-153
Figure 12.1.9-2: Median Household Income in Nebraska, by County, 2013	12-156
Figure 12.1.9-3: Unemployment Rates in Nebraska, by County, 2014.....	12-157
Figure 12.1.10-1: Potential for Environmental Justice Populations in Nebraska, 2009– 2013.....	12-168
Figure 12.1.11-1: Timeline of Prehistoric Human Occupation	12-171
Figure 12.1.11-2: Approximate Historic Boundaries of Tribes in Nebraska.....	12-175
Figure 12.1.11-3: National Register of Historic Places (NRHP) Sites in Nebraska.....	12-182
Figure 12.1.11-4: Representative Architectural Styles of Nebraska.....	12-184
Figure 12.1.12-1: Nonattainment and Maintenance Counties in Nebraska	12-191
Figure 12.1.12-2: Federal Class I Areas with Implications for Nebraska	12-193
Figure 12.1.13-1: Sound Levels Typical of Sounds	12-195
Figure 12.1.14-1: Nebraska CO ₂ Emissions by Source 1980-2013.....	12-202
Figure 12.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties	12-203
Figure 12.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014.....	12-210
Figure 12.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Nebraska	12-213
Figure 12.1.15-3: Track Hoe Excavating Contaminated Surface Soil.....	12-215
Figure 12.2.14-1: Nebraska Low Emission Scenario Projected Temperature Change.....	12-392
Figure 12.2.14-2: Nebraska High Emission Scenario Projected Temperature Change	12-392
Figure 12.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario	12-394
Figure 12.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario	12-395

Page Intentionally Left Blank.

12. NEBRASKA

Nebraska was populated for centuries by American Indian tribes with a rich cultural history. The Nebraska territory was organized in 1854, first as a slave holding territory and then as a free territory once the legislature voted to abolish slavery. In 1867, Nebraska became the first state to join the Union after the Civil War ended (NDOR, 2012a). Nebraska is bordered by South Dakota to the north, Wyoming and Colorado to the west, Iowa and Missouri to the east, and Kansas to the south. This chapter provides details about the existing environment of Nebraska as it relates to the Proposed Action.



General facts about Nebraska are provided below:

- **State Nickname:** The Cornhusker State
- **Area:** 76,824 square miles; **U.S. Rank:** 16 (U.S. Census Bureau, 2015a)
- **Capital:** Lincoln
- **Counties:** 93 (U.S. Census Bureau, 2015b)
- **2014 Estimated Population:** Over 1.8 million people; **U.S. Rank:** 38 (U.S. Census Bureau, 2015a)
- **Most Populated Cities:** Omaha and Lincoln (U.S. Census Bureau, 2015b)
- **Main Rivers:** Missouri River, Platte River, and Niobrara River
- **Bordering Waterbodies:** Missouri River
- **Mountain Ranges:** Nebraska Badlands
- **Highest Point:** Panorama Point (5,424 ft) (USGS, 2016)

12.1. AFFECTED ENVIRONMENT

12.1.1. Infrastructure

12.1.1.1. Definition of the Resource

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

Section 12.1.1.3 provides an overview of the traffic and transportation infrastructure in Nebraska, including road and rail networks and airport facilities. Nebraska public safety infrastructure could include any infrastructure utilized by a public safety entity¹ as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et seq.) (the Act), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in Nebraska are presented in more detail in Section 12.1.1.4. Section 12.1.1.5 describes specific public safety communications infrastructure and commercial telecommunications infrastructure in Nebraska. An overview of utilities in Nebraska, such as power, water, and sewer, are presented in Section 12.1.1.6.

12.1.1.2. Specific Regulatory Considerations

Multiple Nebraska laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 12.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state’s applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

¹ The term “public safety entity” means an entity that provides public safety services (7 U.S. Code [U.S.C.] § 1401(26)).

Table 12.1.1-1: Relevant Nebraska Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Nebraska Revised Statutes: Chapter 86 Telecommunications and Technology	Division of Communications; Public Safety Commission	Ensures public safety by providing efficient, reliable communications systems; invests in the public safety communication infrastructure; encourages regional approaches to communications planning and preparedness; assists local communities and public safety agencies desiring to connect with a network of regional communications systems; provides for the mutual assistance between states to manage any emergency or disaster.
Nebraska Revised Statutes: Chapter 66 Oils, Fuels, and Energy	Nebraska Public Service Commission (NPSC)	Manages utilities and natural gas public utilities for public use; conducts investigations, test, audits, and inspections of natural gas public utilities; regulates natural gas public utilities.

Source: (Nebraska Legislature, 2017a) (Nebraska Legislature, 2017b)

12.1.1.3. Transportation

This section describes the transportation infrastructure in Nebraska, including specific information related to the road networks, airport facilities, and rail networks. 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 Nebraska are based on a review of maps, aerial photography, and federal and state data sources.

The Nebraska Department of Roads (NDOR) has jurisdiction over freeways and major roads, as well as railroads; local counties have jurisdiction for smaller streets and roads. The NDOR is responsible for “the planning, development, design, construction, maintenance, and administration of the state highway system” (NDOR, 2015a). The Nebraska Department of Aeronautics (NDA) has jurisdiction over airports in the state. The NDA’s mission is to “encourage and facilitate the development and use of aviation in Nebraska” (NDA, 2014).

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

- 93,770 miles of public roads (FHWA, 2014) and 15,374 bridges (FHWA, 2015a);
- 3,461 miles of rail network that includes passenger rail and freight (Association of American Railroads, 2014);
- 84 public and 147 private aviation facilities, including airstrips and heliports (FAA, 2015a); and
- No major harbors or ports (U.S. Harbors, 2015).

Road Networks

As identified in Figure 12.1.1-1, the major urban centers of the state of Grand Island, Lincoln, and Omaha are located in the southeastern portion of the state. Nebraska has one major interstate, I-80, connecting its major metropolitan areas to one another, as well as to other states (western terminus at Bushnell, Wyoming to the eastern terminus of Omaha, Nebraska at the Iowa border). Travel outside the major metropolitan areas is conducted on interstates, state, and county roads. 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 in the west (FHWA, 2015b).

In addition to the Interstate System, Nebraska has State Scenic Byways, which are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA, 2013). Some State Scenic Byways may be designated on portions of National Scenic Byways, but in Nebraska, there are no National Scenic Byways (see Section 12.1.8, Visual Resources). Table 12.1.1-1 illustrates the major transportation networks, including roadways, in Nebraska. State Scenic Byways in Nebraska are designated and managed by NDOR. Nebraska has nine State Scenic Byways that crisscross the entire state (NDOR, 2012a) (NDOR, 2015b):²

- Bridges to Buttes Byway;
- Gold Rush Byway;
- Heritage Highway;
- Lewis and Clark Scenic Byway;
- Lincoln Highway Scenic and Historic Byway;
- Loup Rivers Scenic Byway;
- Outlaw Trail Scenic Byway;
- Sandhills Journey Byway; and
- Western Trails Scenic and Historic 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.

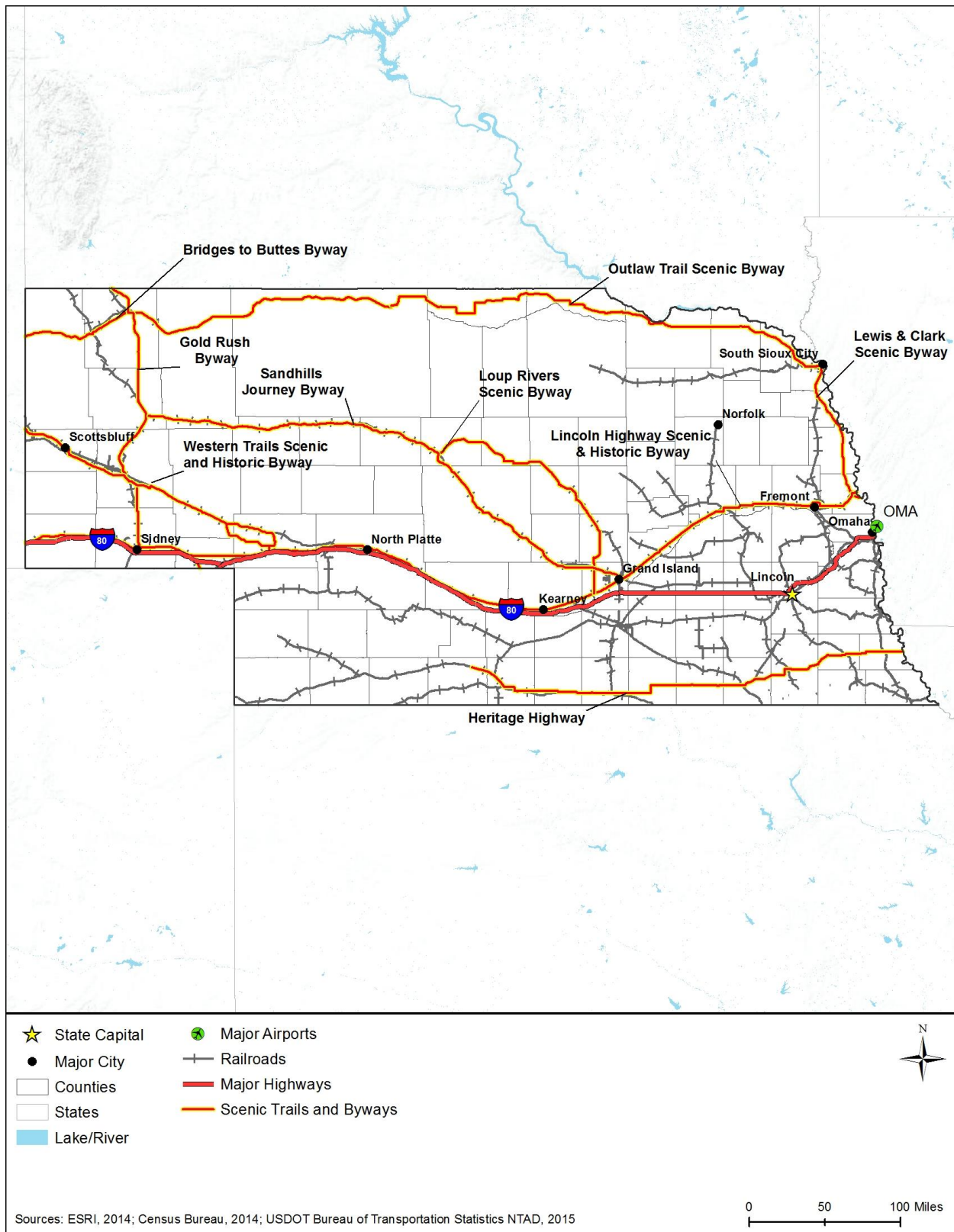


Figure 12.1.1-1: Nebraska Transportation Networks

Airports

Air service to the state is provided by Eppley Airfield (OMA) in Omaha, which is the major airport in Nebraska. The Omaha Airport Authority (OAA) owns and operates the Airfield. The OAA's mission is "to provide, operate, maintain, and develop premier air transportation facilities to serve the Greater Omaha and surrounding area" (OMA, 2015a). In 2014, OMA served 4.1 million passengers, handled 113 million pounds of cargo, and facilitated approximately 70 to 75 daily air carrier departures (OMA, 2015b). OMA is Nebraska's busiest airport with 97,900 annual operations (NDA, 2014). Figure 12.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 12.1.7, Land Use, Recreation, and Airspace, provides greater detail on airports and airspace in Nebraska.

Rail Networks

Nebraska is connected to a network of passenger rail (Amtrak) and freight rail. Figure 12.1.1-1 illustrates the major transportation networks, including rail lines, in Nebraska.

Amtrak runs one line through Nebraska, the California Zephyr. On its route from Chicago to the San Francisco Bay Area, the line stops at five stations in Nebraska (Amtrak, 2015a). Within Nebraska, Amtrak operates on tracks owned by the Burlington Northern and Santa Fe Railway (BNSF) (NDOR, 2003). However, Amtrak only stops at the Nebraska stations at night, and provides "limited value in meeting travel needs between Nebraska communities" (NDOR, 2003). Table 12.1.1-2 provides a complete list of Amtrak lines that run through Nebraska.

Table 12.1.1-2: Amtrak Train Routes Serving Nebraska

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Nebraska
California Zephyr	Chicago, IL	Emeryville, CA	51 hours 20 minutes	Omaha, Lincoln, Hastings, Holdrege, McCook

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

The freight rail system in Nebraska is more comprehensive than the passenger rail system. The Federal Railroad Administration (FRA) classifies railroads as Class I, Class II, or Class III based on corporate revenue thresholds (FRA, 2015a). Three Class I railroads operate in Nebraska, as well as one regional railroad and a handful of local carriers. The BNSF owns 60 percent of the state's rail system, or 1,651 miles of track, which makes it the largest freight railroad in Nebraska. The second largest freight rail in Nebraska is the Union Pacific Railway, as it owns 39 percent of the state's rail system, or 1,067 miles of track. In 2012, Nebraska's top-originated rail freight commodities were farm and food products, ranking fourth and fifth nationally, respectively. In addition, Nebraska's rail network serves as an energy transportation source. It is second in the nation in terms of originated rail tons of ethanol and 73 percent of Nebraska electricity is generated by coal delivered by rail (Association of American Railroads, 2014).

Harbors and Ports

Nebraska has no major harbors or ports (U.S. Harbors, 2015).

12.1.1.4. Public Safety Services

Nebraska's public safety services generally consist of public safety infrastructure and first responder personnel throughout the state. The general abundance and distribution of public safety services may roughly follow key state demographic indicators. Table 12.1.1-3 presents Nebraska'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 12.1.9, Socioeconomics.

Table 12.1.1-3: Key Nebraska Indicators

Nebraska Indicators	
Estimated Population (2014)	1,881,503
Land Area (square miles) (2010)	76,824
Population Density (persons per sq. mile) (2010)	24
Municipal Governments (2013)	530

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

Table 12.1.1-4 presents Nebraska's public safety infrastructure, including fire and police stations. Table 12.1.1-5 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 12.1.1-4: Public Safety Infrastructure in Nebraska by Type

Infrastructure Type	Number
Fire and Rescue Stations ^a	473
Law Enforcement Agencies ^b	225
Fire Departments ^c	391

Source: (USFA, 2015a) (U.S. Bureau of Justice Statistics, 2011a)

^a Data collected by the U.S. Fire Administration in 2015.

^b Number of agencies from state and local law enforcement include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.

^c Data collected by the U.S. Fire Administration in 2015.

Table 12.1.1-5: First Responder Personnel in Nebraska by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers ^a	920
Fire and Rescue Personnel ^b	5,058
Law Enforcement Personnel ^c	5,227
Emergency Medical Technicians and Paramedics ^{d e}	**

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

** Estimates not released.

^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.

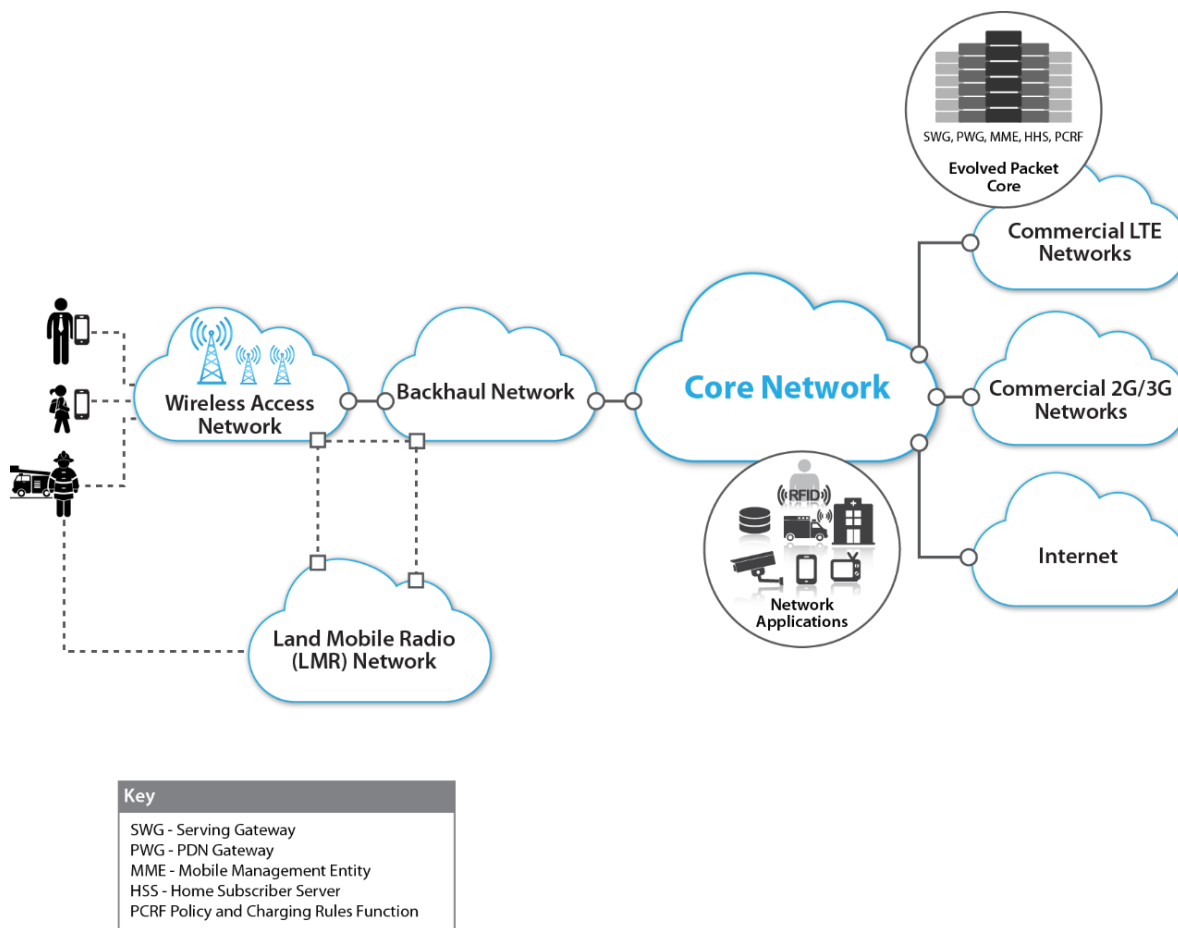
^d BLS Occupation Code: 29-2041.

^e All BLS data collected in 2015.

12.1.1.5. Telecommunications Resources

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

Communications throughout the state are based on a variety of publicly and commercially owned technologies. Figure 12.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio (LMR) network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications (FCC, 2016a).



Prepared by: Booz Allen Hamilton

Figure 12.1.1-2: Wireless Network Configuration

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 12.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information, including jurisdictional challenges, funding challenges, the pace of technology evolution, and communication interoperability. 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 at the state level, including in Nebraska.

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

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

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

Nebraska’s primary public safety LMR network providing statewide LMR coverage and supporting its 9-1-1 system is the Nebraska Statewide Radio System (SRS) operating in the Very High Frequency (VHF)3 band (RadioReference.com, 2015a). According to Nebraska’s Office of the CIO (OCIO), “The Nebraska SRS modernized state public safety communications to a completely digital system, providing statewide roaming and a multitude of communications resources for first responders and dispatchers. Through 54 towers across Nebraska and double redundant call processors, the SRS is supporting 17 agencies that rely on the system full time, and more than 80 percent of counties use the SRS for interoperability with the state” (Nebraska Office of the CIO, 2015).

Nebraska’s SRS is a partnership between the state and Nebraska Public Power District (NPPD). The Nebraska Wireless Interoperable Council explained SRS’s structure and funding as follows: “The statewide land mobile radio system was designed to serve the needs of the NPPD and the state government of Nebraska, as well as other organizations such as first responders, state and local officials, and local utilities. Rather than build two separate radio systems, state and NPPD officials entered into an agreement to equally share the cost of developing the statewide radio network. The funding mechanism for the SRS was designed to be as simple as possible, match funding to utilization and promote utilization of the system” (Nebraska Wireless Interoperable Network Council, 2011).

Like most states, Nebraska’s public safety LMR network environment is in transition and reflects the challenges of the need for greater system capabilities, broader coverage, and technology modernization to broadband and fuller data capability delivery. Responsibility for the Nebraska SRS network is with a Public Safety Communications Team within Nebraska’s OCIO that manages its operation; coordinate with local, state, and federal agencies on using the system; and trains dispatchers and users (Nebraska CIO, 2015).

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

Statewide and Multi-County Public Safety Networks

Four broad coverage public safety digital Project 25 (P-25) systems operate in Nebraska: SRS,⁴ the Omaha Regional Interop Network (ORION), Siouxland Tristate Area Radio Communications (STARCOMM), and Radio Communications (RACOM), a multi-state Midwestern LMR network (State of Nebraska Radio Systems-Trunked Systems, 2015). Nebraska's public safety LMR network operates on VHF, and was constructed in four major phases, and was regionally deployed beginning in 2010. It supports statewide public safety statewide organizations and other state agencies, such as the Nebraska State Patrol and the Department of Corrections, as well as county and local public safety users. SRS also provides communications to NPPD, the state's utility partner in the SRS (RadioReference.com, 2015b). ORION is an 800 MHz system providing wireless communications to public safety users, such as police and fire departments in nine Nebraska counties⁵ and the county of Pottawattamie in Iowa (RadioReference.com, 2015c). RACOM's 800 MHz network, using Enhanced Digital Access System (EDACS) technology, also provides public safety network coverage in four Nebraska Counties: Douglas, Seward, Madison, and Lancaster Counties (RadioReference.com, 2015d). STARCOMM provides 800 MHz coverage in three states and three counties: Dakota County (Nebraska), Woodbury County (Iowa), and Union County (South Dakota) (RadioReference.com, 2015e).

Statewide Mutual Aid occurs in Nebraska on the SRS network offering three lower frequency VHF channels: Statewide Medical Net, Statewide Law Enforcement Net, and Statewide EMA Net. Nebraska's Region 26 EMS Emergency Communications also provides mutual aid communications in eight counties over VHF (Nebraska Mutual Aid, 2015).

City and County Public Safety Networks

In addition to access to the Statewide SRS LMR system, Nebraska counties and local communities have access to additional VHF networks which support local police/sheriff, fire, and EMS users for tactical communications, dispatch, and mutual aid response. Three county/city examples are described below: Lincoln (Lancaster County), Omaha (Douglas County), and Chadron (Dawes County) to illustrate the multiple frequencies and network diversity in Nebraska.

Lincoln, the capitol of Nebraska, is in Lancaster County where users have access to the Nebraska SRS, public safety agencies and a diverse mix of additional LMR radio frequencies. The Lincoln-Lancaster EDACS network supports the Sheriff Department on Ultra High Frequency (UHF),⁶ whereas fire department communications occur on VHF (fire rescue/paging) and 800 MHz for mutual aid, fire rescue, coverage extension/repeater, and UHF (coverage extension/repeater) (RadioReference.com, 2015f).

Omaha, located in Douglas County, is served by ORION, a multi-county 800 MHz P-25 system. In addition, the counties within the Omaha metro region served by ORION also have access to

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

⁵ The nine Nebraska counties are: Douglas, Cass, Washington, Sarpy, Nemaha, Otoe, Richardson, Pawnee, and Saunders.

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

VHF and UHF systems addressing additional tactical communications needs. In Douglas County, for example, although most services are on the 800 MHz ORION system, additional UHF and VHF networks are available to public safety users, such as UHF for fire (paging/dispatch) and VHF (emergency management). In the city of Omaha, most public safety services are on the SRS network, but additional UHF and VHF public safety frequencies are in use (RadioReference.com, 2015g).

Dawes County in northwest Nebraska (a low-population, rural county with two small towns, Chadron and Crawford) is typical of rural communities in Nebraska. Dawes County operates public safety networks and municipal networks operating on VHF, and public safety agencies (police, fire, EMS) also have access to Nebraska's SRS system (RadioReference.com, 2015h).

Public Safety Answering Points (PSAPs)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 91 PSAPs in Nebraska serving Nebraska's 93 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Nebraska'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 Nebraska's commercial telecommunications infrastructure, including information on the number of carriers and technologies deployed; geographic coverage; voice, Internet access, and wireless subscribers; and the quantity and location of telecommunications towers, fiber optic plant, and data centers.

Carriers, Coverage, and Subscribers

Nebraska'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 12.1.1-6 presents the number of providers of switched access⁷ lines, Internet access,⁸ and mobile wireless services including coverage.

⁷ "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)" (FCC, 2013).

⁸ Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

Table 12.1.1-6: Telecommunications Access Providers and Coverage in Nebraska as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines ^a	124	97.5% of households
Internet access ^b	71	59% of households
Mobile wireless ^c	8	92% of population

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

^a Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of service providers was reported by the FCC as of December 31, 2013 in Table 17 in "Local Telephone Competition: Status as of December 31, 2013" as the total of ILEC and non-ILEC providers (FCC, 2014b).

^b Internet access providers are presented in Table 21 in "Internet Access Services: Status as of December 31, 2013" by technology provided; number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers (FCC, 2014a).

^c Mobile wireless provider data is provided by the FCC in the sources identified. However, NTIA's National Broadband Map provides newer data, so FirstNet is using NTIA's GIS-based data from the National Broadband Map instead of the data reported by the FCC. The process for retrieving the National Broadband Map data is explained in detail in a subsequent footnote in Section 12.1.1.5, Last Mile Fiber Assets.

Table 12.1.1-7 shows the wireless providers in Nebraska along with their geographic coverage. The following five maps: Figure 12.1.1-3, Figure 12.1.1-4, Figure 12.1.1-5, Figure 12.1.1-6, and Figure 12.1.1-7 show: Verizon Wireless and AT&T Mobility LLC's coverage; U.S. Cellular and Viaero Wireless's coverage; Sprint, ATCJet.Net LLC, Connecting Point, and Future Technology's coverage; Vistabeam, Hamilton.Net Inc., Huntel Cablevision, Telebeep Wireless, and Affordable Internet Solutions' coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 12.1.1-7: Wireless Telecommunications Coverage by Providers in Nebraska

Wireless Telecommunications Providers	Coverage
Verizon Wireless	92.32%
U.S. Cellular	67.66%
Viaero Wireless	66.00%
AT&T Mobility LLC	27.88%
Connecting Point	14.55%
Future Technologies	9.02%
Sprint	8.74%
Wireless Net, LLC	8.73%
ATCJet.Net LLC	7.93%
Hamilton.Net, Inc.	7.65%
Vistabeam	7.36%
Huntel Cablevision	6.12%
Telebeep Wireless	5.81%
Affordable Internet Solutions	5.21%
Other ^a	30.50%

Source: (NTIA, 2014)

^a Other: Provider with less than 5 percent coverage area. Providers include: Pinpoint Communications Inc.; STE Wireless, Inc.; Glenwood Telecommunications Inc.; Diode Communications; Blaze Wireless; BWTelcom; Superior Net; Cricket Communications, Inc.; Action Communications; Skywave Wireless, Inc.; Omni-Tech Inc.; SpeedConnect; Eagle Communications, Inc.; Jagwireless; Sandhills Wireless; KDSI Internet Services; Internet Nebraska Corporation; Geneva Broadband, LLC; PC Telcom; Access Direct Communications; Peetz Communications, LLC; FiberComm L.C.; Nyecom Teleservices.

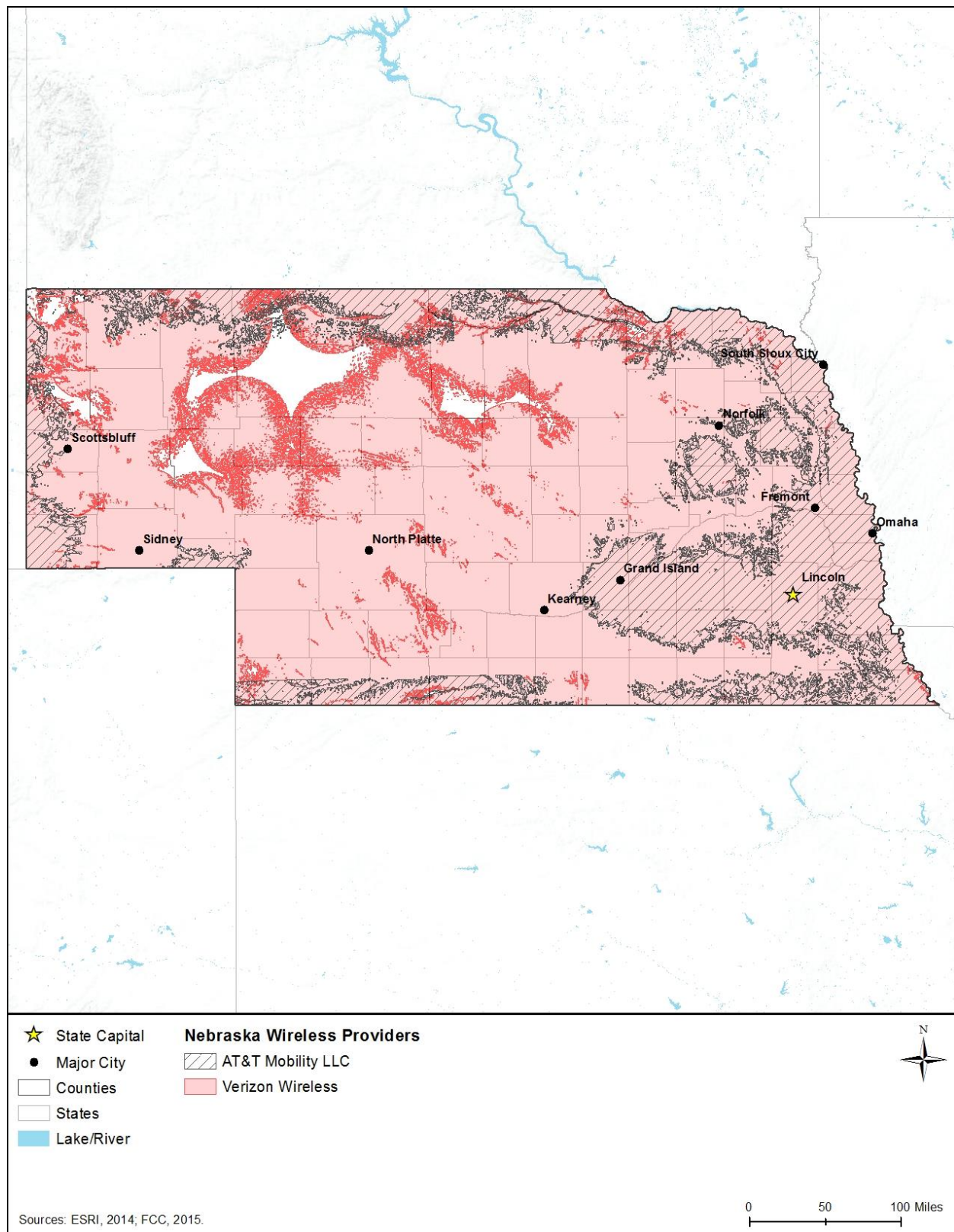


Figure 12.1.1-3: AT&T and Verizon Wireless Availability in Nebraska

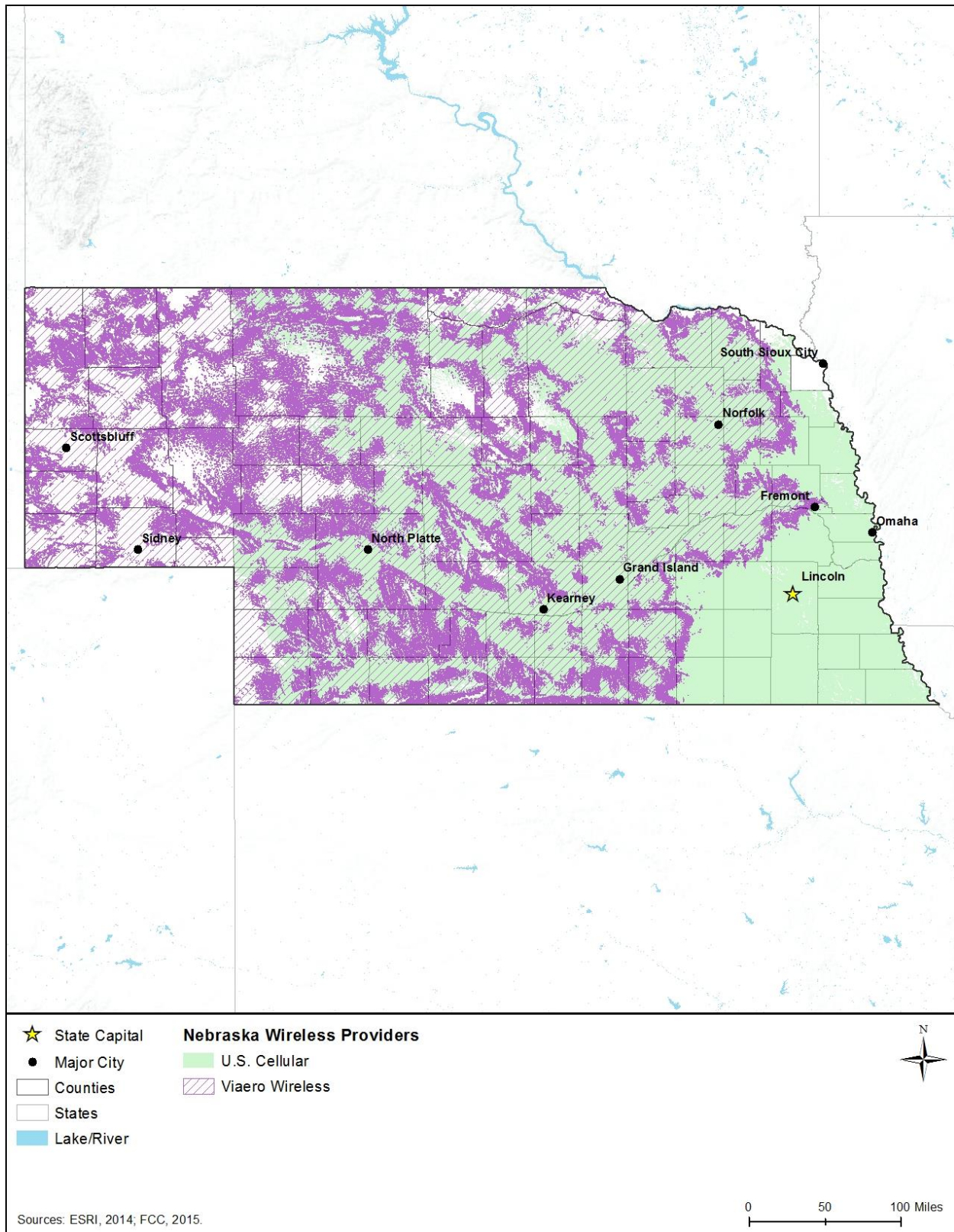


Figure 12.1.1-4: U.S. Cellular and Viaero Wireless Availability in Nebraska

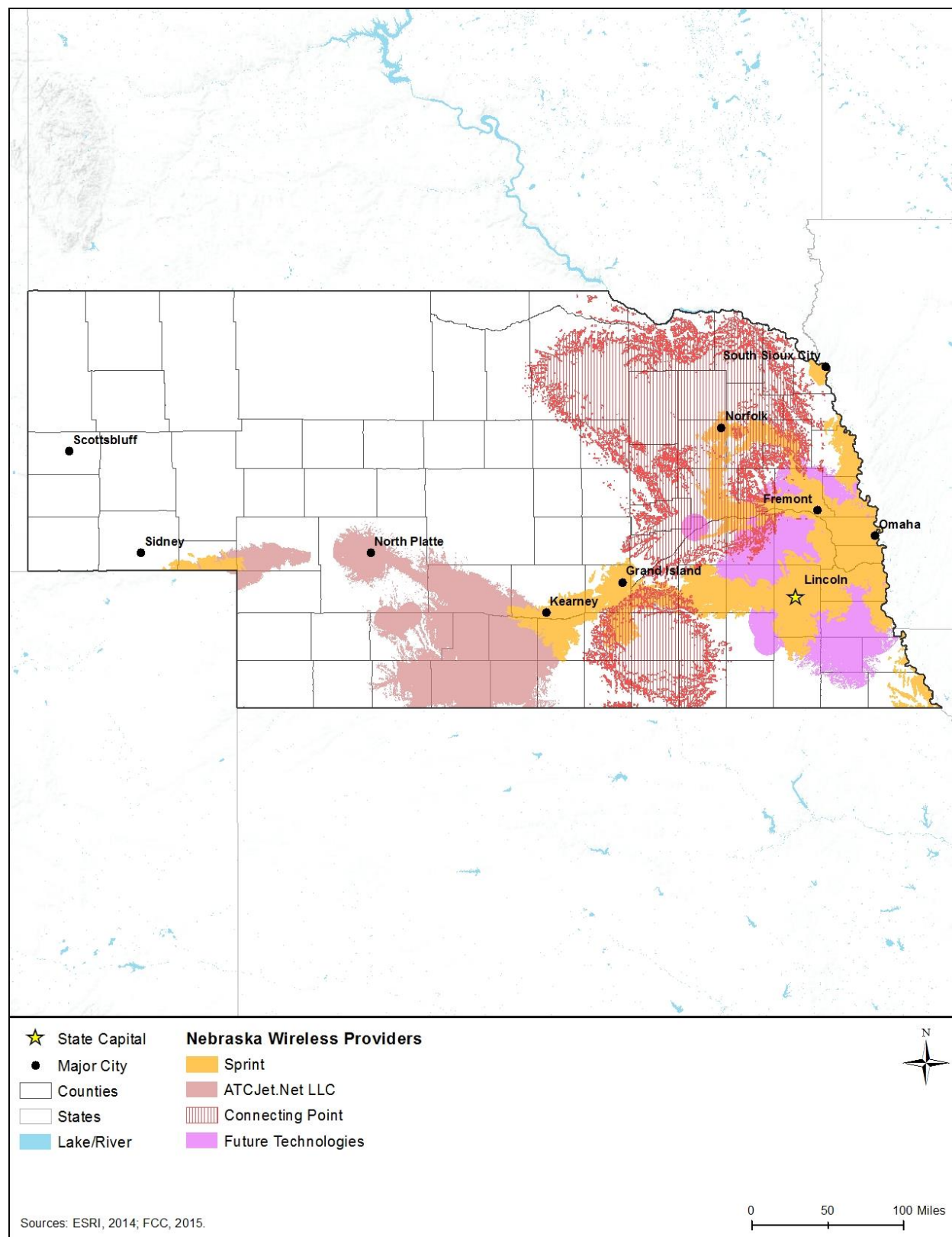


Figure 12.1.1-5: Sprint, ATCJet.Net LLC, Connecting Point, and Future Technologies Wireless Availability in Nebraska

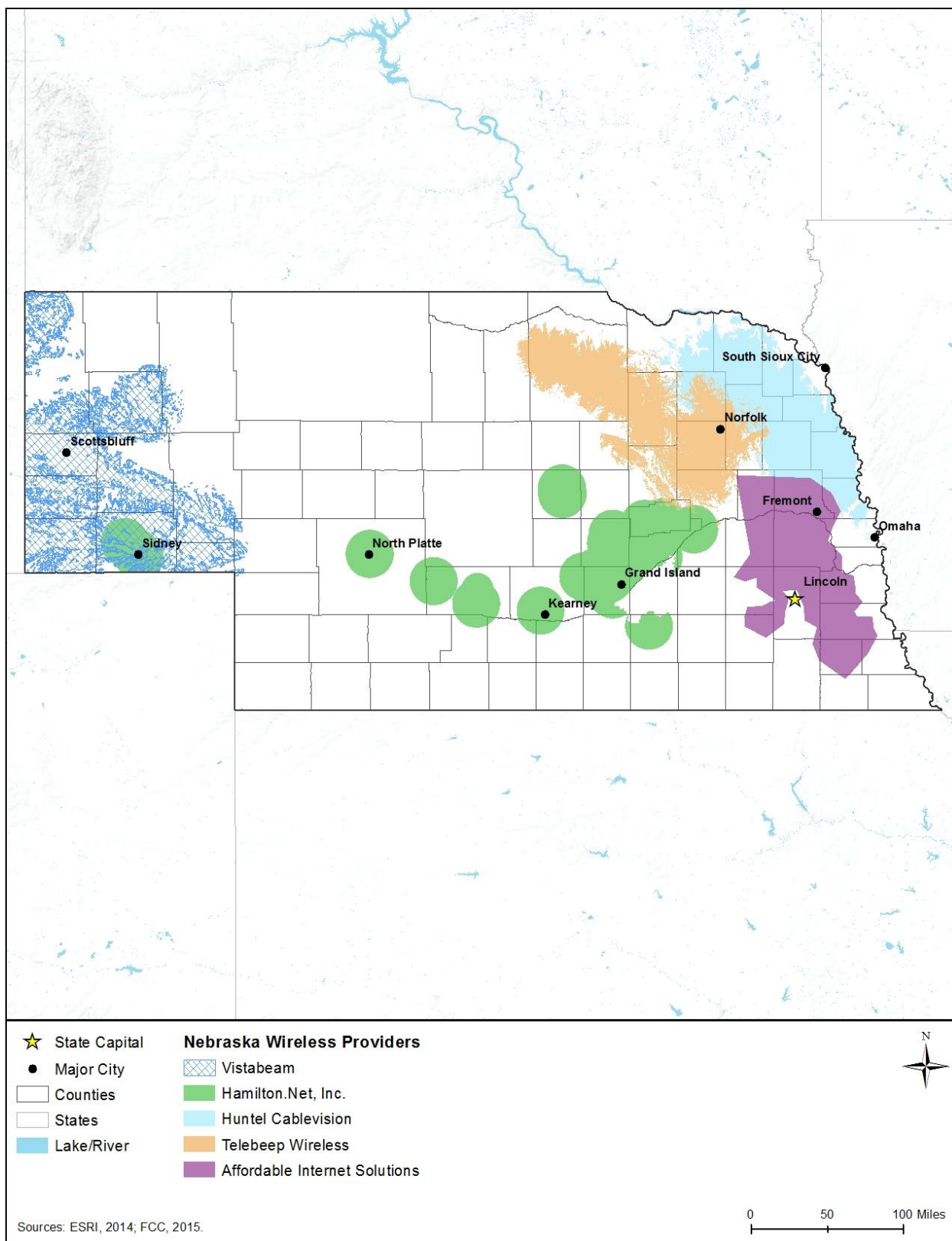


Figure 12.1.1-6: Vistabeam, Hamilton.Net Inc., Huntel Cablevision, Telebeep Wireless, and Affordable Internet Solutions Wireless Availability in Nebraska

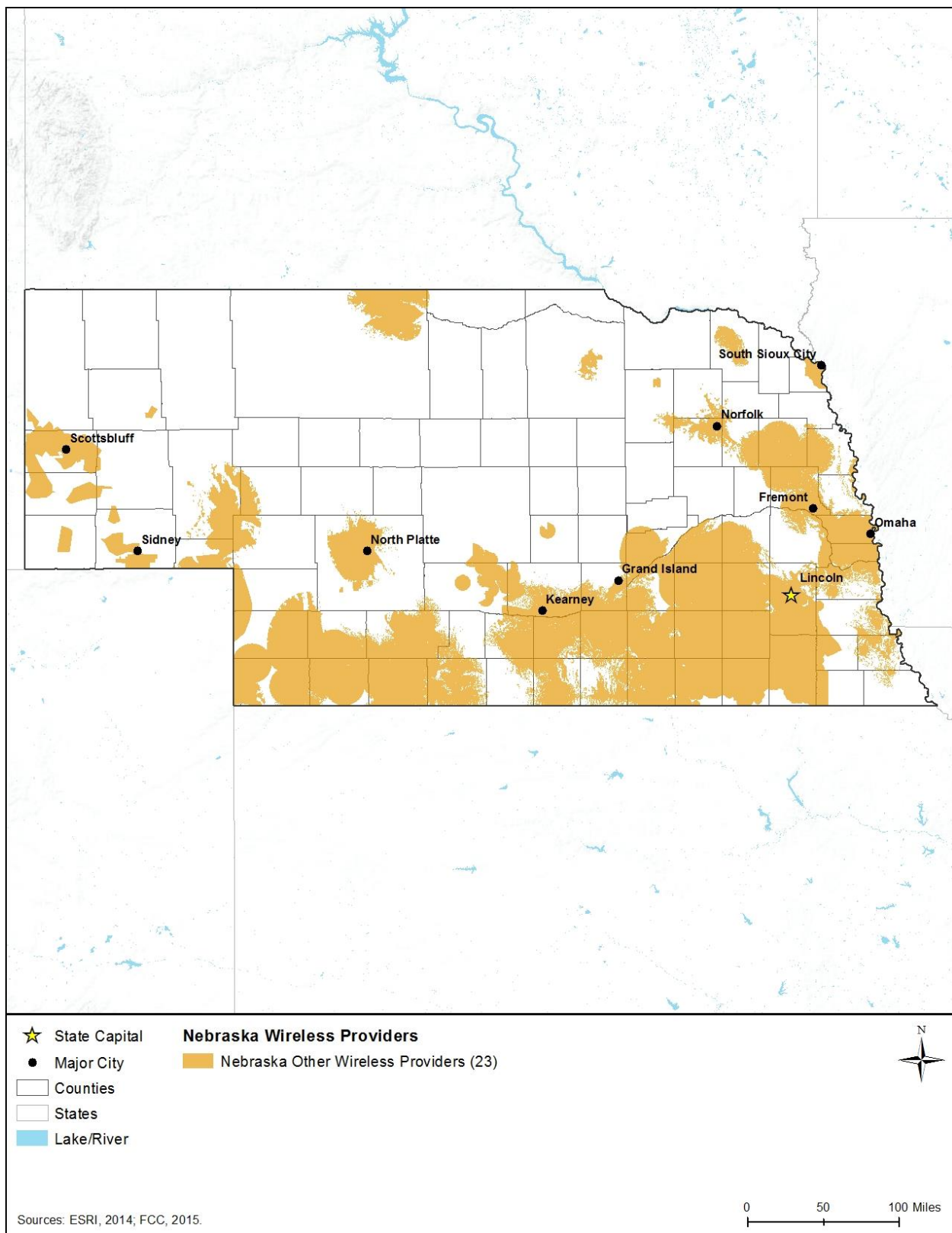


Figure 12.1.1-7: Other Providers Wireless availability in Nebraska

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency (RF) needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 12.1.1-8 presents representative examples of each of these categories or types of towers.



Monopole
100–200 feet

Source:
http://laps.noaa.gov/birk/laps_intranet/site_photos/Monarch/tower.jpg



Lattice
200–400 feet

Source: Personal Picture



Guyed
200–2,000 feet

Source:
<http://www.esrl.noaa.gov/gmd/ccgg/insitu/>

Figure 12.1.1-8: Types of Towers

Telecommunications tower infrastructure can be found throughout Nebraska, although tower infrastructure is concentrated in the higher and more densely populated areas of Scottsbluff, Sidney, North Platte, Kearny, Grand Island, Lincoln, Omaha, Fremont, Norfolk, and South Sioux City. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016d).⁹ Table 12.1.1-8 presents the number of towers (including broadcast towers) registered with the FCC in Nebraska and Figure 12.1.1-9 presents the location of those structures, as of July 2016.

⁹ An antenna structure must be registered with the FCC if the antenna structure is taller than 200 ft. above ground level or may interfere with the flight path of a nearby airport (FCC, 2016b).

Table 12.1.1-8: Number of Commercial Towers in Nebraska by Type

Constructed^a Towers^b		Constructed Monopole Towers	
100ft and over	354	100ft and over	0
75ft – 100ft	367	75ft – 100ft	1
50ft – 75ft	334	50ft – 75ft	9
25ft – 50ft	194	25ft – 50ft	30
25ft and below	48	25ft and below	7
Subtotal	1,297	Subtotal	47
Constructed Guyed Towers		Buildings with Constructed Towers	
100ft and over	42	100ft and over	0
75ft – 100ft	35	75ft – 100ft	4
50ft – 75ft	9	50ft – 75ft	0
25ft – 50ft	3	25ft – 50ft	5
25ft and below	0	25ft and below	1
Subtotal	89	Subtotal	10
Constructed Lattice Towers		Multiple Constructed Structures^c	
100ft and over	21	100ft and over	0
75ft – 100ft	59	75ft – 100ft	0
50ft – 75ft	30	50ft – 75ft	0
25ft – 50ft	20	25ft – 50ft	1
25ft and below	6	25ft and below	0
Subtotal	136	Subtotal	1
Constructed Tanks^d			
Tanks	7		
Subtotal	7		
Total All Tower Structures		1,587	

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, 2015c).

^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).

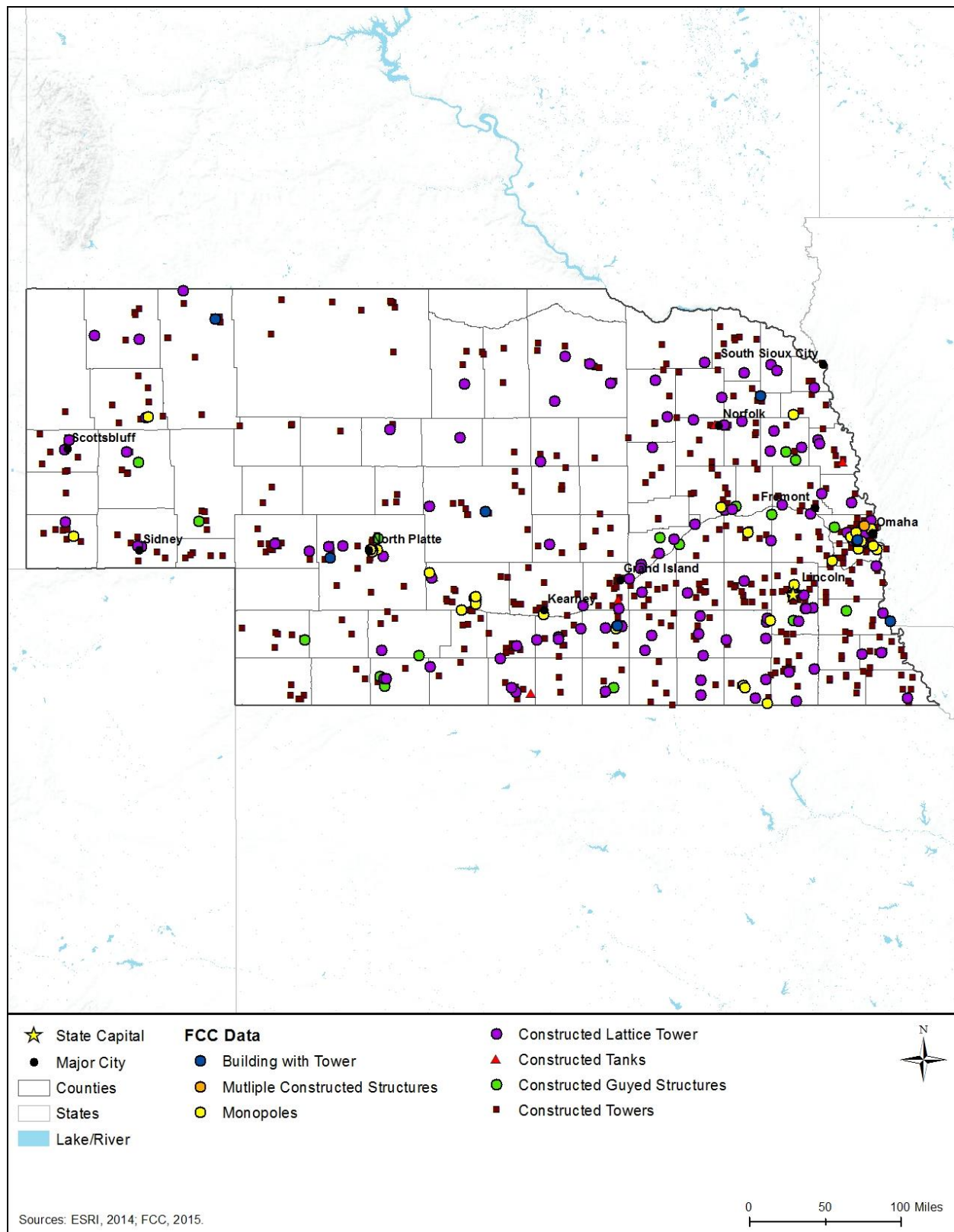
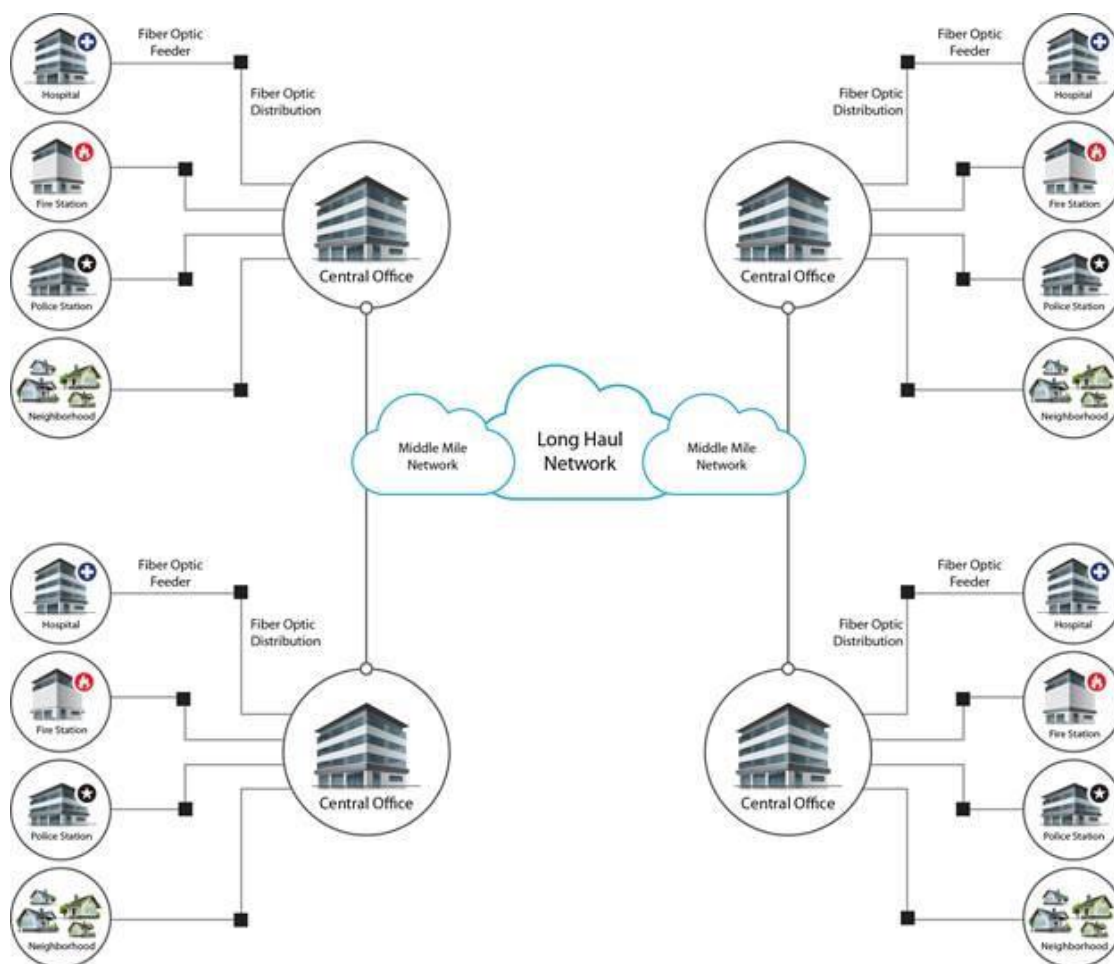


Figure 12.1.1-9: FCC Tower Structure Locations in Nebraska

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way (ROWs). A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 12.1.1-10. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions) (FCC, 2000).



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

Figure 12.1.1-10: Typical Fiber Optic Network in Nebraska

Last Mile Fiber Assets

In Nebraska, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Nebraska, there are 56 fiber providers that offer service in the state, as listed in Table 12.1.1-9. Figure 12.1.1-11 shows coverage for Internet Nebraska Corporation and KDSI Internet Services, and Figure 12.1.1-12 shows coverage for all other providers with less than 5 percent coverage area.¹⁰

Table 12.1.1-9: Fiber Provider Coverage

Fiber Provider	Coverage
Internet Nebraska Corporation	8.42%
KDSI Internet Services	5.56%
Other ^a	28.80%

Source: (NTIA, 2014)

^aOther: Provider with less than 5 percent coverage area. Providers include: Windstream; Frontier Communications of Nebraska; CenturyLink; Northeast Nebraska Telephone Company; Consolidated Telephone Company; Nebraska Central Telephone Co.; Unite Private Networks, LLC; Huntel Communications; Glenwood Telecommunications Inc.; Dalton Telecommunications Inc.; NebraskaLink; Three River Communications, LLC; ATC Communications; Charter Communications Inc.; Hamilton Telephone Company; Southeast Nebraska Communications; Pierce Telephone Co Inc.; Diode Communications; Pinpoint Communications Inc.; Cox Communications; Nyecom Teleservices; Wauneta Telephone Company; Curtis Telephone Company, Inc.; K & M Telephone Company, Inc.; Westel Systems; Cozad Telephone Company; Great Plains Communications, Inc.; Hartelco BWTelcom; Mobius Communications Company; Stanton Telecom, Inc.; Time Warner Cable; Hartman Telephone Exchanges, Inc.; Zito Media; Mainstay Communications; Nebraska Technology & Telecommunications; Golden West Telecommunications Cooperative, Inc.; Mobius Communications Company; Hershey Cooperative Telephone Company; Cable One; Action Communications; Rural Telephone Service Company, Inc.; Blue Valley Telecommunications, Inc.; OrbitCom, Inc.; Peetz Communications, LLC; ALLO Communications; Long Lines Siouxland, LLC; USA Communications; FiberComm L.C.; PC Telcom; Level 3; Fort Randall Cable Systems, Inc.; Geneva Broadband, LLC; Cogent Communications, Inc.

¹⁰ The broadband map utilized data collected as part of the broadband American Recovery and Reinvestment Act initiative. The data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). Each state's broadband data was downloaded accordingly. The data pertaining to broadband data/coverage for census blocks, streets, addresses, and wireless were used. Census blocks, roads, and addresses were merged into one file and dissolved by similar business and provider names. Square miles were calculated for each provider. The maps show all providers over 5% on separate maps; providers with areas under 5% were merged and mapped as "[State Name] Other Fiber Providers." All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "[State Name] Other Wireless Providers." Providers under 5% were denoted in their respective tables.

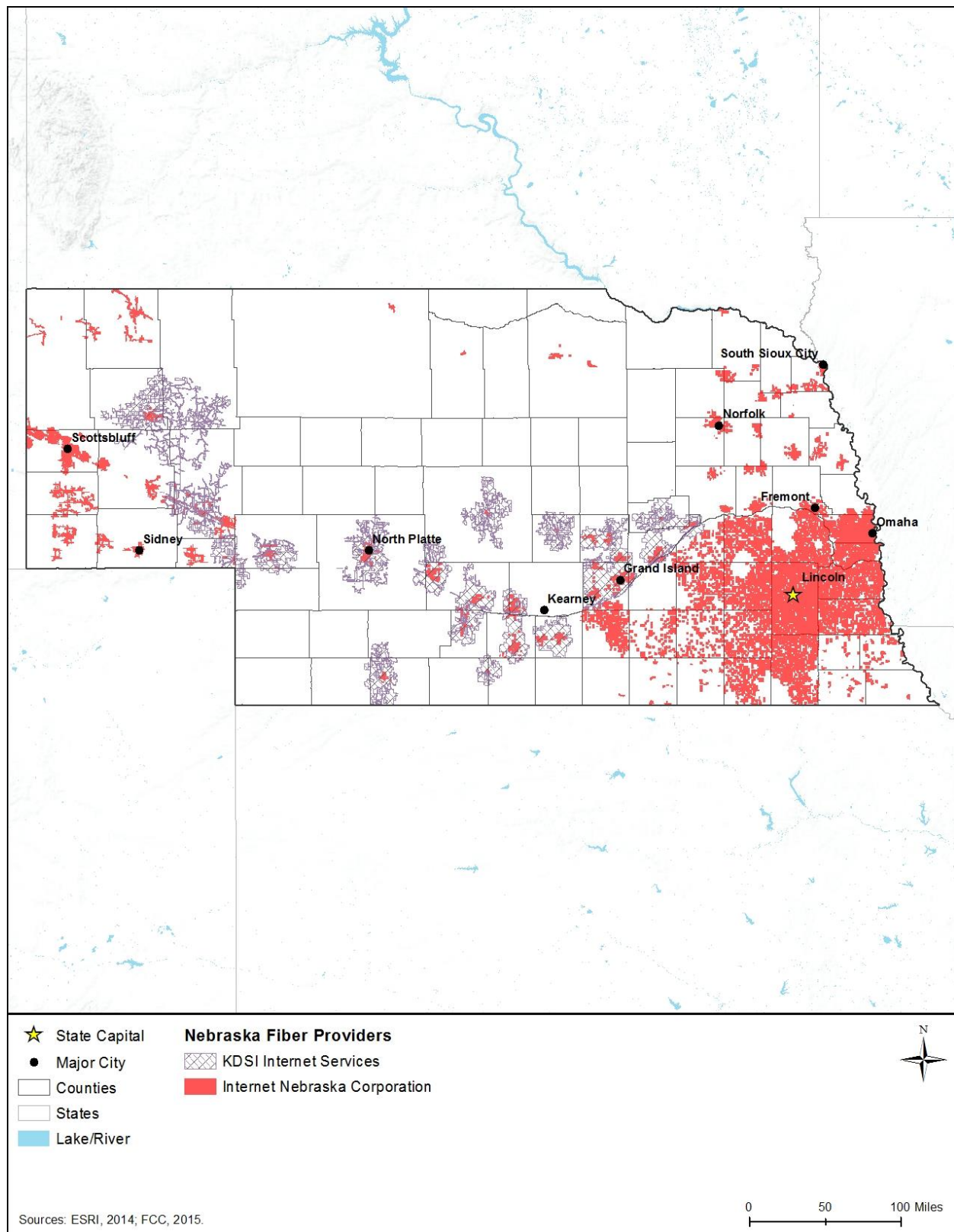


Figure 12.1.1-11: Fiber Availability in Nebraska for KDSI Internet Services and Internet Nebraska Corporation

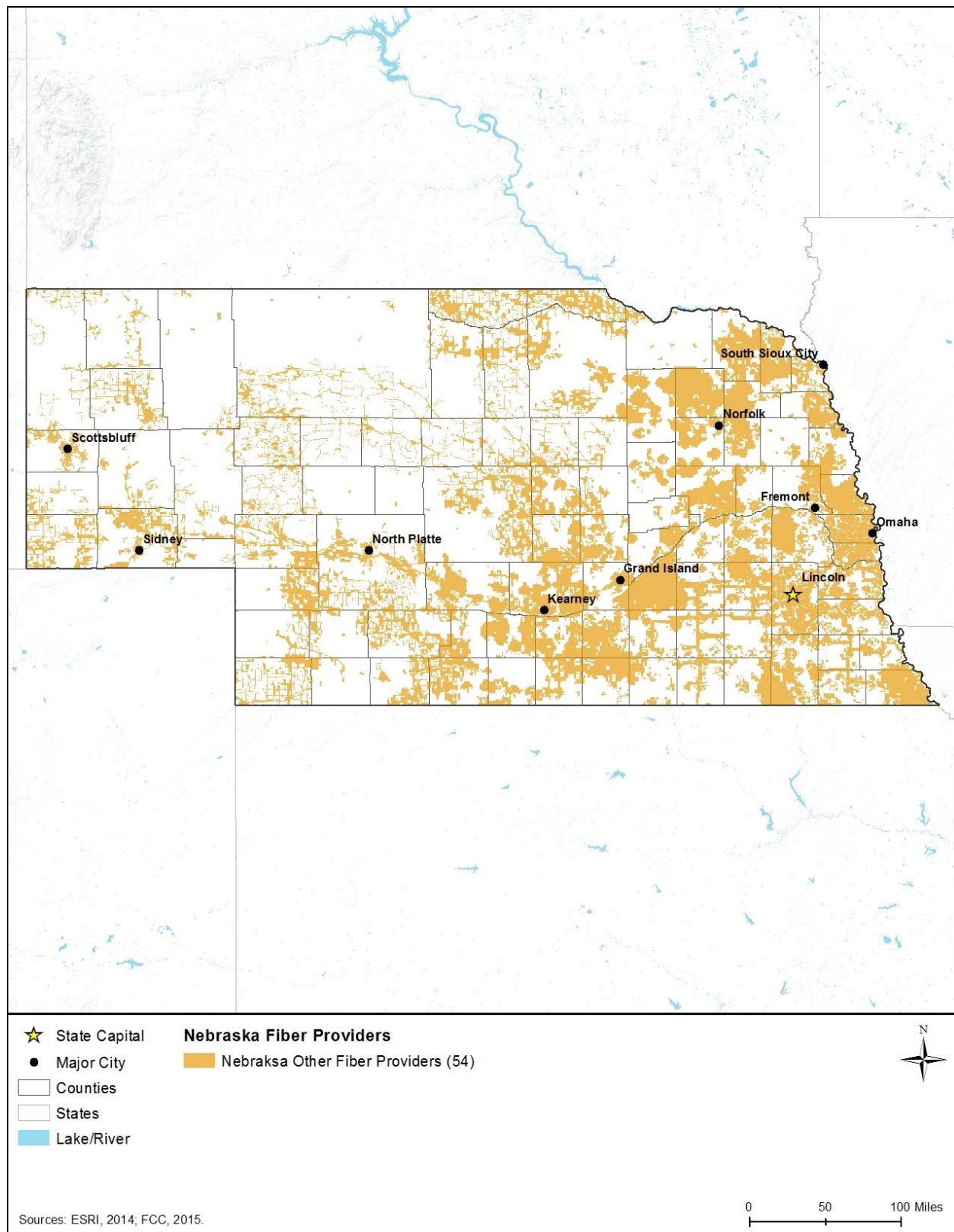


Figure 12.1.1-12: Other Providers' Fiber Availability in Nebraska

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.

12.1.1.6. 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 12.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Nebraska's publicly owned electric utilities are regulated by the Nebraska Power Review Board. The state has no operating private electric utilities. Public utilities operate in a number of formats, including cooperatives, municipal power systems, and power districts. The Power Review Board itself consists of five Governor-appointed members serving four-year terms (NPRB, 2015a). The current environment of Nebraska's electric utilities involves the use of retail service areas. Each area is controlled by an individual utility, where the utility has sole rights to supply electricity to customers in their area. The Power Review Board mandates that the utility in charge of a given service area must "establish electric power to all customers requesting service, if it is economically feasible to service and supply the customer" (NPRB, 2015b). One of the Power Review Board's main duties is overseeing the agreements that define these service areas. The Power Review Board currently upholds 390 agreements regarding geographic territory in Nebraska (NPRB, 2015a). Among the Board's other responsibilities is the need to approve construction of new electricity generation facilities to be used by public utilities. They also approve the construction of new transmission lines and the acquisition of existing lines (NPRB, 2015c). Construction or acquisition of transmission lines inside the service area of a given supplier do not need to be approved by the Power Review Board, these regulations exist for changes to transmission equipment outside of the supplier's service area (NPRB, 2015a).

Nearly all of Nebraska's electricity comes from the use of coal and nuclear power facilities (EIA, 2015a). In 2014, the state produced 39,431,291 megawatthours¹¹ of electricity from several sources; of this, coal accounted for 24,922,175 megawatthours (61.5 percent) and nuclear power facilities accounted for 10,101,838 megawatthours (26.3 percent) with a combined 9.8 percent

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

produced by hydroelectric power and wind power. Natural gas, petroleum fuels, and renewable sources such as biomass were each used to produce minimal amounts of electricity (EIA, 2015a). These trends in electricity generation have held true for several years. From 2001 to present day, coal and nuclear power facilities have supplied the bulk of Nebraska's electricity. However, wind power in particular has risen sharply over the last 10 years. In 2004, wind power was responsible for just 0.1 percent of Nebraska's electricity; in contrast to the 6.9 percent it provided in 2014 (EIA, 2015b). There is opportunity for the expansion of wind power facilities in the state. In 2013, the National Renewable Energy Laboratory estimated that more than 90 percent of the state is suitable for electrical generation by wind power (EIA, 2015c). Regarding the consumption of energy, in 2013, industrial sources use 42.7 percent of the state's totals. Transportation was the second largest consumer (22.4 percent) and residential and commercial customers accounting for 18.8 percent and 16.1 percent respectively (EIA, 2015c).

Water

Public water systems in Nebraska are regulated by the Public Water System Program of the Division of Public Health, which is itself a part of the Department of Health and Human Services. The Public Water System Program upholds regulations based on Nebraska's Safe Drinking Water Act, which are in agreement with the U.S. Safe Drinking Water Act. Of the 1,311 systems regulated by the Public Water System Program, nearly all are systems classified as either community or transient non-community systems (TNC) (NEDHHS, 2013a). Community water systems (CWS) are those that have a minimum of 15 service connections use year-round, or serve at least 25 residents year-round. TNCs are those that do not serve the same 25 (or more) people in a six month period. This would include water systems at an interstate rest stop or a roadside café; as both of these see frequent transient traffic. Nebraska has 595 CWSs and 565 systems designated as TNCs. The remaining 151 systems are categorized as non-transient non-community (NTNC). In contrast to TNCs, these serve the same 25 or more people over a six month period. An example of NTNC would be a water system serving a school (NEDHHS, 2013a). Most of the state's public water systems are relatively small. Nearly half (49.8 percent) serve less than 100 people. A further 31.8 percent serve between 101 and 500 people. The remaining 18.4 percent serve anywhere between 500 and 50,000 people. Of the total population of Nebraska, 95 percent are served by a CWS. NTNC's serve 3 percent, whereas TNC's serve the remaining 2 percent (NEDHHS, 2013a).

Most of the drinking water served to the state's populace comes from groundwater. Approximately 63 percent of the population of Nebraska uses groundwater as the source of their drinking water. Yearly reports on the quality of groundwater are required by the Nebraska Department of Environmental Quality (NDEQ). Reports on the quality of surface waters are also required by the NDEQ. In pursuit of its goals of clean drinking water, the NDEQ also issues permits for discharge of pollutants into state waters. This allows the NDEQ to monitor the locations and amounts of contaminants in the water, and respond accordingly (NDEQ, 2015a).

Wastewater

Many aspects of wastewater treatment are overseen and regulated by the NDEQ. The NDEQ issues National Pollutant Discharge Elimination System (NPDES) permits to anyone intending to discharge contaminants into state bodies of water. This includes municipal, commercial, or industrial sources of contaminated water, or wastewater. It also includes stormwater from municipal or industrial sources, and water that is a combination of sanitary waters and unsanitary waters from overflowing sewers (as can happen in bad storms). Permit applications must be submitted a minimum of 180 days before the applicant intends to begin discharging. The permits issued by the NDEQ are specific to the type of waste to be discharged and the location of the discharge (NDEQ, 2015b). The NDEQ also issues certifications for treatment facility operators, as a means of ensuring competent treatment of wastewater before it is discharged. The Wastewater Treatment Facility Operator Certification Program issues new certifications, renews existing certifications, and rates facilities by their needs (NDEQ, 2015c). The operation of onsite wastewater treatment systems, such as septic tanks or holding tanks, are regulated by NDEQ (NDEQ, 2015d).

Solid Waste Management

The Integrated Waste Management Program of Nebraska regulates the disposal of the state's solid waste materials in designated disposal areas. Many of these disposal areas are designed specifically to handle the types of waste they accept for disposal. These areas include municipal solid waste landfills, construction landfills, and fossil fuel combustion ash disposal areas. These facilities require an operating permit from NDEQ, as do the several types of waste processing facilities found in the state (NDEQ, 2015e). In total, Nebraska has 23 municipal landfills, 37 transfer stations, 8 large composting operations, and 21 construction/demolition landfills (NDEQ, 2015f). In 2012, the 23 state maintained municipal landfills interred a total of 2,120,813 tons of solid waste (NDEQ, 2012). While the state does not maintain a recycling program, a study conducted by the University of Nebraska's Public Policy Center showed that the state had an estimated recycling rate of 17.04 percent in 2013. This indicates that Nebraska lags behind other states such as South Dakota (18.5 percent), Missouri (19.6 percent) and Colorado (22.8 percent) (University of Nebraska, 2015).

12.1.2. Soils

12.1.2.1. Definition of the Resource

The Soil Science Society of America defines soil as:

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

12.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are described in Section 1.8, Overview of Relevant Federal Laws and Executive Orders. A list of applicable state laws and regulations is included in Table 12.1.2-1 below.

Table 12.1.2-1: Relevant Nebraska Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Title 119 Rules and Regulations Pertaining to the Issuance of Permits under the NPDES	NDEQ	Specifies requirements for NPDES Construction Stormwater General Permits (if construction disturbs over one acre of land) and erosion and sediment control measures in Storm Water Pollution Prevention Plans (SWPPP).

Source: (NDEQ, 2015b)

12.1.2.3. Environmental Setting

Nebraska is composed of three Land Resource Regions (LRR),¹² as defined by the Natural Resources Conservation Service (NRCS) (NRCS, 2006):

- Central Feed Grains and Livestock Region;
- Central Great Plains Winter Wheat and Range Region; and
- Western Great Plains Range and Irrigated Region.

¹² Land Resource Region: “A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics” (NRCS, 2006).

Within and among Nebraska's three LRR 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 Nebraska's MLRAs are presented in Figure 12.1.2-1 and Table 12.1.2-2, respectively.

Soil characteristics are an important consideration for FirstNet inasmuch 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, biota¹⁴ such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils¹⁵ 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 rutting¹⁶ (discussed further in the subsections below).

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 materials" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil" (Rogers, Olshansky, & Rogers, 2004).

¹⁶ Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009b).

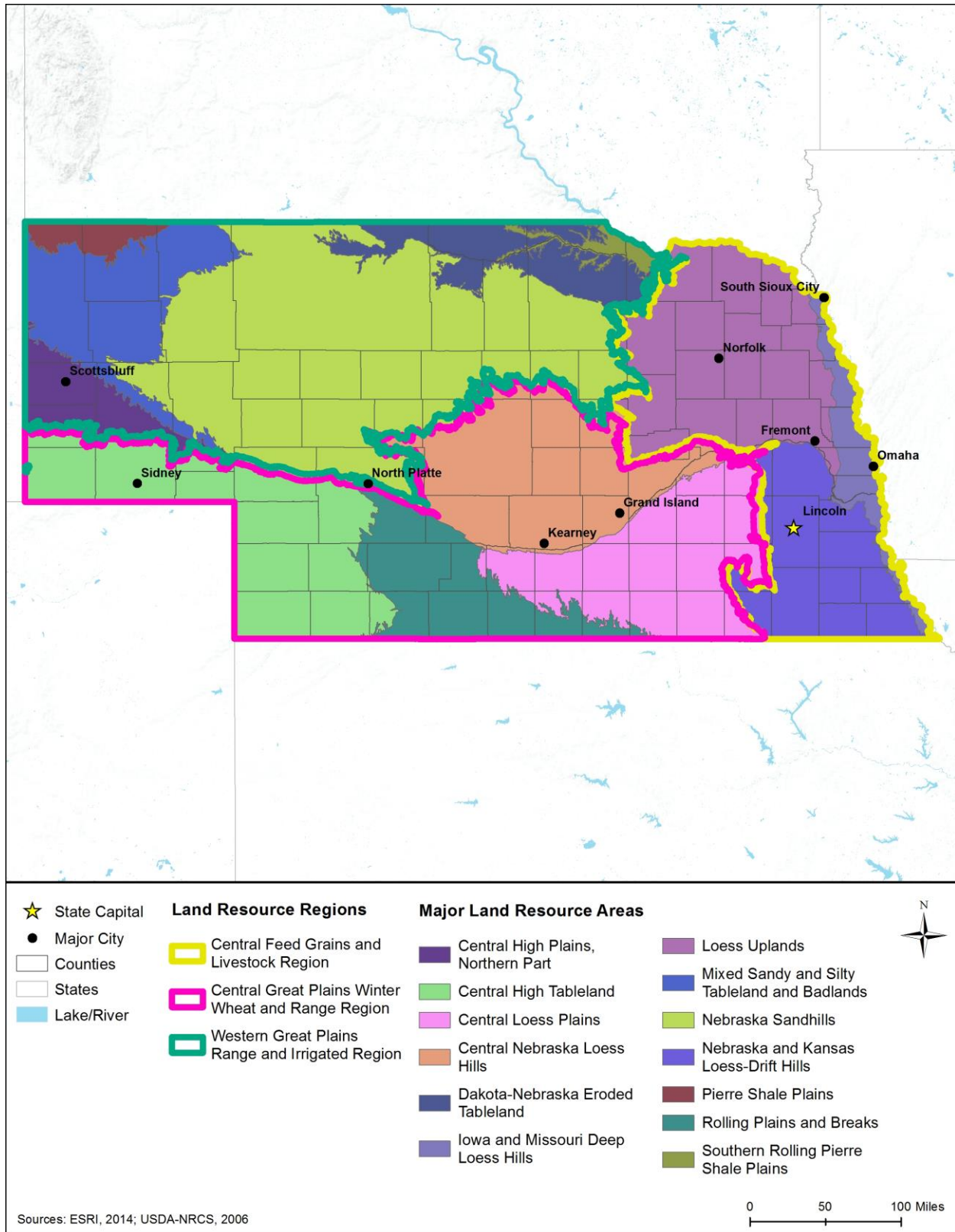


Figure 12.1.2-1: Locations of Major Land Resource Areas in Nebraska

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

MLRA Name	Region of State	Soil Order Characteristics
Central High Plains, Northern Part	Northwestern Nebraska	Entisols ^a and Mollisols ^b are the dominant soil orders. These sandy or loamy soils ¹⁷ range from poorly drained to well drained, and from shallow to deep.
Central High Tableland	Southwestern Nebraska	Entisols and Mollisols are the dominant soil orders. These sandy or loamy soils are typically moderately well drained to excessively drained, and are very deep.
Central Loess Plains	Southern Nebraska	Mollisols is the dominant soil order. These loamy or clayey soils typically range from moderately well drained to somewhat poorly drained, and are moderately deep to very deep.
Central Nebraska Loess Hills	Central Nebraska	Entisols and Mollisols are the dominant soil orders. These loamy or sandy soils are typically well drained to excessively drained, and are very deep.
Dakota-Nebraska Eroded Tableland	Northern Nebraska	Entisols and Mollisols are the dominant soil orders. These sandy or loamy soils are typically well drained to excessively drained, and are very deep.
Iowa and Missouri Deep Loess Hills	Eastern Nebraska	Mollisols is the dominant soil order, with Alfisols ^c and Entisols less so. These loamy or silty soils are typically moderately well drained to well drained, and are very deep.
Loess Uplands	Northeastern Nebraska	Mollisols is the dominant soil order. These clayey or loamy soils are moderately well drained to somewhat excessively drained and range from very deep to shallow.
Mixed Sandy and Silty Tableland and Badlands	Northwestern Nebraska	Entisols, Inceptisols ^d , and Mollisols are the dominant soil orders. These sandy or loamy soils are typically well drained or somewhat excessively drained, and range from shallow to very deep.
Nebraska Sandhills	Northern Nebraska	Entisols and Mollisols are the dominant soil orders. These sandy and very deep soils typically range from somewhat poorly drained to excessively drained.
Nebraska and Kansas Loess-Drift Hills	Southeastern Nebraska	Alfisols, Entisols, and Mollisols are the dominant soil orders.
Pierre-Shale Plains	Northwestern Nebraska	Alfisols, Entisols, Inceptisols, and Vertisols ^e are the dominant soil orders. These clayey and well drained soils typically range from shallow to very deep.

¹⁷ Loamy Soil: “[A soil] that combines [sand, silt, and clay] in relatively equal amounts.” (Purdue University Consumer Horticulture, 2006)

MLRA Name	Region of State	Soil Order Characteristics
Rolling Plains and Breaks	Southern Nebraska	Mollisols is the dominant soil order, with Entisols less so. These clayey or loamy soils are moderately well drained to excessively drained. They range from shallow to very deep.
Southern Rolling Pierre Shale Plains	Northeastern Nebraska	Entisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These clayey or loamy soils are typically well drained and range from shallow to very deep.

Source: (NRCS, 2006)

^a Entisols: “Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16 percent of the world’s ice-free land surface.” (NRCS, 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 Alfisols: “Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10 percent of the world’s ice-free land surface.” (NRCS, 2015b)

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

^e Vertisols: “Vertisols have a high content of expanding clay minerals. They undergo pronounced changes in volume with changes in moisture, and have cracks that open and close periodically, and that show evidence of soil movement. Vertisols transmit water very slowly, have undergone little leaching, and tend to be high in natural fertility. They make up about 2 percent of the world’s ice-free land surface.” (NRCS, 2015b)

12.1.2.4. *Soil Suborders*

Soil suborders are part of the soil taxonomy.¹⁸ Soil orders are the highest level in the taxonomy; there are 12 soil orders in the world and they are characterized by both observed and inferred¹⁹ 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). FirstNet used the STATSGO2 database to obtain soils information at the programmatic level to ensure consistency across all the states and territories. This regional information provides a sufficient level of detail for a programmatic analysis. The best available soils data and information, including the use of the more detailed SSURGO database, will be used, as appropriate, during subsequent site-specific assessments. The STATSGO2²⁰ soil database identifies eleven different soil suborders in Nebraska (NRCS, 2015d). Figure 12.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil orders/suborders identified in Table 12.1.2-2; the distribution of the soil suborders is illustrated in Figure 12.1.2-3.



Source: (NGPC, 2014)

Figure 12.1.2-2: Nebraska Sandhills

The Nebraska Sandhills (Figure 12.1.2-1) is one of the largest sand dune formations in the Western Hemisphere, and one of the largest stabilized sand regions in the world. This area covers approximately 19,300 square miles, with soils formed from wind-driven sand and held in place by vegetation (typically grasses). These sandy soils contain little organic matter, and are light in color. The Sandhills receives little precipitation, and the semi-arid climate along with sandy soils has prevented much of this area from being converted to cropland. (USFWS, 2014a) (UNL, 2016)

¹⁸ Taxonomy: “A formal representation of relationships between items in a hierarchical structure” (USEPA 2013).

¹⁹ “Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)” (NRCS, 2015e).

²⁰ STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset; the U.S. General Soil Map is comprised of general soil association units and is maintained and distributed as a spatial and tabular dataset.

Page Intentionally Left Blank.

Table 12.1.2-3: Major Characteristics of Soil Suborders²¹Found in Nebraska, as depicted in Figure 12.1.2-3

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^a	Hydrologic Group	Runoff Potential	Permeability ^b	Erosion Potential	Compaction and Rutting Potential
Mollisols	Albolls	Albolls have a fluctuating groundwater table, with gentle slopes. They supported grasses and shrubs, and are typically used as cropland.	Silt Loam	0-1	Somewhat poorly drained to poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Loam, fine sandy loam	0-2	Somewhat poorly drained to poorly drained	No, Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Sand, silt loam, silty clay, very fine sandy loam	0-2	Somewhat poorly drained to poorly drained	No, Yes	A, C, D	Low, Medium, High	High, Low, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions
Mollisols	Aquolls	Aquolls support grass, sedge, and forb vegetation, as well as some forest vegetation. However, most have been artificially drained and utilized as cropland.	Fine sandy loam, silty clay loam	0-2	Somewhat poorly drained to very poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Fine sand, loam, loamy fine sand, silt loam, stratified sand to loamy fine sand, very gravelly sand	0-9	Moderately well drained to excessively drained	No	A, B	Low, Medium	High, Moderate	Low to Medium, depending on slope	Low
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Clay, clay loam, fine sandy loam, loam, loamy very fine sand, silt loam, silty clay, unweathered bedrock, very fine sandy loam, weathered bedrock	0-60	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Fine sand, loamy fine sand, loamy sand	0-60	Moderately well drained to excessively drained	No	A	Low	High	Low	Low
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay loam, fine sandy loam, silt loam, silty clay, silty clay loam	0-30	Somewhat poorly drained to excessively drained	No	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	Low
Inceptisols	Ustepts	Ustepts are freely drained soils, typically used as pasture or cropland, although some support forest, rangeland, and wildlife habitat.	Clay, silty clay loam	9-30	Well drained	No	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	Low

²¹ Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^a	Hydrologic Group	Runoff Potential	Permeability ^b	Erosion Potential	Compaction and Rutting Potential
Vertisols	Usterts	Usterts are soils with low permeability, and receive low rainfall amounts. They support grasses and forbs, and are mostly used for rangeland or cropland. However, but due to their low permeability, they typically need to be artificially drained if irrigated, to prevent standing water and a buildup of salinity.	Weathered bedrock	6-30	Well drained	No	D	High	Very Low	High	Low
Mollisols	Ustolls	Ustolls typically supported grass and forest vegetation, and are now primarily used as cropland or rangeland. They are generally freely drained, and found in subhumid to semiarid climates. Areas with drought are common, and blowing soil can be an issue.	Clay loam, coarse sand, fine sandy loam, loam, loamy coarse sand, loamy fine sand, loamy sand, loamy very fine sand, sandy clay loam, sandy loam, silt loam, silty clay loam, stratified sand to gravelly sand, very fine sandy loam	0-30	Somewhat poorly drained to excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low

Sources: (NRCS, 2015d) (NRCS, 1999)

^a Hydric Soil: “A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part” (NRCS, 2015f). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydric while others are not.

^bBased on Runoff Potential, described in Section 12.1.2.5.

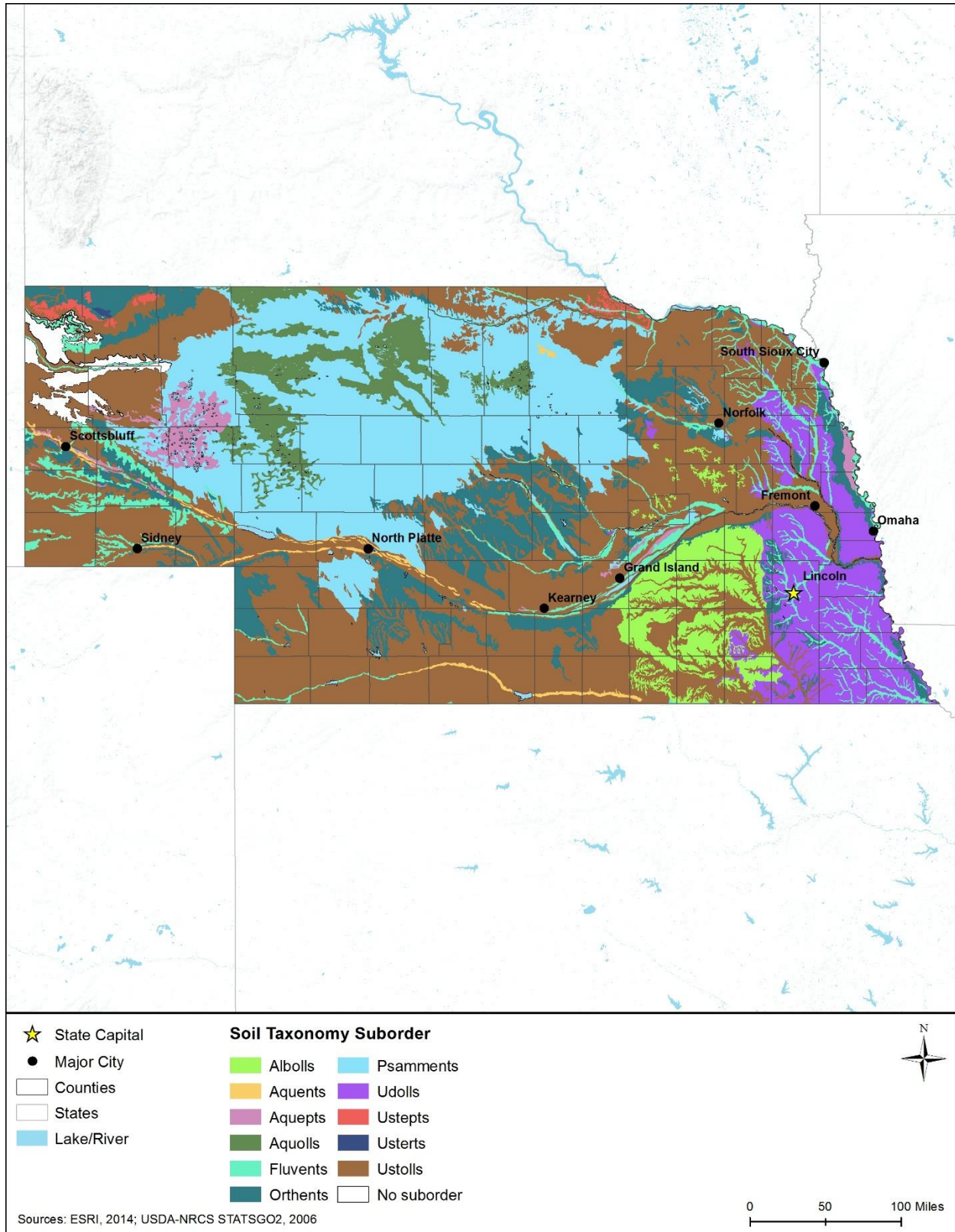


Figure 12.1.2-3: Nebraska Soil Taxonomy Suborders

12.1.2.5. *Runoff Potential*

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.²² Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 12.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Nebraska.

Group A. Sand, loamy sand or sandy loam soils. This group of soils has “low runoff potential and high infiltration rates²³ 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). Aquepts, Fluvents, Psamments, and Ustolls fall into this category in Nebraska.

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. Aquepts, Fluvents, Orthents, Udolls, and Ustolls fall into this category in Nebraska.

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. Aquepts, Aquolls, Orthents, Ustepts, and Ustolls fall into this category in Nebraska.

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

Soil Erosion

“Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity” (NRCS, 2015g). Water-induced erosion can transport soil into streams, rivers, and lakes, degrading water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil particles displaced by wind can cause human health problems and reduced visibility, creating a public safety hazard (NRCS, 1996a) Table 12.1.2-3 provides a summary of the erosion potential

²² Classifying soils is highly generalized and it is challenging to differentiate orders as soil properties can change with distance or physical properties. The soil suborders are at a high level, therefore soil groups may be found in multiple hydrologic groups within a state, as composition, topography, etc. varies in different areas.

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

for each soil suborder in Nebraska. Soils with the highest erosion potential in Nebraska include those in the Albolls, Aquents, Aquepts, Aquolls, Fluvents, Orthents, Udolls, Ustepts, Usteris, and Ustolls suborders, which are found throughout most of the state (Figure 12.1.2-3).

Soil Compaction and Rutting

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

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 12.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Nebraska. Soils with the highest potential for compaction and rutting in Nebraska include those in the Albolls, Aquents, Aquepts, and Aquolls suborders, which are found generally along streams and rivers, and in the northern parts of the state (Figure 12.1.2-3).

12.1.3. Geology

12.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability. Several of these elements are discussed in other sections of this Final PEIS, including Water Resources (Section 12.1.4), Human Health and Safety (Section 12.1.15), and Climate Change (Section 12.1.14).

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

- Section 12.1.3.3, Environmental Setting: Physiographic Regions and Provinces^{24, 25}
- Section 12.1.3.4, Surface Geology
- Section 12.1.3.5, Bedrock Geology²⁶
- Section 12.1.3.6, Paleontological Resources²⁷
- Section 12.1.3.7, Fossil Fuel and Mineral Resources
- Section 12.1.3.8, Geologic Hazards²⁸

12.1.3.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the NEPA and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 12.1.3-1 below.

Table 12.1.3-1: Relevant Nebraska Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Title 163, NAC, Ch. 5	Nebraska Game and Parks Commission (NGPC)	Any paleontological items found on state park lands are to be left undisturbed.
Nebraska Building Codes	Local Agencies	Check county, city, and other local agencies for seismic guidelines in building codes

Sources: (State of Nebraska, 2013) (City of Omaha, 2014)

12.1.3.3. Environmental Setting: Physiographic Regions and Provinces

The concept of physiographic regions was created in 1916 by geologist Nevin Fenneman as a way to describe areas of the 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 subdivided into physiographic provinces based on differences observed on a more local scale. (Fenneman, 1916)

Nebraska is entirely within the Interior Plains Physiographic Region (Central Lowland and Great Plains Provinces) (USGS, 2012a) (Figure 12.1.3-1).

²⁴ Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).

²⁵ Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

²⁶ Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015a).

²⁷ Paleontology: “Study of life in past geologic time based on fossil plants and animals.” (USGS, 2015b)

²⁸ Geologic Hazards: “Any geological or hydrological process that poses a threat to people and/or their property, which includes but is not limited to volcanic eruptions, earthquakes, landslides, sinkholes, mudflows, flooding, and shoreline movements.” (NPS, 2013a)

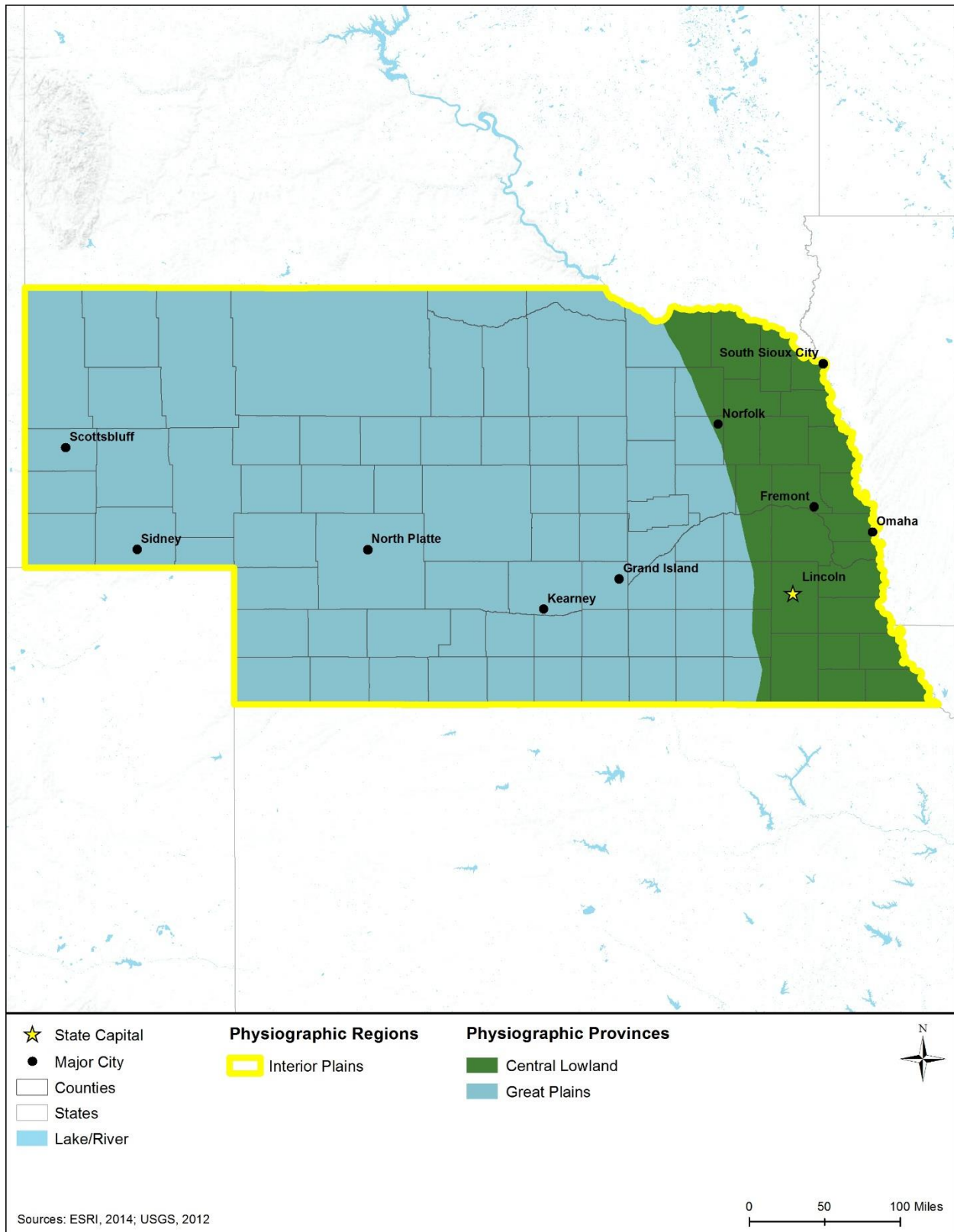


Figure 12.1.3-1: Physiographic Regions and Provinces of Nebraska

Interior Plains Region

The Interior Plains Region extends across much of the interior of the United States, roughly between the western edge of the Appalachian Highlands (near states including Ohio, Tennessee, and Alabama) and the eastern edge of the Rocky Mountain System (including states such as Montana, Wyoming, and Colorado) (Fenneman, 1916). Metamorphic and igneous 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, 2014b).

As reported above, the Interior Plains Region within Nebraska contains of two provinces: the Central Lowland and Great Plains Provinces (USGS, 2003b).

Central Lowland Province – As the largest physiographic province in the United States, the Central Lowland Province includes more than 580,000 square miles and encompasses the eastern portion of the Interior Plains Region. Much of the region is flat lying and is at approximately 2,000 feet (ft.) above sea level (ASL) (NPS, 2014a).

Within Nebraska, the Central Lowland Province includes roughly 20 to 25 percent of the state's land area within the eastern portion of the state. The Central Lowland Province within Nebraska is referred to as the Dissected Till Plains, which are characterized by a flat-lying area covered in glacial till.³³ “Windblown dust (loess) later settled on the till, and over the years, streams dissected the region, forming a rolling terrain. Along the Missouri River, the terrain includes bluffs and river-deposited lowlands” (Nebraska Legislature, 2015a).

Great Plains Province – The Great Plains Province includes more than 450,000 square miles and encompasses the western portion of the Interior Plains Region. The Great Plains, which are the second largest physiographic province in the United States, are noted for their flat topography that is interrupted by the occasional hill or lowland (USGS, 2003b) (NPS, 2014a).

Within Nebraska, the Great Plains Province represent roughly 75 to 80 percent of the western portion of Nebraska. The province is flat with elevations rising to approximately 5,000 ft. ASL in the westernmost part of the state (USGS, 2015d). The Nebraska portion of the Great Plains is often referred to as the High Plains. The High Plains are characterized by a broad plateau bordered on its edges by escarpments.³⁴ The northern edge of the High Plains is within Nebraska

²⁹ For consistency, this Final PEIS uses the University of California Berkeley Geologic Time Scale for all of the FirstNet PEIS state documents. Time scales differ among universities and researchers; FirstNet utilized a consistent time scale throughout, which may differ slightly from other sources (University of California Museum of Paleontology, 2011).

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, 2014a)

³¹ Sandstone: “Sedimentary rock made mostly of sand-sized grains.” (USGS, 2015c)

³² Mudstone: “A very fine-grained sedimentary rock formed from mud.” (USGS, 2015c)

³³ 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)

³⁴ Escarpments: “A cliff formed by faulting, erosion, or landslides.” (USGS, 2015c)

and is defined as the Pine Ridge Escarpment in the extreme northwestern portion of the state. Within the High Plains, “the Nebraska Sand Hills [constitute] the largest area of sand dunes in the western hemisphere... [They extend] from the White River in South Dakota southward beyond the Platte River almost to the Republican River in western Nebraska” (Trimble, 1980).

12.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till, sand and gravel, or clays that overlie bedrock. The surface terrain, which can include bedrock outcrops, provides information on the rock compositions and structural characteristics of the underlying geology. Because surface materials are exposed, they are subject to physical and chemical changes due to weathering from precipitation (rain and snow), wind and other weather events, and human-caused interference. Depending on the structural characteristics and chemical compositions of the surface materials, heavy precipitation can cause slope failures,³⁵ subsidence,³⁶ and erosion (Thompson, 2015).

Surficial deposits in Nebraska are particularly abundant in north-central areas of the state between the Platte and Niobrara Rivers. This area contains about 20,000 square miles of sand dunes referred to as the Nebraska Sandhills (Gutentag, Heimes, Krothe, Luckey, & Weeks, 1984). The Nebraska Sandhills likely date to the Holocene Epoch (within the last 11,700 years) and are covered in 9 to 24 meters of sand deposits (Ahlbrandt & Fryberger, 1979). Loess³⁷ deposits in eastern Nebraska are generally between 2 and 10 meters in thickness (Fullerton, Bush, & Pennell, 2003). Within eastern Nebraska's Central Lowlands Province, alluvial and fine- to coarse-grained glacial deposits are common (USGS, 2015d). Figure 12.1.3-2 depicts a generalized illustration of the surface geology for Nebraska.

³⁵ Slope failure: “Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses.” (Idaho State University, 2000)

³⁶ Subsidence: “Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials.” (USGS, 2000)

³⁷ Loess: “A wind-blown deposit of sediment made mostly of silt-sized grains.” (USGS, 2015c)

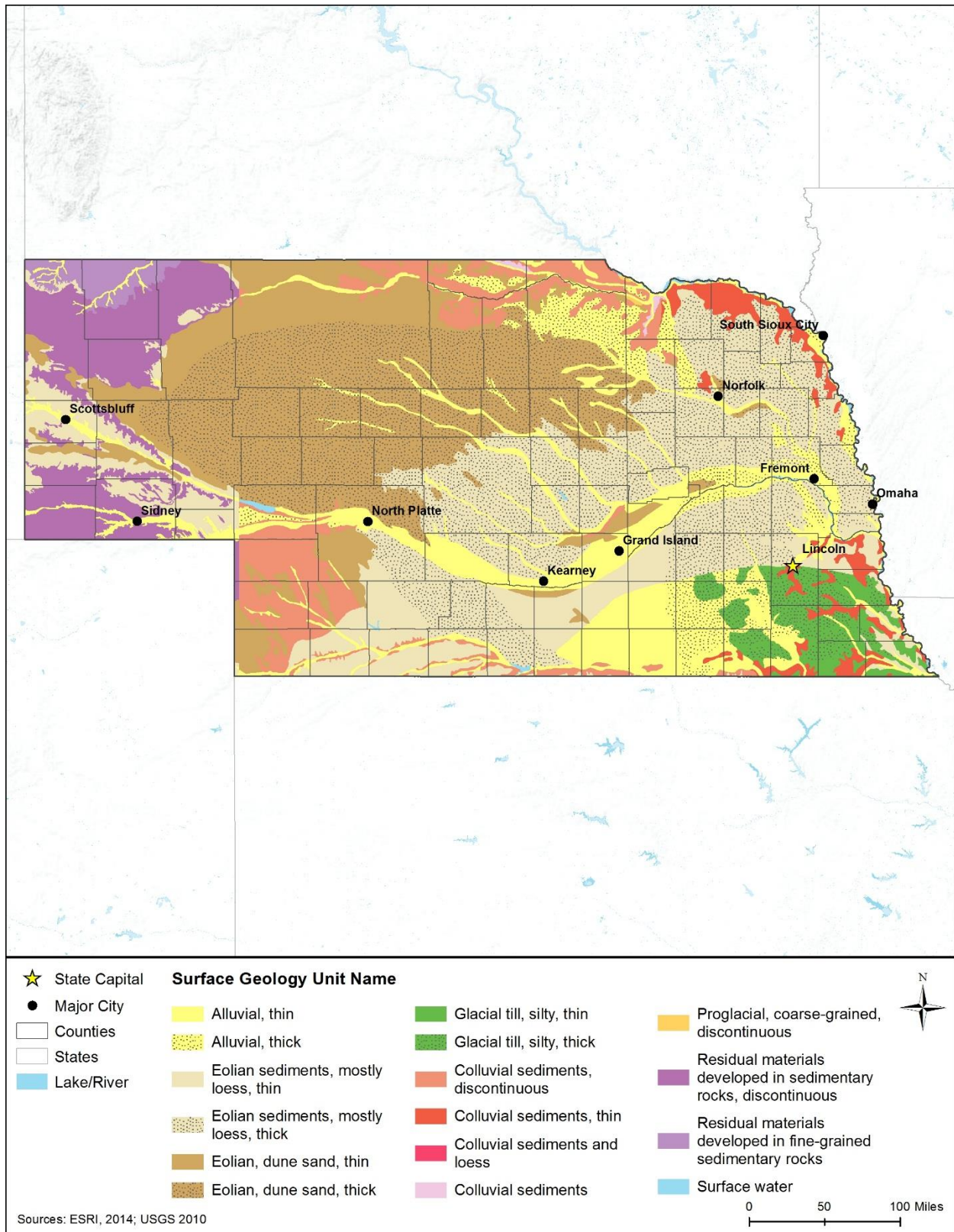


Figure 12.1.3-2: Generalized Surface Geology for Nebraska

12.1.3.5. Bedrock Geology

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015e) reveals important information about a region's surface and subsurface characteristics (i.e., 3-dimensional geometry), including dip (slope of the formation),³⁸ rock composition, and regional tectonism.³⁹ These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (New Hampshire Department of Environmental Services, 2014).

Much of Nebraska, including all of the state within the Great Plains Province, is underlain sedimentary rocks that range from the Permian Period (299 to 251 MYA) to the Tertiary Period (66 to 2.6 MYA) (USGS, 2014c). The uppermost units, which constitute the High Plains (or Ogallala) aquifer,^{40,41} are composed of “poorly sorted clay, silt, sand, and gravel, generally unconsolidated, deposited by streams and wind (Ogallala Formation and Quaternary units), very fine to fine-grained sandstone⁴² (Arikaree Group), and siltstone⁴³ containing sandstone and interconnected fractures (upper part of the Brule Formation)” (USGS, 2014c). Beneath the Ogallala aquifer, the underlying bedrock units are composed of “siltstone, shale,⁴⁴ loosely to moderately cemented clay and silt, chalk, limestone,⁴⁵ dolomite,⁴⁶ conglomerate,⁴⁷ claystone, gypsum,⁴⁸ anhydrite,⁴⁹ and bedded salt” (USGS, 2014c). Figure 12.1.3-3 displays the generalized bedrock for Nebraska.

³⁸ Dip: “A measure of the angle between the flat horizon and the slope of a sedimentary layer, fault plane, metamorphic foliation, or other geologic structure.” (NPS, 2000)

³⁹ Tectonism: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust.” (USGS, 2015c)

⁴⁰ The High Plains aquifer is one of the principal sources of groundwater for the central United States (Gutentag, Heimes, Krothe, Luckey, & Weeks, 1984).

⁴¹ On a nationwide basis, the Ogallala aquifer accounts for roughly 30 percent of all groundwater used to support agricultural irrigation (NRCS, 2011).

⁴² Sandstone: “Sedimentary rock made mostly of sand-sized grains.” (USGS, 2015c)

⁴³ Siltstone: “A sedimentary rock made mostly of silt-sized grains.” (USGS, 2015c)

⁴⁴ 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, 2015c)

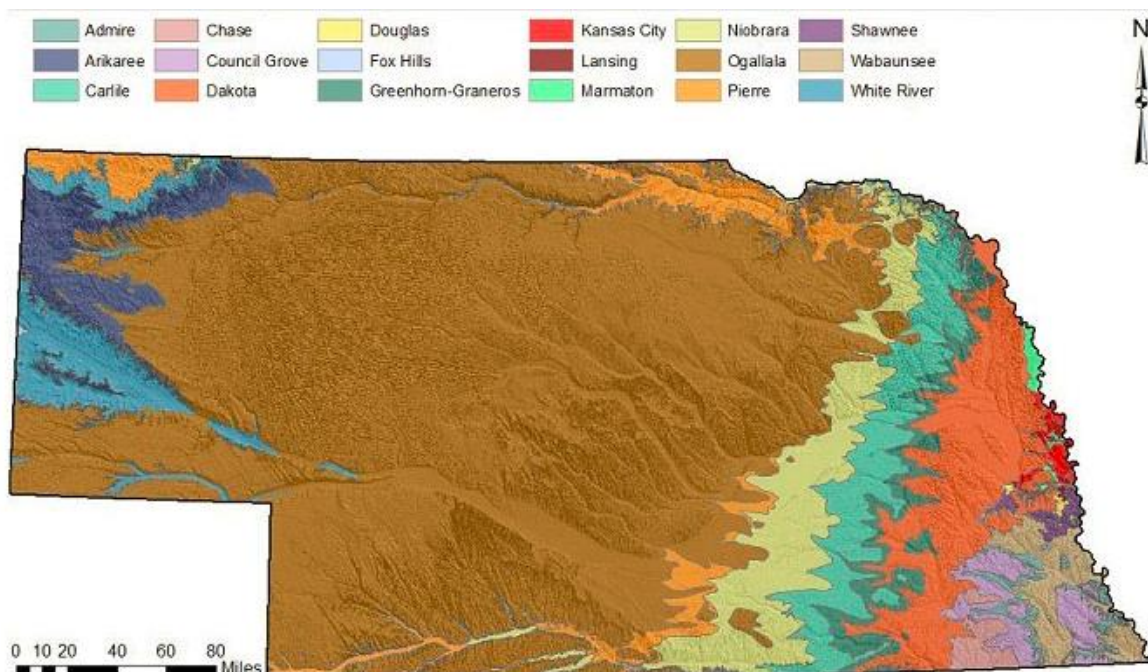
⁴⁵ Limestone: “A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation.” (USGS, 2015c)

⁴⁶ Dolomite: “A magnesium-rich carbonate sedimentary rock.” (USGS, 2015c)

⁴⁷ Conglomerate: “A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix.” (USGS, 2015c)

⁴⁸ Gypsum: Calcium sulfate dihydrate (NRCS, 2016).

⁴⁹ Anhydrite: “[Mineral] which [does] not have water as [a] primary constituent.” (USGS, 2015c)



Geologic bedrock groups of Nebraska consisting of Pennsylvanian (Marmaton, Kansas City, Lansing, Douglas, Shawnee, Wabaunsee, Admire, Council Grove), Permian (Council Grove, Chase), Cretaceous (Dakota, Greenhorn-Graneros, Carlile, Niobrara, Pierre, Fox Hills), and Tertiary (White River, Arikaree, Ogallala) Systems

Source: (USGS, 2017a)

Figure 12.1.3-3: Generalized Bedrock Geology for Nebraska

12.1.3.6. Paleontological Resources

Nebraska was covered by an inland sea throughout the Carboniferous Period (359 to 299 MYA). Sediment deposits formed in swamps in the eastern part of the state; these swamps eventually yielded plant fossils. Areas covered by deeper waters have produced marine fossils, while shallower waters preserved reefs. During the beginning of the Permian Period (299 to 251 MYA), Nebraska was covered by warm seas; marine fossils have been recorded from limestone and black shale from that time. Sea level fluctuated throughout the Mesozoic Era (251 to 66 MYA); fossils from both terrestrial and marine organisms have been found. During the early Cenozoic Era (66 MYA to present), western Nebraska was above water. The Ashfall Fossil Beds State Historical Park in northeastern Nebraska (Figure 12.1.3-4) preserves animals that were buried during a series of volcanic eruptions from the Rocky Mountains to the west about 10 MYA. Additionally, abundant deposits of Miocene fossils are preserved in the Agate Fossil Beds National Monument (24 to 5 MYA) (Figure 12.1.3-4). During the Pleistocene Epoch (2.6 MYA to 11,700 years ago), glaciers covered all but far eastern Nebraska; terrestrial fossils have been recorded from this time (Paleontology Portal, 2015).



Nebraska State Fossil Mammoth Fossil

Source: (State of Nebraska, 2015)

Carboniferous Period fossils include plant fossils from giant horsetails and ferns, as well as marine fossils of brachiopods,⁵⁰ bryozoans,⁵¹ corals, crinoids,⁵² eurypterids, fusulinids,⁵³ mollusks, stromatolites, trilobites,⁵⁴ bony fish, conodonts,⁵⁵ shark, shrimp, and other cartilaginous fish. Permian Period fossils recorded in Nebraska include brachiopods, bryozoans, corals, crinoids, eurypterids, fusulinids, mollusks, stromatolites, and trilobites found in limestone, and conodonts, crustaceans, sharks, and fish found in the Pierre Shale Formation. Many Mesozoic Era fossils have been found in Nebraska, including early flowering plants, leafy trees, and animals such as plesiosaurs, mosasaurs, giant sea turtles, and sharks. Billions of microscopic fossils have also been recorded from the Pierre shale, including ammonites. Cenozoic Era fossils include the well-preserved fossils of camels, cranes, horses, rhinos, and turtles found in ash beds in the state. Fossils recorded in Nebraska from the Pleistocene Epoch include birds, bison, camels, ferrets, horses, mastodons, and mammoths (Paleontology Portal, 2015). The mammoth is the state fossil of Nebraska (State of Nebraska, 2015).

⁵⁰ 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)

⁵¹ Bryozoan: “Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies.” (Smithsonian Institution, 2016)

⁵² Crinoid: “The common name for any echinoderm of the class Crinoidea, including sea lilies, feather stars, etc. Crinoids are common fossils in the Paleozoic and persist to the present. Many species have stalks and radiating arms and feed on particles in the water column.” Echinoderm: “Common name for members of the phylum Echinodermata. These organisms are characterized by bodies showing radial symmetry (usually in fives) and the presence of tube feet in most forms.” (Smithsonian Institution, 2016)

⁵³ Fusulinids: “Any member of a group of extinct foraminifera that first appeared in the Carboniferous and went extinct at the end of the Permian. Many fusulinids were large for single-celled organisms.” (Smithsonian Institution, 2016)

⁵⁴ 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)

⁵⁵ Conodonts: “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)

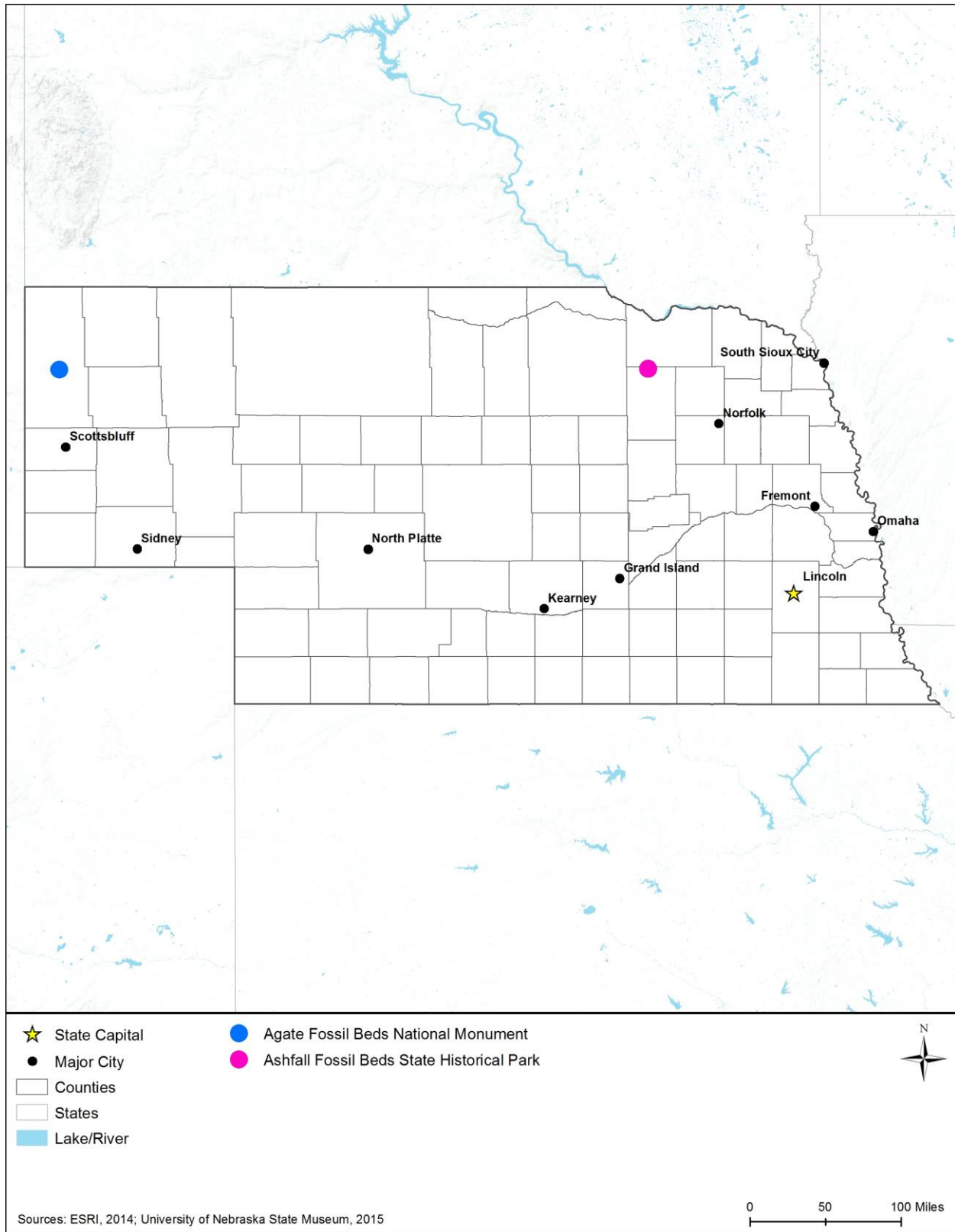


Figure 12.1.3-4: Ashfall Fossil Beds State Historical Park

12.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2015, Nebraska produced 2,896 thousand barrels of crude oil, ranking 22nd nationwide in total production (EIA, 2015d). Most oil in Nebraska is produced in the western part of the state. Withdrawals of natural gas in Nebraska is declining; from a high in 2008 of 3,083 million cubic feet to just 476 million cubic feet in 2015 (EIA, 2016b).

Minerals

In 2016, Nebraska's total non-fuel mineral production was valued at \$196M, ranked 39th nationwide (in terms of dollar value). Nebraska's non-fuel commodities, in order of value, are Portland cement, crushed stone, sand and gravel (construction), sand and gravel (industrial), and lime (USGS, 2017b).

12.1.3.8. Geologic Hazards

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

Earthquakes

Between 1973 and March 2012, there were nine earthquakes of a magnitude 3.5 (on the Richter scale)⁵⁶ or greater in Nebraska (USGS, 2014e). Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface (USGS, 2012b).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common in Nebraska, 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" (Oregon Department of Geology, 2015). Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014f). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale (Oregon Department of Geology, 2015). Nebraska is located far from any convergence boundaries.

Figure 12.1.3-5 depicts the seismic risk throughout Nebraska; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) that have a 2 percent chance of being exceeded in a 50-

⁵⁶ The Richter scale is a numerical scale for expressing the magnitude of an earthquake on the basis of seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9; the scale is logarithmic and a difference of one represents an approximate thirtyfold difference in magnitude (USGS, 2014d).

year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 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 Nebraska are concentrated in the northcentral and northwest portions of the state (USGS, 2014g). The largest earthquake ever recorded in Nebraska was a magnitude 5.1 earthquake that occurred near the town of Merriman. This seismic event resulted in damage to nearby roadways and landslides into the Niobrara River (USGS, 2012c).

Landslides

The database of Nebraska Landslides documented 311 landslides throughout the state between the mid-1980s and mid-2000s (UNL, 2015a). “The term 'landslide' describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures” (USGS, 2003a). Geologists use the term “mass movement” to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale (USGS, 2003a).

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

According to the database of Nebraska Landslides, Boyd and Knox Counties, both of which are rural counties in northeastern Nebraska along the Missouri River, account for nearly half of the landslides recorded in Nebraska since 1982. Boyd County experiences 56 landslides since 1982, and Knox County experienced 81 landslides since 1982. Listed causes for landslides in Nebraska include both natural causes, such as stream undercutting and steep slopes, and anthropogenic⁵⁷ causes such as the creation of road cuts and collapse of road fill (UNL, 2015a). Several landslides impacting urban areas in Omaha have been documented as well. Total costs related to landslides in Nebraska between 1981 and 2002 totaled \$4,698,508 (Eversoll, 2005). Figure 12.1.3-6 shows landslide incidence and susceptibility throughout Nebraska.

⁵⁷ 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, 2016)

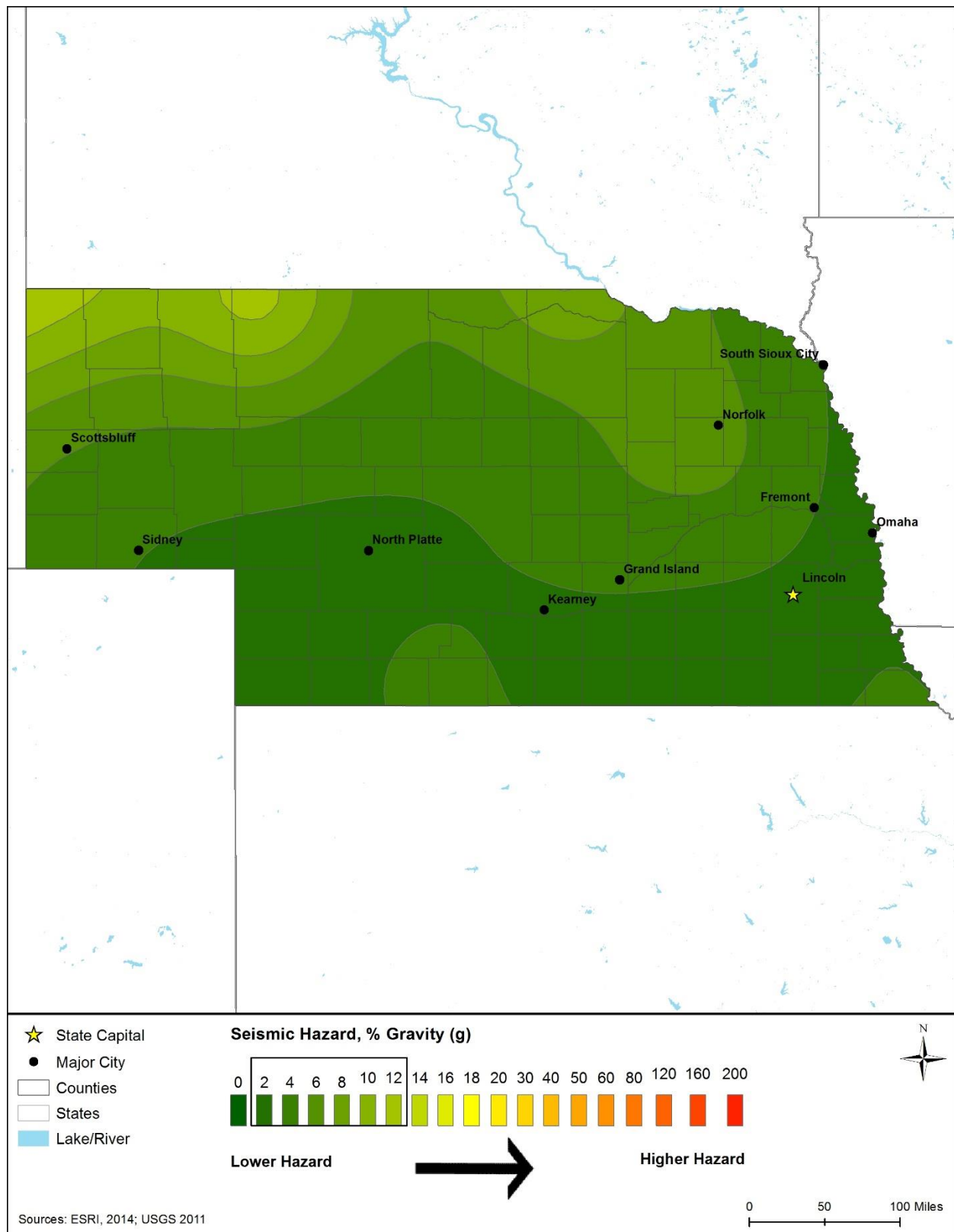


Figure 12.1.3-5: Nebraska 2014 Seismic Hazard Map

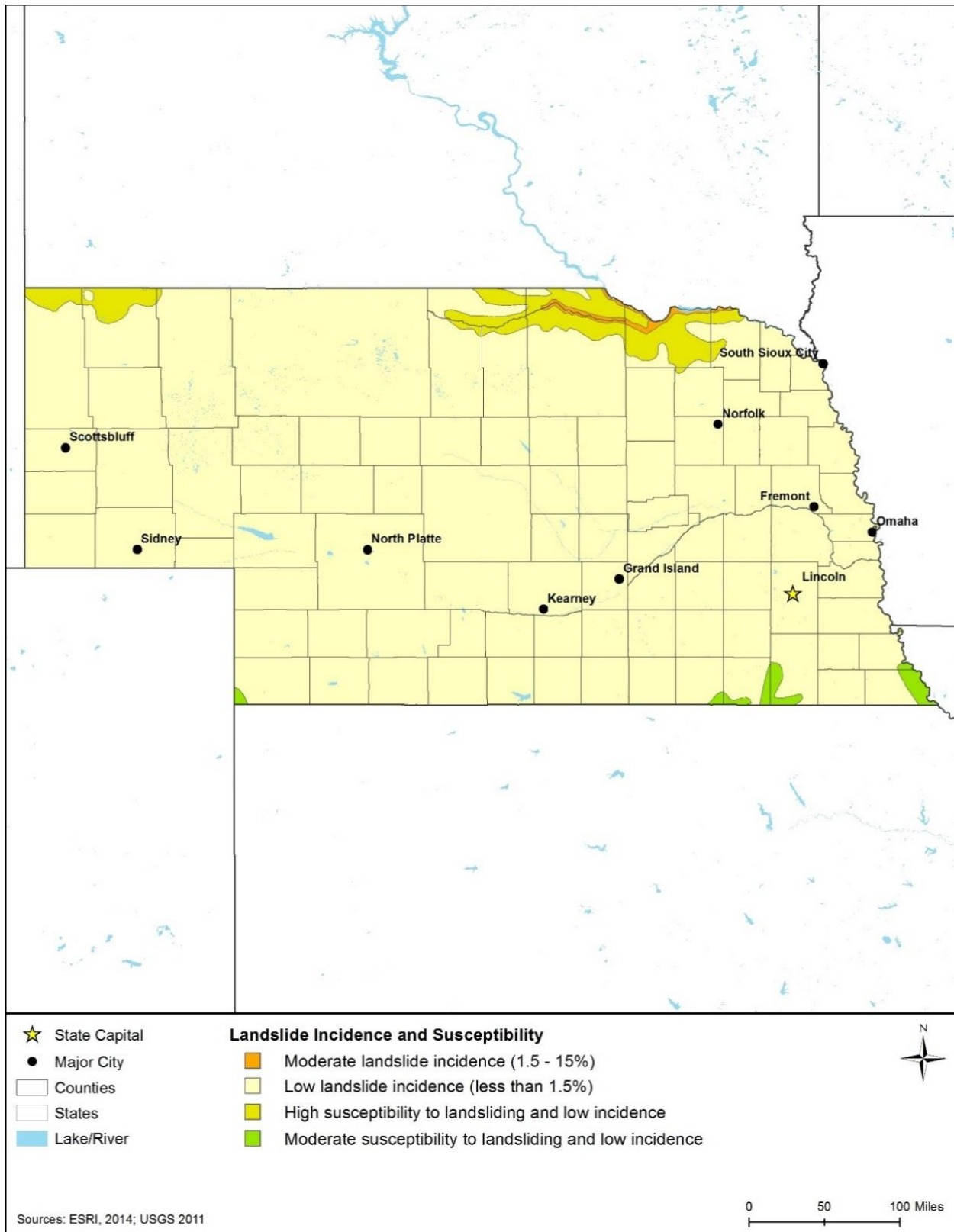


Figure 12.1.3-6: Nebraska Landslide Incidence and Susceptibility Hazard Map⁵⁸

Land Subsidence

Land subsidence is a “gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials.” Within Nebraska, land subsidence due to karst⁵⁹ topography has been documented in eastern portions of the state (Tobin & Weary, 2004). The main triggers of land subsidence can be aquifer compaction, drainage of organic soils, mining, sinkholes, and thawing permafrost. 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 (U.S. Geological Survey, 2013b). Land subsidence is not considered to be a major risk in Nebraska; as a widespread geologic hazard. However, as noted above, land subsidence due to sinkhole formation has occurred in isolated areas of Nebraska (NEMA, 2014). For example, in 2009, the Bureau of Reclamation documented sinkholes below the Red Willow Dam near McCook in the southern part of the state (USBR, 2009). A map of karst topography (which represents areas susceptible to sinkhole formation) throughout Nebraska is included in Figure 12.1.3-7.

⁵⁸ Susceptibility hazards not indicated in Figure 12.1.3-6 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated (USGS, 2014h).

⁵⁹ Karst: “A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater.” (USGS, 2015c)

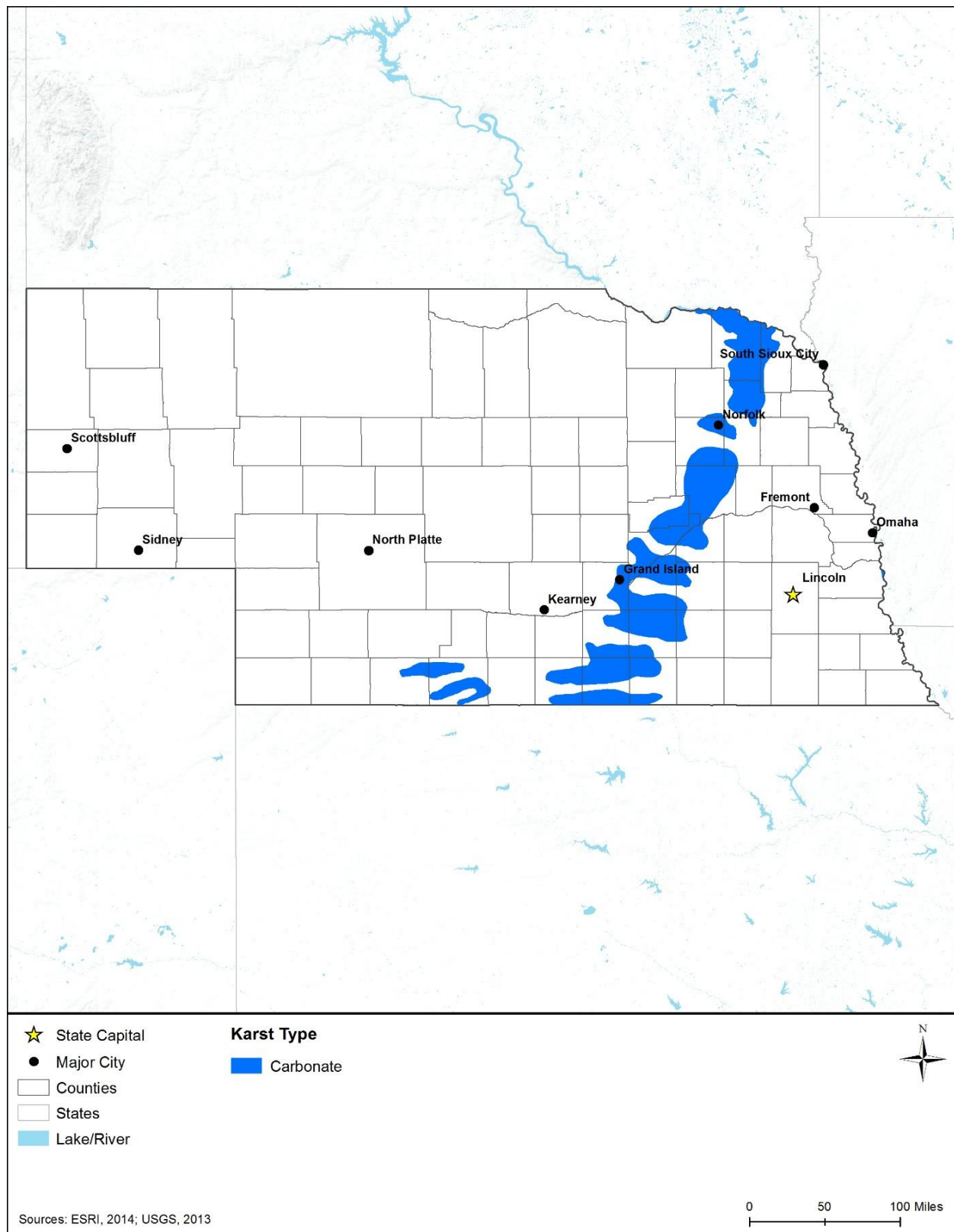


Figure 12.1.3-7: Karst Topography in Nebraska

12.1.4. Water Resources

12.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 12.1.5). These resources can be grouped into watersheds which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological health (USGS, 2014i).

12.1.4.2. Specific Regulatory Considerations

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

Table 12.1.4-1: Relevant Nebraska Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Nebraska General Water Statutes	Nebraska Department of Natural Resources (NDNR)	All general water status, including water rights, surface water, water appropriations, emergency regulations, and others (http://www.dnr.ne.gov/swr/ownership-and-rights).
Nebraska Pollutant Discharge Elimination System Program	NDEQ	Construction activities that disturb one or more acre of soil and causes soil erosion that transports sediment to surface water.
		Construction excavation activities that result in the discharge of pollutants to surface waters. These discharges can occur when groundwater or rainwater collect in excavated sites that are deeper than the water table, and are pumped out of the excavated site and subsequently discharged to surface waters.
Clean Water Act (CWA) Section 404 permit, Nationwide Permit, Nebraska regional conditions	US Army Corps of Engineers (USACE), Omaha District	Must provide pre-construction notification to the USACE before beginning dredge and fill activities in the Missouri, North Platte, South Platte, Platte, Loup, Elkhorn, and Republican Rivers, Taylor, Big, Brush, and Union Creeks, all Class A State Resource Waters, the Niobrara National Scenic River, the Missouri National Recreational River, and any National River Inventory river.
CWA Section 401	NDEQ	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 NDEQ indicating that the proposed activity will not violate water quality standards.

Source: (Nebraska Legislature, 2017c) (NDEQ, 2015b) (US Army Corps of Engineers, 2017) (NDEQ, 2008)

12.1.4.3. Environmental Setting: Surface Water

Nebraska has approximately 430 square miles of lakes and reservoirs, and approximately 24,000 miles of rivers and streams. Water quality issues primarily stem from runoff, both from rain and irrigation that transport sediment and chemicals to surface water (NDEQ, 2015a).

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). Nebraska's waters (lakes, rivers, and streams) are divided into eight major watersheds, or drainage basins (Figure 12.1.4-1). The Blue River Basin in south-central Nebraska includes the Big Blue and Little Blue Rivers and their watersheds, which encompasses approximately 7,100 square miles. Nearly all of the surface water in this watershed is used for irrigation and storage. The Lower Platte River Basin is in central Nebraska, stretching from its confluence with the Loup River to the Missouri River confluence, an area of just over 25,000 square miles. The majority (approximately three-fourths) of surface water in this watershed is used for irrigation. The Missouri Tributaries Basin along northern and eastern Nebraska includes all tributaries that drain in the Missouri, except for the Niobrara River and Platte River basins, and includes an area of approximately 6,000 square miles (Nebraska DNR, 2014). Surface water in this watershed is primarily used for irrigation and storage. Visit <http://www.dnr.nebraska.gov/iwm> for more information about each watershed.

Freshwater

As shown in Figure 12.1.4-1, major rivers in Nebraska include the Missouri, the North and South Platte, Platte, Elkhorn, Niobrara, White, Republican, Little Blue, and Big Blue Rivers. The Platte River flows through Nebraska from the west to the Missouri River in the east (NGPC, 2015a). The Missouri River forms the eastern border between Nebraska and Iowa. The USFWS has initiated recovery programs for the Platte and Colorado River basins, including the portions in Nebraska, to ensure that depletions in the water supply do not jeopardize the continued existence of threatened and endangered species in the state. Activities that would require a Section 404 permit, a special use permit from USFS, or that use federal funding are subject to Section 7 ESA compliance by the Platte River Recovery Implementation Program and the Colorado River Basin Recovery Program. Although dams regulate much of the river between its start in Montana to its confluence 2,340 miles downriver with the Mississippi River in Missouri, two segments of the river in Nebraska are still in a semi-natural state. These segments are managed by the National Park Service (NPS) as Wild and Scenic River segments (see Section 12.1.4.4 below) (NGPC, 2015b). The Niobrara River flows over 500 miles through northern Nebraska before emptying into the Missouri River; it too was designated a Wild and Scenic River (see Section 12.1.4.4 below) (NGPC, 2015c).

Lake McConaughy is the state's largest lake, and is over 20 miles long with a shoreline nearly 80 miles in length. It drains approximately 33,000 square miles, has a surface water of approximately 31,000 acres, and stores nearly 650 billion gallons of water (NGPC, 2015d). The Harlan County Lake was created with the completion of the Harlan County Dam in 1952 for

flood control on the Republican River. Managed by the U.S. Army Corps of Engineers (USACE), the lake drains approximately 7,000 square miles (USACE, 2015a). The Lewis and Clark Lake is on the border of Nebraska and South Dakota, and managed by the South Dakota Game, Fish, and Parks Department (South Dakota Game, Fish, and Parks, 2015). See Section 15.1.4, South Dakota Water Resources, for more information about the lake.

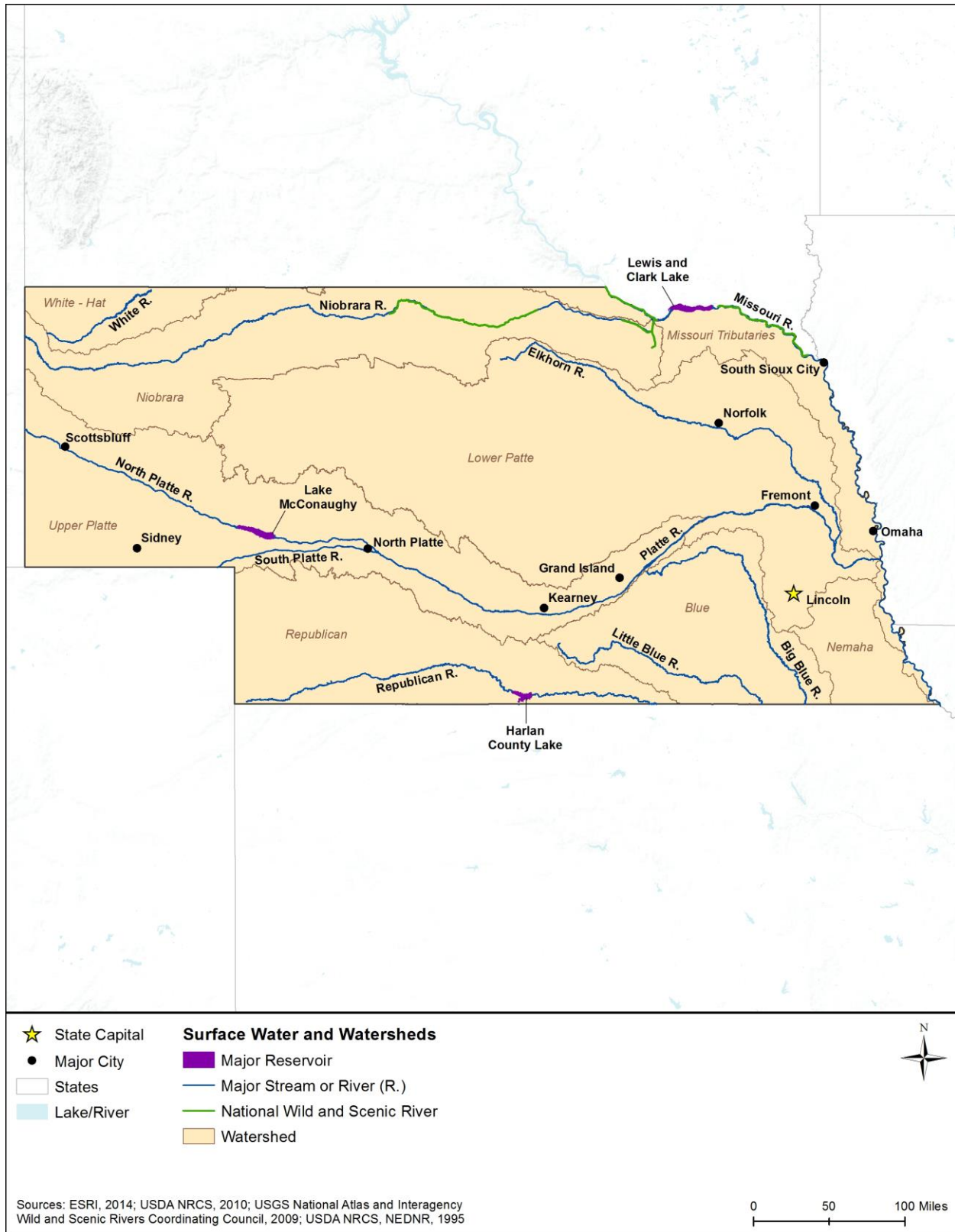


Figure 12.1.4-1: Major Nebraska Watersheds, Defined by Nebraska DNR, and Surface Waterbodies

12.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Portions of the Missouri River in eastern Nebraska and the Niobrara River in northern Nebraska are federally designated National Wild and Scenic Rivers (Figure 12.1.4-1) (see Appendix C, Environmental Laws and Regulations, for more information). Designated sections of the Missouri River include two segments that total 98 miles of river that are classified as recreational. Designated sections of the Niobrara River include 76 miles classified as scenic and 28 miles classified as recreational (National Wild and Scenic Rivers System, 2015).

12.1.4.5. Impaired Waterbodies

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue, are used to evaluate water quality. Under CWA Section 303(d), states are required to assess water quality and report a listing of impaired waters,⁶⁰ the causes of impairment, and probable sources. Table 12.1.4-2 summarizes the water quality of Nebraska's assessed major waterbodies by category, percent impaired, designated use,⁶¹ cause, and probable sources. Figure 12.1.4-2 shows the Section 303(d) waters in Nebraska as of 2014.

As shown in Table 12.1.4-2, various sources affect Nebraska's waterbodies, causing impairments. Pollutants found in Nebraska's streams and rivers come from sources such as agricultural, industrial, and municipal wastewater and runoff, and include pesticides, nutrients such as nitrogen and phosphorus, and sediment. The most common lake impairments in Nebraska are nutrients and algae-related issues, which can increase the pH of water and make it toxic to aquatic organisms. High concentrations of microcystin, a toxin produced by blue green algae, also can occur from excessive nutrients. (NDEQ, 2013)

Of the assessed waters, 58% of Nebraska's rivers and streams, and 90% of Nebraska's lakes, reservoirs, and ponds are impaired. Designated uses of the impaired rivers and streams and lakes include agriculture water supply, aquatic life, and primary contact recreation. (USEPA, 2015b)

⁶⁰ 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).

⁶¹ Designated Use: an appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply (USEPA, 2015a).

Table 12.1.4-2: Section 303(d) Impaired Waters of Nebraska, 2014

Water Type^a	Amount of Waters Assessed^b (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	12%	58%	Agriculture water supply, aquatic life, primary contact recreation, public drinking water supply	E. coli, selenium, cause unknown-biological integrity, atrazine ^c , temperature	NA
Lakes, Reservoirs, and Ponds	51%	90%	Aesthetics, Agriculture Water Supply, Aquatic Life, Primary Contact Recreation	chlorophyll-A, total phosphorus, mercury, total nitrogen	NA

Source: (USEPA, 2015b)

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

^b Nebraska has not assessed all waterbodies within the state.

^c Atrazine: “herbicide widely used in large-scale agriculture, primarily on corn” (NRCS, 2015h).

12.1.4.6. Floodplains

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

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

Riverine and lake floodplains are the primary type of floodplain in Nebraska. These floodplains occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. Flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water (FEMA, 2014b).

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015a). There are several causes of flooding in Nebraska, including river flooding, flash floods, ice jams, and dam and levee failures (Nebraska DNR, 2013).

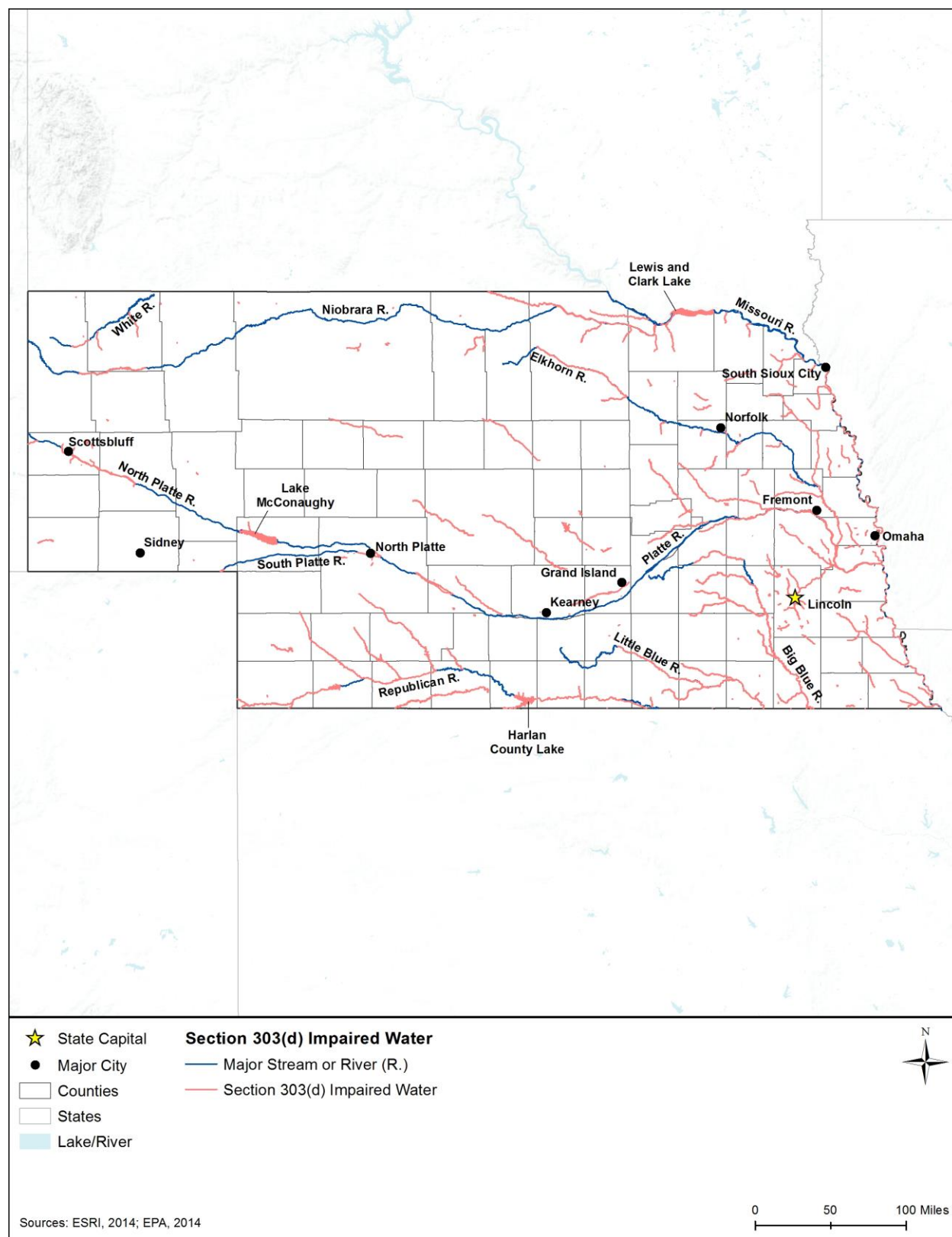


Figure 12.1.4-2: Section 303(d) Impaired Waters of Nebraska, 2014

Some areas, particularly locations in the eastern and southeastern parts of the state, are more prone to flooding impacts, since these areas have a higher population density and more development. Disaster declarations due to flooding in Nebraska during the 2000s resulted in over \$235M in public assistance and \$147M was requested during 2010 and 2011 after the Elkhorn, Missouri, and North Platte Rivers experienced record flooding (Nebraska DNR, 2013).

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 400 communities in Nebraska through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities “to adopt and enforce floodplain management regulations and to implement broader floodplain management programs” and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015a). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Nebraska had six communities participating in the CRS (FEMA, 2014d).⁶²

12.1.4.7. Groundwater

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



2011 Flooding

Source: (FEMA, 2011)

Missouri River flooding near Bellevue, Nebraska as part of statewide flooding that occurred in spring of 2011.

⁶² A list of the six CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communities_May_1_2014.pdf) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

Nebraska's aquifers consist of alluvial aquifers,⁶³ consolidated sandstone, and carbonate rock⁶⁴ aquifers. The groundwater in Nebraska is generally suitable for most uses, although some locations have experienced high concentrations of nitrates, along with pesticides such as atrazine. The majority of Nebraska's drinking water (over 80 percent) comes from groundwater, and approximately 94 percent of the total groundwater use in the state is for agricultural irrigation (Moody, Carr, Chase, & Paulson, 1986).

Table 12.1.4-3 provides details on aquifer characteristics in the state. Figure 12.1.4-3 shows Nebraska's principal aquifers. There are no sole source aquifers within Nebraska (USEPA, 2015c).

Table 12.1.4-3 Description of Nebraska's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin These aquifers consist mainly of the sand, gravel, and bedrock eroded by the glaciers.	Eastern Nebraska	Groundwater quality can be variable and the use of fertilizers and pesticides has affected the quality in some areas.
High Plains Aquifer Unconfined to partially unconfined	Entire state, except far southeast and northeast areas	Groundwater quality can be variable and the use of fertilizers and pesticides has affected the quality in some areas.
Lower Cretaceous Aquifers Consolidated sandstone with variable porosity and permeability	East-central Nebraska	Groundwater quality is variable, depending on local recharge, how long the water is in the aquifer, and whether the aquifer system has been leached.

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

⁶³ An alluvial aquifer is formed on a floodplain or in a river channel by material deposited during physical processes (Kansas Geological Survey, 2000).

⁶⁴ Carbonate-rock aquifers typically consist of limestone with highly variable water-yielding properties (some yield almost no water and others are highly productive aquifers) (Olcott, 1995a).

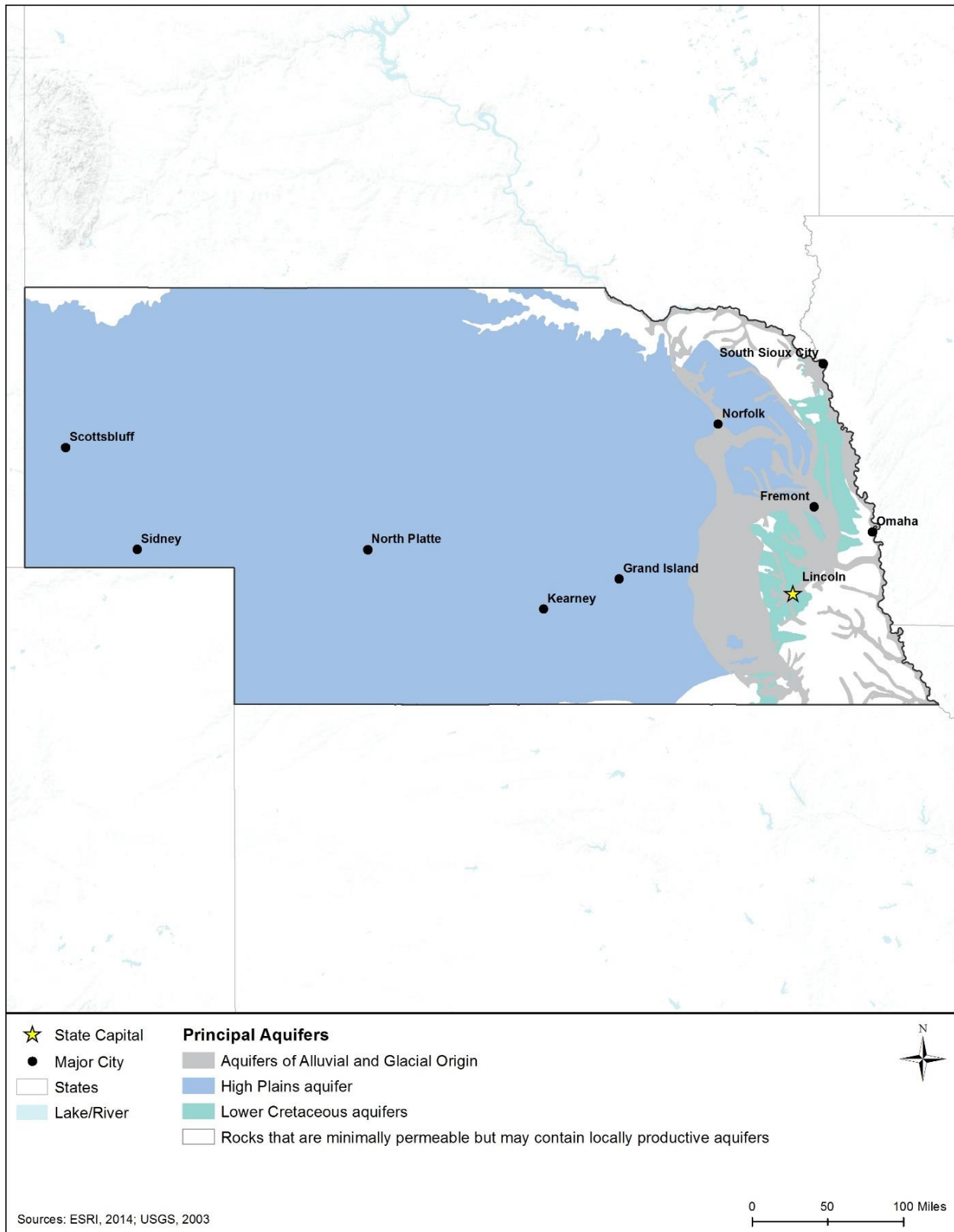


Figure 12.1.4-3: Principal Aquifers of Nebraska

12.1.5. Wetlands

12.1.5.1. Definition of the Resource

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

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

12.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, explains the pertinent federal laws to protecting wetlands in detail. Table 12.1.5-1 summarizes the major Nebraska state laws and permitting requirements relevant to wetlands.

Table 12.1.5-1: Relevant Nebraska Wetlands Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 404 permit, Nebraska regional requirements	USACE, Omaha District	Must provide pre-construction notification to the USACE before beginning dredge and fill projects in wetlands classified as peatlands ^a , Rainwater Basin wetlands, and Eastern Saline wetlands.
Nebraska Pollutant Discharge Elimination System Program	NDEQ	Construction activities that disturb one or more acre of soil and causes soil erosion that transports sediment to surface water.
CWA Section 401 Water Quality Certification	NDEQ	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 NDEQ indicating that the proposed activity will not violate water quality standards.

Source: (Nebraska Legislature, 2017c) (NDEQ, 2015b) (US Army Corps of Engineers, 2017) (NDEQ, 2008)

^a“Peatlands are saturated and inundated wetlands where conditions inhibit organic matter decomposition and allow for the accumulation of peat. Under cool, anaerobic, and acidic conditions, the rate of organic matter accumulation exceeds organic decay.” (USACE, 2015b)

12.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service’s (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard that classifies wetlands according to shared

environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 12.1.5-2). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats (USFWS, 2015a).

- The Marine System consists of open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 30 percent salty) water chemistry; minimal influence from rivers or estuaries. Where wave energy is low, mangroves, or mudflats may be present.
- “The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and the ocean water is at least occasionally diluted by freshwater runoff from the land.”
- “Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt.”
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- “Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent.” The system is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types) (Cowardin et al., 1979) (FGDC, 2013).

Three of these systems—Riverine, Lacustrine, and Palustrine—are present in Nebraska, as detailed in Table 12.1.5-2. Nebraska has over 800,000 acres of wetlands, including playa lakes/wetlands, saline wetlands, sandhills wetlands, and riparian wetlands. Table 12.1.5-2 uses 2014 NWI data to characterize and map Nebraska wetlands on a broad-scale.⁶⁵ These data are not intended for site-specific analyses and are not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations which may be conducted, as appropriate, at the site-specific level once those locations are known. The applicable wetland types are detailed in Table 12.1.5-2 with map codes and colorings corresponding to the wetland types in Figure 12.1.5-1 and Figure 12.1.5-2.

⁶⁵ The wetland acreages were obtained from the USFWS (2014) National Wetlands Inventory. Data from this inventory was downloaded by state at <https://www.fws.gov/wetlands/>. The wetlands data contains a wetlands classification code, which are a series of letter and number codes, adapted to the national wetland classification system in order to map from (e.g., PFO). Each of these codes corresponds to a larger wetland type; those wetland areas are rolled up under that wetlands type. The codes and associated acres that correspond to the deepwater habitats (e.g., those beginning with M1, E1, L1) were removed. The wetlands acres were derived from the geospatial datafile, by creating a pivot table to capture the sum of all acres under a particular wetland type. The maps reflect/show the wetland types/classifications and overarching codes; the symbolization used in the map is standard to these wetland types/codes, per the USFWS and Federal Geographic Data Committee.

Table 12.1.5-2: Nebraska 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 ft. tall. Floodplain forests, hardwood swamps, and silver maple-ash swamps are examples of PFO wetlands.	Throughout the state	109,797
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 ft. tall dominate PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens, ⁶⁶ prairie potholes, and sloughs.	Throughout the state, concentrated in north central Nebraska	510,633
Palustrine unconsolidated bottom	PUB	PUB and PAB wetlands are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Throughout the state	94,932
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, ⁶⁷ and other miscellaneous wetlands are included in this group.	Throughout the state	8,550
Riverine wetland	R	Riverine systems include rivers, creeks, and streams. They are contained in natural or artificial channels periodically or continuously containing flowing water.	Found along major rivers and streams throughout the state	46,925
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 include any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are less than 8.2 ft. deep.	Throughout the state, but especially in western and northern Nebraska	63,258
TOTAL				834,095

Source: (Cowardin et al., 1979) (USFWS, 2015a) (FGDC, 2013)

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

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

⁶⁶ Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water (Edinger, et al., 2014).

⁶⁷ Saline seep is an area where saline groundwater discharges at the soil surface. Saline soils and salt tolerant plants characterize these wetland types (City of Lincoln, 2015).

Palustrine Wetlands

In Nebraska, the dominant wetland type is palustrine emergent wetlands (PEM) (approximately 511,000 acres) which are found across the state. Typical plant species found in these wetlands include cattail (*Typha latifolia*), arrowhead (*Sagittaria sp.*), sweet flag (*Acorus calamus*), bulrush (*Schoenoplectus sp.*), water hemlock (*Cicuta*), wild rice (*Zizania sp.*), and common reed (*Phragmites australis*). Plant species found in wet meadows and edges include cotton grass (*Baeothryon alpinum*), marsh marigold (*Caltha palustris*), prairie white-fringed orchid (endangered) (*Platanthera leucophaea*), and swamp rose mallow (*Hibiscus moscheutos*). Woody plant species found in Nebraska wetlands include Willow (*Salix sp.*), buttonbush (*Conocarpus erectus*), dogwood (*Cornus*), elderberry (*Sambucus nigra*), silver maple (*Acer saccharinum*), cottonwood (*Populus*), and sycamore (*Acer pseudoplatanus*). (NGPC, 2005a)

Additional palustrine wetlands found in Nebraska include playas, sandhills wetlands, and saline wetlands. Playa wetlands are small circular depressions with a clay layer at the bottom, which prevents water from soaking into the ground. They are formed by the wind, and are found throughout the southern half of the state, as well as some areas in the northeast part of Nebraska (NGPC, 2015e). These wetlands are only found in southeastern Nebraska, in Lancaster and Saunders Counties. Sandhills wetlands are usually freshwater wetlands (although a few can be open water) and include shallow marshes and wet meadows fed by groundwater. These wetlands are found in the sandhills region of the state (north-central Nebraska), and some in the western portion of the sandhills are highly alkaline (pH values above 7.0). Saline wetlands, which are fed by groundwater, and as the groundwater flows through the salts in the bedrock the water becomes highly saline. Plants found in these wetlands include the endangered saltwort, and saltgrass (NGPC, 2005b).

Lacustrine Wetlands

Lacustrine wetlands are found throughout the state on over 63,000 acres, and include open lakes in the sandhills (NGPC, 2015e).

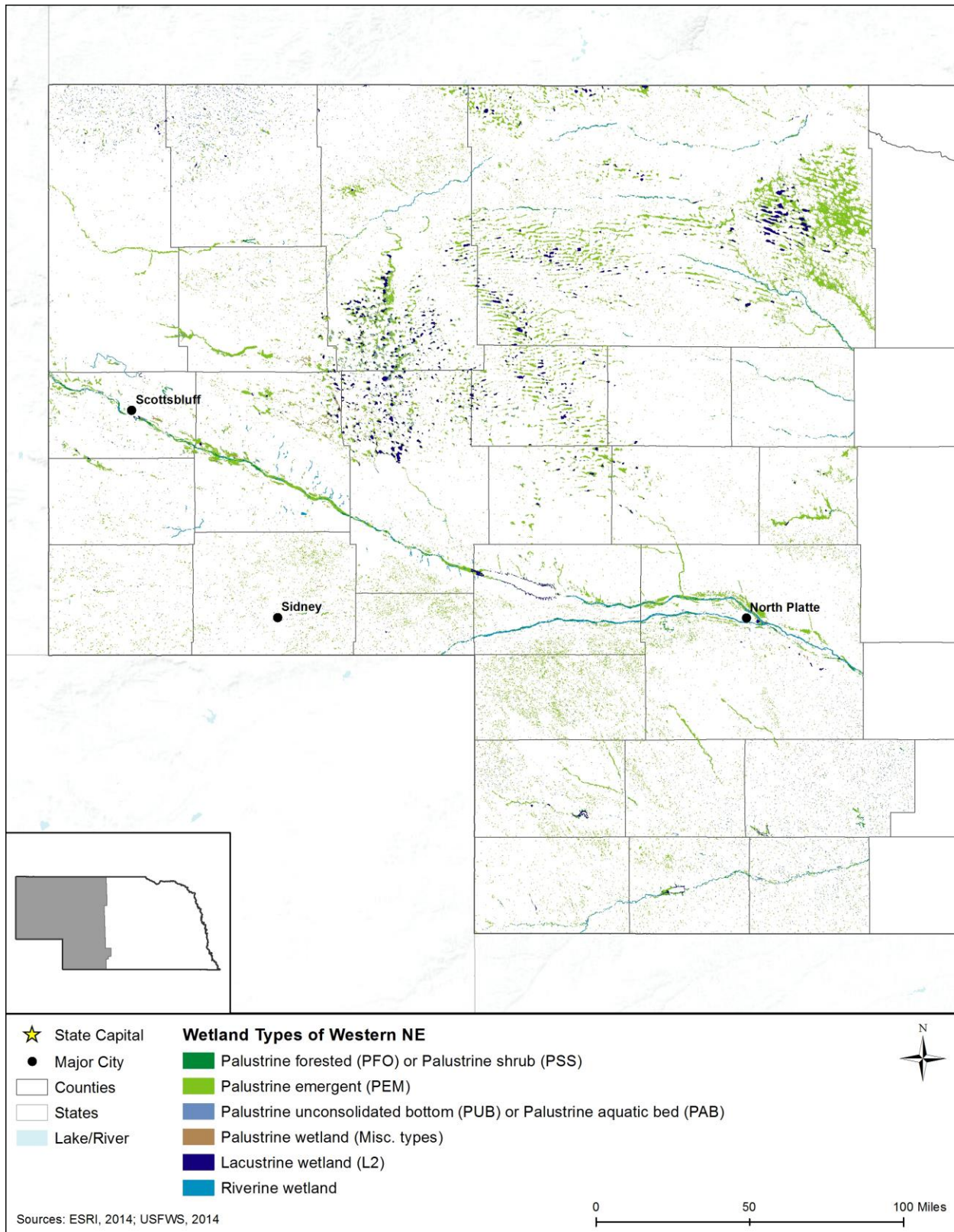


Figure 12.1.5-1: Wetlands by Type in Western Nebraska, 2014

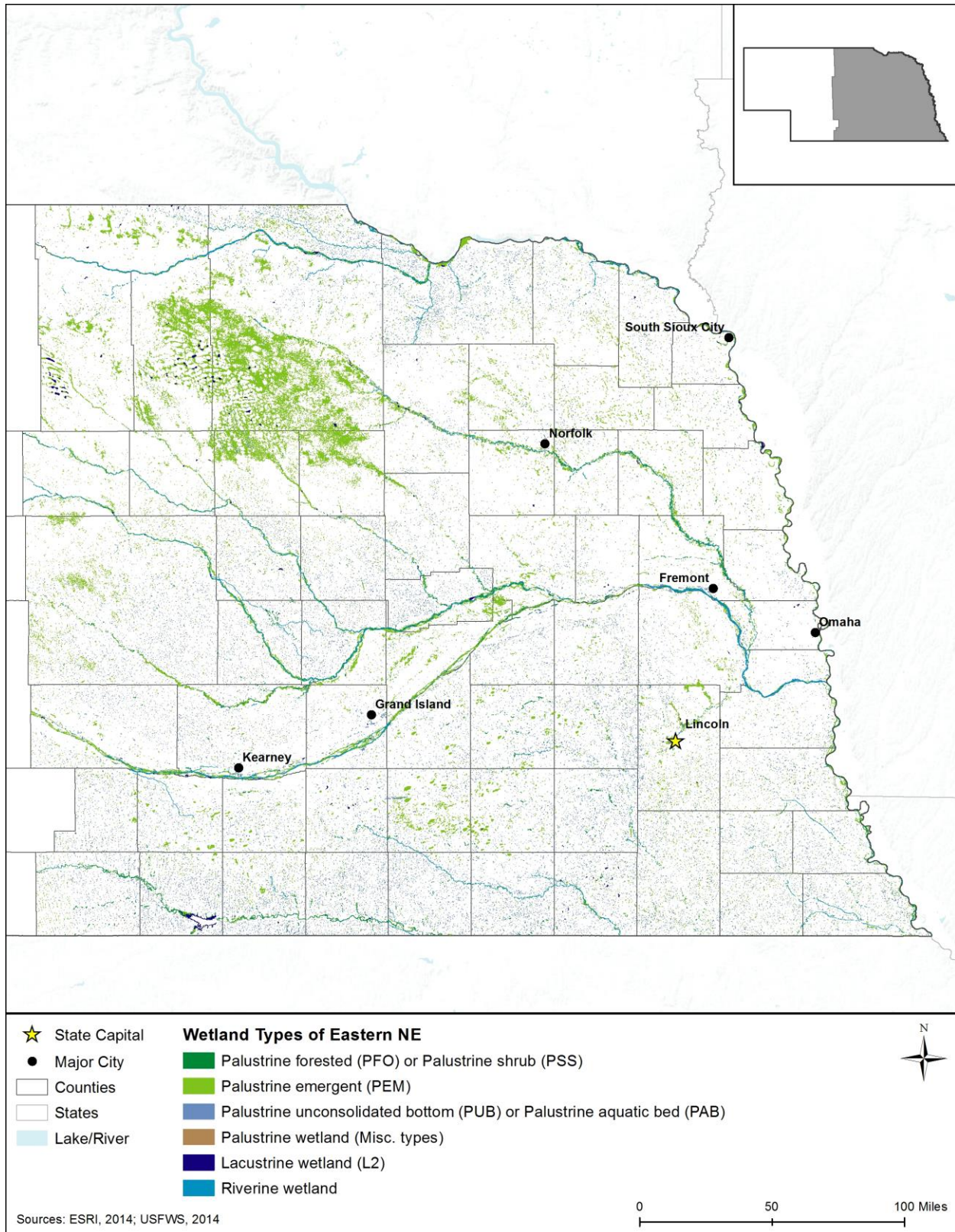


Figure 12.1.5-2: Wetlands by Type in Eastern Nebraska, 2014

Riverine Wetlands

Riverine wetlands are found along larger rivers and streams in Nebraska on nearly 47,000 acres, including the Platte, Missouri, Niobrara, and Elkhorn Rivers. Riverine wetlands include riparian zones, wetlands, sandbars, tree falls, side channels, wooded areas, and oxbows (abandoned stream channels) (NGPC, 2015e) (UNL Water, 2015).

All amphibian species, and approximately half of all plant and bird species found in Nebraska, use the state's wetlands as habitat. Wetlands also provide habitat to nearly 70 percent of all endangered and threatened species in Nebraska. It is estimated that approximately 35 percent of

Nebraska's wetlands have been lost to activities including ditching, tiling, filling, channelization, as well as declining water tables, and changes in the use of surrounding uplands that has resulted in diverted surface water runoff or increased sediment flows into wetlands. There is still a large wetland resource in the sandhills, but approximately 90 percent of eastern saline wetlands and rainwater basin playa wetlands have been lost (NGPC, 2005a). The major threats to existing wetlands in Nebraska include land conversion to other uses, primarily agricultural uses and associated building sites, roads, and feedlots. Watershed alterations and sedimentation from agricultural practices are also a major threat. Woody trees and shrubs have invaded wetlands in historically prairie ecosystems, and invasive species, including purple loosestrife, salt cedar, common reed, hybrid cattail, and reed canary grass have reduced wetland habitat and wildlife diversity. Other threats include long-term rest of lands without wetlands management that results in invasive species abundance, fragmentation of wetlands, repetitive management, and overgrazing (NGPC, 2005b).



Source: (NGPC, 2005a)

Sandhills Wetland, Garden County

12.1.5.4. Wetlands of Special Concern or Value

Special wetlands or high quality wetlands in Nebraska include eastern saline wetlands (discussed in Section 12.1.5.3 above) and playa wetlands found in the rainwater basin (see below for information about the Rainwater Basin Wetland Management District [WMD])⁶⁸. Peatlands⁶⁹ include the fen ecosystems found in the valleys between sand dunes in the Nebraska sandhills (Harvey, Swinchart, & Kurtz, 2007).

⁶⁸ The Rainwater Basin Wetland Management District manages all the waterfowl production areas in a multi-county area (USFWS, 2016).

⁶⁹ "Peatlands are saturated and inundated wetlands where conditions inhibit organic matter decomposition and allow for the accumulation of peat. Under cool, anaerobic, and acidic conditions, the rate of organic matter accumulation exceeds organic decay." (USACE, 2015b)

Important Wetland Sites in Nebraska

- There are six National Wildlife Refuges (NWR) located in Nebraska. To learn more, visit www.fws.gov/refuges/profiles/ByState.cfm?state=NE.
- The Rainwater Basin WMD is comprised of over 24,000 acres of wetlands and uplands throughout the state. Within the WMD, there are 61 Waterfowl Production Areas managed mostly for migratory waterfowl. To learn more, visit www.fws.gov/refuge/Rainwater_Basin_WMD/.
- Wildlife Management Areas (WMA) are designed to enhance wildlife habitat and provide for public hunting and fishing. To learn more about state WMAs, visit <https://outdoornebraska.gov/?s=Wildlife+Management+Areas>.
- There are five National Natural Landmarks (NNL) in Nebraska, and are owned by the state, USFWS, and private organizations and individuals (NPS, 2014b). Visit www.nature.nps.gov/nnl/state.cfm?State=NE to learn more about Nebraska's NNLs.
- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including NRCS, private landowners, and easements managed by natural resource conservation groups, such as The Nature Conservancy, Ducks Unlimited, and state land trusts. 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 80,000 acres in conservation easements in Nebraska (NCED, 2015).

For more information on Nebraska's WMAs, NNLs, and conservation programs, see Section 12.1.8, Visual Resources, and Section 12.1.7, Land Use, Recreation, and Airspace.

12.1.6. Biological Resources

12.1.6.1. Definition of the Resource

This section describes the biological resources of Nebraska. Biological resources include terrestrial⁷⁰ vegetation, wildlife, fisheries and aquatic habitats,⁷¹ and threatened⁷² and endangered⁷³ species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Given Nebraska's varied landscape, which includes mountains, valleys, wetlands, lakes, and rivers, Nebraska supports a large number of habitats that supports a diversity of biological resources. Each of these topics is discussed in more detail below.

⁷⁰ Terrestrial: "Pertaining to the land." (USEPA, 2015d)

⁷¹ Habitat: "The environment in which an organism or population of plants or animals lives; the normal kind of location inhabited by a plant or animal." (USEPA, 2015d)

⁷² 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))

⁷³ 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))

12.1.6.2. *Specific Regulatory Considerations*

The federal laws relevant to the protection and management of biological resources in Nebraska are summarized in detail in Appendix C, Environmental Laws and Regulations. Table 12.1.6-1 summarizes state laws relevant to Nebraska’s biological resources.

Table 12.1.6-1: Relevant Nebraska Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Noxious Weed Control Act (§ 2-945.01 to § 2-968 Nebraska Revised Statutes [NRS])	Nebraska Department of Agriculture	Establishes a program for the control and monitoring of noxious weeds, establishment of noxious weed species, public education, and administration of noxious weed control laws at the county level.
Game Law - Aquatic invasive species; wild or nonnative animals; importation, possession, or release; prohibition; violation; penalty (§ 37-524 to § 37.524.03 NRS)	NGPC	Regulates the importation, possession, or release of aquatic invasive species, wild pigs, the San Juan rabbit, or any other wild vertebrate animal that has been declared by the NGPC to constitute a serious threat to economic or ecologic conditions.
Game Law - Aquatic invasive species; wildlife; prohibited acts; penalty; release, importation, commercial exploitation, and exportation permits; fees; commission; powers and duties (§ 37-548 NRS)	NGPC	Regulates the importation or release of aquatic invasive species and live wildlife except those approved in the Nebraska Game Law.
Nebraska Nongame and Endangered Species Conservation Act (§ 37-801 to § 37-811 NRS)	NGPC	Provides protection against the taking, possessing, or transportation of wildlife or plants that are members of an endangered or threatened species, as established by the federal Endangered Species Act as well as any species determined by the NGPC to be threatened or endangered in the state.

Source: (USDA, 2016) (Nebraska Legislature, 2007)

12.1.6.3. *Terrestrial Vegetation*

The distribution of flora within Nebraska is a function of the characteristic geology,⁷⁴ soils, climate,⁷⁵ and water of a given geographic area and correlates with distinct areas identified as ecoregions.⁷⁶ Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed; they depict a general area with

⁷⁴ USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and groundwater availability.

⁷⁵ 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, 2015d)

⁷⁶ Ecoregion: “A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.” (USEPA, 2015d)

similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (World Wildlife Fund, 2015).

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

As shown in Figure 12.1.6-1, the USEPA divides Nebraska into six Level III ecoregions, which closely follow various prairie grassland habitats and Sandhills portions of the state. Plant communities are predominantly prairie grasslands throughout much of the state including tallgrass and mixed grass prairies, with sand sage prairie in the drier hills, floodplain forests along the major waterways, and ponderosa pine (*Pinus ponderosa*) forests in the eastern portion of the state (Chapman, et al., 2001). Table 12.1.6-2 provides a summary of the general abiotic⁷⁷ characteristics, vegetative communities, and the typical vegetation found within the six Nebraska ecoregions.

In addition to the USEPA ecoregions, geographic regions have been included in Table 12.1.6-2 and will be used in describing Nebraska's biological resources in the following sections. Nebraska can generally be divided into three geographic regions (and their corresponding ecoregions): Panhandle (High Plains and Northwestern Great Plains); Sandhills and Central Nebraska (Sandhills, Central Great Plains, Western High Plains, Northwestern Glaciated Plains, and Northwestern Great Plains); and Eastern Nebraska (Northwestern Glaciated Plains, Western Corn Belt Plains, and Central Great Plains) (USEPA, 2015e).

⁷⁷ Abiotic: "Nonliving characteristic of the environment; the physical and chemical components that relate to the state of ecological resources." (USEPA, 2015d)

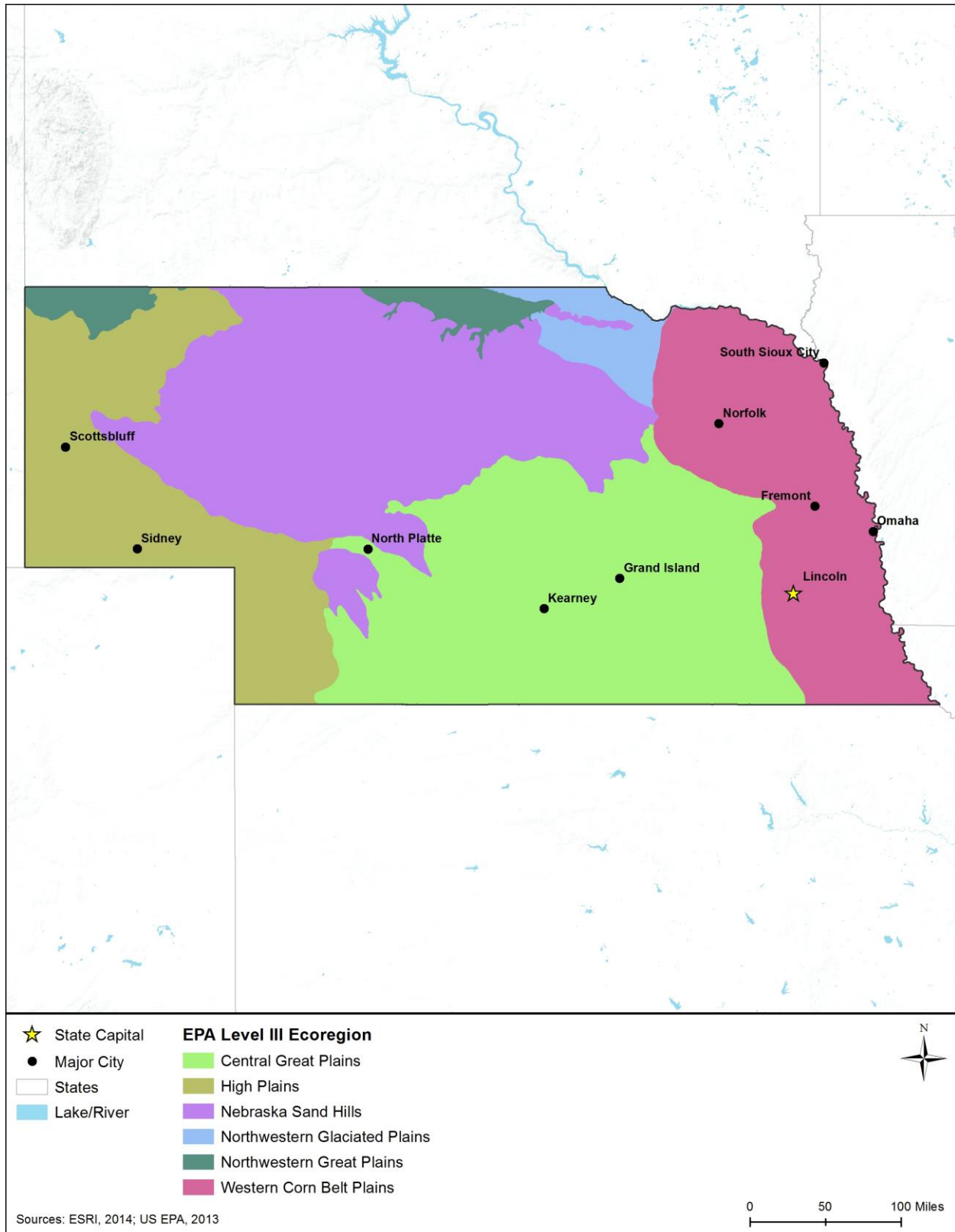


Figure 12.1.6-1: USEPA Level III Ecoregions of Nebraska

Table 12.1.6-2: USEPA Level III Ecoregions of Nebraska

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Panhandle				
43	Northwestern Great Plains	Encompasses the Missouri Plateau section of the Great Plains. Characterized by semiarid rolling plain of shale, sandstone, and siltstone with occasional buttes. Erratic precipitation, limited irrigation sources, and a climate of harsh, cold winters, short growing season, and dry, hot summers restrict agricultural activities.	Mixed grass prairie, Sandhills transition prairie, Ponderosa pine woodlands, Floodplain woodlands	<p>Deciduous Trees – Bur oak (<i>Quercus macrocarpa</i>), Basswood (<i>Tilia americana</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Paper birch (<i>Betula papyrifera</i>), Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>)</p> <p>Conifers – Ponderosa pine (<i>Pinus ponderosa</i>), Eastern redcedar (<i>Juniperus virginiana</i>)</p> <p>Shrubs and Subshrubs – Prairie sagebrush (<i>Artemisia frigida</i>), Big sagebrush (<i>Artemisia tridentata</i>)</p> <p>Forbs and Grasses – Western wheatgrass (<i>Pascopyrum smithii</i>), Green needlegrass (<i>Nassella viridula</i>), Blue grama (<i>Bouteloua gracilis</i>), Buffalograss (<i>Bouteloua dactyloides</i>), Threadleaf sedge (<i>Carex filifolia</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>), Little bluestem (<i>Schizachyrium scoparium</i>)</p>
25	Western High Plains	Characterized by a semi-arid to arid climate in the rain shadow of the Rocky Mountains. Terrain generally consists of smooth to slightly irregular plains. Loess deposits in southwestern Nebraska. Natural gas deposits yield a majority of natural gas produced in the Midwest United States.	Mixed grass prairie, Shortgrass prairie, Sandsage prairie, Ponderosa pine woodlands, Sandsage prairie, Lowland tallgrass prairie, Floodplain woodlands	<p>Deciduous Trees – Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>)</p> <p>Conifers – Ponderosa pine (<i>Pinus ponderosa</i>), Rocky Mountain juniper (<i>Juniperus scopulorum</i>)</p> <p>Shrubs and Subshrubs – Western snowberry (<i>Symphoricarpos occidentalis</i>), Skunkbush sumac (<i>Rhus trilobata</i>), Choke cherry (<i>Prunus virginiana</i>), Prairie sagebrush (<i>Artemisia frigida</i>)</p> <p>Forbs and Grasses – Western wheatgrass (<i>Pascopyrum smithii</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>), Little bluestem (<i>Schizachyrium scoparium</i>), Blue grama (<i>Bouteloua gracilis</i>), Threadleaf sedge (<i>Carex filifolia</i>), Alkali sacaton (<i>Sporobolus airoides</i>), Inland saltgrass (<i>Distichlis spicata</i>), Prairie cordgrass (<i>Spartina pectinata</i>), Switch grass (<i>Panicum virgatum</i>)</p>

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Sandhills and Central Nebraska				
44	Nebraska Sandhills	One of the largest areas of grass stabilized sand dunes in the world. These fragile, sandy rangelands are susceptible to wind erosion or denuded sand dunes so overgrazing and vegetation loss are a concern for cattle ranching. Numerous lakes and wetlands throughout region, some areas are without streams.	Sandhills mixed grass prairie, Sandhills transition mixed grass prairie, Wetlands	Forbs and Grasses – Prairie sandreed (<i>Calamovilfa longifolia</i>), Little bluestem (<i>Schizachyrium scoparium</i>), Sand bluestem (<i>Andropogon hallii</i>), Switch grass (<i>Panicum virgatum</i>), Sand lovegrass (<i>Eragrostis trichodes</i>), Needle and thread (<i>Hesperostipa comata</i>), Blue grama (<i>Bouteloua gracilis</i>), Hairy grama (<i>Bouteloua hirsuta</i>), Alkali sacaton (<i>Sporobolus airoides</i>), Inland saltgrass (<i>Distichlis spicata</i>), Prairie cordgrass (<i>Spartina pectinata</i>), Alkaline/cosmopolitan bulrush (<i>Bolboschoenus maritimus</i>)
25	Western High Plains	Characterized by a semi-arid to arid climate in the rain shadow of the Rocky Mountains. Terrain generally consists of smooth to slightly irregular plains. Loess deposits in southwestern Nebraska. Natural gas deposits yield a majority of natural gas produced in the Midwest United States.	Mixed grass prairie, Shortgrass prairie, Sandsage prairie, Ponderosa pine woodlands, Sandsage prairie, Lowland tallgrass prairie, Floodplain woodlands	Deciduous Trees – Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>) Conifers – Ponderosa pine (<i>Pinus ponderosa</i>), Rocky Mountain juniper (<i>Juniperus scopulorum</i>) Shrubs and Subshrubs – Western snowberry (<i>Symphoricarpos occidentalis</i>), Skunkbush sumac (<i>Rhus trilobata</i>), Choke cherry (<i>Prunus virginiana</i>), Prairie sagebrush (<i>Artemisia frigida</i>) Forbs and Grasses – Western wheatgrass (<i>Pascopyrum smithii</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>), Little bluestem (<i>Schizachyrium scoparium</i>), Blue grama (<i>Bouteloua gracilis</i>), Threadleaf sedge (<i>Carex filifolia</i>), Alkali sacaton (<i>Sporobolus airoides</i>), Inland saltgrass (<i>Distichlis spicata</i>), Prairie cordgrass (<i>Spartina pectinata</i>), Switch grass (<i>Panicum virgatum</i>)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
27	Central Great Plains	Characterized by somewhat irregular, flat to rolling loess-covered plains. Subsurface salt deposits and leaching contribute to the high salinity occurring in some streams.	Historically grassland with scattered low trees and shrubs; currently cropland, mixed grass prairie, Tallgrass prairie, Lowland tallgrass prairie, Wetlands Floodplain forest	Deciduous Trees – Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Peachleaf willow (<i>Salix amygdaloides</i>), Silver maple (<i>Acer saccharinum</i>) Conifers – Eastern redcedar (<i>Juniperus virginiana</i>) Shrubs – Sandbar willow (<i>Salix exigua</i>), Roughleaf dogwood (<i>Cornus drummondii</i>), Red osier dogwood (<i>Cornus sericea</i>) Forbs and Grasses – Needle and thread (<i>Hesperostipa comata</i>), Little bluestem (<i>Schizachyrium scoparium</i>), Big bluestem (<i>Andropogon gerardii</i>), Blue grama (<i>Bouteloua gracilis</i>), Needle and thread, Sideoats grama (<i>Bouteloua curtipendula</i>), Western wheatgrass (<i>Pascopyrum smithii</i>), Spike rushes (<i>Eleocharis</i> spp.), Slender bulrush (<i>Schoenoplectus heterochaetus</i>)
42	Northwestern Glaciated Plains	Considered a transitional area between the generally more level, moister plains to the east (Western Corn Belt Plains) and the more irregular, drier plains to the west and southwest (Nebraska Sandhills). This region coincides with the limits of glaciation with little, if any, glacial influence within Nebraska.	Native vegetation includes mixed grass prairie, Deciduous woodland; currently much of it is agricultural row crops	Deciduous Trees – Bur oak (<i>Quercus macrocarpa</i>), Basswood (<i>Tilia americana</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>), Willows (<i>Salix</i> spp.) Conifers – Eastern redcedar (<i>Juniperus virginiana</i>) Forbs and Grasses – Little bluestem (<i>Schizachyrium scoparium</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>), Western wheatgrass (<i>Pascopyrum smithii</i>), Green needlegrass (<i>Nassella viridula</i>), Sideoats grama (<i>Bouteloua curtipendula</i>), Switchgrass (<i>Panicum virgatum</i>), Sand dropseed (<i>Sporobolus cryptandrus</i>), Sand bluestem (<i>Andropogon hallii</i>)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
43	Northwestern Great Plains	Encompasses the Missouri Plateau section of the Great Plains. Characterized by semiarid rolling plain of shale, sandstone, and siltstone with occasional buttes. Erratic precipitation, limited irrigation sources, and a climate of harsh, cold winters, short growing season, and dry, hot summers restrict agricultural activities.	Mixed grass prairie, Sandhills transition prairie, Ponderosa pine woodlands, Floodplain woodlands	Deciduous Trees – Bur oak (<i>Quercus macrocarpa</i>), Basswood (<i>Tilia americana</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Paper birch (<i>Betula papyrifera</i>), Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>) Conifers – Ponderosa pine (<i>Pinus ponderosa</i>), Eastern redcedar (<i>Juniperus virginiana</i>) Shrubs and Subshrubs – Prairie sagebrush (<i>Artemisia frigida</i>), Big sagebrush (<i>Artemisia tridentata</i>) Forbs and Grasses – Western wheatgrass (<i>Pascopyrum smithii</i>), Green needlegrass (<i>Nassella viridula</i>), Blue grama (<i>Bouteloua gracilis</i>), Buffalograss (<i>Bouteloua dactyloides</i>), Threadleaf sedge (<i>Carex filifolia</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>), Little bluestem (<i>Schizachyrium scoparium</i>)
Geographic Region: Eastern Nebraska (including Omaha Metro)				
47	Western Corn Belt Plains	This region is characterized by nearly level to gently rolling glaciated till plains and hilly loess plains. Climate consists of ample precipitation occurring mainly during the growing season. Fertile, warm, moist soils have resulted in extensive agricultural activities, including one of the most highly productive areas globally for corn and soybeans.	Historically Tallgrass prairie, Lowland tallgrass prairie, Sandhills border mixed grass prairie, Northern floodplain forest, Oak-hickory forest, Floodplain woodlands; currently 90% of land is cropland agriculture	Deciduous Trees – Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Boxelder (<i>Acer negundo</i>), Elm (<i>Ulmus spp.</i>), Hickory (<i>Carya spp.</i>), Bur oak (<i>Quercus macrocarpa</i>), Basswood (<i>Tilia americana</i>), Black walnut (<i>Juglans nigra</i>), Willows (<i>Salix spp.</i>) Forbs and Grasses – Big bluestem (<i>Andropogon gerardii</i>), Prairie cordgrass (<i>Spartina pectinata</i>), Switch grass (<i>Panicum virgatum</i>), Sedges, Indian grass (<i>Sorghastrum nutans</i>), Little bluestem (<i>Schizachyrium scoparium</i>), Porcupine grass (<i>Hesperostipa spartea</i>), Sideoats grama (<i>Bouteloua curtipendula</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
42	Northwestern Glaciated Plains	Considered a transitional area between the generally more level, moister plains to the east (Western Corn Belt Plains) and the more irregular, drier plains to the west and southwest (Nebraska Sandhills). This region coincides with the limits of glaciation with little, if any, glacial influence within Nebraska.	Native vegetation includes mixed grass prairie, Deciduous woodland; currently much of it is agricultural row crops	<p>Deciduous Trees – Bur oak (<i>Quercus macrocarpa</i>), Basswood (<i>Tilia americana</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>), Willows (<i>Salix</i> spp.)</p> <p>Conifers – Eastern red cedar (<i>Juniperus virginiana</i>)</p> <p>Forbs and Grasses – Little bluestem (<i>Schizachyrium scoparium</i>), Prairie sandreed (<i>Calamovilfa longifolia</i>), Needle and thread (<i>Hesperostipa comata</i>), Western wheatgrass (<i>Pascopyrum smithii</i>), Green needlegrass (<i>Nassella viridula</i>), Sideoats grama (<i>Bouteloua curtipendula</i>), Switchgrass (<i>Panicum virgatum</i>), Sand dropseed (<i>Sporobolus cryptandrus</i>), Sand bluestem (<i>Andropogon hallii</i>)</p>
27	Central Great Plains	Characterized by somewhat irregular, flat to rolling loess-covered plains. Subsurface salt deposits and leaching contribute to the high salinity occurring in some streams.	Historically grassland with scattered low trees and shrubs; currently cropland, mixed grass prairie, Tallgrass prairie, Lowland tallgrass prairie, Wetlands Floodplain forest	<p>Deciduous Trees – Plains cottonwood (<i>Populus deltoides ssp. monilifera</i>), Green ash (<i>Fraxinus pennsylvanica</i>), Peachleaf willow (<i>Salix amygdaloides</i>), Silver maple (<i>Acer saccharinum</i>)</p> <p>Conifers – Eastern red cedar (<i>Juniperus virginiana</i>)</p> <p>Shrubs – Sandbar willow (<i>Salix exigua</i>), Roughleaf dogwood (<i>Cornus drummondii</i>), Red osier dogwood (<i>Cornus sericea</i>)</p> <p>Forbs and Grasses – Needle and thread (<i>Hesperostipa comata</i>), Little bluestem (<i>Schizachyrium scoparium</i>), Big bluestem (<i>Andropogon gerardii</i>), Blue grama (<i>Bouteloua gracilis</i>), Needle and thread, Sideoats grama (<i>Bouteloua curtipendula</i>), Western wheatgrass (<i>Pascopyrum smithii</i>), Spike rushes (<i>Eleocharis</i> spp.), Slender bulrush (<i>Schoenoplectus heterochaetus</i>)</p>

Sources: (Chapman, et al., 2001) (USEPA, 2015e)

Communities of Concern

Nebraska contains vegetative communities of concern that include rare natural plant communities, plant communities with greater vulnerability or sensitivity to disturbance, and communities that provide habitat for rare plant and wildlife species. The ranking system for these communities gives an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these areas to potential disturbances. This ranking system also gives an indication of the level of potential impact to a particular community that could result from implementation of an action.

The Nebraska Game and Park Commissions (NGPC) Nebraska Natural Heritage Program (NNHP) maintains a statewide inventory of plant and wildlife resources, including lists of all types of natural communities known to occur, or that have historically occurred, in the state. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the NNHP ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Nebraska (NGPC, 2011). Communities ranked as an S1 by the NNHP are of the greatest concern. This rank is typically based on the number of known examples, total area occupied, population trends, and the degree of threat to the community.

The Nebraska Natural Legacy Project provides for the conservation of flora and fauna in the state's Wildlife Action Plan. The Wildlife Action Plan lists the natural terrestrial vegetation communities within the state, 83 total including wetland and upland types. Of those 83 terrestrial vegetation communities, 13 vegetative communities are ranked as S1 communities⁷⁸ in Nebraska (NGPC, 2011) (NRCS, 2010). These communities occur throughout the state, primarily in Eastern Nebraska where native prairie and floodplain areas have been converted to agricultural use. Nebraska Appendix A, Table A-1, provides a description of the S1 communities of conservation concern in Nebraska along with their distribution, abundance, and the associated USEPA Level III ecoregions and geographic regions.

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

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive plants. Direct impacts to nuisance and invasive plants may be viewed as beneficial to the environment, but often such impacts result in the inadvertent and unintended spread and dispersal of these species. Construction sites in particular provide colonizing opportunities for nuisance and invasive species, and long-term maintenance activities can perpetuate a disturbance regime that facilitates a continued dispersal mechanism for the spread of these species.

⁷⁸ S1 – Critically imperiled and extremely rare in the state or because of factors making it especially vulnerable to extirpation from the state, generally with fewer than five high quality occurrences (NGPC, 2011).

Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (Government Printing Office, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S. (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015b), of which, 12 are known to occur in Nebraska:

- **Trees, Shrubs and Vines** – salt cedar (*Tamarix parviflora* and *T. ramosissima*).
- **Terrestrial Forbs, Grasses, and Grass-like Plants** – plumeless thistle (*Carduus acanthoides*), musk thistle (*Carduus nutans*), diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea stoebe* ssp. *micranthos* [syn. *C. maculosa*]), Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), Japanese knotweed (*Fallopia japonica* [syn. *Polygonum cuspidatum*]), giant knotweed (*Fallopia sachalinensis*), purple loosestrife (*Lythrum salicaria* and *L. virgatum*), phragmites (*Phragmites australis* ssp. *australis*), and sericea lespedeza (*Sericea lespedeza*) (25 NAC 10-001, 2014).

Noxious weeds are a threat to Nebraska's working forests, agricultural lands, waterways, and natural areas. Noxious weeds can have adverse ecological and economic impacts to these resources by displacing and outcompeting plants in both natural ecosystems and managed lands. Nebraska passed the Noxious Weed Control Act in 2012 that regulates the importation, movement, sale, possession, cultivation, and distribution of certain invasive plants, and most recently updated the noxious weed list in 2014 (25 NAC 10-001, 2014). The Nebraska Department of Agriculture is responsible for maintaining the statewide prohibited noxious weed list and updates to that list, as necessary. By state statute, each county is responsible for enforcement of noxious weed control within their jurisdiction. Sale of plants on the noxious weed list is prohibited in the nursery and landscaping trades (25 NAC 10-001, 2014).

In addition to the Nebraska Department of Agriculture, noxious weeds in Nebraska are addressed by the Nebraska Invasive Species Advisory Council. The council does not have regulatory authority, but rather endeavors to educate the public and policymakers on invasive species issues and promote cooperative efforts to address invasive species concerns. The council also makes recommendations to the Nebraska Department of Agriculture to minimize the effects of harmful invasive species and updates the statewide adaptive management plan for invasive species. The Nebraska Invasive Species Council includes representatives from state and federal government, nonprofit organizations, private industry, and at-large appointees to address invasive plant issues in Nebraska (NDA, 2016).

Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Nebraska, divided among mammals,⁷⁹ birds,⁸⁰ reptiles and amphibians,⁸¹ and invertebrates.⁸² 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,⁸³ nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Nebraska. 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. Current records indicate Nebraska is home to 95 mammal species, 461 bird species, 62 reptile and amphibian species, more than 10,000 invertebrate species, and 114 fish species (Hoback, Brust, Dankert, & Nagel, 2005) (Nebraska Ornithologists' Union, 2016) (NGPC, 2015f) (NGPC, 2011).

Nebraska has utilized a two-tiered approach to identifying species that may be at-risk of extinction or extirpation from the state, also referred to as Species of Greatest Conservation Need. Tier I at-risk species include threatened or endangered species under the federal Endangered Species Act (ESA) or the Nebraska Nongame and Endangered Species Conservation Act (NЕСSA); species ranked critically imperiled (S1), imperiled (S2),⁸⁴ or vulnerable (S3)⁸⁵ by the NNHP; and species considered to be declining, endemic, or disjunct. The Nebraska Legacy Project has chosen to focus conservation efforts on the 89 species identified as Tier I at-risk species. An additional 679 species were identified as Tier II at-risk species in Nebraska. The at-risk lists consist of at-risk species that are rare or declining, and State Wildlife Grants can provide funding for efforts to prevent fish and wildlife populations⁸⁶ from becoming endangered. Although these species have been targeted for conservation they are not currently under legal protection. The at-risk lists are updated periodically and are used by the state of Nebraska to focus their conservation efforts and as a basis for implementing the Nebraska Wildlife Action Plan (NGPC, 2011).

Mammals

Common and widespread mammalian species in Nebraska include white-tailed deer (*Odocoileus virginianus*), woodchuck (*Marmota monax*), deer mice (*Peromyscus maniculatus*), raccoons (*Procyon lotor*), bats (*Chiroptera* spp.), and squirrels (*Sciurus* spp.). Other species such as beaver (*Castor canadensis*), coyote (*Canis latrans*), elk (*Cervus canadensis*), and river otter

⁷⁹ 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, 2015d)

⁸⁰ Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves." (USEPA, 2015d)

⁸¹ 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, 2015d)

⁸² Invertebrates: "Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc." (USEPA, 2015d)

⁸³ Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

⁸⁴ S2 = Imperiled because of rarity or other factor making it very vulnerable to extirpation from the state; 6 to 20 occurrences or few remaining individuals (NGPC, 2011).

⁸⁵ S3 = Vulnerable because it is rare and uncommon in the state; 21 to 80 occurrences (NGPC, 2011).

⁸⁶ 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, 2015d)

(*Lontra canadensis*) are also common but less widespread. Most mammal species are widely distributed throughout the state; however, some species such as river otter and beaver may be more commonly encountered in larger drainages (rivers and streams) in the eastern two-thirds of the state, or coyote, mule deer (*Odocoileus hemionus*), antelope (*Antilocapra americana*), and mountain lion (*Puma concolor*), which may be limited to the western or northern portions of the state. Nebraska is home to 95 mammal species, 10 of which have been identified as Tier I at-risk species (NGPC, 2011). Two threatened or endangered mammals, the northern long-eared bat (*Myotis septentrionalis*) and black-footed ferret (*Mustela nigripes*) are known to occur in Nebraska. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, discusses these species.

In Nebraska, white-tailed deer (*Odocoileus virginianus*), mule deer, antelope, bighorn sheep (*Ovis canadensis*), elk, and wild turkey (*Meleagris gallopavo*) are considered big game species. Small game species include small mammals (e.g., rabbits, jackrabbits [*Lepus* spp.], and squirrels), furbearers, and upland and migratory bird species including waterfowl. The following 13 species of furbearers may be legally hunted or trapped in Nebraska: red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), beaver, muskrat (*Ondatra zibethicus*), mink (*Neovison vison*), skunk, badger (*Taxidea taxus*), bobcat, weasel (*Mustela* spp.), raccoon (*Procyon lotor*), opossum, coyote, and mountain lion (NGPC, 2011).

Birds

The number of native bird species documented in Nebraska varies according to the timing of the data collection effort, changes in bird taxonomy,⁸⁷ and the reporting organization's method for categorizing occurrence and determining native versus non-native status. The diverse ecological communities (i.e., large rivers and lakes, dry western hills, plains, and prairies) found in Nebraska support a variety of bird species. Approximately 461 species of resident and migratory birds have been documented in Nebraska (Nebraska Ornithologists' Union, 2016). Among the 461 species in Nebraska, 22 Tier I at-risk species have been identified (NGPC, 2011) (Nebraska Ornithologists' Union, 2016). Four threatened or endangered bird species are known to occur in Nebraska (USFWS, 2015c) and are discussed in Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern. Critical habitat for the endangered whooping crane (*Grus americana*) and threatened piping plover (*Charadrius melodus*) occurs within Nebraska (Figure 12.1.6-3) (USFWS, 2015d).

Nebraska is located within the Central Flyway, which spans the Rocky Mountains, Great Plains, arid Southwest, and western Gulf Coast. The Central Flyway extends from northern Canada and Arctic islands south to Central and South America. The Central Flyway resembles an hourglass shape, with a wider path at the northern and southern portions in the United States and narrowing over the state of Nebraska, where the Platte River is considered one of the nation's most important spring migrating staging areas for several species (NAS, 2015a). Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall.

⁸⁷ Taxonomy: "A formal representation of relationships between items in a hierarchical structure." (USEPA, 2015d)

“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 (BGEPA). Bald eagles are generally found near large rivers and lakes in the entire state all year (eBird, 2015a). Golden eagles are generally found in a variety of habitats within their range, but they generally nest in mountains and cliffs. Golden eagles are found in the Panhandle year round, and are seen in Central and Eastern Nebraska during the winter season (eBird, 2015b).

A number of Important Bird Areas (IBAs) have also been identified in Nebraska (Figure 12.1.6-2). The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds, and to conserve these areas. These IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international conservation-oriented non-governmental organizations (NGOs), state and federal government agencies, local conservation groups, academics, grassroots environmentalists, and birders. These IBAs link global and continental bird conservation priorities to local sites that provide key habitat for native bird populations. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental scale, but do not meet the criteria for a global IBA. State IBAs are sites determined important for state rare species or support local populations of birds (NAS, 2015b).

According to the National Audubon Society, a total of 25 IBAs have been identified in Nebraska, covering more than 425,000 acres, including breeding,⁸⁸ migratory stop-over, feeding areas, and a variety of habitats and wintering rounds (NAS, 2015b). As depicted in Figure 12.1.6-2, these IBAs are widely distributed throughout the state, although the largest concentration of IBAs are located along the Missouri, Platte, and Niobrara Rivers in the northern, central, and eastern portions of the state.

⁸⁸ Breeding range: “The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared.” (USEPA, 2015d)

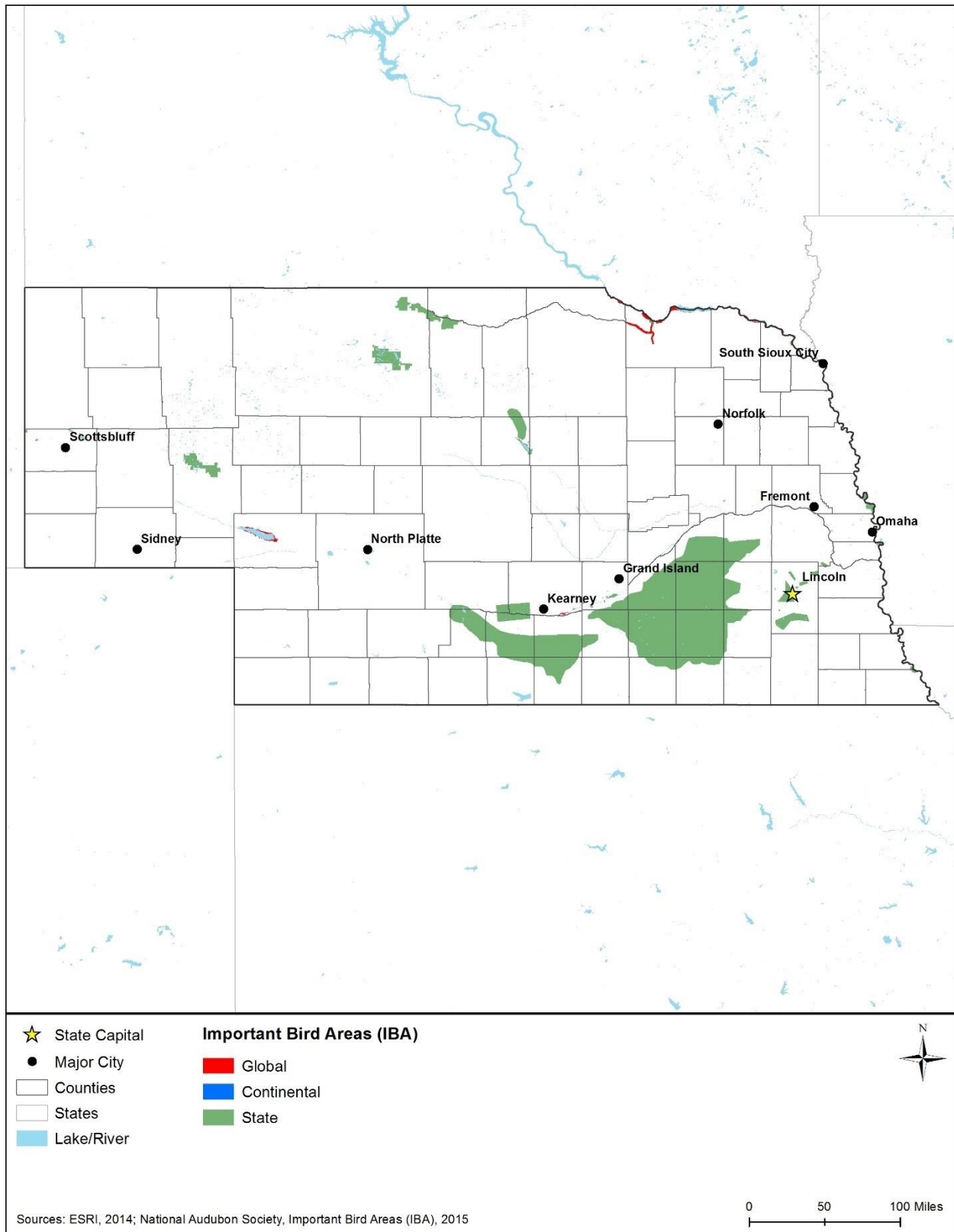


Figure 12.1.6-2: Important Bird Areas in Nebraska

Reptiles and Amphibians

A total of 62 native reptile and amphibian species occur in the state of Nebraska. Of these species are 9 turtles, 10 lizards, 14 amphibians, and 29 snakes (NGPC, 2011). These species occur in a wide variety of habitats across the state, with some having widespread distribution and others being limited to a smaller region or locations in the state. Of these 62 reptile and amphibian species, 4 Tier I at-risk species have been identified; however, no threatened or endangered reptile or amphibian species are known to occur in Nebraska (NGPC, 2011).

Nebraska's reptile and amphibian species are classified as wildlife under the Game Law (§37-201 to § 37-811 and § 37-1501 to § 37-1510 NRS) and are protected from hunting and fishing except for certain species classified as baitfish, which include barred/tiger salamander (*Ambystoma catesbeianus*; 163 Nebraska Administrative Code, Chapter 2, § 009).

Invertebrates

The total number of invertebrate species occurring in Nebraska is unknown but is believed to be greater than 10,000, including approximately 100 species of dragonflies and damselflies, over 200 species of butterflies, and a wide variety of moths, mayflies, ants, and beetles. These invertebrates provide an abundant food source for birds, reptiles, amphibians, fish, mammals, and other invertebrates. In the United States, one-third of all agricultural output depends on pollinators.⁸⁹ In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity⁹⁰ and plant diversity. "As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites" (NRCS, 2009). Life history, distribution, and abundance information is limited to a small number of Nebraska's invertebrates. Given this lack of information on invertebrate species within the state, Nebraska has chosen to focus identification of at-risk species and species groups for which adequate information is available, resulting in a list of 14 invertebrate Tier I at-risk species (NGPC, 2011). Two endangered terrestrial invertebrate species are known to occur in Nebraska (USFWS, 2015c) and are discussed in Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Invasive Wildlife Species

The Nebraska Invasive Species Council addresses invasive species of all types, including noxious weeds as previously mentioned. Several wildlife species are considered invasive in Nebraska, including brown rat (*Rattus norvegicus*), house mouse (*Mus musculus*), Eurasian collared dove (*Streptopelia decaocto*), European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), mute swan (*Cygnus olor*) rock dove/feral pigeon (*Columba livia*), and feral hog (*Sus scrofa*) (Nebraska Invasive Species Program, 2015). In Nebraska, feral swine could adversely impact several native large and small mammals, including turkey, waterfowl, and deer (Invasive.org 2010). They feed on reptiles and amphibians, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans.

⁸⁹ Pollinators: "Animals or insects that transfer pollen from plant to plant." (USEPA, 2015d)

⁹⁰ Diversity: "An ecological measure of the variety of organisms present in a habitat." (USEPA, 2015d)

There are no regulated invasive reptiles and amphibians in Nebraska; however, invasive species such as the red-eared slider (*Trachemys scripta elegans*), a turtle species, have been found in the state. This species is highly adaptable and could threaten native wildlife by competing with them for food sources and also spread disease (Invasive Species Specialist Group, 2010).

Two invasive insect species are known to occur in Nebraska, including the Japanese beetle (*Halyomorpha halys*) and mountain pine beetle (*Dendroctonus ponderosa*) (Nebraska Invasive Species Program, 2015). An additional eight insect species are on the Nebraska Invasive Species Program watchlist but are not known to occur in the state (Nebraska Invasive Species Program, 2015). Aquatic invasive species are addressed in Section 12.1.6.5, Fisheries and Aquatic Habitat.

The link between nonnative forest insect and disease infestations and firewood as a major source of these infestations has been widely recognized (Zouhar, K. et al., 2008). Nebraska does not currently have comprehensive firewood restrictions. Citizens are asked on a voluntary basis to buy firewood in-state and no longer bring in firewood from outside the state. Emerald ash borer is not known to occur in Nebraska although it has been found in surrounding states and is therefore being considered an item of potential concern for the state, as well as municipalities and private landowners due to the prevalence of ash trees in certain areas. Federal restrictions currently exist for firewood from Canada, as well as from areas known to have emerald ash borer or Asian longhorned beetle infestations. This quarantine area for emerald ash borer continues to expand and currently includes states adjacent to or near Nebraska, including Iowa, Missouri, and parts of eastern Kansas (USDA, 2015c).

12.1.6.4. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Nebraska, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. Fish in Nebraska are commonly split in two groups – coldwater species and cool water/warm water species, reflecting the general aquatic habitats in which fish occur. A distinctive feature of the Nebraska landscape with regard to aquatic wildlife are the major rivers (e.g., Platte, Niobrara, Missouri) and the smaller coldwater stream reaches in the western portion of the state. No Essential Fish Habitat identified by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) exists in the state of Nebraska. Critical habitat for one federally endangered fish species (Topeka shiner [*Notropis topeka*]), as defined by the ESA, exists within Nebraska (USFWS, 2015d).

Freshwater Fish

Nebraska is home to 114 species of freshwater fish, ranging in size from small minnows to medium sized species such as walleye (*Sander vitreus*), yellow perch (*Perca flavescens*), and striped bass (*Morone saxatilis*). These species are grouped into 23 families, as follows: bowfin, bullheads/catfishes, burbot, drums, eel, gars, herrings, killifishes, lamprey, livebearers (e.g., mosquitofish), minnows, mooneyes, paddlefish, perches, pikes, silversides, smelt, sticklebacks, sturgeons, suckers, sunfish/bass, temperate basses, and trout (NGPC, 2015f). Among these species are numerous recreational and game fish, such as yellow perch, walleye, muskellunge

(*Esox masquinongy*), catfish, sunfishes, bass, and trout. Of these 114 species in Nebraska, 10 Tier I at-risk species have been identified (NGPC, 2011). Two endangered fish species, pallid sturgeon (*Scaphirhynchus albus*) and Topeka shiner (*Notropis topeka*), are known to occur in Nebraska (USFWS, 2015c) and are discussed in Section 12.1.6.6, Threatened and Endangered Species.

Fish communities in Nebraska follow a roughly defined distribution among two general habitat types: habitats adjacent to and including large rivers or deep lakes and reservoirs, and those of smaller streams or shallow lakes and ponds. Large rivers or deeper aquatic habitat fish species include largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), American eel (*Anguilla rostrata*), and paddlefish (*Polyodon spathula*), among others. Small streams or shallow aquatic habitat fish species include chub and minnows, bluegill (*Lepomis macrochirus*), brook trout (*Salvelinus fontinalis*), yellow perch, and brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*). Some fish species use both habitat types (e.g., yellow perch, walleye, carp), but many tend to occur in one of the two general habitat types (NGPC, 2011).

Freshwater fish and associated freshwater habitats are considered one of the most highly threatened ecosystems based on the decline in species population numbers (Walks, 2009). Approximately 40 percent of fish species in North America are considered at risk or vulnerable to extinction⁹¹ (National Fish Habitat Board, 2010). Major threats to freshwater fisheries include habitat modification and destruction (dams, culverts, weirs, urban development, and agricultural practices), overfishing, invasive species, and environmental pollution and impaired water quality. Among freshwater fish in Nebraska and the northern Great Plains states in general, agriculture, livestock, and pasture farming are the primary threats to habitat. Two species, pallid sturgeon (*Scaphirhynchus albus*) and Topeka shiner (*Notropis topeka*), are among those that have been most impacted by human activities in the region. Dam construction and agricultural drawdown of aquifers have greatly altered water flow in the region, and in conjunction with habitat degradation and fragmentation have resulted in population declines of these and other species (National Fish Habitat Board, 2010).

Shellfish and Other Invertebrates

A complete inventory of freshwater mollusks and crustaceans has not been completed for Nebraska. Species that are known to occur in Nebraska include freshwater snails (31 species), ambersnails (*Succinea sp.*), pond mussels, and sandshells. Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other Nebraska freshwater invertebrates that spend their lives in aquatic systems include crayfish (*Paranephrops planifrons*), amphipods, and snails (*Helix sp.*) (NGPC, 2016).

Six mollusk species have been identified as Tier I at-risk species in Nebraska, with an additional eight Tier II at-risk species (NGPC, 2011). One endangered mussel (scaleshell mussel [*Leptodea leptodon*]) is located in Nebraska (USFWS, 2015c) and is discussed in Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

⁹¹ Extinction: “The disappearance of a species from part or all of its range.” (USEPA, 2015d)

Invasive Aquatic Species

As previously discussed, Nebraska has adopted regulations that prohibit or regulate the importation, movement, sale, possession, cultivation, and distribution of certain invasive plants and animals. In addition, Nebraska has established an aquatic invasive species program to prevent the introduction of invasive species, promote early detection and response to control new infestations, and reduce the impact of aquatic invasive species (37-355 NRS). Four aquatic invasive species are currently established in the state of Nebraska and include Asian clam (*Corbicula fluminea*), Chinese mysterysnail (*Cipangopaludina chinensis*), rudd (*Scardinius erythrophthalmus*), and rusty crayfish (*Orconectes rusticus*). In addition to these species, several parasites and fungal species are considered established, and Nebraska also has a list of potential aquatic invasive species that have the potential to become established in the state (Nebraska Invasive Species Program, 2015).

12.1.6.5. 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 state of Nebraska. The USFWS has identified eight federally endangered and six federally threatened species known to occur in Nebraska (USFWS, 2015c). Of these, four have designated critical habitat⁹² as shown in Figure 12.1.6-3 (USFWS, 2015d). In addition, one candidate species⁹³ is identified by USFWS as occurring within the state (USFWS, 2015e). Candidate species are not afforded statutory protection under the ESA. However, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2014b). Both the Platte River Recovery Implementation Program and the Colorado River Basin Recover Program may apply to water-related projects in the state of Wyoming. Under these two programs, water-related activities that may require a Section 404 Clean Water Act permit, a special use permit from the USFS, or those that receive federal funding are subject to Section 7 of the ESA. The 14 federally listed species include 1 mammal, 4 birds, 2 fish, 3 invertebrates, and 4 plants (USFWS, 2015c) and are discussed in detail under the following sections.

⁹² 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))

⁹³ Candidate species are plants and animals that the USFWS has “sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.” (USEPA, 2015d)

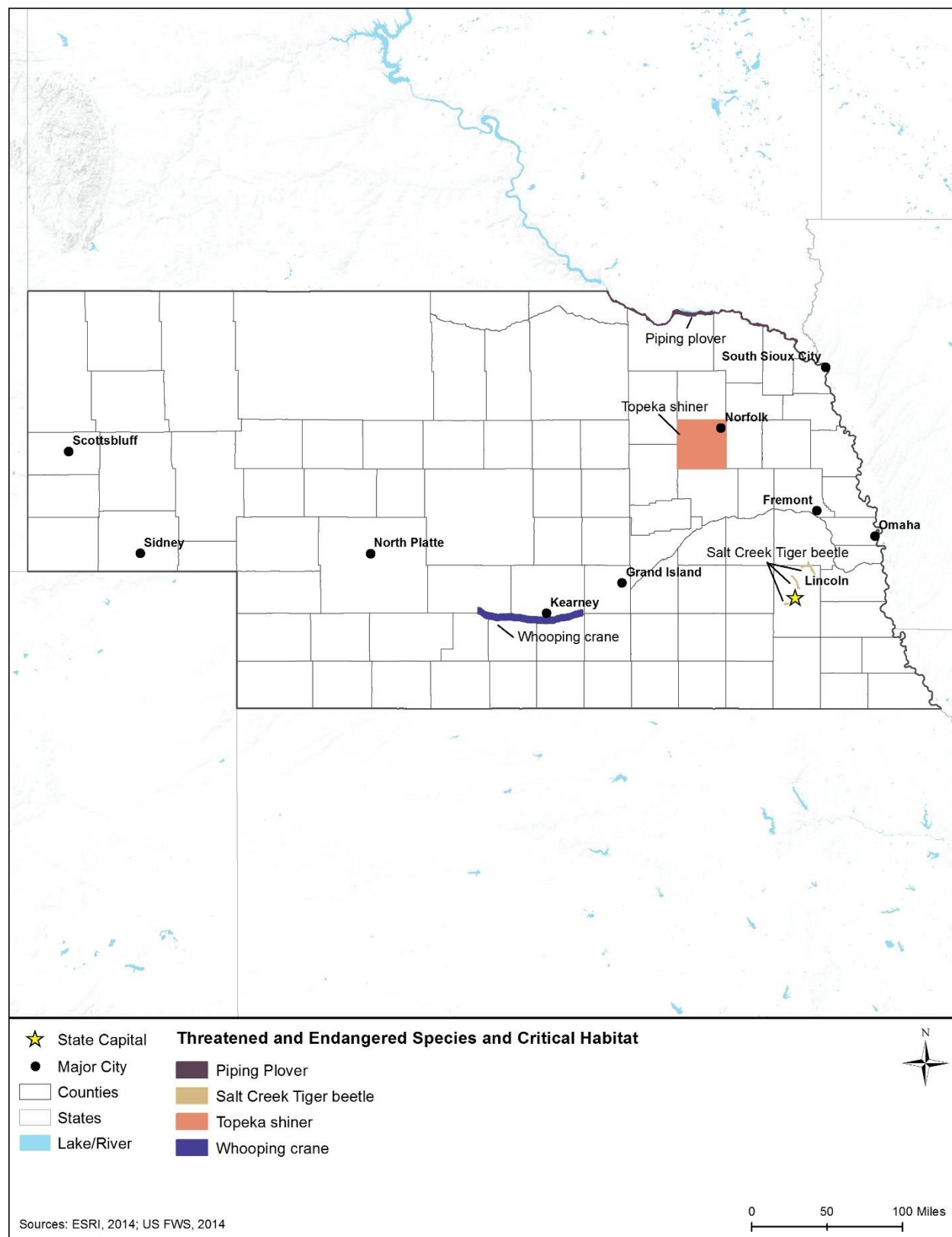


Figure 12.1.6-3: ESA Designated Critical Habitat in Nebraska

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

Mammals

One threatened mammal is federally listed in Nebraska as summarized in Table 12.1.6-3. The northern long-eared bat (*Myotis septentrionalis*) may be found throughout the state in forests, mines, and caves (USFWS, 2015c). Information on the habitat, distribution, and threats to the survival and recovery of this species in Nebraska is provided below.

Table 12.1.6-3: Federally Listed Mammal Species of Nebraska

Common Name	Scientific Name	Federal Status	Critical Habitat in Nebraska	Habitat Description
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Threatened	No	Caves, mines, and forests throughout the state.

Source: (USFWS, 2015c)

Northern Long-eared Bat. The northern long-eared bat is a medium-sized (3 to 3.7 inches in length), brown furred, insectivorous bat with long ears, relative to other members of the genus *Myotis*. It was listed as threatened in 2015 (80 FR 17973 18033, April 2, 2015). In the U.S., its range includes most of the eastern and north central states (USFWS, 2015f). In Nebraska, their range includes north and east counties of the state with specific habitat in limestone mines near Louisville, mines along the Platte River, and the Fontenelle Forest on the outskirts of Omaha (USFWS, 2014c) (USFWS, 2015g).

This species hibernates in caves and mines that exhibit constant temperatures, high humidity, and no air currents. In the summer, they roost singly or in colonies beneath bark, or in crevices or cracks of both live and dead trees. Although mating occurs in the fall, fertilization occurs following hibernation. Pregnant females then migrate to summer areas where they roost in small colonies (USFWS, 2014c) (USFWS, 2015g).

White Nose Syndrome is the leading cause for the decline of this species. Other threats include temperature or air flow impacts to their hibernating habitat, forest management practices that are incompatible with this species' habitat needs, habitat fragmentation, and wind farm operations (USFWS, 2015f).

Birds

Two endangered and two threatened bird species are federally listed in Nebraska (Table 12.1.6-4). The least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*) may be found in riverine environments of the Platte, Missouri, Loup, and Niobrara Rivers (USFWS, 2015c) (USFWS,

2015e). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Nebraska is provided below.

Table 12.1.6-4: Federally Listed Bird Species of Nebraska

Common Name	Scientific Name	Federal Status	Critical Habitat in Nebraska	Habitat Description
Least Tern	<i>Sterna antillarum</i>	Endangered	No	Sandbars near on the Platte and Missouri Rivers in northern and central Nebraska.
Piping Plover	<i>Charadrius melodus</i>	Threatened	Yes – Along the Missouri River in eastern NE	Open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers.
Red Knot	<i>Calidris canutus rufa</i>	Threatened	No	Mudflats and sand bars of eastern Nebraska.
Whooping Crane	<i>Grus americana</i>	Endangered	Yes – Platte River of central NE	Riverine habitats of the Platte River, North and Middle Loup Rivers, and Niobrara River.

Sources: (USFWS, 2015c) (USFWS, 2015e)

Least Tern. The least tern is a 9 inch long, grey, and white gull, with black markings on its head. The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). The tern is a summer resident in Nebraska and breeds along several major river systems in the U.S., which include the Missouri, Ohio, Red, and Rio Grande Rivers. Specifically in Nebraska, the Platte and Missouri Rivers have been known to host breeding populations (USFWS, 1990).

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

Piping Plover. The piping plover is a small, migratory shorebird of approximately 7 inches in length, a wingspan of 19 inches, and weighing approximately 2 ounces. The species has a grey back, white underbelly, black head markings, and neck ring (USFWS, 2012a). In the northern plains region, the species was listed as threatened in 1985 (50 FR 50726 50734, December 11, 1985) with critical habitat designated in 2002 (67 FR 57637, September 11, 2002). The piping plover may be found in northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. during the summer breeding season. Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. In Nebraska, critical habitat is found for nesting sites in wetland areas of the Missouri river in north western parts of the state (Figure 12.1.6-3). Threats to piping plovers include destruction and degradation of preferred habitat resulting from construction and development

activities and water control structures, nest predation, and nest abandonment caused by human presence or disturbance (USFWS, 2003).

Red Knot. The red knot is a ruddy brown bird with grey and white speckled wings of approximately 9 to 11 inches in length. The species was listed as threatened in 2014 (79 FR 73705 73748, December 11, 2014). Red knots spend their winters in the southern tip of South America, northern Brazil, the Caribbean, and the southeastern and Gulf Coasts of the U.S. and breed in the tundra of the central Canadian Arctic. Some have been documented to fly more than 9,300 miles from south to north every spring and return south in autumn stopping at staging areas (USFWS, 2015h).

Though Delaware Bay on the Atlantic coast is a favorite staging area, red knots have been sighted in Nebraska at in mudflats and sand bars. Mostly absent in the western part of the state, the red knot is frequently observed in Lancaster, Sarpy, and Douglas Counties (Nebraska Bird Library, 2015a). Threats to this species include impacts to the reduced availability for foraging at staging areas and reduction of arctic breeding habitat as a result of climate change (USFWS, 2014d).

Whooping Crane. The whooping crane is large snowy white plumed bird with a black beak and feet. It is the tallest bird in North America, growing to a height of up to 5 feet. 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 whooping crane nests in Canada and in Florida and Wisconsin in the U.S. In Nebraska, the whooping crane passes through in spring and fall migrations, and have been observed from early April to late October along the Platte River, North and Middle Loup Rivers, and Niobrara River (USFWS, 2007).



Whooping Crane

Photo credit: USFWS

Suitable habitat for the whooping crane consists of marshes, wet meadows and prairies, riverine habitats, and agricultural fields. Critical habitat for the whooping crane has been designated in riverine habitats of the Platte River in Central Nebraska (USFWS, 2011). Historically, threats to the whooping crane included hunting, displacement by humans, and loss of habitat. Current reasons for this species' decline are their isolated populations, loss and degradation of migration stopover habitat, construction of additional power lines, degradation of coastal ecosystems, and threat of chemical spills (USFWS, 2011).

Fish

Two endangered fish are federally listed in Nebraska as summarized in Table 12.1.6-5. The pallid sturgeon (*Scaphirhynchus albus*) can be found in the Missouri River and portions of the Platte and lower Niobrara Rivers while the Topeka shiner (*Notropis topeka*) is presumed to exist in small clean pools in streams in northern Nebraska (USFWS, 2015c). Information on the

habitat, distribution, and threats to the survival and recovery of each of these species in Nebraska is provided below.

Table 12.1.6-5: Federally Listed Fish Species of Nebraska

Common Name	Scientific Name	Federal Status	Critical Habitat in Nebraska	Habitat Description
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered	No	Missouri River and portions of the Platte and lower Niobrara Rivers.
Topeka Shiner	<i>Notropis topeka</i>	Endangered	Yes	Small clean pools in streams of Cherry and Madison Counties.

Source: (USFWS, 2015c)

Pallid Sturgeon. The pallid sturgeon is a long, slender fish with a long life span (reaching up to 40 years) that grows up to 60 inches in length and 65 pounds in weight; however, in the Missouri River along the Nebraska border, the species is typically 10 pounds (Nebraska Rare Species, 2014). The species is pale colored with a shovel shaped snout, armored body,⁹⁴ and skeleton made of cartilage. The pallid sturgeon is found in the Missouri River and ranges from Montana through the Missouri-Mississippi confluence and down to New Orleans, Louisiana (USFWS, 2014e). In Nebraska, pallid sturgeon are typically found in the Missouri River and portions of the Platte and lower Niobrara Rivers (Nebraska Rare Species, 2014).



Pallid Sturgeon

Photo credit: USFWS

Pallid sturgeon prefer large rivers with strong currents; they can withstand a wide range of turbidity conditions. The key reason for this species' decline has been habitat fragmentation and alteration from the damming of major rivers and other large tributaries, coupled with limited reproductive success with most of the fish found today nearing the end of their lifespan (Nebraska Rare Species, 2014).

Topeka Shiner. The Topeka shiner is a silvery minnow with a dark stripe on its side growing to approximately 3 inches in length. The species was federally listed as endangered in 1998 (63 FR 69008 69021, December 15, 1998) and had critical habitat designated in 2004 (69 FR 44736 44770, July 27, 2004). The Topeka shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska. The Topeka shiners occurs primarily along small prairie streams in pools containing clear, clean water, clean gravel, rock, or sand bottoms (USFWS, 2010a).

⁹⁴ Pallid sturgeon have "five rows of sharp bony plates called scutes." (Nebraska Rare Species, 2014)

In Nebraska, the shiner is known to occur in Madison and Cherry Counties. A single Topeka shiner was found in a small stream in Cherry County in 2006, confirming the continued existence of the species in the region. It is not known if the species currently continues to exist in Madison County. Threats to the species include alterations to stream quality such as increases in sedimentation/nutrients from fertilizers, changes in stream flow volume or temperatures, and restricted access for species river movement and isolation of populations (USFWS, 2010a).

Invertebrates

Three endangered invertebrates are federally listed in Nebraska (Table 12.1.6-6) (USFWS, 2015c). The American burying beetle (*Nicrophorus americanus*) has been identified along the Platte River and the Salt Creek tiger beetle (*Cicindela nevadica lincolniana*) is found along specific creeks near Lincoln in eastern Nebraska. The scaleshell mussel (*Leptodea leptodon*) was once thought to exist in Cedar County, but has not been confirmed in over 100 years. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Nebraska is provided below.

Table 12.1.6-6: Federally Listed Invertebrate Species of Nebraska

Common Name	Scientific Name	Federal Status	Critical Habitat in Nebraska	Habitat Description
American Burying Beetle	<i>Nicrophorus americanus</i>	Endangered	No	Deciduous or scrub forests along the Platte River
Salt Creek Tiger Beetle	<i>Cicindela nevadica lincolniana</i>	Endangered	Yes – specific creeks in Lancaster and Saunders Counties	Muddy banks and wetlands of saline creeks in eastern Nebraska.
Scaleshell Mussel	<i>Leptodea leptodon</i>	Endangered	No	Beds of clean cool streams and rivers with suitable host species – thought extirpated from Nebraska

Source: (USFWS, 2015c)

American Burying Beetle. The American burying beetle is the largest carrion beetle in North America with a length of between 1 to 2 inches with a shiny black shell, smooth shiny black legs, with pronounced orange markings on its body and orange club shaped antennae. The beetle buries carcasses to feed its larvae and upon which it feeds while caring for its young. The species was listed as endangered in 1989 (54 FR 29652 29655, July 13, 1989) (USFWS, 1991).

The American burying beetle can be found in flat topography with forest litter and decomposing plant matter in the top layers of well-drained soil. Historically, the species ranged in more than 150 counties in 35 states of the eastern and central U.S. (USFWS, 1991), but today is found in 5 distinct populations across 10 states. In 2012, Missouri established a non-essential experimental population with efforts to reintroduce the American burying beetle. In Nebraska, the American burying beetle is found along in deciduous or scrub forests along the Platte River. Threats to the

species include habitat loss, fragmentation, and overall loss or reduction of small vertebrates to host the species (USFWS, 1991).

Salt Creek Tiger Beetle. The Salt Creek tiger beetle is a dark, brown-green colored insect approximately 0.5 inches in length with a distinct shape and coloration. The species was federally listed as endangered in 2005 (70 FR 58335 58351, October 6, 2005) and had critical habitat designated in 2015 (79 FR 26013 26038, May 6, 2014) (NGPC, 2013a) (USFWS, 2015i) (USFWS, 2014f). The Salt Creek tiger beetle is found solely in eastern Nebraska, with critical habitat identified for eastern saline wetlands along Rock, Little Salt, Oak, and Haines Branch Creeks of Lancaster and Saunders counties (Figure 12.1.6-3) (USFWS, 2014f).

The Salt Creek tiger beetle requires open salty mud flats and stream banks for constructing burrows. Threats to the species include degradation of saline habitats due land conversion and development, changes in stream hydrology due to construction of levees, reservoirs, and channelization, and other human impacts from contamination and artificial lighting (USFWS, 2015i) (NGPC, 2013a).

Scaleshell Mussel. The scaleshell mussel is a smooth brownish green freshwater mussel of approximately 4 inches in length with paper thin shell and lighter brown markings. The scaleshell was federally listed as endangered in 2001 (66 FR 54808 54832, October 30, 2001) (USFWS, 2015j). Historically, the scaleshell mussel once occurred in 56 rivers of the Mississippi River Basin but in the last 25 years, this species has only been documented in 18 streams, 3 of which it presently can be found (in Missouri). Within Nebraska, the species was once reported in Cedar County in 1877, but this report has not been confirmed since (USFWS, 2010b).

Though each mussel produces more than 400,000 larvae (approximately double comparable mussels), the scaleshell has specific host requirements met by the freshwater drum (*Aplodinotus grunniens*) and requires specific ranges for temperature, flow, and oxygen in its habitat which limit species populations. Present threats to the scaleshell include: declining oxygen levels in streams (eutrophication), sedimentation from mining and dredging operations, contamination from municipal and industrial wastes or agricultural run-off, competition from non-native species (such as the Asian clam and Zebra mussel), and impoundment of rivers which modify stream and river hydrology (USFWS, 2010b).

Plants

One endangered and three threatened plants are federally listed in Nebraska as summarized in Table 12.1.6-7 (USFWS, 2015c). The blowout penstemon (*Penstemon haydenii*) grows in disturbed transition areas of Nebraska Sandhills, the Colorado butterfly plant (*Gaura neomexicana* var. *coloradensis*) and Ute ladies'-tresses (*Spiranthes diluvialis*) are predominantly wetland and meadow species of north or west Nebraska, and the western prairie fringed orchid (*Platanthera praeclara*) grows in moist, disturbed plans of eastern parts of the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Nebraska is provided below.

Table 12.1.6-7: Federally Listed Plant Species of Nebraska

Common Name	Scientific Name	Federal Status	Critical Habitat in Nebraska	Habitat Description
Blowout Penstemon	<i>Penstemon haydenii</i>	Endangered	No	Eroded sand blowouts in the Nebraska's Sandhills.
Colorado Butterfly Plant	<i>Gaura neomexicana</i> var. <i>coloradensis</i>	Threatened	No	Streambeds and wetlands of the high plains – thought extirpated from Nebraska.
Ute Ladies'-tresses	<i>Spiranthes diluvialis</i>	Threatened	No	Meadows and wetlands of central and north western Nebraska.
Western Prairie Fringed Orchid	<i>Platanthera praeclara</i>	Threatened	No	Plains with periodic disturbance and consistent soil moisture in eastern Nebraska.

Source: (USFWS, 2015c)

Blowout Penstemon. Blowout penstemon is a short-lived perennial, often growing in clumps of up to 2 ft. tall with long blue-green leaves, and blue/lavender flowers approximately 1.5 inches long. The species was federally listed as endangered in 1987 (52 FR 32926 32929, September 1, 1987). This species is named for the blowouts in the Nebraska Sandhills where wind erosion has scooped out craters in the sand. The species is transitional and once other grasses emerge, the species lacks competitive advantage to thrive (USFWS, 2015k).

Seeds have a thick, hard seed coat specifically adapted for wind dispersal. Germination is rare as sand must remain damp for a period of two weeks at the appropriate time in the spring – these conditions occur approximately every eight years. Threats to the species include seed predation by small mammals and insects, trampling, collection, utility developments, pesticides, and extended droughts and climate change (USFWS, 1992).

Colorado Butterfly Plant. The Colorado butterfly plant is a perennial flowering plant and member of the evening primrose family. The plant grows to approximately 2 ft. tall and has white, half inch, 4 petal flowers and leaves of 2 to 6 inches in length. It was federally listed as threatened in 2000 (65 FR 62302 62310, October 18, 2000) (USFWS, 2015l). Although the historic range of the Colorado butterfly plant is unknown, the Colorado butterfly plant is typically found along stream channels and wetlands or among grasses of the high plains. Today, the species occurs in southeastern Wyoming,⁹⁵ northcentral Colorado, and possibly western Nebraska. The Butterfly plant is presumed extirpated from Nebraska, but was last found there on ranches and natural areas of Kimball county (USFWS, 2010c) (USFWS, 2015l). Threats to the species include ecological succession and overgrowth of vegetation. The Colorado butterfly plant grows in open and disturbed areas historically maintained by flooding and fire. Today grazing is an important component of maintaining disturbed grasslands and Colorado butterfly plant habitat (USFWS, 2015l).

⁹⁵ Specific critical habitat designated for this species within Wyoming in 2004 (69 FR 47834, August 6, 2004)

Ute Ladies'-tresses. The Ute ladies'-tresses is a perennial orchid that grows up to 24 inches in height and that typically flowers from early August to early September. The Ute ladies' tresses was federally listed as threatened in 1992 (57 FR 2048, January 17, 1992) and was proposed for delisting in 2004. Though the species is recovering, its threatened status is current. The species occurs throughout Colorado, Idaho, Montana, Nebraska, Nevada, Utah, Washington, and Wyoming. Within Nebraska, the species is believed to grow in wetlands, meadows, and swales⁹⁶ of central and northwestern regions of the state. Threats to this species include urbanization, agriculture, recreation, grazing, and invasive non-native species (USFWS, 2015m).

Western Prairie Fringed Orchid. The Western prairie fringed orchid grows stalks up to 4 ft. tall with 24 one-inch white flowers. The species was federally listed as threatened in 1989 (54 FR 39857 39863, September 28, 1989) and can be found along the edge of the plains from Minnesota south to Oklahoma. The orchid is found in prairies and meadows and utilizes support from mycorrhizal fungi during seed germination and before plants are capable of photosynthesis. The western prairie fringed orchid requires measured periodic disturbance (i.e., fire, mowing, or grazing) and consistent soil moisture. In Nebraska, the western prairie fringed orchid can be found along the Loup, Platte, and Elkhorn River basins eastern portions of the state. Threats to the species include land conversion, impacts to the few species of sphinx moths which pollinate the orchid, and lowering of groundwater levels (USFWS, 2015n).

12.1.7. Land Use, Recreation, and Airspace

12.1.7.1. Definition of the Resource

The following summarizes major land uses, recreational venues, and airspace considerations in Nebraska, 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, 2012d).

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.

⁹⁶ Swale: “A swale, sometimes called a biofilter, is a grass-lined channel that is designed to convey stormwater in shallow flow. Pollutant removal is accomplished through filtration through the vegetation and swales are frequently designed to allow for infiltration of stormwater.” (USEPA, 2015d)

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

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

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

12.1.7.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, summarizes numerous federal environmental laws and regulations that, to one degree or another, *may affect* land use in Nebraska. 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. Table 12.1.7-1 identifies Nebraska state statutes that address the safety of the airspace and flight safety in the state.

Table 12.1.7-1: Relevant Nebraska Airspace Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Nebraska Revised Statutes, Chapter 3, Aeronautics	Nebraska Department of Aeronautics	Provides for the protection, safety, and promotion of aeronautics. Addresses what constitutes airspace hazards such as obstructions. Regulates structures as it obtains to potential impacts to navigable airspace and permitting requirements (§§401-409).

Source: (Nebraska Legislature, 2017d)

12.1.7.3. Land Use and Ownership

For the purposes of this analysis, Nebraska is classified into primary land use groups based on coverage type such as shrub and grassland, agriculture, forest and woodland, and developed. Land ownership within Nebraska has been classified into four main categories; private, federal, state, and tribal.

Land Use

Table 12.1.7-1 identifies the major land uses by coverage type in Nebraska. Shrub and grassland comprise the largest portion of land use with 54 percent of Nebraska's total land area occupied by this category (Table 12.1.7-2 and Figure 12.1.7-1). Agricultural land is the second largest area of land use with 37 percent of the total land area. As the third largest category, forest and woodland accounts for approximately 4 percent of the total land area. The fourth largest use is comprised of developed land, with 4 percent of the land occupied by this use. The remaining percentage of land includes public land, surface water, and other land cover, shown in Figure 12.1.7-1, that are not associated with specific land uses (1 percent) (USGS, 2012e).

Table 12.1.7-2: Major Land Use in Nebraska by Coverage Type

Land Use	Square Miles ^a	Percent of Land
Shrub and Grassland	41,768	54%
Agricultural Land	28,546	37%
Forest and Woodland	2,889	2%
Developed	2,726	4%

Source: (USGS, 2012e)

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

Shrub and Grassland

Over half (54 percent) of the state's land is comprised of range, pasture, and grasslands. These lands are primarily used for ranching in the grassland areas while winter wheat and summer fallow dryland farming is common within the plains and irrigated valleys (Nebraska Department of Revenue, 2015). Ranching in Nebraska consists of large cattle and livestock ranches and farms. Range and grasslands are primarily located within the central and northern portions of the state. Owned by the federal government and managed by the USDA Forest Service, the Oglala Gap National Grassland is located in the northwest corner of the state.

Agricultural Land

Agricultural land exists in every region of the state (Figure 12.1.7-1), with most of this use taking place within the eastern and southern halves. Approximately 37 percent, or 28,546 square miles, of land in Nebraska is classified as agricultural. In 2012, there were 49,969 farms in Nebraska and most were owned and operated by small, family businesses, with the average farm size of 907 acres (USDA, 2012). Some of the state's largest agricultural uses include corn, soybeans, and small grains (wheat, oats, rye, millet). Other agricultural uses include livestock for dairy and meat, goats, sheep and hogs. For more information by county, access the USDA Census of Agriculture website:

http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Nebraska/

Forest and Woodland

National Forests

Forest and woodland areas are primarily located within the Nebraska National Forest and the Samuel R. McKelvie National Forest. These areas are mostly utilized for recreation. Section 12.1.6, Vegetation, presents additional information about terrestrial vegetation.

Private Forest and Woodland

A number of communities in Nebraska border national and local forested areas. These private lands serve a number of land use purposes, including recreation, wood products and ranching.

Developed Land

Developed land in Nebraska tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 12.1.7-1). Although only 4 percent of Nebraska land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 12.1.7-3 lists the top five developed metropolitan areas within the state and their associated population estimates; Figure 12.1.7-1 shows where these areas are located within the Developed land use category.

Table 12.1.7-3: Top Five Developed Metropolitan Areas in Nebraska (2014 estimate)

Metropolitan Area	Population Estimate
Omaha, NE—IA	446,599
Lincoln, NE	272,996
Grand Island, NE	51,236
Kearney, NE	32,469
Fremont, NE	26,500
Total Estimated Population of Metropolitan Areas	829,800
Total State Estimated Population	1,881,503

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



Figure 12.1.7-1: Major Land Use Distribution by Coverage Type

Land Ownership

Land ownership within Nebraska has been classified into four main categories: private, federal, state, and tribal (Figure 12.1.7-2).⁹⁷

Private Land

The majority of land in Nebraska is privately owned, with most of this land falling under the land use categories of agricultural and developed (Figure 12.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas. Private land exists in all regions of the state.⁹⁸

Federal Land

The federal government manages over 1,000 square miles (over 1 percent) of Nebraska land with a variety of land types and uses, including monuments, historic sites, military bases, wilderness areas, grazing land, and national forests⁹⁹ (Figure 12.1.7-2). Several federal agencies manage the majority of federal lands throughout the state (Table 12.1.7-4 and Figure 12.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.

Table 12.1.7-4: Federal Land in Nebraska

Agency	Square Miles	Representative Type
Bureau of Reclamation	29	Reservoirs
Agricultural Research Service	54	Roman L. Hruska U.S. Animal Meat Research Center
Department of Defense	61	Army Training Areas, Facilities, Rifle Range, Air Force Base
NPS	67	National Monuments, Historic Sites
USFWS	242	NWR, Wilderness Areas
United States Forest Service (USFS)	546	National Forest, National Grassland, Wilderness
USACE	70	Lakes, Recreation areas, Dams
Bureau of Land Management (BLM) ^a	10	Livestock grazing
Total	1,079	

Sources: (USGS, 2012f) (USGS, 2014j) (BLM, 2011a) (recreation.gov, 2015)

^a BLM also manages about 500,000 acres of sub-surface mineral lands

⁹⁷ 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.

⁹⁸ Total acreage of private land could not be obtained for the state.

⁹⁹ BLM and USACE GIS data were unavailable to include in Figure 12.1.7-2.

*State Land*¹⁰⁰

The Nebraska state government owns approximately 420 square miles of land comprised of historic sites, state offices, educational facilities, and recreation areas. State parks contain natural, historic, cultural, and/or recreational resources of significance to Nebraska residents and visitors. There are 8 state parks, 9 state historical parks, and 57 state recreation areas throughout Nebraska (NGPC, 2015g).

Tribal Land

The Bureau of Indian Affairs, along with individual tribes, manages over 650 square miles, or less than 1 percent of the total land area currently located in Nebraska.¹⁰¹ These lands are composed of five Indian Reservations located throughout the state (Figure 12.1.7-2 and Table 12.1.7-5).¹⁰² For additional information regarding tribal land, see Section 12.1.11, Cultural Resources.

Table 12.1.7-5: Indian Reservations and Other Tribal Land Holdings in Nebraska

Reservation Name	Square Miles
Ponca Tribe of Nebraska	0.2
Winnebago Reservation	175
Santee Sioux Reservation	182
Omaha Reservation	250
Sac and Fox Reservation	47
Iowa Tribe	1.3
Total	655.5

Source: (USGS, 2012f)

¹⁰⁰ 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.

¹⁰¹ Although the Bureau of Indian Affairs “manages” American Indian lands, the Bureau of Indian Affairs is different than other land management agencies as the lands are held in trust and are sovereign nations.

¹⁰² As described in Section 12.1.11, Cultural Resources, there are six federally recognized tribes in Nebraska but only five of the tribes manage federal land in the state.

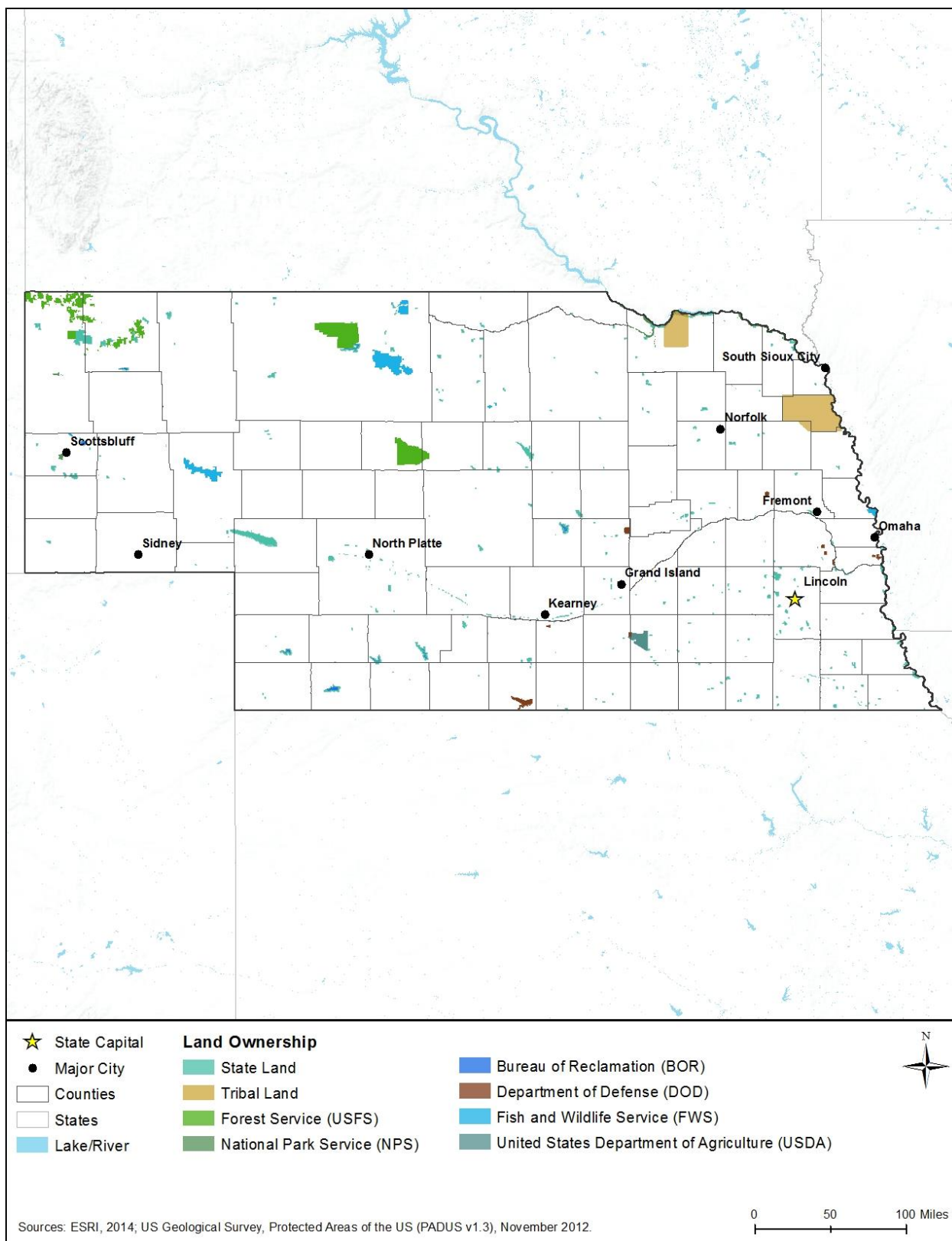


Figure 12.1.7-2: Land Ownership Distribution

12.1.7.4. Recreation

Nebraska's grasslands, sandhills, upland forests, lakes, rivers, and bluffs provide hundreds of recreational opportunities. Water-based recreation is the dominant leisure activity, with fishing, boating, and camping as the top interests. One popular way to enjoy Nebraska's rivers is by flat-water boating often referred to as "tanking," which utilizes a large metal stock watering tank as a vessel for floating down calm rivers (NGPC, 2013b). The habitat is also well known for its importance as a resting and feeding stop for migrating birds to and from the Gulf Coast, Central, and South America wintering grounds and northern and arctic summering grounds; as well as a courtship and nesting location for eagles, prairie chickens, grouse, ducks, geese, and song birds. Protected NWRs provide excellent opportunities for birdwatching and photography and Nebraska has several National Historic Trails crossing through it.

On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities including: community and recreation centers, theaters, museums, indoor/outdoor pools, athletic fields and courts, golf courses, multi-use trails, playgrounds, picnicking areas, theme/amusement parks, 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 8 state parks and 68 state WMAs (NGPC, 2015g) (StateParks.com, 2015). Federally, the NPS, USFS, USFWS, and the USACE manage areas in Nebraska with recreational attributes.

This section discusses recreational opportunities and activities representative of various regions of Nebraska. The NGPC categorized the state into distinct park areas based on their location in the state: Panhandle, Sandhills, Northeast, Southwest, South-central, and Southeast (Figure 12.1.7-3).¹⁰³ The following subsections describe recreational opportunities in the Panhandle, Sandhills, Northeast, and the combined Southern areas (Southwest, South-central, and Southeast) (NGPC, 2015g). For information on visual resources, such as scenic byways, see Section 12.1.8, Visual Resources, and for detailed information on culturally/historically significant resources, see Section 12.1.11, Cultural Resources.

Panhandle Region

The Panhandle Region is the northwest corner of the state, bordered by South Dakota's Buffalo Gap National Grassland and Pine Ridge Indian Reservation to the north, the Sandhills Region to the east, Colorado to the south, and Wyoming to the west. The North Platte River flows in from Wyoming near the city of Scottsbluff and meets the South Platte River at North Platte, Nebraska to form the Platte River (Figure 12.1.7-3). The Scottsbluff area has rugged rocky buttes and forested canyons. Nearby sites like Wildcat Hills State Recreation Area and the Scotts Bluff National Monument allow visitors to explore this setting through opportunities for hiking,

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

picnicking, wildlife viewing, and interpretive centers. Water-based recreational facilities are well developed at Lake Minatare, Oliver, and Box Butte Reservoir State Recreation Areas. Fort Robinson State Park in the scenic northern Pine Ridge area, has a unique combination of cultural, historical, paleontological, and recreational opportunities for visitors. Cabins, campgrounds, restaurants, multi-use trails, boating, swimming, and horseback riding are all available at this top-rated park.

Other popular recreational sites in this region are the Agate Fossil Beds National Monument, Oglala National Grassland, Toadstool Geologic Park, Nebraska National Forest, Pine Ridge National Recreation Area, and Crescent Lake NWR. Opportunities for camping, hiking, cross-country skiing, snowshoeing, biking, off-road vehicles and horse riding, rock hounding, hunting, and fishing are abundant (NGPC, 2015h). A quirky art attraction is Alliance's "Carhenge"; this art installation of classic American cars painted grey replicates the stone formation at Stonehenge in Great Britain (Nebraska Tourism Commission, 2015).

Sandhills Region

The Sandhills Region, located in north central Nebraska and bordered by South Dakota to the north, is the most sparsely populated and undeveloped of the regions (Figure 12.1.7-3). Sandhill terrain is characterized by sand dunes that are completely covered by grasses, and contain some wetlands and lakes that are formed almost exclusively by underground water sources. The majority of the 20,000 square miles of Nebraska Sandhill terrain is located in this region. The other most prominent natural features in this region are the Niobrara National Scenic River, McKelvie and Nebraska National Forests, Fort Niobrara and Valentine NWR, and the North, Middle, and South Loup Rivers. Several reservoirs, such as Merritt, Calamus, Davis Creek, and Sherman offer premiere fishing and boating opportunities. The Snake River and Smith Falls near Valentine, and Victoria Springs State Recreation Area are popular sightseeing stops (NGPC, 2015i).

Northeast Region

This region's history is most heavily influenced by the presence of the Missouri River on its eastern border and the Platte River that crosses from west to east centrally (Figure 12.1.7-3). Several state parks/recreation areas have been developed near sites associated with the Lewis and Clark Expedition, Fort Atkinson, and pioneer-emigrant trails. Ponca State Park's Missouri National Recreational River Resource and Education Center provides interpretive opportunities to visitors, as well as many recreational activities centered on the upstream 98 mile segment of the Missouri River that is still free-flowing (NGPC, 2015j). Ashfall Fossil Beds State Historical Park has paleontologists working onsite recovering prehistoric animal fossils. Indian Cave State Park's pristine dense hardwood forests and river bluffs attracts backpackers as well as history-buffs.

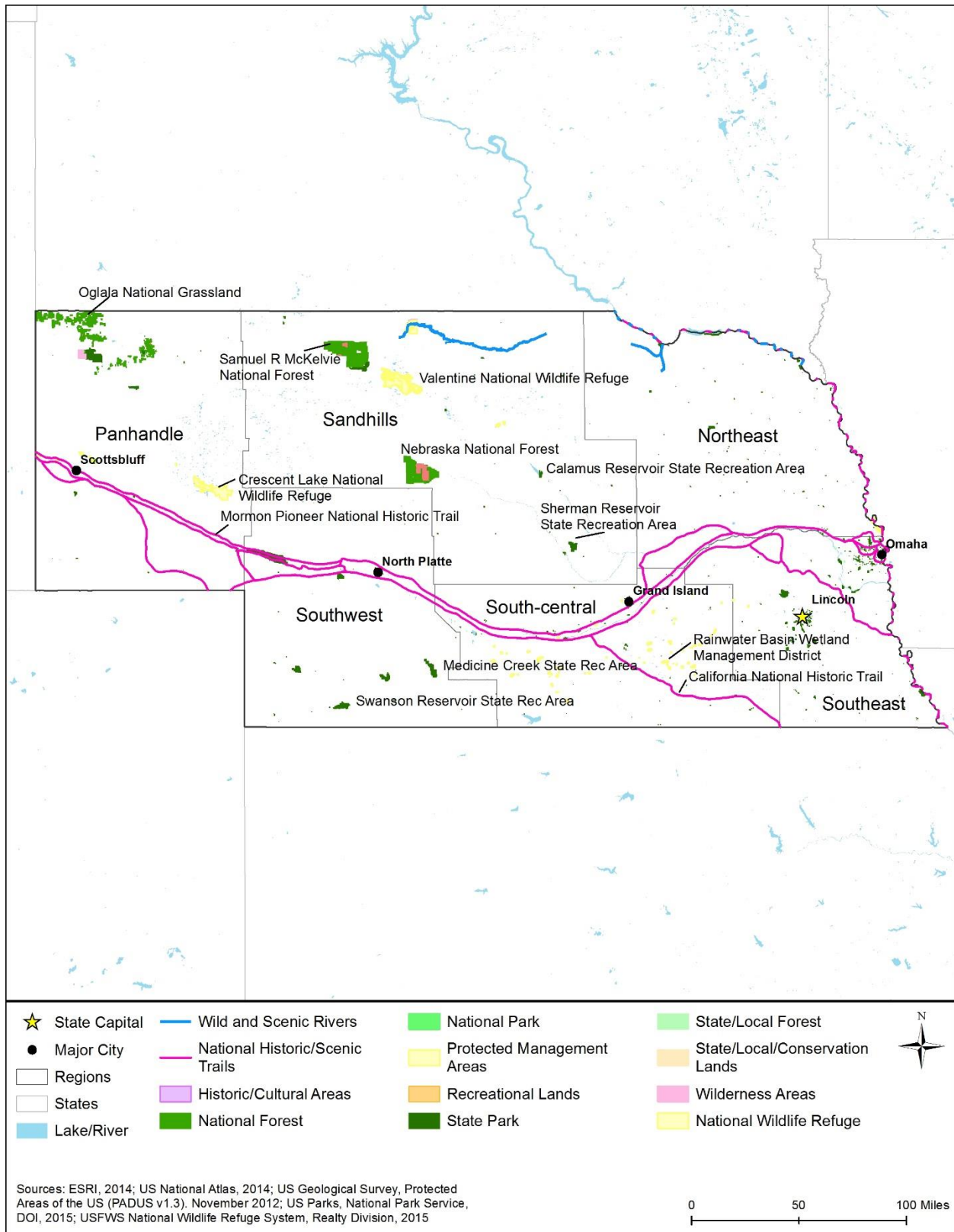


Figure 12.1.7-3: Nebraska Recreation Resources

This region is the state's most densely populated area, including the cities of Omaha and the state capital, Lincoln. Pawnee, Branched Oak, and Two Rivers State Recreation Areas and Platte River State Park are a few of the many recreational sites located nearby that provide residents and visitors with diverse and profuse recreational opportunities. Boating, fishing, swimming, camping, picnicking, hiking, biking, horseback riding, and archery/gun ranges are most popular. Fremont Lakes State Recreation Area's 20 lakes have been individually developed to support a wide variety of water enthusiasts, including: ramps for personal water crafts, boat launches for water skiers or anglers, and beaches for swimmers and paddlers (NGPC, 2015j).

Omaha's arts and cultural attractions include: The Henry Doorly Zoo, Durham Museum, Joslyn Art Museum, The Old Market, and numerous theaters and entertainment venues. Lincoln's Historic Haymarket District, Pinnacle Bank Arena, Pinewood Bowl Amphitheater, and Lied Center for Performing Arts provide lots of entertainment opportunities. Many museums are present in Lincoln highlighting the state's rich natural and historical history, and art collections (Nebraska Tourism Commission, 2015).

Southern Region

Bordered on the south by Kansas, this region's prominent natural features are the Platte River, sandhill terrain, and many lakes and reservoirs (Figure 12.1.7-3). Like the other regions in Nebraska, water-based recreation (e.g., fishing, hunting, pleasure boating, sailing, swimming, and water skiing) is dominant. Lake McConaughy is Nebraska's largest reservoir and has over 2,800 camping sites. Medicine Creek State Recreation Area is located in the heart of the state's pheasant and quail range, bringing hunters to areas that have been managed primarily for wildlife habitat (NGPC, 2015k).

Interstate 80's traverses east and west through the center of this region. During its construction, the state created a parallel 160-mile "Chain of Lakes" through this region connecting many of the large excavation pits used to gather fill material for the road. State recreation areas were developed at 10 of these locations and because they are so easily accessible to travelers, many are well developed with picnic shelters, campgrounds, boat launches, and swimming beaches. The Windmill State Recreation Area has a collection of historic, restored working windmills erected on the site and is especially popular to passing motorists (NGPC, 2015k).

Fort Kearney State Historical Park was developed to provide visitors with insight into the events and conditions associated with the settlement of the American West. Several nearby state recreation areas host extraordinary concentrations of migrating sandhill cranes that photographers and bird watchers come to witness. The forested creek bottoms, prairie hilltops, and rugged ravines of Rock Creek Station State Recreation Area is popular for horse-supported primitive camping (NGPC, 2015l). Grand Island's Fonner Horse Racing Park, and North Platte's Golden Spike Tower overlooking the Bailey Rail Yard are unique attractions in this region (Nebraska Tourism Commission, 2015).

12.1.7.5. *Airspace*

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

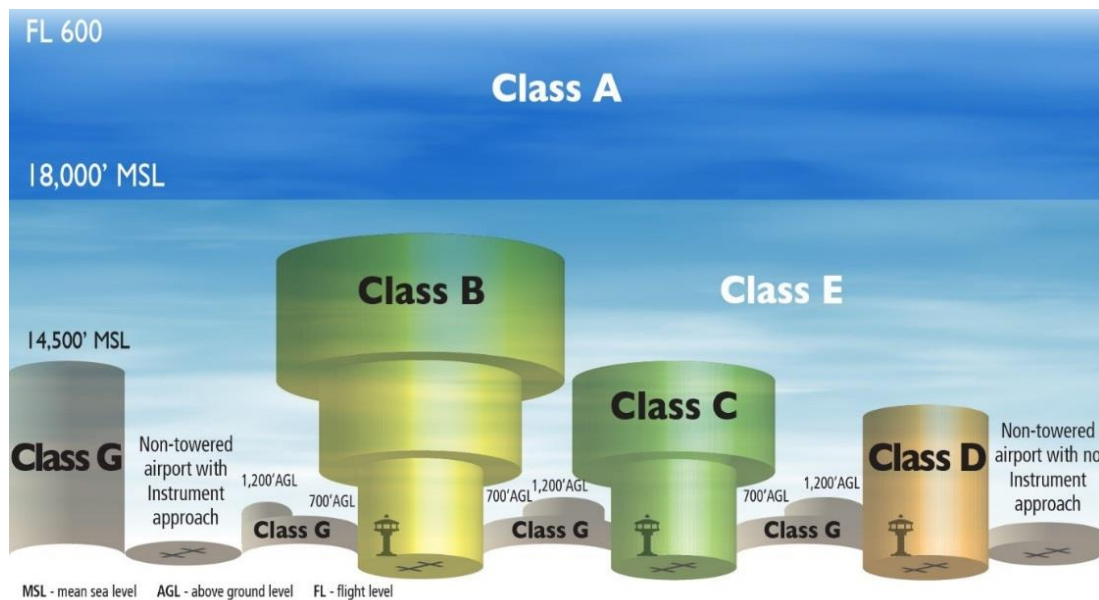
Airspace Categories

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. Source: Derived from

Figure 12.1.7-4 depicts the different classifications and dimensions for controlled airspace. ATC¹⁰⁴ service is based on the airspace classification (FAA, 2008).



Source: Derived from (FAA, 2008)

Figure 12.1.7-4: National Air Space Classification Profile

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

Controlled Airspace

- **Class A:** Airspace from 18,000 ft. to 60,000 ft. Mean Sea Level (MSL).¹⁰⁵ Includes the airspace over waters off the U.S. coastlines (48 contiguous States and Alaska) within 12 Nautical Miles (NM). All operations must be conducted under Instrument Flight Rules (IFR).¹⁰⁶
- **Class B:** Airspace from the surface up to 10,000 ft. 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 ft. 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 ft. to 4,000 ft. 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 ft. above the airport elevation surrounding airports with an operational control tower. Airspace area is tailored. Aircraft entering the airspace must establish and maintain radio contact with the controlling ATC.
- **Class E:** Controlled airspace not designated as Class A, B, C, or D. Class E airspace extends upward from the surface or a designated altitude to the overlying or adjacent controlled airspace (FAA, 2008).

Uncontrolled Airspace

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

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (Table 12.1.7-6).

Other Airspace Areas

Other airspace areas, explained in Table 12.1.7-7, 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.

¹⁰⁵ MSL – The average level of for the surface of the ocean; “The height of the surface of the sea midway between the average high and low tides.” (Merriam Webster Dictionary, 2015b)

¹⁰⁶ IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015c).

Table 12.1.7-6: SUA Designations

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

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

Table 12.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	<p>There are three types:</p> <ul style="list-style-type: none"> • Local Airport Advisory – Operated within 10 statute miles (5,280 feet/mile) of an airport where there is a 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	<p>TFRs are established to:</p> <ul style="list-style-type: none"> • 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. <p>Only those TFRs annotated with an ending date and time of “permanent” are included in this Final PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.</p>
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, 2015c) (FAA, 2008)

12.1.7.6. Aerial System Considerations

Unmanned Aerial Systems

Unmanned Aerial Systems (UASs) are widely used by the military, private entities, public service, educational institutions, federal/state/local governments, and other agencies. The FAA's UAS 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.

12.1.7.7. Obstructions to Airspace Considerations

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

- “Any construction or alteration exceeding 200 ft above ground level
- Any construction or alteration:

- o 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.
 - o 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.
 - o 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, 2015d).

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.

12.1.7.8. Nebraska Airspace

The NDA is a state agency responsible for furthering public interest in aviation and tracking aeronautical progress within the state. The 2014 NDA Annual Report provides “NDA is dedicated to carrying out the Nebraska Aviation System Plan to aid in ensuring a safe, viable, and sustainable air transportation system that enhances the state’s economy and quality of life; and provides safe, reliable, and efficient air transportation with aviation services to support all state governmental entities. NDA is committed to the development of strategic plans, problem-solving processes that address statewide aviation issues, coordinating and managing aviation-related legislative issues, participating in multi-modal transportation coordination, and providing outreach to aviation constituents and airport sponsors and users throughout the State of Nebraska” (Nebraska Government, 2014). There are six divisions within the NDA (State Owned Airfields, Accounting and Support, Navigational Aids, Operations, Pavement and Maintenance and Engineering). There is one FAA FSDO located in Lincoln, Nebraska (FAA, 2015b).

Nebraska airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the State's airport system, as well as addressing key associated with their airports. (NASAO, 2015). Figure 12.1.7-5 presents the different aviation airports/facilities residing in Nebraska, while Figure 12.1.7-6 and Figure 12.1.7-7 present the breakout by public and private airports/facilities. There are approximately 231 airports within Nebraska as presented in Table 12.1.7-8, and Figure 12.1.7-6 and Figure 12.1.7-7 (USDOT, 2015).

Table 12.1.7-8: Type and Number of Nebraska Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	83	113
Heliport	0	34
Seaplane	1	0
Ultralight	0	0
Balloonport	0	0
Gliderport	0	0
Total	84	147

Source: (USDOT, 2015)

There are Class C and D controlled airports located in Nebraska as follows:

- Three Class C –
 - o Eppley Airfield, Omaha
 - o Lincoln
 - o Offutt Air Force Base
- One Class D –
 - o Central Nebraska Regional (FAA, 2015e).

SUAs (i.e., two MOAs) located in Nebraska are as follows:

- Lincoln – 8,000 ft. MSL to, but not including, FL 180
- O’Neill – 500 ft. Above Ground Level (AGL) to but, not including, FL 180 (FAA, 2015f).

The Lake Andes MOA (6,000 ft. MSL to, but not including, FL 180) of South Dakota extends into the northern portion of Nebraska. The SUAs for Nebraska are presented in Figure 12.1.7-8. There are no TFRs (See Figure 12.1.7-8) (FAA, 2015g). MTRs in Nebraska, presented in Figure 12.1.7-9, consist of nine Visual Routes and nine Instrument Routes.

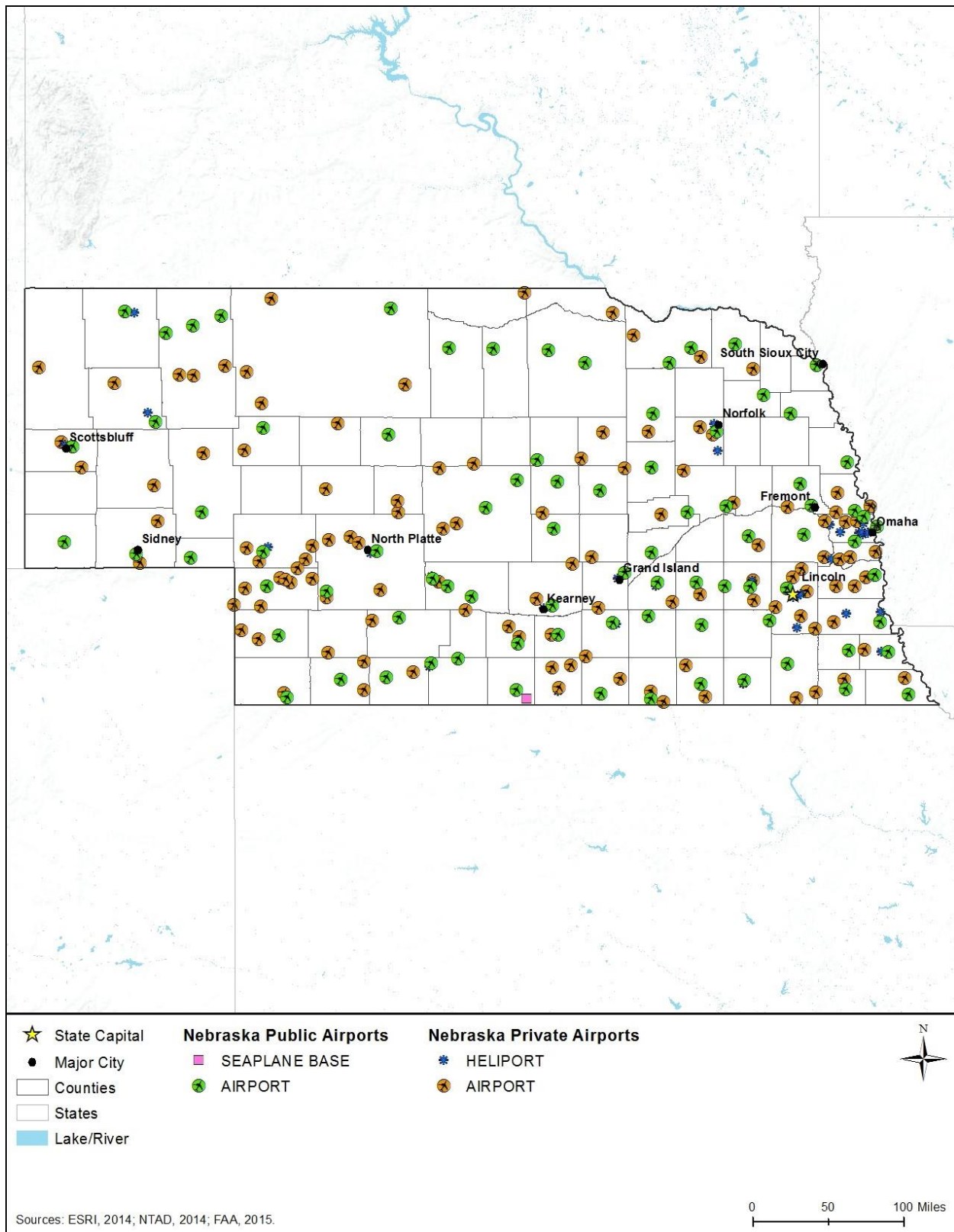


Figure 12.1.7-5: Nebraska Public and Private Airports/Facilities

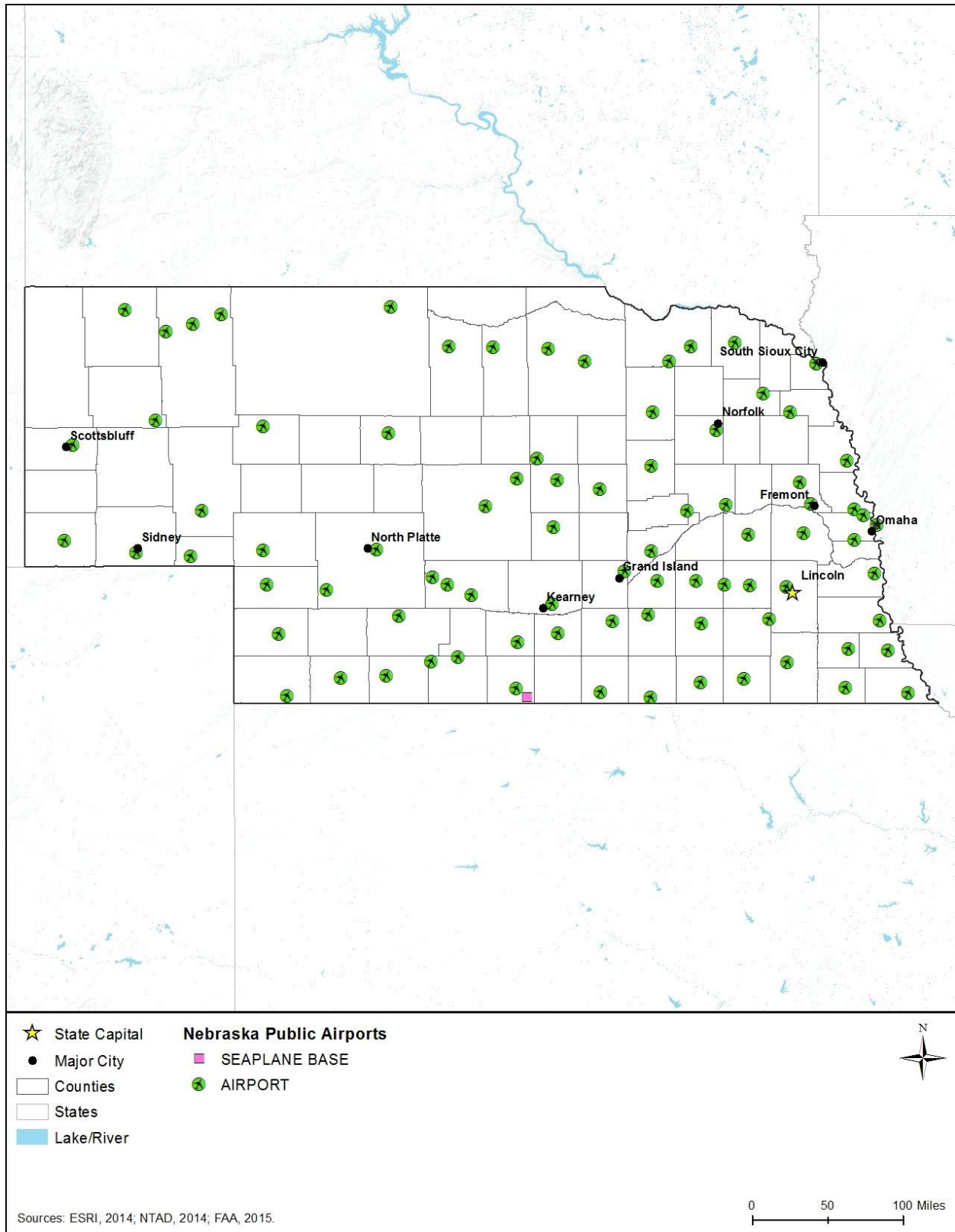


Figure 12.1.7-6: Public Nebraska Airports/Facilities

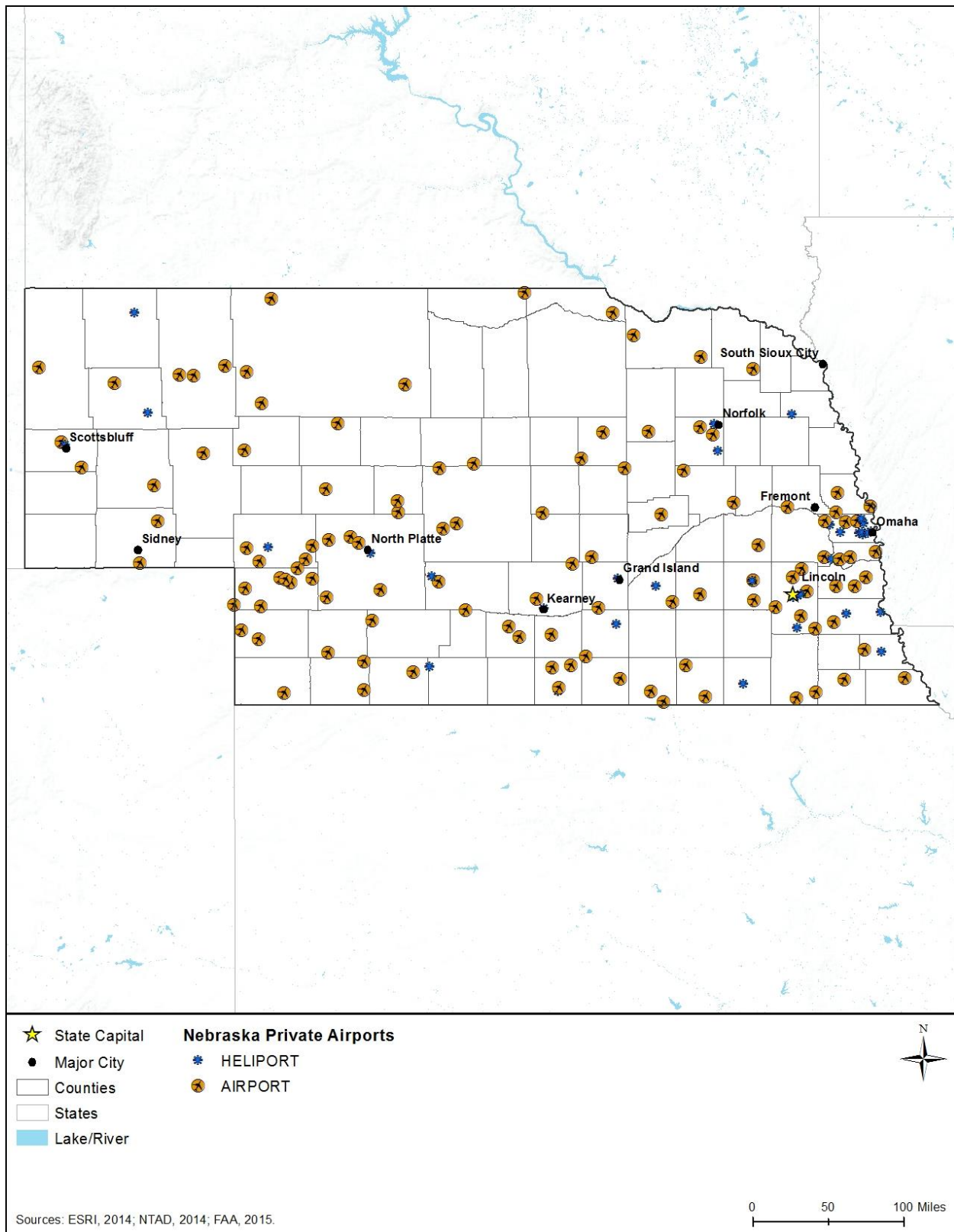


Figure 12.1.7-7: Private Nebraska Airports/Facilities

UAS Considerations

The NPS signed a policy memorandum on June 20, 2014 that “directs superintendents nationwide to prohibit launching, landing, or operating UA on lands or waters administered by the National Park Service” (NPS, 2014c). There are 5 NPS areas in Nebraska that must comply with this agency directive (NPS, 2015a).

Obstructions to Airspace Considerations

Several references in Nebraska statutes address airspace hazards. As defined by the Nebraska Revised Statute, an airport hazard is “...any structure, object of natural growth, or use of land which obstructs the air space required for the flight of aircraft in landing or taking off at any airport or restricted landing area or is otherwise hazardous to such landing or taking off” (Nebraska Legislature, 2015b). Nebraska Revised Statute, Chapter 3-403, regulate structures, as it obtains to potential impacts to navigable airspace. A permit is required from the NDA to construct and maintain structures with a height of 150 ft. above the surface of the ground where it is installed (Nebraska Legislature, 2015b) (Nebraska Government, 2015).

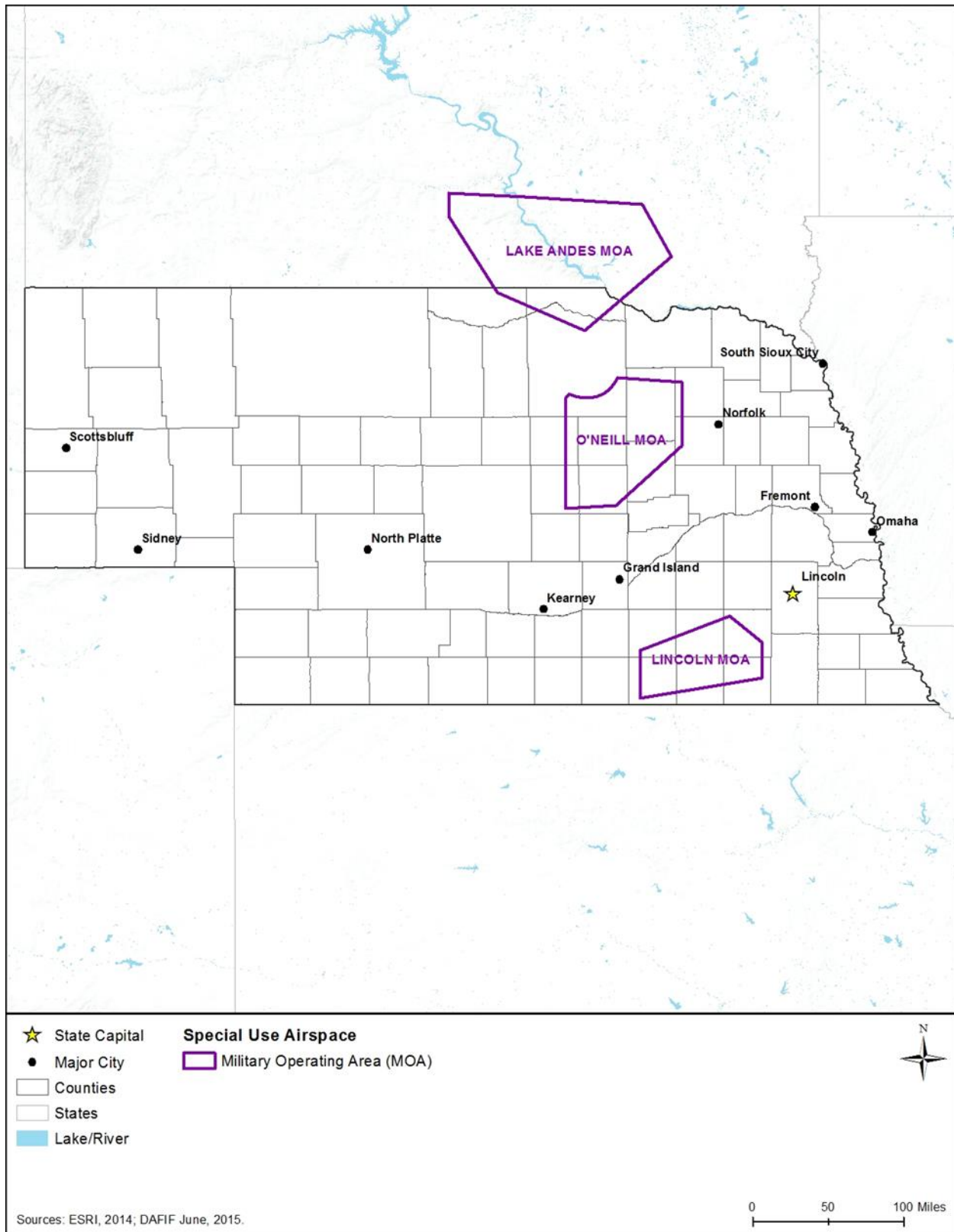


Figure 12.1.7-8: SUAs in Nebraska

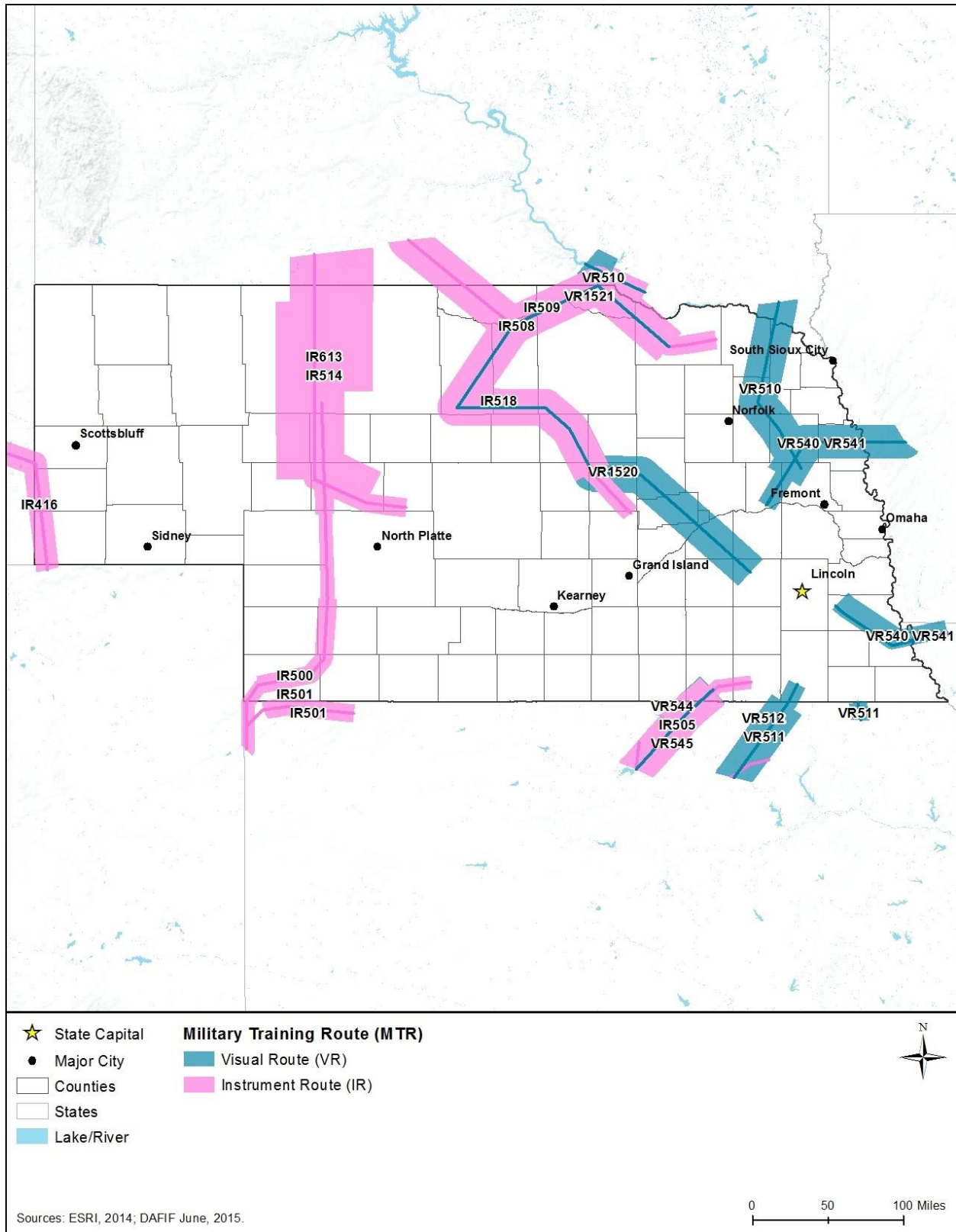


Figure 12.1.7-9: MTRs in Nebraska

12.1.8. Visual Resources

12.1.8.1. Definition of the Resource

Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. 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 Final 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)

12.1.8.2. Specific Regulatory Considerations

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

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

State Law/Regulation	Regulatory Agency	Applicability
Nebraska Archaeological Resources Preservation Act (82-503 NRS)	The State Archaeology Office	“To coordinate and encourage appropriate archaeological undertakings and to preserve archaeological resources.”
Legislative Bill 165, Section 86-704, an Act relating to telecommunications	Local municipalities	Regulates how and where telecommunication lines are constructed, including highways and lands used by the public.

Source: (Nebraska Legislature, 2005)

In addition to 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. Nebraska does encourage comprehensive community planning as guided by the Nebraska Planning Handbook first published in 2002. The handbook does not specify planning for visual resources, but encourages the protection of the character and natural resources of a municipality. (Scholz, et al., 2002)

12.1.8.3. Character and Visual Quality of the Existing Landscape

Nebraska is known as the “cornhusker state” as 93 percent of the state’s lands are used for farming and ranching (45.6 million acres) predominantly for corn. The state is primarily comprised of a variety of plains, with a central region of Sandhills; all of these areas offer prime range and farmland. Nebraska offers miles of prairies and fields of wheat and other crops, allowing for herds of cattle to roam and graze. The highest point in Nebraska is found in the southwest corner of the panhandle at 5,424 ft.; however, this is not a mountaintop but a gradual

increase in elevation as the land gets higher towards the Rocky Mountains. The lowest point is along the Missouri River near the Kansas border at 840 ft. Although there are no mountain ranges in Nebraska, there is a section of the Badlands stretching from South Dakota which contains unique scenery and geology (Nebraska Legislature, 2015c).

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

Nebraska has considered the management and protection of historic resources and location of telecommunication infrastructure, along with comprehensive municipal planning (Scholz, et al., 2002) (Nebraska Legislature, 2005) (Nebraska Legislature, 2011). Those policies may allow for consideration of visual resources in certain landscapes. While the state and many municipalities have some regulation of scenic and visual resources, not all scenic areas within the state have been identified or have policy or regulations for management or protection by the state. The areas listed below have some measure of management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

12.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 12.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Nebraska, there are 1,112 NRHP listed sites, including 20 NHLs, two National Monuments, and one National Monument of America (NPS, 2013b). Some State Historic Sites, State Heritage Areas, and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time.

The Secretary of the Interior's Standards for the Treatment of Historic Properties addresses four aspects: preservation, rehabilitation, restoration, and reconstruction, whereas The Guidelines for the Treatment of Cultural Landscapes, both authored by the NPS, provides guidance for applying protections to all aspects of the historic and cultural landscape, such as forests, gardens, trails, structures, ponds, and farming areas, to meet the Standards (NPS, 1995). The Standards "require retention of the greatest amount of historic fabric, including the landscape's historic form, features, and details as they have evolved over time," which directly protects historic properties and the visual resources therein (NPS, 1995). The BLM issued a 1997 Memorandum of Understanding with the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers regarding the manner in which BLM will meet its

responsibilities under the NHPA (BLM, 2004). In addition, BLM is required to manage scenic resources under the Federal Land Policy and Management Act of 1976 (FLPMA) and Manuals 8100 and 8140 protecting cultural resources. The BLM conducts visual resource inventories for all of the public lands they manage during their land use planning process, every 10-15 years (BLM, 2005a) (BLM, 2014a).

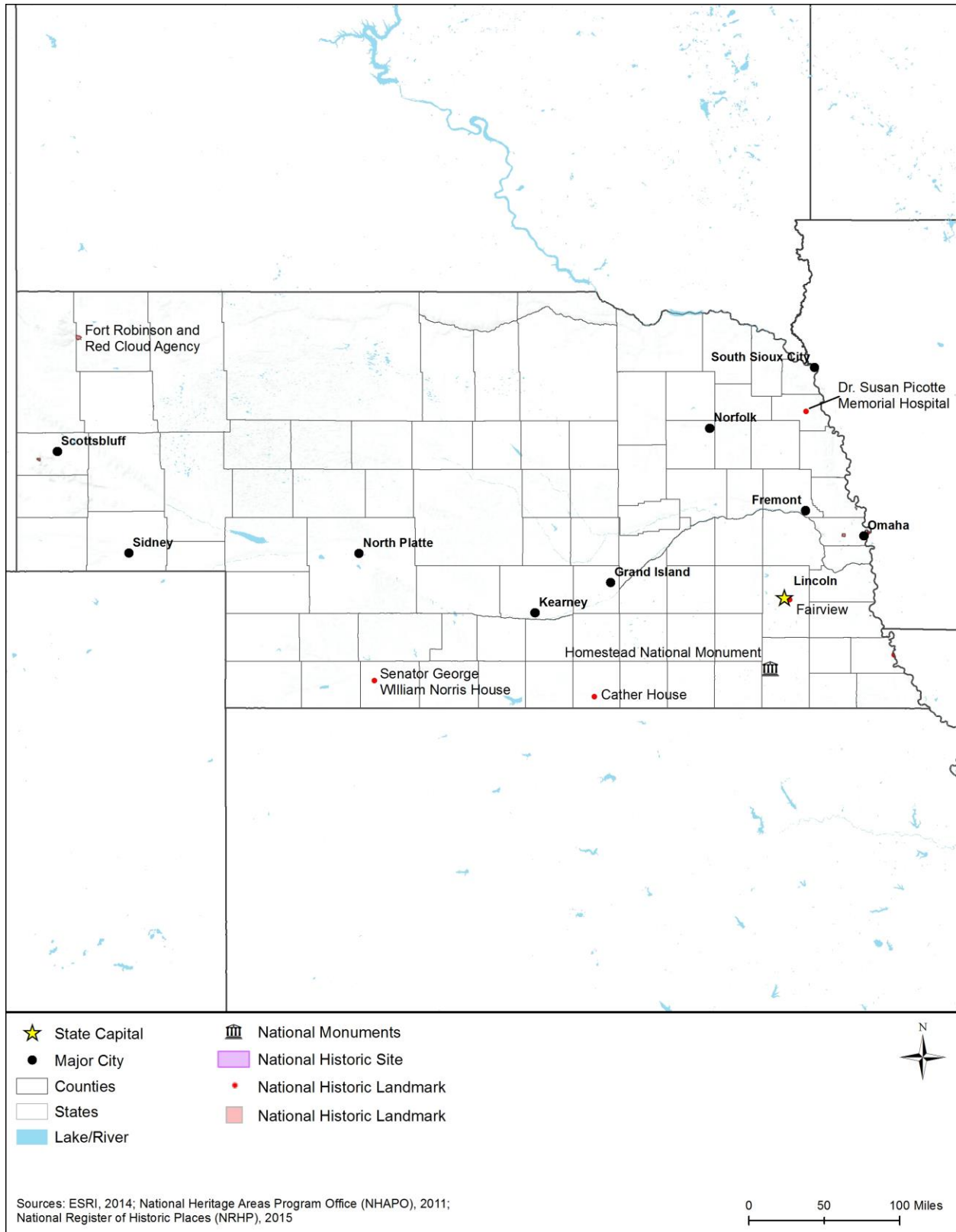


Figure 12.1.8-1: Representative Sample of Some Historic and Cultural Areas that May Be Visually Sensitive

National Historic Landmarks

There are 20 NHLs in Nebraska, which include a variety of historic structures but also include historic stopovers along travel routes and natural areas. The scenic and visual resources of these landmarks and surrounding areas are managed for consistency with the historic resource and aesthetics of the landscape (NPS, 2015b). 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, 2015c). In Nebraska, NHLs are comprised of historic landmarks (Figure 12.1.8-2) and American Indian sites. NHLs may include “historic buildings, sites, structures, objects, and districts” (NPS, 2016). Other types of historic properties include natural areas and travel routes. 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.



Source: (NPS, 2015d)

Figure 12.1.8-2: Signal Butte National Historic Landmark

The NHLs in Nebraska are:

- Ash Hollow Cave in Ash Hollow Historic District;
- Captain Meriwether Lewis;
- Coufal Site;
- Dr. Susan LaFlesche Picotte Memorial Hospital;
- Father Flanagan’s Boys’ Home;
- Fort Atkinson;
- Fort Robinson and Red Cloud Agency;
- George W. Norris House;
- J. Sterling Morton House;

- Nebraska State Capitol;
- Palmer Site;
- Pike Pawnee Village Site;
- Robidoux Pass;
- Schultz Site;
- Signal Butte (Figure 12.1.8-2);
- Leary Site;
- USS HAZARD;
- Walker Gilmore Site;
- Willa Cather House (Cather House); and
- William Jennings Bryan House.

By comparison, there are over 2,500 NHLs in the United States (NPS, 2015e). Figure 12.1.8-4 provides a representative sample of some historic and cultural resources that may be visually sensitive. The scenic and visual resources of these landmarks and surrounding areas are managed for consistency with the historic resource and aesthetics of the landscape (NPS, 2015b).

National Historic Trails

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Trails are defined as extended trails that “provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which they pass” (NPS, 2012a).

There are five National Historic Trails crossing Nebraska, including the Lewis and Clark, Oregon, Mormon Pioneer, California, and Pony Express. The California (Figure 12.1.8-3), Mormon Pioneer, and Pony Express National Historic Trails follow the Platte and North Platte Rivers across the Great Plains and the entire state (Figure 12.1.7-3). Visual resources along these trails include historic buildings, riparian forest, plains, and grasslands (NPS, 2015f).

The Oregon Trail and an additional portion of the California Trail follow the Platte, North Platte, and Little Blue Rivers across Nebraska. These trails track the pathway of historic travelers across the west, including trail ruts, other sites, and stopovers (NPS, 2015f).



Source: (NPS, 2015g)

Figure 12.1.8-3: Scenic View from the California National Historic Trail

The Lewis and Clark National Historic Trail consists of several trails that the expedition took following the Missouri River along the north and eastern borders of Nebraska. There are several state parks located along the trail route in Nebraska, and visual resources encompass riparian forests, plains and prairies, and the majestic Missouri River (NPS, 2015h).

National and State Historic Sites

Chimney Rock National Historic Site, 83 acres located along the California-Oregon Trails, is a historic, visual, and scenic landmark in the plains of Nebraska (NPS, 2015i). The site “is administered by the Nebraska State Historical Society, the city of Bayard and the National Park Service under a cooperative agreement” (Nebraska Legislature, 2015c).

There are at least four state historic sites in Nebraska: the Willa Cather House, the John G. Neihardt, Senator George W. Norris House, and Neligh Mill. These sites contain historic buildings and scenic areas (Nebraska State Historical Society, 2015).

There are nine state historical parks in Nebraska (Table 12.1.8-2) (NGPC, 2015g). These areas contain both historic and natural areas with scenic values.

Table 12.1.8-2: State Historical Parks

Park Name	Acres	Visual Resources
Arbor Lodge State Historical Park	72	Historic mansion and buildings, cultivated gardens
Ash Hollow State Historical Park	1,001	Historic sites, hilltop views, springs, plains, grasslands
Ashfall Fossil Beds State Historical Park	360	Geologic features, plains, grasslands
Bowring Ranch State Historical Park	325	Historic ranch, plains, grasslands, Sandhills
Buffalo Bill Ranch State Historical Park	25	Historic ranch, plains, grasslands, Platte River views, riparian forest,
Fort Atkinson State Historical Park	157	Historic fort, grasslands
Fort Hartsuff State Historical Park	18	Historic fort, grasslands
Fort Kearney State Historical Park	39	Historic fort, grasslands, river views
Rock Creek Station State Historical Park	353	Creek views, riparian forest, ravines, prairie, historic trail ruts

Source: (NGPC, 2015g)

12.1.8.5. Parks and Recreation Areas

Parks and recreation areas often contain scenic resources and are visited because of their associated visual or aesthetic qualities. Figure 12.1.8-4 identifies resources that may be visually sensitive in Nebraska.¹⁰⁷ For additional information about recreation areas, including national and state parks, see Section 12.1.7, Land Use, Recreation, and Airspace.

National Park Service

National Parks are managed by the National Park Service (NPS) and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use. In Nebraska, there are five¹⁰⁸ officially designated NPS units. Nebraska is home to the Agate Fossil Beds and Scotts Bluff National Monuments and the Homestead National Monument of America (Figure 12.1.8-4). Agate Fossil Beds is 3,050 acres, with scenic geologic features and bluffs that contain fossils and layers of agate¹⁰⁹ (NPS, 2015j). Other scenic resources include expansive high plains, the Niobrara River, riparian forest, and wetlands (NPS, 2015j). The Scotts Bluff National Monument highlights visually significant high bluffs, visible for miles from the surrounding prairie. The Homestead National Monument of America honors the Homestead Act of 1862 allowing for the westward expansion of the U.S. The scenic resources within this 3,000 acre park include bluffs, the North Platte River, riparian forest, wetlands, mixed-grass prairie, and historic sites (NPS, 2015k).

Bureau of Land Management

The BLM manages approximately 6,600 acres in Nebraska, most are small parcels used for livestock grazing (BLM, 2011a). These lands are managed under a multiple use mandate (FLPMA) meaning that BLM must allow many land uses from recreation to livestock grazing, forestry, wildlife habitat, and energy development (BLM, 2015a). The BLM uses their visual resources management system to “identify and evaluate scenic values to determine the appropriate levels of management.” Lands classified with high scenic values are assigned management that prevents or reduces impacts to the visual resources, protecting the scenic landscape (BLM, 2012). BLM lands with high scenic values are less likely to be developed or have disturbed visual resources. Management varies among uses and resources, some areas, like lands adjacent to wild and scenic rivers, will be managed for high quality visual resources. Other areas, such as where energy development is occurring, may be managed for lower quality visual resources. BLM manages over 500,000 acres of sub-surface mineral resources (BLM, 2011a).

¹⁰⁷ 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.

¹⁰⁸ This count is based on the NPS website “by the numbers” current as of 9/30/2014 (NPS, 2015a). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

¹⁰⁹ Agate is within a larger group of minerals called chalcedony, which includes many well-known varieties of cryptocrystalline quartz gemstones (USGS, 2013a).

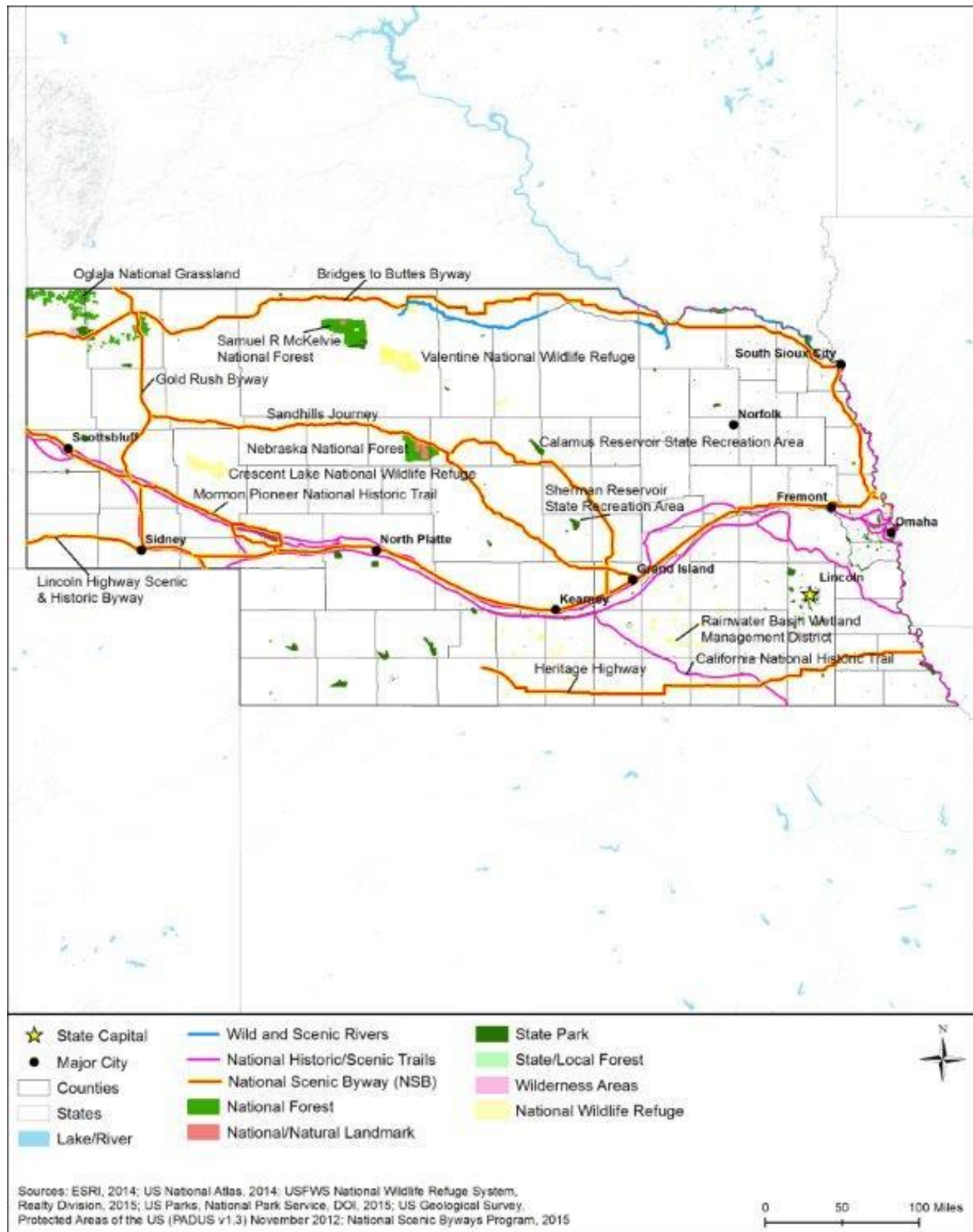


Figure 12.1.8-4: Natural Areas that May be Visually Sensitive

U.S. Forest Service

There are two National Forests solely in Nebraska (USFS, 2015a) (Figure 12.1.8-4). The Nebraska National Forest spans between Nebraska and South Dakota, and the Samuel R. McKelvie National Forest is entirely within Nebraska. The USFS conducts inventories of forest lands and assigns scenic resource categories from which they manage for scenic and visual resources (USFS, 1995). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USFS, 1995).

The 6,600 acre Pine Ridge National Recreation Area is within the Nebraska National Forest, and allows non-motorized recreation within scenic natural areas of forests, plains and open spaces (USFS, 2015b). The Samuel R. McKelvie National Forest has numerous scenic resources that include grasslands, forests, and water features such as the Niobrara River and Merritt Reservoir (USFS, 2015c).

Army Corps of Engineers Recreation Areas

There are 31 USACE managed lakes and recreation areas, facilities, and flood risk management areas within the state (Figure 12.1.8-4) (recreation.gov, 2015). These 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).

Bureau of Reclamation

The Bureau of Reclamation manages 15 reservoirs and recreation areas in Nebraska, most often in partnership with state and federal agencies. The areas are primarily for water storage and secondary recreation use. The managing agencies that consider visual resources in their planning processes may apply management to protect scenic resources within these areas. (USBR, 2015).

State Parks

There are 74 sites within Nebraska's State Park System, including parks, recreation areas, and historical parks. Recreation areas are the most numerous, with 57 recreation areas and 8 state parks (NGPC, 2015g). Table 12.1.8-3 lists representative samples of Nebraska State Parks, acreage, and visual resources.

Table 12.1.8-3: Nebraska State Parks

Park Name	Acres	Visual Resources
Chadron	973	Pine forest, lake views
E.T. Mahoney	690	River views, forest
Fort Robinson	22,673	Historic fort, hilltops, forest
Indian Cave	4,000	Missouri River views, riparian forest, geologic features, historic structures
Niobrara	1,260	Niobrara and Missouri River views, riparian forest, geologic features, plains
Platte River	418	River views, riparian forest, forested hills
Ponca	2,400	Missouri River views, riparian forest, forested hills
Smith Falls	252	Scenic waterfall, Niobrara River views, riparian forest,

Source: (NGPC, 2015g)

Federal and State Trails

As identified in Section 12.1.8.4, there are five National Historic Trails crossing Nebraska: Lewis and Clark, Oregon, Mormon Pioneer, California, and Pony Express. Visual resources along these trails include historic buildings, riparian forest, plains, and grasslands. In addition, there are over 40 state trails including the Cowboy trail, the nation's longest rail to trail conversion for hiking, biking, and horseback riding. Scenic resources along the Cowboy trail include the Niobrara River, riparian forest, plains, and grasslands (NGPC, 2015m). There are also numerous water trails along the many rivers and creeks within the state that encompass the scenic resources within those watersheds (NGPC, 2015n).

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

State Forests

There are two Nebraska State Forest properties, the 640 acre Cedar Canyon State Forest and the 240 acre Horning State Farm Demonstration Forest. The Cedar Canyon State Forest contains scenic resources including canyons, streams, forested hillsides, and bottomland habitat. The Horning State Farm Demonstration Forest is comprised of both native plant species and a park-like arboretum with trees and plants from around the world (Nebraska Forest Service, 2015).

12.1.8.6. Natural Areas

Rivers Designated as National or State Wild, Scenic or Recreational

National wild, scenic, or recreational rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. Parts 1271-1287). Portions of the Missouri and Niobrara Rivers in Nebraska are designated as wild and scenic (Figure 12.1.4-1) (National Wild and Scenic Rivers System, 2015). Designated sections of the Missouri River include two segments (98 miles total) classified as the Missouri National Recreational River and are a unit of the National Park System (NPS, 2015l). The Niobrara River has 28 miles of recreational and 76 miles of scenic, with 200 waterfalls and is jointly managed by the NPS and the USFWS (National Wild and Scenic Rivers System, 2015). The scenic resources of these rivers are protected by the federal designations.

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

There are six NWRs and one WMD in Nebraska protecting over a 100,000 acres of habitat and the visual resources within and surrounding the refuge. Many of the refuges encompass lakes, rivers, or wetlands and surrounding habitat; however, other areas are within the Sandhills ecoregion, such as the Valentine and Crescent Lake NWRs (USFWS, 2015o).

There are at least two WMAs managed by the NGPC to protect and conserve wildlife habitat. Clear Creek WMA is 6,200 acres along Lake McConaughy (NGPC, 2015o). The Sacramento-Wilcox WMA covers 2,313 acres of ponds, forest, and wetlands (NGPC, 2015p). These areas contain protected habitat for plants and animals without disturbance from development and habitat loss.

National Natural Landmarks

The five NNLs in Nebraska cover over 100,000 acres and are owned by USFS and USFWS, along with tribes and private landowners. 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, 2014b). These landmarks may be considered visual resources or visually sensitive. Table 12.1.8-4 displays a list of NNLs, their size, and some of the scenic resources protected within these areas (NPS, 2014b).

Table 12.1.8-4: National Natural Landmarks with Scenic Resources

National Natural Landmarks	Acres	Visual Resources
Ashfall Fossil Beds	360	Geologic, paleontological
Dissected Loess Plain	10,883	Geological features, canyons, grassland
Fontenelle Forest	1,500	Forest, bluffs, riparian forest, river views, prairie
Nebraska Sandhills	32,900	Sandhill dunes
Valentine NWR	71,516	Sandhill tallgrass prairie, expansive vistas

Source: (NPS, 2012b)

National Grasslands

The Oglala National Grassland covers 94,000 acres of scenic mixed grass prairie in Nebraska (USFS, 2015d). Soldier Creek Wilderness Area is within the Oglala National Grassland and encompasses 7,794 acres of scenic pine forest, grasslands, and wild landscapes; the grasslands also contain unique geologic features (Figure 12.1.8-5) (USFS, 2015e).



Source: (USFS, 2015e)

Figure 12.1.8-5: Soldier Creek Wilderness within the Oglala National Grassland

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 as “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the “forces of nature” and as that which “may also contain ecological, geological, or other features of scientific, education, scenic, or historical value” (NPS, 2015m). Over 106 million acres of federal public lands have been designated as wilderness areas in the United States. Of these federal lands, 25 percent are located in 47 NPS units (44 million acres) and are part of National Park System. These designated wilderness areas are managed by the USFS, BLM, and USFWS (NPS, 2015m). In Nebraska, there are 2 designated wilderness areas covering about 11,000 acres. The Soldier Creek Wilderness Area is 7,794 acres and is managed by the USFS (Figure 12.1.8-5) (USFS, 2015a). The Fort Niobrara Wilderness Area covers 4,635 acres managed by the USFWS (Wilderness.net, 2015).

State Scenic and Historic 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 (FHWA, 2015c). There are no National Scenic Byways in Nebraska. However, Nebraska has nine State Scenic Byways, or highways, that are listed as scenic or historic within the state, as presented in Section 12.1.1, Infrastructure (NDOR, 2012a) (NDOR, 2015b).

12.1.9. Socioeconomics

12.1.9.1. Definition of the Resource

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

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

The financial arrangements for deployment and operation of the FirstNet network have socioeconomic implications. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however this is not intended to be either descriptive or prescriptive of FirstNet’s financial model or anticipated total expenditures and revenues associated with the deployment of the Nationwide Public Safety Broadband Network (NPSBN). This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet *may affect*.

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

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau¹¹⁰ (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this Final 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 Final 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.

12.1.9.2. Specific Regulatory Considerations

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to socioeconomics for this Final PEIS.

¹¹⁰ For U.S. Census Bureau sources, a URL (see references section) that begins with "http://factfinder.census.gov" indicates that the American FactFinder (AFF) interactive tool can be used to retrieve the original source data via the following procedure. If the reference's URL begins with "http://dataferrett.census.gov," significant socioeconomic expertise is required to navigate this interactive tool to the specific data. However, the data can usually be found using AFF. As of May 24, 2016, the AFF procedure is as follows: 1) Go to <http://factfinder.census.gov>. 2) Select "Advanced Search," then "Show Me All." 3) Select from "Topics" choices, select "Dataset," then select the dataset indicated in the reference; e.g. "American Community Survey, 2013 1-Year Estimates" or "2012 Census of Governments." Click "Close." Note: ACS is the abbreviation in the AFF for the American Community Survey. SF is the abbreviation used with the 2000 and 2010 "Summary Files." For references to the "2009-2013 5-Year Summary File," choose "2013 ACS 5-year estimates" in the AFF. 4) Click the "Geographies" box. Under "Select a geographic type," choose the appropriate type; e.g. "United States – 010" or "State – 040" or "..... County – 050" then select the desired area or areas of interest. Click "Add to Your Selections," then "Close." For Population Concentration data, select "Urban Area - 400" as the geographic type, then select 2010 under "Select a version" and then choose the desired area or areas. Alternatively, do not choose a version, and select "All Urban Areas within United States." Regional values cannot be viewed in the AFF because the regions for this Final 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.

12.1.9.3. *Communities and Populations*

This section discusses the population and major communities of Nebraska (NE). It 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 12.1.9-1 presents the 2014 estimated population and population density of Nebraska in comparison to the Central region¹¹¹ and the nation. The estimated population of Nebraska in 2014 was 1,881,503. The population density was 24 persons per square mile (sq. mi.), which was considerably lower than the population density of both the region (66 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Nebraska was the 37th largest state by estimated population among the 50 states and the District of Columbia, 15th largest by land area, and had the 44th greatest population density (U.S. Census Bureau, 2015c) (U.S. Census Bureau, 2015d).

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

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Nebraska	76,824	1,881,503	24
Central Region	1,178,973	77,651,608	66
United States	3,531,905	318,857,056	90

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

Estimated population growth is an important subject for this Final PEIS given FirstNet's mission. Table 12.1.9-2 presents the population growth trends of Nebraska from 2000 to 2014 in comparison to the Central region and the nation. The state's annual growth rate increased slightly in the 2010 to 2014 period compared to 2000 to 2010, from 0.65 percent to 0.75 percent. The growth rate of Nebraska in the latter period was higher than the growth rate of the region (0.45 percent) and slightly lower than the growth rate of the nation (0.81 percent).

¹¹¹ The Central region is comprised of the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Utah, Wisconsin, and Wyoming. Throughout the socioeconomics section, figures for the Central region represent the sum of the values for all states in the region, or an average for the region based on summing the component parameters. For instance, the population density of the Central region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

Table 12.1.9-2: Recent Population Growth of Nebraska

Geography	Estimated Population			Numerical Population Change		Rate of Estimated Population Change (AARC) ^a	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Nebraska	1,711,263	1,826,341	1,881,503	115,078	55,162	0.65%	0.75%
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, 2015e) (U.S. Census Bureau, 2015c)
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 12.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia’s Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis service (ProximityOne, 2015) (University of Virginia Weldon Cooper Center, 2015). The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates Nebraska’s estimated population will increase by approximately 187,512 people, or 10.0 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.60 percent, which is slightly lower than the historical growth rate from 2010 to 2014 of 0.75 percent. The projected growth rate of the state matches that of the region (0.60 percent) and is less than the projected growth rate of the nation (0.80 percent).

Population Distribution and Communities

Figure 12.1.9-1 presents the distribution and relative density of the estimated population of Nebraska. 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, 2015f).

Table 12.1.9-3: Projected Estimated Population Growth of Nebraska

Geography	Population 2014 (estimated)	Projected 2030 Estimated Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) 2014 to 2030
Nebraska	1,881,503	1,983,249	2,154,780	2,069,015	187,512	10.0%	0.60%
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, 2015c) (ProximityOne, 2015) (University of Virginia Weldon Cooper Center, 2015)
AARC = Average Annual Rate of Change (compound growth rate)

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, 2015g). These population concentrations often include multiple incorporated areas as well as some unincorporated areas.

Other groupings of brown dots on the map represent additional, but smaller, population concentrations. Dispersed dots indicate dispersed population across the less densely settled areas of the state. The map shows that much of Nebraska is very sparsely populated. For more information about the geography of the state, see Section 12.1.7, Land Use, Recreation, and Airspace.

Table 12.1.9-4 provides the populations of the 10 largest population concentrations in Nebraska, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.¹¹² In 2010, the largest population concentration was the Nebraska portion of the Omaha area, which had 656,462 people. The state had no other population concentrations over 500,000. The smallest of these 10 population concentrations was the Columbus area, with a 2010 population of 22,106. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Omaha area (Nebraska portion), with an annual growth rate of 1.55 percent.

Table 12.1.9-4 also shows that the top 10 population concentrations in Nebraska accounted for 62.9 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 122.3 percent of the entire state's growth. This figure of over 100 percent indicates that the population of the remainder of the state, as a whole, declined from 2000 to 2010.

¹¹² 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.

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

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Columbus	21,018	22,106	22,096	10	1,088	0.51%
Fremont	25,734	27,471	27,440	5	1,737	0.66%
Grand Island	45,499	50,440	51,290	3	4,941	1.04%
Hastings	24,094	24,312	24,137	9	218	0.09%
Kearney	27,404	31,287	31,728	4	3,883	1.33%
Lincoln	226,582	258,719	262,440	2	32,137	1.34%
Norfolk	26,257	26,769	26,758	6	512	0.19%
North Platte	24,124	25,213	25,055	8	1,089	0.44%
Omaha (NE/IA) (NE Portion)	562,701	656,462	668,466	1	93,761	1.55%
Scottsbluff	24,525	25,946	25,426	7	1,421	0.56%
Total for Top 10 Population Concentrations	1,007,938	1,148,725	1,164,836	NA	140,787	1.32%
Nebraska (statewide)	1,711,263	1,826,341	1,841,625	NA	115,078	0.65%
Top 10 Total as Percentage of State	58.9%	62.9%	63.3%	NA	122.3%	NA

Sources: (U.S. Census Bureau, 2012b) (U.S. Census Bureau, 2015h) (U.S. Census Bureau, 2015i)
AARC = Average Annual Rate of Change (compound growth rate)

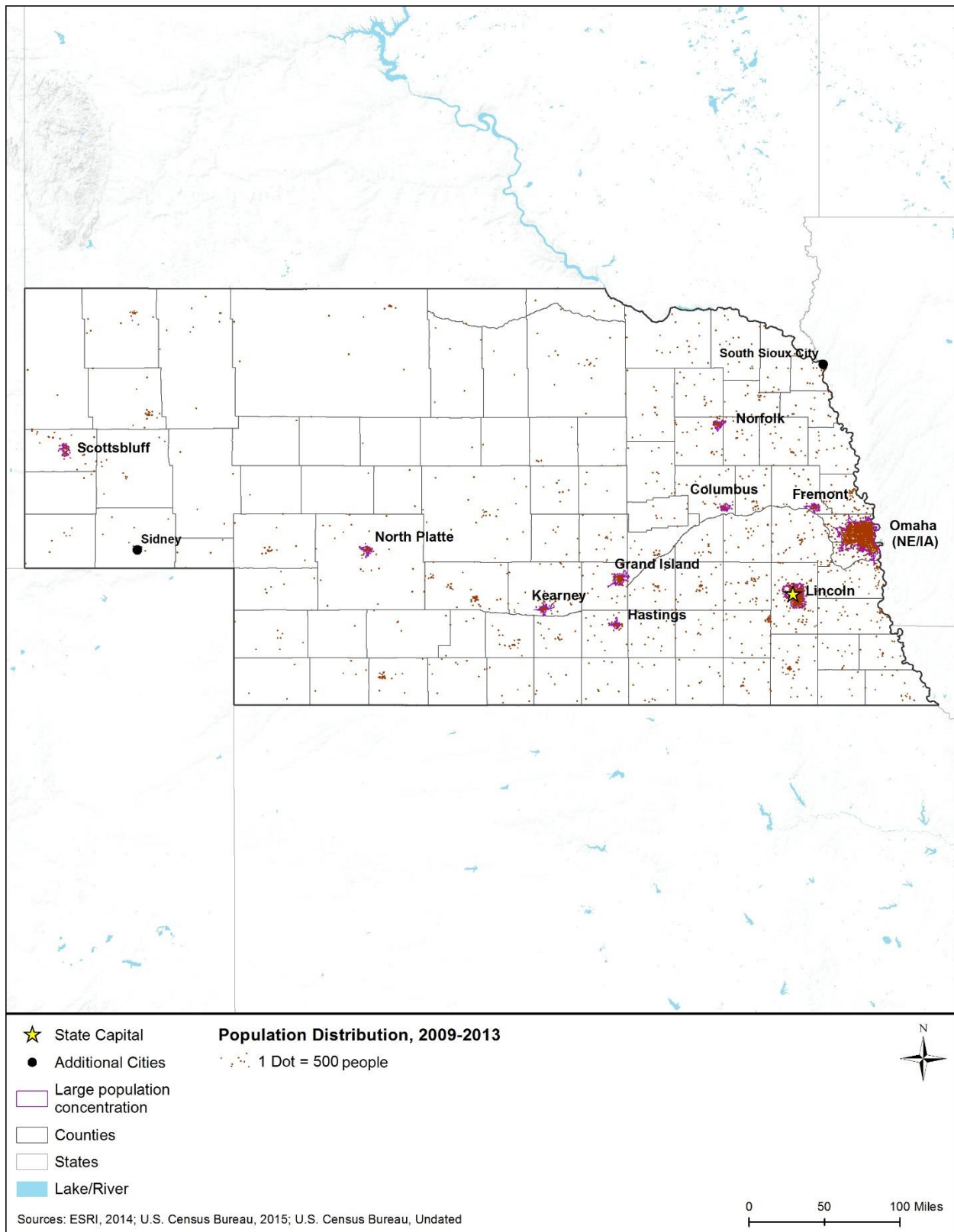


Figure 12.1.9-1: Estimated Population Distribution in Nebraska, 2009–2013

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 12.1.9-5 shows that in 2013, the MHI in Nebraska (\$51,502) was \$543 lower than that of the region (\$52,045), and \$748 lower than that of the nation (\$52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 12.1.9-5 compares the unemployment rate in Nebraska to the Central region and the nation. In 2014, Nebraska's statewide unemployment rate of 3.3 percent was considerably lower than the rate for the region (5.7 percent) and the rate for the nation (6.2 percent).¹¹³

Table 12.1.9-5: Selected Economic Indicators for Nebraska

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Nebraska	\$27,093	\$51,502	3.3%
Central Region	\$27,528	\$52,045	5.7%
United States	\$28,184	\$52,250	6.2%

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

Figure 12.1.9-2 and Figure 12.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015j) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 12.1.9-1 (U.S. Census Bureau, 2012a) (U.S. Census Bureau, 2015g). Following these two maps, Table 12.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across Nebraska.

Figure 12.1.9-2 shows that the majority of counties in Nebraska have an MHI below the national median. Counties with MHI above or similar to the national median are generally in areas surrounding the 10 largest population concentrations. Table 12.1.9-6 shows that MHI in the Nebraska portion of the Omaha area was above the state average (\$51,672). MHI in all other population concentrations was below the state average. MHI was lowest in the Scottsbluff area at \$40,944.

Figure 12.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that only one county (i.e., Thurston) in the northeastern portion of Nebraska, on the Iowa

¹¹³ Unemployment rates can change quarterly.

border, had an unemployment rate above the national average. All other counties had unemployment rates below the national average (i.e., better employment performance). When comparing unemployment in the population concentrations to the state average (Table 12.1.9-6) most areas had a 2009–2013 unemployment rate that was similar or higher than the state average (5.7 percent). Only two areas, Kearney and Norfolk, had unemployment rates lower than the state average. All of the population concentrations had unemployment rates within 2 percentage points of the state average.

Detailed employment data provide useful insights into the nature of a local, state, or national economy. Table 12.1.9-7 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers was slightly lower in Nebraska than in the Central region and the nation. The percentage of government workers was higher in the state than in the region and nearly matched the nation's percentage. The percentage of self-employed workers was slightly higher in the state than in both the region and nation.

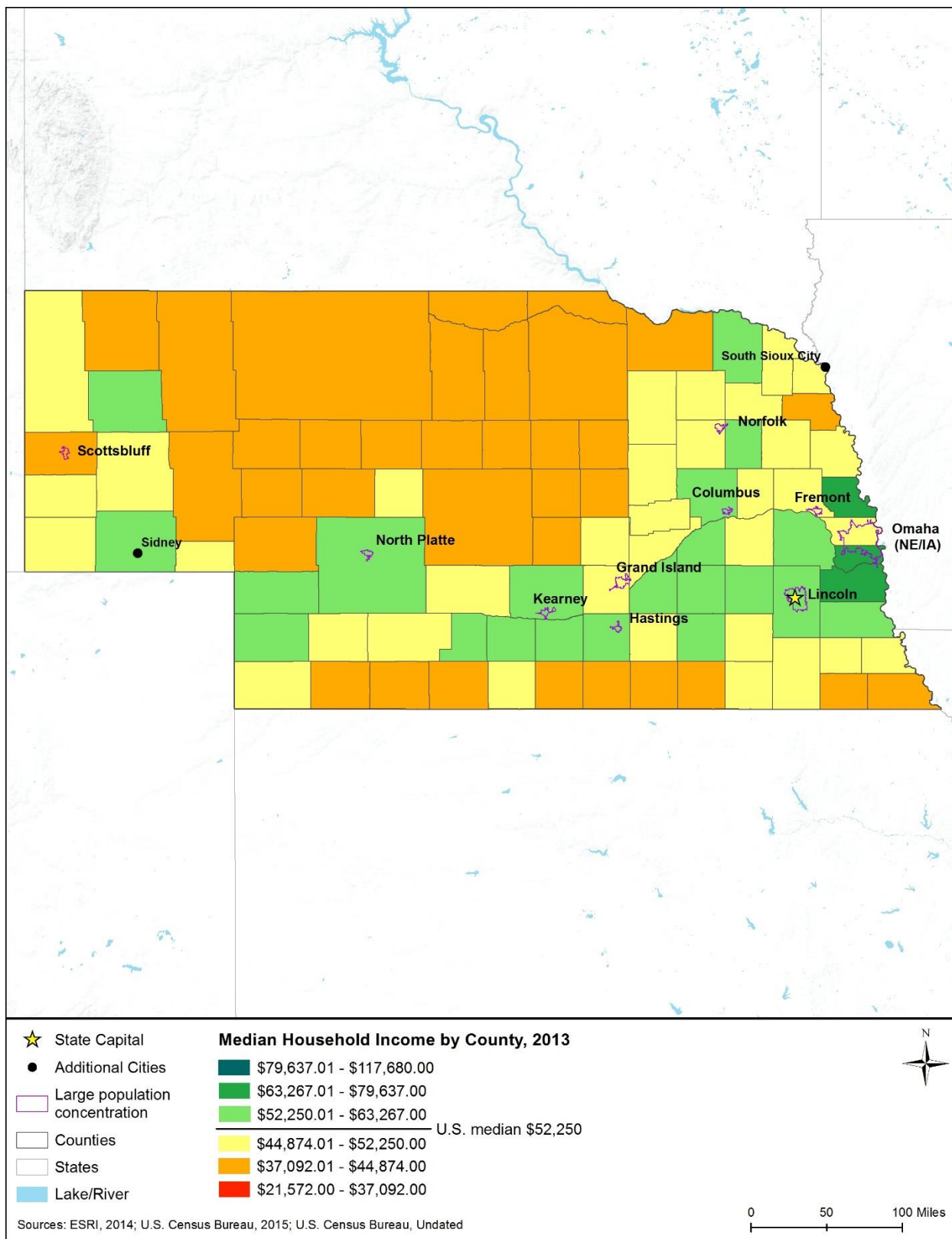


Figure 12.1.9-2: Median Household Income in Nebraska, by County, 2013

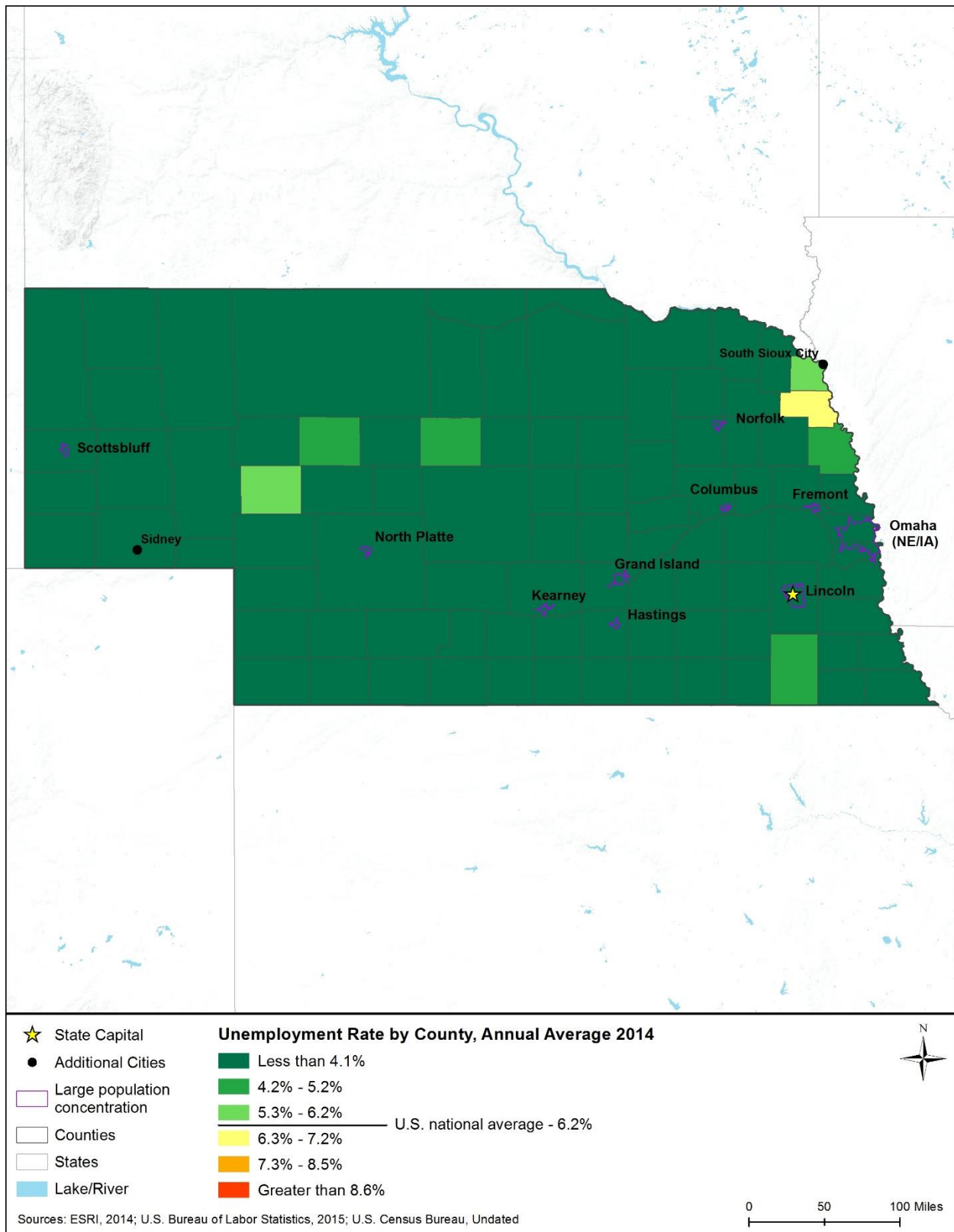


Figure 12.1.9-3: Unemployment Rates in Nebraska, by County, 2014

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

Area	Median Household Income	Average Annual Unemployment Rate
Columbus	\$47,148	5.9%
Fremont	\$48,330	5.7%
Grand Island	\$46,323	7.2%
Hastings	\$43,848	7.0%
Kearney	\$46,508	4.3%
Lincoln	\$49,199	6.8%
Norfolk	\$43,300	5.3%
North Platte	\$43,078	6.3%
Omaha (NE/IA) (NE Portion)	\$56,535	6.5%
Scottsbluff	\$40,944	7.1%
Nebraska (statewide)	\$51,672	5.7%

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

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

Class of Worker and Industry	Nebraska	Central Region	United States
Civilian Employed Population 16 Years and Over	965,779	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	79.3%	81.7%	79.7%
Government workers	14.0%	12.8%	14.1%
Self-employed in own not incorporated business workers	6.5%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	4.5%	2.2%	2.0%
Construction	6.7%	5.6%	6.2%
Manufacturing	11.0%	14.0%	10.5%
Wholesale trade	2.6%	2.7%	2.7%
Retail trade	11.8%	11.5%	11.6%
Transportation and warehousing, and utilities	5.6%	4.9%	4.9%
Information	1.9%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	7.3%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	8.3%	9.7%	11.1%
Educational services, and health care and social assistance	23.6%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.1%	9.1%	9.7%
Other services, except public administration	4.4%	4.6%	5.0%
Public administration	4.1%	3.9%	4.7%

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

By industry, Nebraska has a mixed economic base and some notable figures in the table are as follows. Nebraska in 2013 had a lower percentage of persons working in “professional, scientific, management, administrative, and waste management services” than did the region or the nation. It had a lower percentage of workers in “manufacturing” than the region and a slightly higher than the percentage for the nation. It also had a considerably higher percentage in “agriculture, forestry, fishing and hunting, and mining” than the region or nation. All other industry percentages in Nebraska were within two percentage points of the region or nation.

Table 12.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 12.1.9-7 for 2013.

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

Area	Constructio n	Transportatio n and Warehousing, and Utilities	Informatio n	Professional, Scientific, Management, Administrative and Waste Management Services
Columbus	7.1%	6.1%	1.0%	7.1%
Fremont	8.1%	4.1%	1.3%	6.2%
Grand Island	6.1%	4.1%	1.4%	5.7%
Hastings	7.5%	3.9%	1.4%	5.7%
Kearney	4.7%	4.1%	1.7%	5.4%
Lincoln	5.6%	4.1%	2.4%	9.2%
Norfolk	5.2%	4.7%	1.4%	5.6%
North Platte	4.9%	18.4%	1.9%	5.5%
Omaha (NE/IA) (NE Portion)	6.3%	5.5%	2.7%	11.5%
Scottsbluff	7.0%	7.3%	1.4%	5.4%
Nebraska (statewide)	6.4%	5.9%	2.0%	8.2%

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

Housing

The housing stock is an important socioeconomic component of communities. The type, availability, and cost of housing in an area reflect economic conditions and affect quality of life. Table 12.1.9-9 compares Nebraska to the Central region and nation on several common housing indicators.

As shown in Table 12.1.9-9, in 2013 Nebraska had a higher percentage of housing units that were occupied (90.5 percent) than the region (88.4 percent) or nation (87.6 percent). Of the occupied units, Nebraska had a somewhat lower percentage of owner-occupied units (66.0 percent) than the region (67.6 percent) and a slightly higher percentage than the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Nebraska in 2013 was 72.8 percent, higher than both the region (67.7 percent) and nation (61.5 percent). The homeowner vacancy rate in Nebraska (1.2 percent) was slightly lower than the rate for both the region (1.8 percent) and the nation (1.9 percent). This rate reflects “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2015o). The vacancy rate among rental units was slightly lower in Nebraska (5.6 percent) than in the region (6.0 percent) and nation (6.5 percent).

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

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Nebraska	806,888	90.5%	66.0%	1.2%	5.6%	72.8%
Central Region	33,580,411	88.4%	67.6%	1.8%	6.0%	67.7%
United States	132,808,137	87.5%	63.5%	1.9%	6.5%	61.5%

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

Table 12.1.9-10 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 12.1.9-10 shows that during this period the percentage of occupied housing units exceeded the state average of 90.7 percent in all areas, ranging between 91.1 percent in the Scottsbluff area to 95.9 percent in the Fremont area.

Table 12.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Nebraska, 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
Columbus	9,315	94.1%	66.8%	0.1%	6.8%	69.8%
Fremont	11,546	95.9%	63.2%	1.7%	3.0%	71.6%
Grand Island	20,376	93.8%	63.3%	3.3%	1.6%	69.0%
Hastings	10,587	94.1%	66.0%	0.6%	3.8%	73.8%
Kearney	13,098	92.8%	58.7%	1.5%	5.4%	59.6%
Lincoln	111,209	94.7%	57.5%	1.3%	5.0%	57.5%
Norfolk	11,381	94.1%	62.3%	1.0%	7.2%	67.0%
North Platte	11,561	93.1%	63.7%	1.0%	9.5%	66.9%
Omaha (NE/IA) (NE Portion)	276,263	92.9%	63.9%	1.7%	7.1%	67.8%
Scottsbluff	11,225	91.1%	62.8%	1.1%	5.0%	70.4%
Nebraska (statewide)	800,277	90.7%	67.0%	1.7%	6.2%	72.8%

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

Property Values

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

Table 12.1.9-11 provides indicators of residential property values for Nebraska 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, 2015o).

The table shows that the median value of owner-occupied units in Nebraska in 2013 (\$132,700) was lower than the corresponding values for the Central region (\$151,200) and the nation (\$173,900).

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

Geography	Median Value of Owner-Occupied Units
Nebraska	\$132,700
Central Region	\$151,200
United States	\$173,900

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

Table 12.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. The median property value in the top 10 population concentrations ranged from \$89,700 (Hastings area) to \$146,300 (Omaha area, Nebraska portion), compared to the state value of \$128,000.

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

Area	Median Value of Owner-Occupied Units
Columbus	\$110,100
Fremont	\$113,600
Grand Island	\$108,600
Hastings	\$89,700
Kearney	\$141,400
Lincoln	\$143,200
Norfolk	\$110,900
North Platte	\$103,700
Omaha (NE/IA) (NE Portion)	\$146,300
Scottsbluff	\$98,900
Nebraska (statewide)	\$128,000

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

Government Revenues

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

Table 12.1.9-13 presents total and selected state and local government revenue sources as reported by 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.

shows that the state government in Nebraska received less total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments, on the other hand, received more revenue per capita. Per capita levels of intergovernmental revenue¹¹⁴ from the federal government in 2012 were similar for state and local governments in Nebraska compared to their counterparts in the Central region and the nation. The state government in Nebraska obtained no revenue from property taxes. Local governments in Nebraska obtained substantially higher levels of property taxes per capita than their counterparts in the region and somewhat higher levels than their counterparts in the nation. Nebraska state and local governments reported higher per capita revenues from general sales taxes than their regional counterparts. The Nebraska state government reported lower revenue from selective sales taxes, and public utility taxes specifically, on a per capita basis than its counterparts in the region and nation. The Nebraska state government reported similar levels of individual and corporate income tax revenues, on a per capita basis, to the levels reported by its counterparts in the region and nation. Local governments in Nebraska did not report any individual or corporate income tax revenues.

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

Type of Revenue	Nebraska		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue (\$M) Per capita	\$9,815 \$5,290	\$12,504 \$6,739	\$463,192 \$6,020	\$231,980 \$3,015	\$1,907,027 \$6,075	\$1,615,194 \$5,145
Intergovernmental from Federal (\$M) Per capita	\$3,141 \$1,693	\$433 \$233	\$125,394 \$1,630	\$9,383 \$122	\$514,139 \$1,638	\$70,360 \$224
Intergovernmental from State (\$M) Per capita	\$0 \$0	\$2,034 \$1,096	\$0 \$0	\$76,288 \$992	\$0 \$0	\$469,147 \$1,495
Intergovernmental from Local (\$M) Per capita	\$53 \$28	\$0 \$0	\$2,721 \$35	\$0 \$0	\$19,518 \$62	\$0 \$0
Property Taxes (\$M) Per capita	\$0 \$0	\$2,954 \$1,592	\$3,626 \$47	\$61,015 \$793	\$13,111 \$42	\$432,989 \$1,379
General Sales Taxes (\$M) Per capita	\$1,570 \$846	\$317 \$171	\$58,236 \$757	\$6,920 \$90	\$245,446 \$782	\$69,350 \$221

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

Type of Revenue	Nebraska		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Selective Sales Taxes (\$M) Per capita	\$523	\$74	\$33,313	\$2,191	\$133,098	\$28,553
	\$282	\$40	\$433	\$28	\$424	\$91
Public Utilities Taxes (\$M) Per capita	\$56	\$66	\$3,627	\$1,153	\$14,564	\$14,105
	\$30	\$35	\$47	\$15	\$46	\$45
Individual Income Taxes (\$M) Per capita	\$1,838	\$0	\$72,545	\$5,148	\$280,693	\$26,642
	\$991	\$0	\$943	\$67	\$894	\$85
Corporate Income Taxes (\$M) Per capita	\$234	\$0	\$9,649	\$310	\$41,821	\$7,210
	\$126	\$0	\$125	\$4	\$133	\$23

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

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

12.1.10. Environmental Justice

12.1.10.1. Definition of the Resource

Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 1.8.11). 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, 2016b). Under the EO, each federal agency must “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 2013).

In 1997, the Council on Environmental Quality (CEQ) issued Environmental Justice: Guidance under the National Environmental Policy Act (NEPA) to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, the USEPA’s Office of Environmental Justice (USEPA, 2015f) offers guidance on Environmental Justice issues and provides an “environmental justice screening and mapping tool,” EJSCREEN (USEPA, 2015g).

The CEQ guidance provides several important definitions and clarifications that this Final PEIS utilizes:

- Minority populations consist of “Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.”
- Low-income populations consist of individuals living in poverty, as defined by the U.S. Census Bureau (Census Bureau).
- Environmental effects include social and economic effects. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment.” (CEQ, 1997)

12.1.10.2. Specific Regulatory Considerations

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 Final PEIS. However, the NDEQ, through established environmental programs, supports low income and minority communities by promoting awareness of environmental permitting activities in their respective areas (University of California, Hastings College of Law, 2010).

12.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 12.1.10-1 presents 2013 data on the composition of Nebraska’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 (4.6 percent), Asian (2.0 percent), or Some Other Race (1.9 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 (88.3 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 Nebraska that identifies as Hispanic (9.8 percent) is slightly larger 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. Nebraska’s All Minorities estimated population percentage (19.0 percent) is considerably lower than both the Central region (23.3 percent) and the nation (37.6 percent).

Table 12.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Nebraska (13.2 percent) is lower than that for the Central region (14.7 percent) and nation (15.8 percent).

Table 12.1.10-1: Estimated Population by Race and Hispanic Status, 2013

Geography	Total Population (estimated)	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Nebraska	1,868,516	88.3%	4.6%	0.8%	2.0%	0.1%	1.9%	2.3%	9.8%	19.0%
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, 2015q)

“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 12.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Nebraska	13.2%
Central Region	14.7%
United States	15.8%

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

12.1.10.4. Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D, Environmental Justice Methodology, presents the methodology used in this Final PEIS to screen each state for the presence of potential environmental justice populations. The methodology builds on CEQ guidance and best practices used for environmental justice analysis. It uses data at the census-block group level; block groups are the smallest geographic units for which regularly updated socioeconomic data are readily available at the time of writing. Figure 12.1.10-1 visually portrays the results of the environmental justice population screening analysis for Nebraska. The analysis used block group data from the Census Bureau’s ACS 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015f) (U.S. Census Bureau, 2015u) (U.S. Census Bureau, 2015v) (U.S. Census Bureau, 2015w) and Census Bureau urban classification data (U.S. Census Bureau, 2012a) (U.S. Census Bureau, 2015g). Figure 12.1.10-1 shows that Nebraska has many areas with high and moderate potential for environmental justice populations. The distribution of these areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some of the state’s most sparsely populated areas, such as the northern regions, on the border with South Dakota.

It is important to understand how the data behind Figure 12.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless

of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups may 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 12.1.10-1 does not definitively identify environmental justice populations. It indicates degrees of likelihood of the presence of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under- or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier-off the methodology of this Final 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 significance criteria), and “appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group” (CEQ, 1997). The Environmental Consequences section (Section 12.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

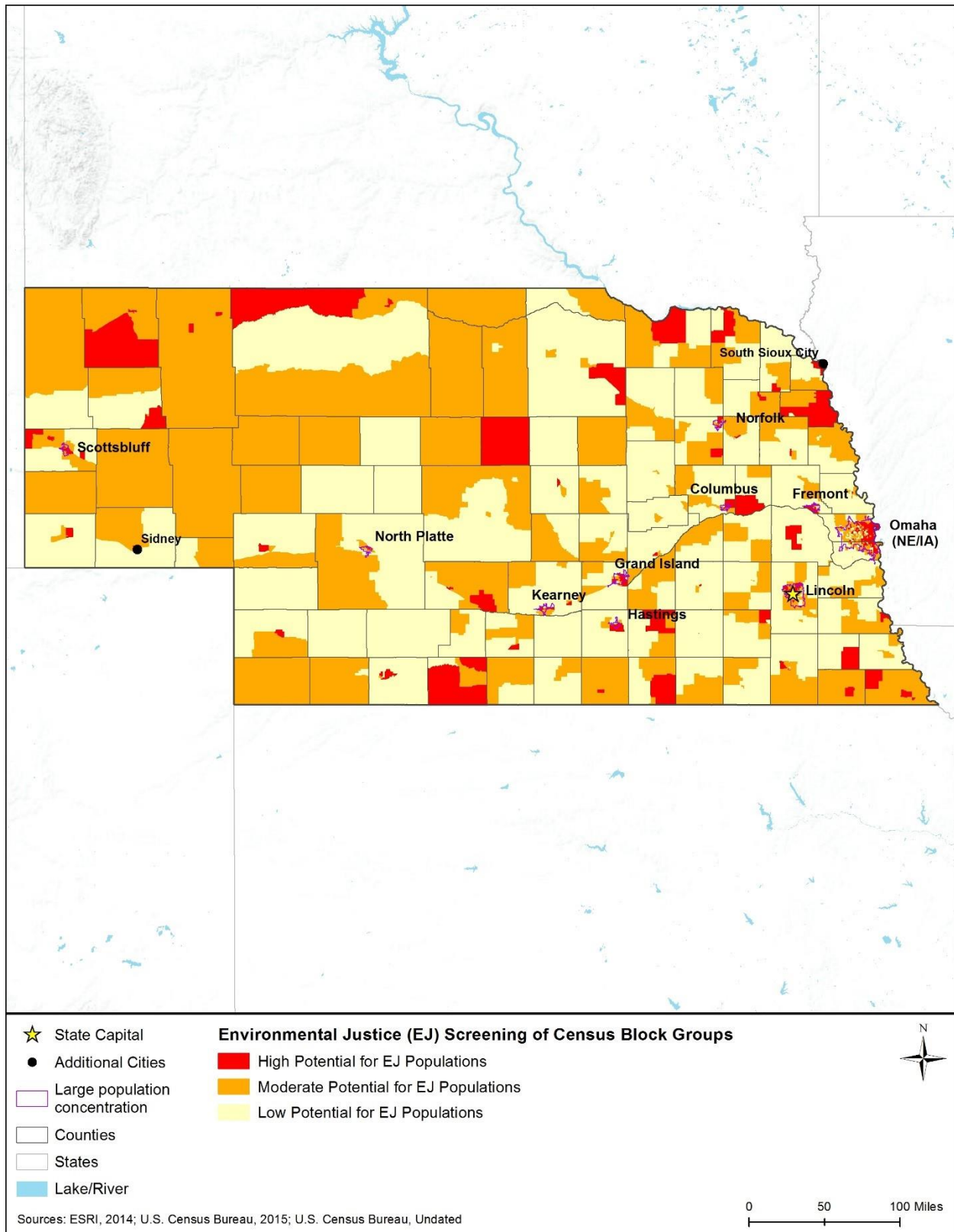


Figure 12.1.10-1: Potential for Environmental Justice Populations in Nebraska, 2009–2013

12.1.11. Cultural Resources

12.1.11.1. Definition of Resource

For the purposes of this Final PEIS, cultural resources are defined as:

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

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

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

12.1.11.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. Applicable federal laws and regulations that apply to Cultural Resources, include the NHPA (detailed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act, ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Nebraska does not have a state regulation that is similar to the NHPA. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations. Table 12.1.11-1 presents state and local laws and regulations that relate to cultural resources.

Table 12.1.11-1: Relevant Nebraska Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Nebraska Archaeological Resources Preservation Act	State Archaeology Office	“To coordinate and encourage appropriate archaeological undertakings and to preserve archaeological resources.”
State Culture and History, Rev. Statute Chapter 82	Nebraska State Historical Society	Establishes the Nebraska State Historical Society and identifies that archaeological sites are an important record of Nebraska’s state heritage
Historic Resources, Rev Statute Chapter 72, Articles 72-808 to 72-810	State Historic Preservation Office	Identifies the preservation of historic structures where possible.
Nebraska State Burial Site Statutes, Rev. Statute Chapter 12-1201-1212	SHPO and local law enforcement	These laws prohibit the physical abuse or mistreatment of human remains, burials, grave markers, and associated objects. If a burial is uncovered during development or construction, work must stop immediately in the area and local law enforcement should be notified. Following determination that the site does not constitute a crime scene and the remains are a prehistoric or historic human burial, the SHPO may assist the project proponent, developer, and/or landowner in contacting appropriate parties, considering options to avoid the burial(s), and advising on the legal process for potentially moving the remains.

Source: (Nebraska Legislature, 2005) (Nebraska Legislature, 2017e) (Nebraska Legislature, 2017f) (Nebraska Legislature, 2017g)

12.1.11.3. Cultural and Natural Setting

Human beings have inhabited Nebraska for some 12,000 years (Haynes, Johnson, & Stafford, 1999) (Pauketat, 2012). The majority of Nebraska'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 94 archaeological site listed on the NRHP (NPS, 2013b).

Archaeologists typically divide large study areas into regions. As identified in Figure 12.1.3-1, Nebraska occupies the Interior Plain Physiographic Region. The Interior Plain is further divided into the Central Lowlands and Great Plains Physiographic Provinces.

Evidence at most archeological sites in Nebraska are in relatively shallow deposits that are located either on the surface or within 1 to 2 ft. 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. These deposits can range between 1 and 10 ft. below the current surface, with older sites usually contained within the deeper sediments. Archaeological sites can be found on hilltops and mountaintops as well. Disturbed ground, including urban areas, may contain archaeological resources in deeper or shallower strata than undisturbed areas (Harris, 1979).

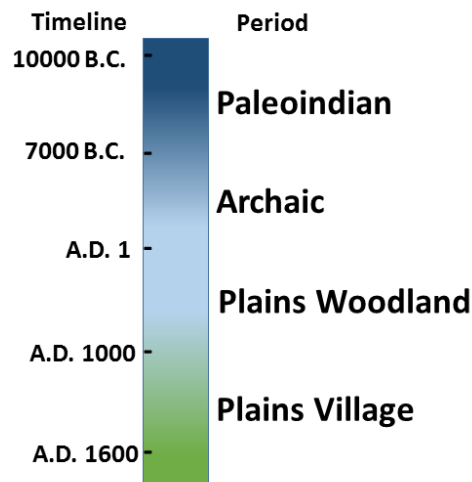
The following sections provide additional detail about Nebraska’s prehistoric periods (approximately 10000 B.C. – A.D. 1600) and the historic period since European colonization in

the 1600s. Section 12.1.11.4 presents an overview of the initial human habitation in Nebraska and the cultural development that occurred before European contact. Section 12.1.11.5 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 12.1.11.6 provides a current list of significant archaeological sites in Nebraska and tools that the state has developed to ensure their preservation. Section 12.1.11.7 documents the historic context of the state since European contact, and Section 12.1.11.8 summarizes the architectural context of the state during the historic period.

12.1.11.4. Prehistoric Setting

Archaeologists divide Nebraska' prehistoric past into four periods: The Paleoindian (10000 - 7000 B.C.), Archaic (7000 B.C. – A.D. 1), Plains Woodland (1 – A.D. 1000), and Plains Village (1000 – A.D. 1600).

Figure 12.1.11-1 a timeline representing these periods of early human habitation of present day Nebraska. 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 Nebraska'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).



Sources: (Institute of Maritime History, 2015)
(Nebraska Legislature, 2011)

Figure 12.1.11-1: Timeline of Prehistoric Human Occupation

Paleoindian Period (10000 – 7000 B.C.)

The Paleoindian Period represents the earliest human habitation Nebraska. 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. Studies show that that such technology was prevalent northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier & Inizan, 2002).

Most of the oldest known evidence of human settlement in Nebraska 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 giant bison, mammoth and other large game animals. Early Paleoindian settlers used the Clovis fluted point technology to hunt this large game (Agenbroad, 1973). These bands established seasonal camps, some of which likely became permanent settlements. It is assumed that 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) (Myers, 1995).

Around 10,000 to 7,000 thousand years ago, there was gradual warming trend in this region, and the Folsom people replaced the Clovis people. The Folsom people had more advanced methods for hunting bison, which lead to overhunting in the region. As hypothesized, the 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. The Paleoindians obtained raw material for making tools from hundreds of miles away from the west of Nebraska, which suggests that they may have migrated from the west into the state (Myers, 1995).

The Medicine Creek Drainage archaeological site in southwestern Nebraska provides evidence that the people were using the same sites during several periods of occupation. The variation in the types of tool technology and the workmanship shows a difference in the skill that went into making these objects (Myers, 1995).

Archaic Period (7000 B.C. – A.D. 1)

The climate had changed during this period. 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 warmer climate. They could no longer rely on the “big game” hunting practices for survival, due to the decline in those species. Instead, they shifted to subsistence pattern based on foraging for plants and hunting for small game. The people hunted larger game such as antelope, deer, and the occasional bison whenever they could. More grounding implements and axes are associated with this period. Other types of projectile points became more sophisticated for hunting smaller game such as deer, rabbit, and birds. Smaller points (arrowheads) are evidence that the bow and arrow was invented during this period of occupation in Nebraska (Thies & Witty, 1992).

During the latter part of the Archaic, the people began to experiment with various forms of pottery. The presences of pottery typically suggests that there was beginning to be some sort of cooking and storage of food going on. Subsistence relied heavily on hunting and gathering and there is little evidence to suggest that any type of agricultural practices were occurring during this period (Thies & Witty, 1992).

Discovered earthen mounds are associated with the later part of the archaic period for this region. Burnt and cracked rock, suggest that the people were cooking in some crude form of ovens as well during the late archaic period (Thies & Witty, 1992).

Plains Woodland Period (A.D. 1 – 1000)

The Plains Woodland period was a time of cultural change that led to the formation of skilled pottery makers in the region. Hunting and gathering continued to be the predominant form of subsistence. The bow and arrow and the atlatl¹¹⁵ were being used as the preferred method for hunting large and small game. The people began to become more sedentary during this period and even started the practice of cultivating crops such as corn and sunflowers (Studies, 2015).

The people were beginning to settle in small villages or hamlets during this period. Evidence comes from excavated archaeological sites. The Naze site in southeastern Nebraska is an example of an early Plains Woodland occupation. Artifacts found at this site include burned daub, burned earth, charred post fragments, post molds, charcoal smears, and other artifacts that indicated a residential settlement. Pottery was beginning to be used as a means for preparing and cooking food (Gregg, 1990; Duddleson, 2008).

Plains Village Period (A.D. 1000 – 1600)

As the name Plains Village Period implies, American Indians established the first real villages in this region. The earthen lodges were established along rivers that flowed through the region because of the retreating ice-melt from the last ice age (Studies, 2015).

Farming became the primary method of subsistence during this period. There is a wealth of evidence of this activity-taking place, including hoes made out of bison shoulder used for tilling the soil. The making and use of pottery is evince that the people were processing and cooking food. They built pits in the floors of the lodges (homes) for storing food to be used later, much as we store food in our pantries today. Hunting and fishing were being practiced and the use of the bow and arrow continued throughout the period. They made bone hooks for fishing in the streams and rivers, so fish also became an important part of their diet (Studies, 2015) (Toom, 2004) (Wood, 1974).

12.1.11.5. Federally Recognized Tribes of Nebraska

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are six federally recognized Tribes in Nebraska: the Iowa Tribe, the Omaha Tribe of Nebraska, the Ponca Tribe of Nebraska, the Sac and Fox Nation of Missouri, the Santee Sioux Nation, and the Winnebago Tribe of Nebraska (BIA, 2015) (National Conference of State

¹¹⁵ A type of spear-thrower using dart or spear that rests on a hook or handle on the end of a stick (Utah State History, 2015).

Legislatures, 2015). The general location of the tribes are shown in Figure 12.1.11-2. Additionally, the figure depicts the general historic location of officially federally recognized tribes that were known to exist in this region of the United States, but may no longer be present in the state.

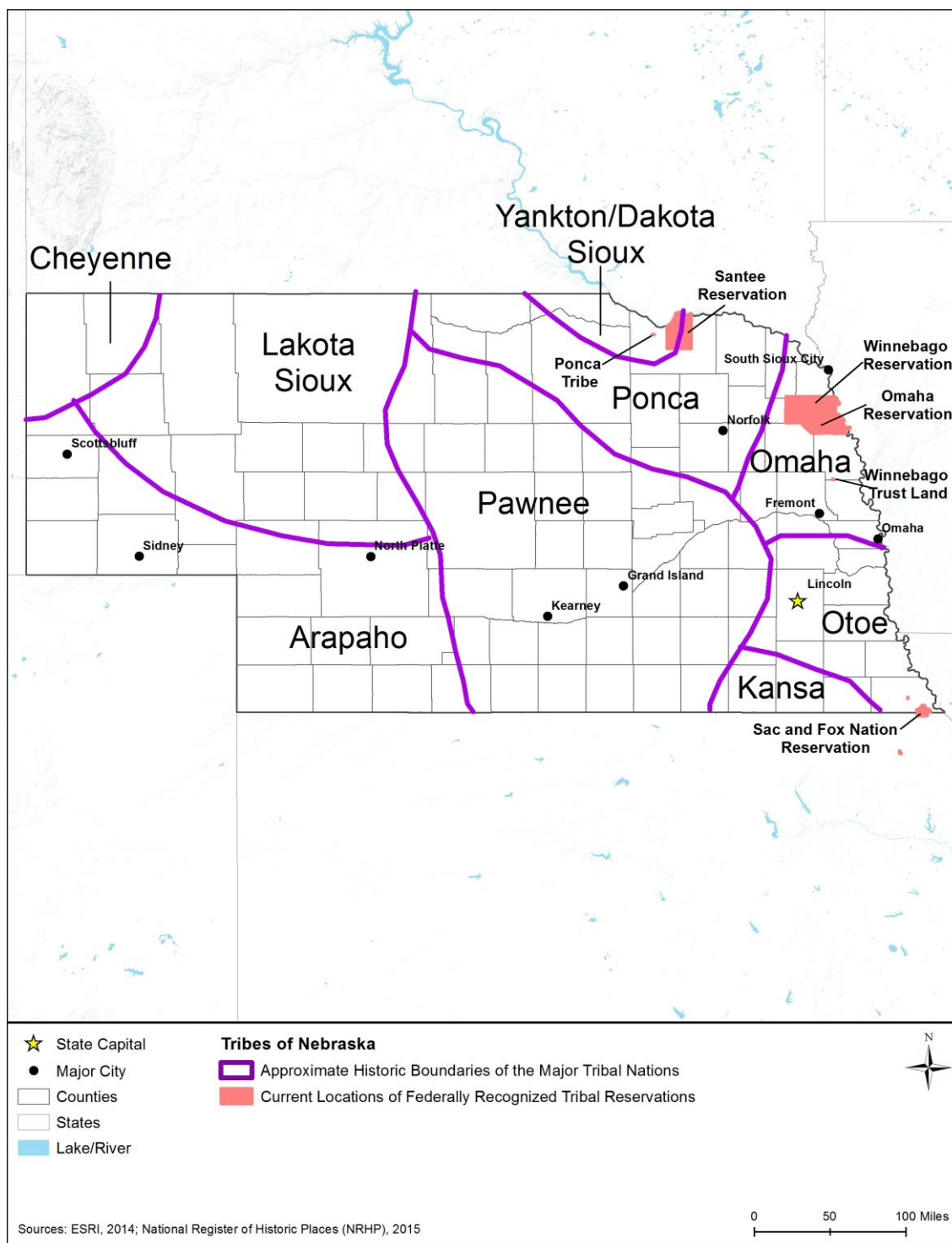


Figure 12.1.11-2: Approximate Historic Boundaries of Tribes in Nebraska¹¹⁶

¹¹⁶ Figure 12.1.11-2 is provided for context and is not intended to be exact as the various sources that were consulted contain varying ancestral territory boundaries. Instead, this figure and corresponding ancestral territory boundaries are provided to show that the historic ancestral territories and the current ancestral interests of a given tribe within a given state are often times complex as ancestral territory boundaries shifted and overlapped over time.

12.1.11.6. Significant Archaeological Sites of Nebraska

As previously mentioned in Section 12.1.11.3, there are 94 archaeological sites in Nebraska listed on the NRHP. Table 12.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are located on the NPS NRHP website at <http://www.nps.gov/nr/> (NPS, 2013b).

Nebraska State Cultural Resources Database and Tools

Nebraska State Historical Society (NSHS)

The Nebraska State Historical Society is an excellent resource for users looking for information on regional history. The society serves as Nebraska's State Historic Preservation Office (SHPO) and provides various services to the community. The NSHS website contains several resources including preservation news, publications, museum information, and the NSHS library collection, which makes 40,000 documents available to the public online. The society also maintains an online database for photographs and artifacts called Past Perfect (Nebraska Legislature, 2011).

Virtual Nebraska

Virtual Nebraska is a compiled archive of satellite imagery and photography arranged to create a digital environment of Nebraska. The project is a partnership between two University of Nebraska campuses (Lincoln and Omaha). The creators believe there is immense educational application in that users can explore and even access historical information on over 600 cities in the system (United States House of Representatives, 2005).

Table 12.1.11-2: Archaeological Sites on the National Register of Historic Places in Nebraska

Closest City	Site Name	Type of Site
Abie	Barcal Site	Prehistoric
Alda	Townsley--Murdock Immigrant Trail Site	Historic, Historic - Aboriginal
Antioch	Antioch Potash Plants	Historic
Ashland	Ashland Archeological Site	Historic - Aboriginal, Prehistoric
Ashland	Ashland Archeological District	Historic - Aboriginal, Prehistoric
Barneston	Barneston Site	Historic - Aboriginal
Bayard	Chimney Rock National Historic Site	Prehistoric
Belgrade	Cottonwood Creek Archeological Site	Historic - Aboriginal
Bellevue	Fontenelle Forest Historic District	Historic, Historic - Aboriginal, Prehistoric
Bellevue	Sarpy, Peter A., Trading Post Site	Historic, Military
Bellwood	Bellwood Archeological Site	Historic - Aboriginal, Prehistoric
Blair	Bertrand Site	Shipwreck
Bloomington	Lost Creek Archeological Site	Prehistoric
Blue Springs	Blue Springs Site	Historic - Aboriginal
Bridgeport	Camp Clarke Bridge Site	Historic, Military
Broadwater	Rush Creek Battlefield	Military
Brule	Archeological Site 25KH68	Prehistoric
Brule	Beauvais Ranch Archeological Site	Historic, Historic - Aboriginal, Military
Brule	Diamond Springs Stage Station Site	Historic
Cambridge	Mowry Bluff Archeological Site	Prehistoric
Cedar Bluffs	Pahuk	Historic
Cotesfield	Coufal Site	Prehistoric
Crawford	Hudson-Meng Bison Kill Site	Prehistoric
Creston	Feye Archeological Site	Prehistoric
Creston	Wurdeman-Lawson Archeological Site	Prehistoric
Dalton	Mud Springs Station Archeological District	Military
Dalton	Mud Springs Station Archeological District (Boundary Increase)	Military
DuBois	Farwell Archeological District	Prehistoric
Florence	Parker, Frank, Archeological Site	Prehistoric
Fullerton	Cunningham Archeological Site	Historic - Aboriginal, Prehistoric
Fullerton	Fullerton Archeological Site	Historic - Aboriginal

Closest City	Site Name	Type of Site
Fullerton	Horse Creek Pawnee Village	Historic - Aboriginal
Genoa	Burkett Archeological Site	Prehistoric
Genoa	Genoa Site	Historic - Aboriginal, Military
Genoa	Pawnee Mission and Burnt Village Archeological Site	Historic - Aboriginal
Genoa	Wright Site	Prehistoric
Gering	Signal Butte	Historic - Aboriginal, Prehistoric
Grand Island	Stolley, William, Homestead and Site of Fort Independence	Historic, Military
Guide Rock	Pike-Pawnee Village Site	Historic - Aboriginal
Hastings	Thirty-Two Mile Station Site	Historic
Hay Springs	Camp Sheridan and Spotted Tail Indian Agency	Historic, Military, Historic - Aboriginal
Homer	Homer Site	Historic
Inglewood	McClean Site	Historic - Aboriginal
Inglewood	Woodcliff Burials	Historic - Aboriginal
Kearney	Dobytown	Historic, Military
La Platte	Moses Merrill Mission and Oto Indian Village	Historic, Historic - Aboriginal
Leshara	Leshara Site	Historic - Aboriginal
Lewellen	Ash Hollow Cave	Historic - Aboriginal, Prehistoric
Linwood	Linwood Site	Historic - Aboriginal, Prehistoric
Loup City	Archeological Site 25SM20	Prehistoric
Lynch	Lynch Archeological Site	Prehistoric
Macy	Blackbird Hill	Historic, Historic - Aboriginal
Marsland	Running Water Stage Station Site	Historic
McCook	Doyle Archeological Site	Prehistoric
Milford	Troyer Site	Prehistoric
Monroe	Hill--Rupp Site	Prehistoric
Monroe	Larson, Hanna, Archeological Site	Historic - Aboriginal
Mullen	Humphrey Archeological Site	Historic - Aboriginal
Mullen	Kelso Site	Prehistoric
Murray	Gilmore, Walker, Site (22CC28)	Prehistoric
Nehawka	Nehawka Flint Quarries	Prehistoric
New Castle	Indian Hill Archeological District	Prehistoric
Niobrara	Ponca Agency	Historic, Historic - Aboriginal, Military
Niobrara	Ponca Agency Archeological District	Historic, Historic - Aboriginal
North Loup	Schultz Site	Prehistoric

Closest City	Site Name	Type of Site
Oakland	Logan Creek Site	Prehistoric
Omaha	Cabanne Archeological Site	Historic
Omaha	Champe-Fremont 1 Archeological Site	Prehistoric
O'Neill	Eagle Creek Archeological Site	Prehistoric
Osceola	Clarks Sit	Historic - Aboriginal
Palmer	Palmer Site	Historic - Aboriginal, Prehistoric
Papillion	Kurz Omaha Village	Historic - Aboriginal
Paxton	Archeological Site 25KH67	Prehistoric
Potter	Stevens, Wes, Site	Historic
Redbird	Redbird I Site	Historic - Aboriginal
Roca	Schrader Archeological Site	Historic
Rulo	Leary Site	Prehistoric
Schuyler	Schuyler Site	Historic, Prehistoric
Schuyler	Wolfe Archeological Site	Prehistoric
Scottsbluff	Fort Mitchell Site	Historic, Military
Scottsbluff	Wind Springs Ranch Historic and Archeological District	Historic, Historic - Aboriginal, Prehistoric
Sidney	Wild Horse Draw--Leeman's Springs Archeological District	Historic, Historic - Aboriginal, Prehistoric
Silver Creek	Strickland Site	Prehistoric
South Bend	Patterson Site	Prehistoric
St. Helena	Schulte Archeological Site	Prehistoric
Stockville	Red Smoke Archeological Site	Prehistoric
Sweetwater	Sweetwater Archeological Site	Prehistoric
Table Rock	Table Rock Archeological Site	Prehistoric
Trenton	Massacre Canyon Battlefield	Historic - Aboriginal, Military, Prehistoric
Verdel	Ponca Fort Site	Historic - Aboriginal
Wauneta	Lovett Site	Prehistoric
Weeping Water	Davis, Theodore, Site	Prehistoric
Wynot	Wiseman Archeological Site	Prehistoric
Yutan	Yutan Site	Historic - Aboriginal

Source: (NPS, 2015o)

12.1.11.7. Historic Context

The land that is now Nebraska was acquired by the United States as part of the Louisiana Purchase in 1803. Minimal exploration had occurred in the 18th century under French and Spanish control such as Etienne Veniard de Bourgmont in 1714, Colonel Pedro de Villasur in 1720, Pierre and Paul Mallet in 1739, and James MacKay in 1795 among others—although the Louis and Clark expedition in 1804 was the first to extensively explore and document the area. Following the Louis and Clark expedition, increased trading, fur trapping, and settlement began to occur. Trading posts were established near rivers, especially the Missouri River, serving pioneers as they moved west in increasing numbers (Nebraska State Historical Society, 1990).

In 1854, the Kansas-Nebraska Act established the Nebraska Territory.¹¹⁷ Settlements continued along rivers, particularly the Missouri, South Platte, Platte, and Elkhorn Rivers. While agriculture was not the dominate industry initially, this had changed by the end of the 1850s and it had become important to the state (Nebraska State Historical Society, 1990).

During the Civil War, Nebraskans tired of the conflict as it drew troops away from frontier forts that were meant to protect settlers from Indian attacks (Naugle, Montag, & Olson, 2014). On March 1, 1867, Nebraska was admitted to the Union as the 37th state, with the capital being moved from Omaha to Lincoln shortly thereafter (Nebraska State Historical Society, 1990).

German, Czech, and other European settlers were common during the 19th century, being spurred into relocation by a variety of external factors within their home countries (Naugle, Montag, & Olson, 2014). Domestic policies such as the Homestead Act of 1862 encouraged settlement as well. All of this was further facilitated by an increase in rail travel, particularly following the completion of the first transcontinental railroad in 1869 which cut east-west across the whole state. Economic fluctuations relating to the agriculture industry affected the state during the latter part of the 19th century, with urban growth at times being hindered as a result of this instability (Nebraska State Historical Society, 1990).

During World War I (WWI), food production increased steeply to support the demands of the war effort, and Nebraska supplied many troops for the armed forces. Following WWI, agricultural prices fell, resulting in hardships for farmers beginning even prior to the onset of the Great Depression. This resulted in increased migration into urban cities, as workers looked for work. The introduction of the automobile in the early 20th century lessened the amount of goods shipped by train, and increased road construction to support these changes in transportation. Farm prices fell further during the Great Depression, with farmers relying heavily on New Deal relief programs. Nebraskans also participated in New Deal programs that built highways, public facilities, and bridges throughout the state (Nebraska State Historical Society, 1990).

During World War II (WWII), Nebraska supported the war effort in a variety of ways. Crop prices increased to meet wartime demands, Nebraskans served in the armed forces, and Omaha was the home of a heavy bomber construction plant that employed both men and women; there were also training facilities and prisoner-of-war camps located in the state. Following the war,

¹¹⁷ The Kansas-Nebraska Act of 1854 was a political compromise relating to the admission of territories allowing slavery and territories not allowing slavery into the Union.

urban growth occurred, as did road construction, including the construction of the interstate highway system (Nebraska State Historical Society, 1990).

Nebraska has 1,112 NRHP listed sites, as well as 20 NHLs (NPS, 2013b). Nebraska contains no National Heritage Areas (NRCS, 2015a). Figure 12.1.11-3 shows the location of NRHP sites within Nebraska.¹¹⁸

¹¹⁸ See Section 12.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

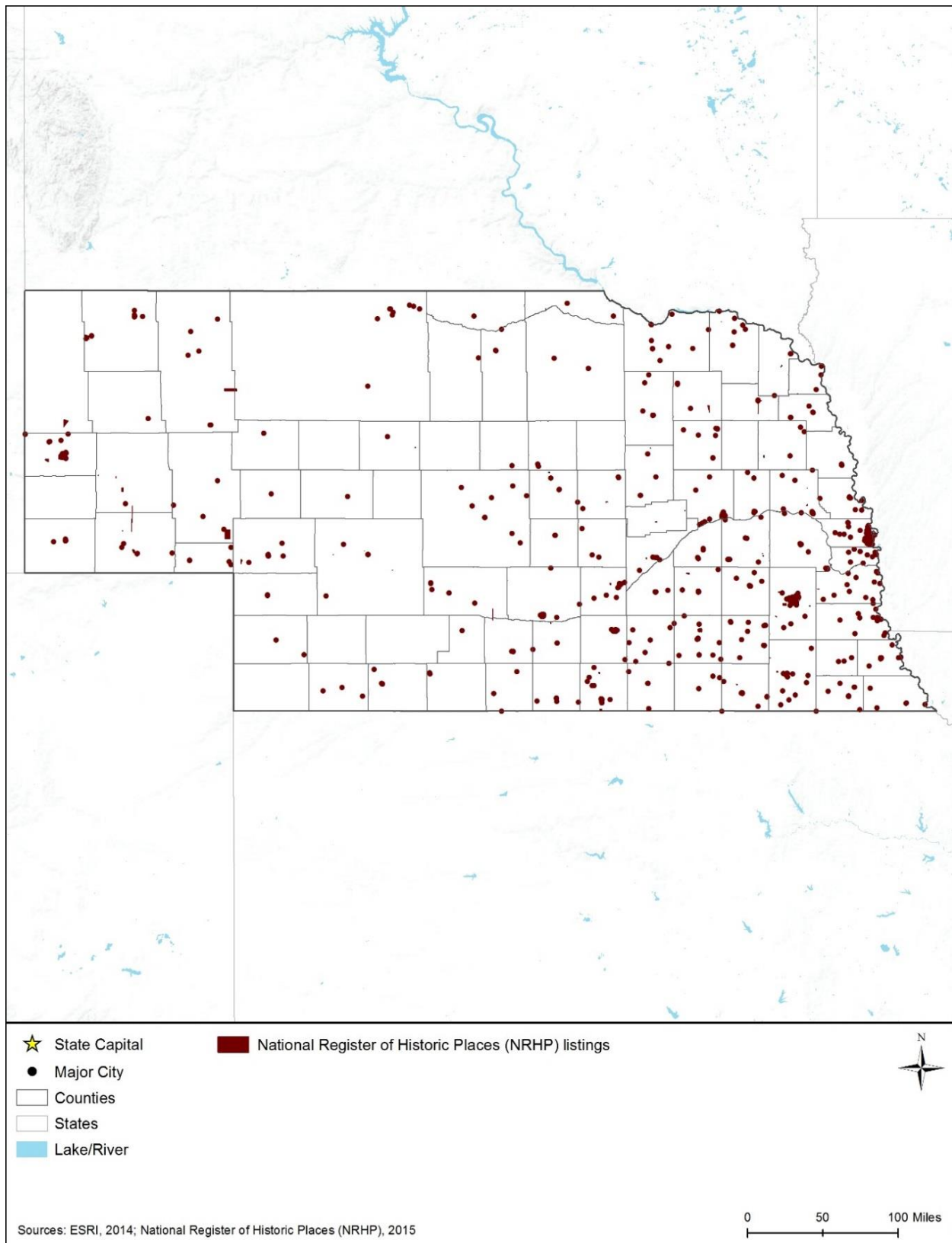


Figure 12.1.11-3: National Register of Historic Places (NRHP) Sites in Nebraska

12.1.11.8. Architectural Context

Indigenous architecture in Nebraska would have largely consisted of earthen dwellings (“earth loges”) inhabited by an Indian population that was involved in farming, but prone to “temporarily abandon the village and hunt bison that roamed the prairie in massive herds” (Society of Architectural Historians, 2015). As settlement increased, early trading posts were established along rivers and popular overland routes. These were often constructed of packed earth or covered with thatch or hide (Nebraska State Historical Society, 2009). While logs were used when available, the sparse vegetation in Nebraska resulted in many dwellings being constructed of hardened earth well into the 19th century. This would have been particularly common among immigrants who lacked the capital to build more elaborate homes (Society of Architectural Historians, 2015). These dwellings traditionally had earthen roofs as well.

As settlement increased following the formation of the Nebraska Territory, and the Homestead Act of 1862, many settlers of European descent continued to live in earthen dwellings because of the scarcity of wood in many places (Society of Architectural Historians, 2015). Nationally popular styles were seen in urban settlements more than in rural areas. Federal architecture had mostly waned by the time development was occurring in Nebraska; however, examples can be seen. Revival architecture was built during the second half of the 19th century, including Greek Revival, Gothic Revival, Queen Anne, Richardsonian Romanesque, and others. In the early 20th century, neoclassical architecture became popular, particular in civic and commercial structures such as banks and jails. Prairie architecture grew as Frank Lloyd Wright exerted his influence on the nation. Further revival styles continued to be built in domestic architecture, including Tudor Revival and Colonial Revival, minimal traditional houses after WWII, and ranch houses during the 1950s and 1960s. Modern architecture can also be found, including Art Deco, Art Moderne, and International (Society of Architectural Historians, 2015).

School buildings are important to the history of the state. As is the case with other Western and Midwestern states, the number of schools, as well as other civic institutions such as courthouses and jails, grew as settlement increased. These were viewed as important beacons of civilization on the frontier, and surviving examples are of particular importance (NPS, 2000). Nebraska also has a collection of Carnegie Libraries that has been documented and recorded. Carnegie Libraries were built with funding from industrialist Andrew Carnegie, and were focal points of the town. These buildings exhibited high-style examples of neoclassical and other styles of architecture (National Register of Historic Places, 1991).

Transportation developments are important to the history of the state. Railroads were crucial to moving people westward early on, with the first transcontinental railroad being a great example (Nebraska State Historical Society, 1990). Beginning in the late 19th century, but especially from the early 20th century up through the development of the interstate system after WWII, roads for automobiles were a large focus of development efforts (Mead & Hunt & Heritage Research, LTD, 2002). The Detroit-Lincoln-Denver Highway, built during the second decade of the 20th century, is a particularly important road that served as one of the country’s first transcontinental roads, allowing goods to move from the Midwest to the western United States (National Register of Historic Places, 2014). Beginning in the early 20th century, aviation facilities were established

in Nebraska, with additional facilities being constructed during WWII (Mead & Hunt, 2001). Figure 12.1.11-4 provides images of representative architectural styles of Nebraska.



Top Left – Sod House (Alliance, NE) – (Rothstein, 1936)
Top Right – Nebraska Capitol Building (Lincoln, NE) – (Highsmith, 2007)
Bottom Left – Smith Building (Omaha, NE) – (HABS, 1933a)
Bottom Middle – Lincoln City Hall (Lincoln, NE) – (HABS, 1933b)
Bottom Right – Houses near railroad tracks (Omaha, NE) – (Vachon, 1938)

Figure 12.1.11-4: Representative Architectural Styles of Nebraska

12.1.12. Air Quality

12.1.12.1. Definition of the Resource

Air Quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography¹¹⁹ 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)¹²⁰ or micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) determined over various periods of time (averaging time).¹²¹ This section discusses the existing

¹¹⁹ Topography: The unique features and shapes of the land (e.g., valleys and mountains).

¹²⁰ Equivalent to 1 milligram per liter (mg/L).

¹²¹ 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, 2015h)

air quality in Nebraska. The USEPA designates areas within the United States as attainment,¹²² nonattainment,¹²³ maintenance,¹²⁴ or unclassifiable¹²⁵ depending on the concentration of air pollution relative to ambient air quality standards. Information is presented regarding national and state ambient air quality standards and nonattainment areas that would be potentially more sensitive to impacts from implementation of the Proposed Action or alternatives.

12.1.12.2. Specific Regulatory Considerations

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, oxides of nitrogen (NO_x), particulate matter (PM_{2.5} and PM₁₀), ozone (O₃), and oxides of sulfur (SO_x). The NAAQS establish various standards, either primary¹²⁶ or secondary,¹²⁷ for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure. A description of the NAAQS is presented in Appendix E.

In addition to the NAAQS, there are standards for hazardous air pollutants (HAP), which are those typically associated with specific industrial processes such as chromium electroplating (hexavalent chromium), dry cleaning (perchloroethylene), and solvent degreasing (halogenated solvents) (USEPA, 2016c). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs.

In conjunction with the federal NAAQS, Nebraska maintains its own air quality standards. Table 12.1.12-1 presents an overview of these standards as defined by the NDEQ.

¹²² Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015i).

¹²³ Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015i).

¹²⁴ Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment (USEPA, 2015i).

¹²⁵ Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant (USEPA, 2015i).

¹²⁶ Primary standard: The primary standard is set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly (USEPA, 2014a).

¹²⁷ Secondary standards: The secondary standard is set to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings (USEPA, 2014a).

Table 12.1.12-1: Nebraska Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard ^a		Secondary Standard		Notes
		µg/m ³	ppm	µg/m ³	ppm	
CO	8-hour	-	9	-	-	Standard is not to be exceeded more than once per year
	1-hour	-	35	-	-	
Lead	3-month	0.15	-	Same as Primary		Rolling three-month average. Not to be exceeded
NO ₂	1-hour	-	0.10	-	-	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Annual	-	0.053	Same as Primary		Annual mean
PM ₁₀	24-hour	150	-	Same as Primary		Not to be exceeded more than once per year on average over 3 years
PM _{2.5}	Annual	12	-	15	-	Annual mean, averaged over 3 years
	24-hour	35	-	Same as Primary		98th percentile, averaged over 3 years
O ₃	8-hour	-	0.075	Same as Primary		Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
SO ₂	1-hour	-	0.075	-	-	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	3-hour	-	-	-	0.5	Not to be exceeded more than once per year
Total Reduced Sulfur	1-minute	-	10.0	-	-	Maximum average concentration
	30-minutes	-	0.10	-	-	Maximum rolling average

Source: (NDEQ, 2015g)

Title V Operating Permits/State Operating Permits

Nebraska 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, 2015j). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015j). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b). The federal Title V operating permit program is also known as Nebraska’s state-specific Class I (major sources) operating permit program. The Nebraska Administrative Code Title 129.05 (Operating Permits – When Required) describes the applicability of Class I (major source) operating permits. The Nebraska DEQ requires Class I operating permits for a major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 12.1.12-2). Nebraska requires

Class II (minor source) operating permits for sources with the potential to emit below the major source criteria, but have actual emissions more than 50 tons per year (tpy) of PM₁₀, NO₂, SO₂, SO₃, VOC or CO; 5 tpy of any one HAP or 12.5 tpy of a combination of HAPs (see Appendix E); and 2.5 tpy of lead (NDEQ, 2015g).

Table 12.1.12-2: 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, 2014b)

Exempt Activities

The Nebraska Administrative Code Title 129.05.002 (Source Category Exemptions) provides exemptions from Class I and Class II operating permits. Sources that are exempt from obtaining a Class I or II operating permit include those sources that “are required to obtain a permit solely because of the presence of a generator whose sole function is to provide back-up power when electrical power from the local utility is interrupted” (NDEQ, 2015g).

Temporary Emission Sources Permits

Nebraska can issue temporary permits for emissions from similar operations by the same source owner or operator at multiple temporary locations. Title 129.10.001 (Operating Permits for Temporary Sources) states, “the operation must be temporary and involve at least one change of location during the term of the permit. No affected source¹²⁸ may be permitted as a temporary source” (NDEQ, 2015g).

The Nebraska DEQ allows temporary operating permits under Title 129.10.004 (Operating Permits for Temporary Sources) for “temporary activities initiated to maintain or restore electrical power supply or prevent imminent power loss.” Title 129.10.004.01 states “temporary power generation units maintained within the state must be covered by an operating permit which identifies them as temporary units, specifies their rating, fuel supply, non-working location, and routine operating practices, and establishes notification procedures for such activities.” Title 129.10.004.02 requires the operator of temporary power generation units maintained outside of the state to notify the Nebraska DEQ prior to bringing them into Nebraska. The operator must notify the Nebraska DEQ in the event of power loss or before conducting maintenance activities (NDEQ, 2015g).

¹²⁸ Affected source: “A source that includes one or more affected units that are subject to emission reduction requirements or limitations under Chapter 26 [Acid Rain]” (NDEQ, 2015g).

State Preconstruction Permits

The Nebraska DEQ requires construction permits under Title 129.17.001 (Construction Permits-When Required) for “any stationary source or emission unit, such that there is a net increase in potential emissions at the stationary source equal to or exceeding the following levels:

- Fifteen (15) tons/year of PM₁₀ emissions;
- Ten (10) tons/year of PM_{2.5} emissions;
- Forty (40) tons/year of sulfur dioxide (SO₂) or sulfur trioxide (SO₃), or any combination of the two;
- Forty (40) tons/year of oxides of nitrogen (calculated as NO₂);
- Forty (40) tons/year of volatile organic compounds (VOC);
- Fifty (50) tons/year of carbon monoxide (CO);
- Six-tenths (0.6) tons/year of lead; and
- Two and one-half (2.5) tons/year of any HAP or an aggregate of ten (10) tons/year of any HAPs, including all associated fugitive emissions¹²⁹ (NDEQ, 2015g).

General Conformity

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

The estimated pollutant emissions are compared to *de minimis*¹³⁰ levels. These values are the minimum thresholds for which a conformity determination must be performed (Table 12.1.12-3).

Table 12.1.12-3: *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 Ozone Transport Region (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

¹²⁹ Fugitive emissions: “Emissions which could not reasonable pass through a stack, chimney, vent, or other functionally equivalent opening” (NDEQ, 2015g).

¹³⁰ 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, 2016)

Pollutant	Area Type	TPY
	Moderate Nonattainment and Maintenance	100
PM _{2.5} (Direct Emissions) (SO ₂) (NO _x [unless determined not to be a significant precursor]) (VOC or ammonia [if determined to be significant precursors])	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

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

If an action does not result in an emissions increase above the *de minimis* levels in Table 12.1.12-3, 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 12.1.12-3, 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,¹³¹ the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state's SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and
- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS (USEPA, 2010).

State Implementation Plan (SIP) Requirements

The Nebraska SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Nebraska's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Nebraska's SIP actions are codified under 40 CFR Part 52 Subpart CC. A list of SIP actions for all six criteria pollutants can be found on the NDEP's website: <http://ndep.nv.gov/baqp/planmodeling/techregsip.html>.

12.1.12.3. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment,

¹³¹ Conformity: Compliance with the State Implementation Plan.

while unclassifiable areas are combined with attainment areas. Figure 12.1.12-1 and Table 12.1.12-4, below, present the nonattainment areas in Nebraska as of January 30, 2015. Table 12.1.12-4 contains a list of the counties and their respective current nonattainment status of each criteria pollutant. The year(s) listed in the table for each pollutant indicate the date(s) when USEPA promulgated an ambient air quality standard for that pollutant. Note certain pollutants have more than one standard in effect (e.g., PM_{2.5}, O₃, and SO₂). Unlike Table 12.1.12-4, Figure 12.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM₁₀ and PM_{2.5} merge in the figure to count as a single pollutant.

Table 12.1.12-4: Nebraska Nonattainment and Maintenance Areas by Pollutant Standard and County

Area	Pollutant and Year USEPA Implemented Standard									
	CO	Lead		NO ₂	PM ₁₀	PM _{2.5}		O ₃		SO ₂
	1971	1979	2008	1971	1987	1997	2006	1997	2008	1971 2010
Douglas		M								

Source: (USEPA, 2015k)

X-1 = Nonattainment Area (Extreme)
X-2 = Nonattainment Area (Severe)
X-3 = Nonattainment Area (Serious)
X-4 = Nonattainment Area (Moderate)
X-5 = Nonattainment Area (Marginal)
X-6 = Nonattainment Area (Unclassified)
M = Maintenance Area

Air Quality Monitoring and Reporting

The Nebraska DEQ measures air pollutants at 26 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (NDEQ, 2014). Annual State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region (NDEQ, 2015h). The Nebraska DEQ reports real-time pollution levels of O₃, CO, and PM on the AirNOW¹³² website to inform the public.

¹³² AirNow is a government website that posts daily Air Quality Index for more than 400 cities.

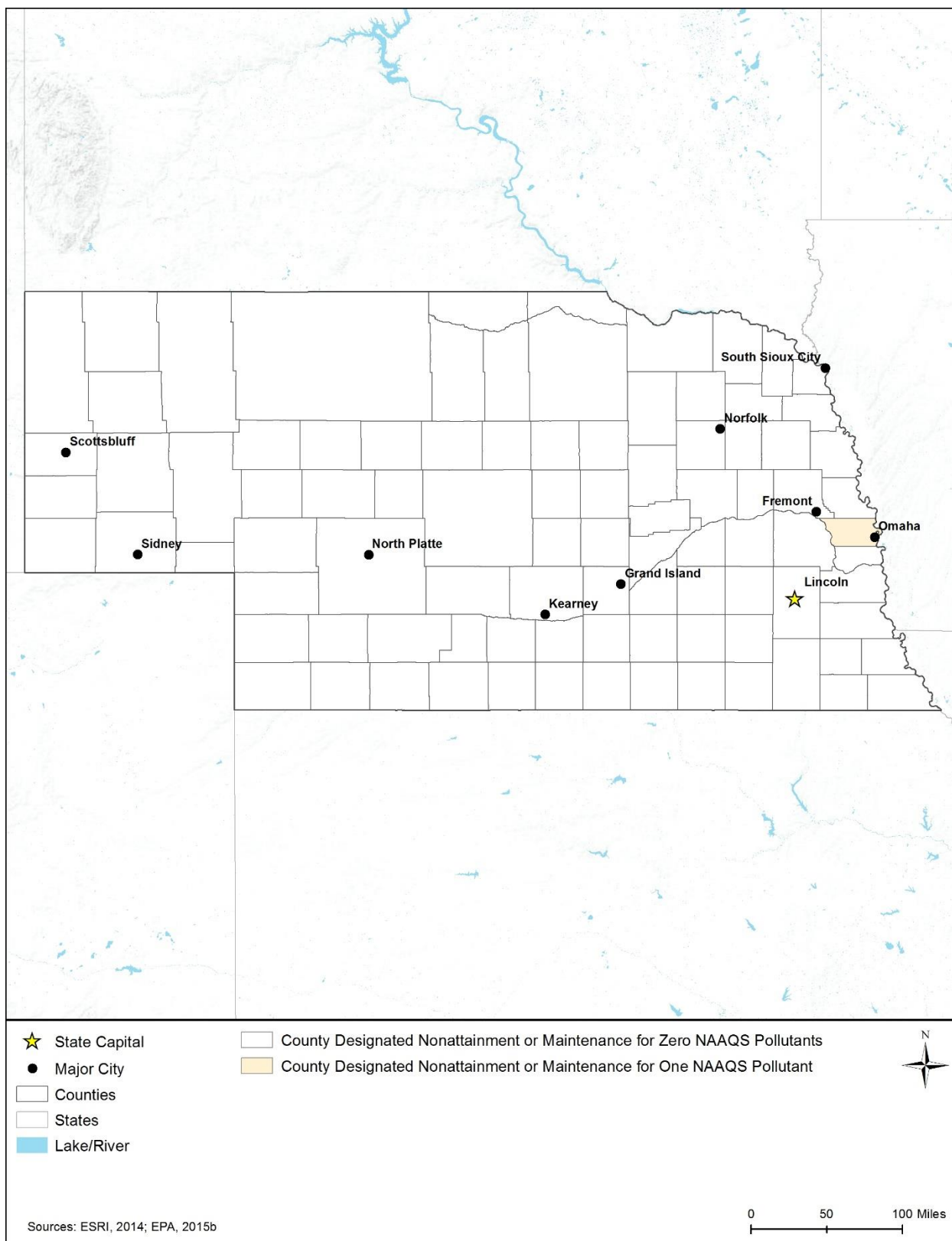


Figure 12.1.12-1: Nonattainment and Maintenance Counties in Nebraska

Air Quality Control Regions

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

In a 1979 USEPA memo 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 kilometers¹³³ of a Class I area. “The EPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. “Historically, the EPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 100 kilometers¹³⁴ (the normal useful range of EPA-approved Gaussian plume models” (USEPA, 1992).

Nebraska does not contain any Federal Class I areas; all of the state is classified as Class II (USEPA, 2012a). If an action is considered a major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 km from the source. South Dakota has Class I area with a 100-km buffer over a few Nebraska counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office. Figure 12.1.12-2 provides a map of Nebraska highlighting all relevant Class I areas and all areas within the 100-km radiuses. The number next to the Class I area in Figure 12.1.12-2 corresponds to the Class I area in Table 12.1.12-5.

Table 12.1.12-5: Relevant Federal Class I Areas

No. ^a	Area	Acreage	State
1	Wind Cave National Park	33,847	SD

Source: (USEPA, 2012a)

^a The numbers correspond to the shaded regions in Figure 12.1.12-2.

¹³³ The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

¹³⁴ The memorandum and associated guidance use kilometers; 50 kilometers is equal to about 31 miles.

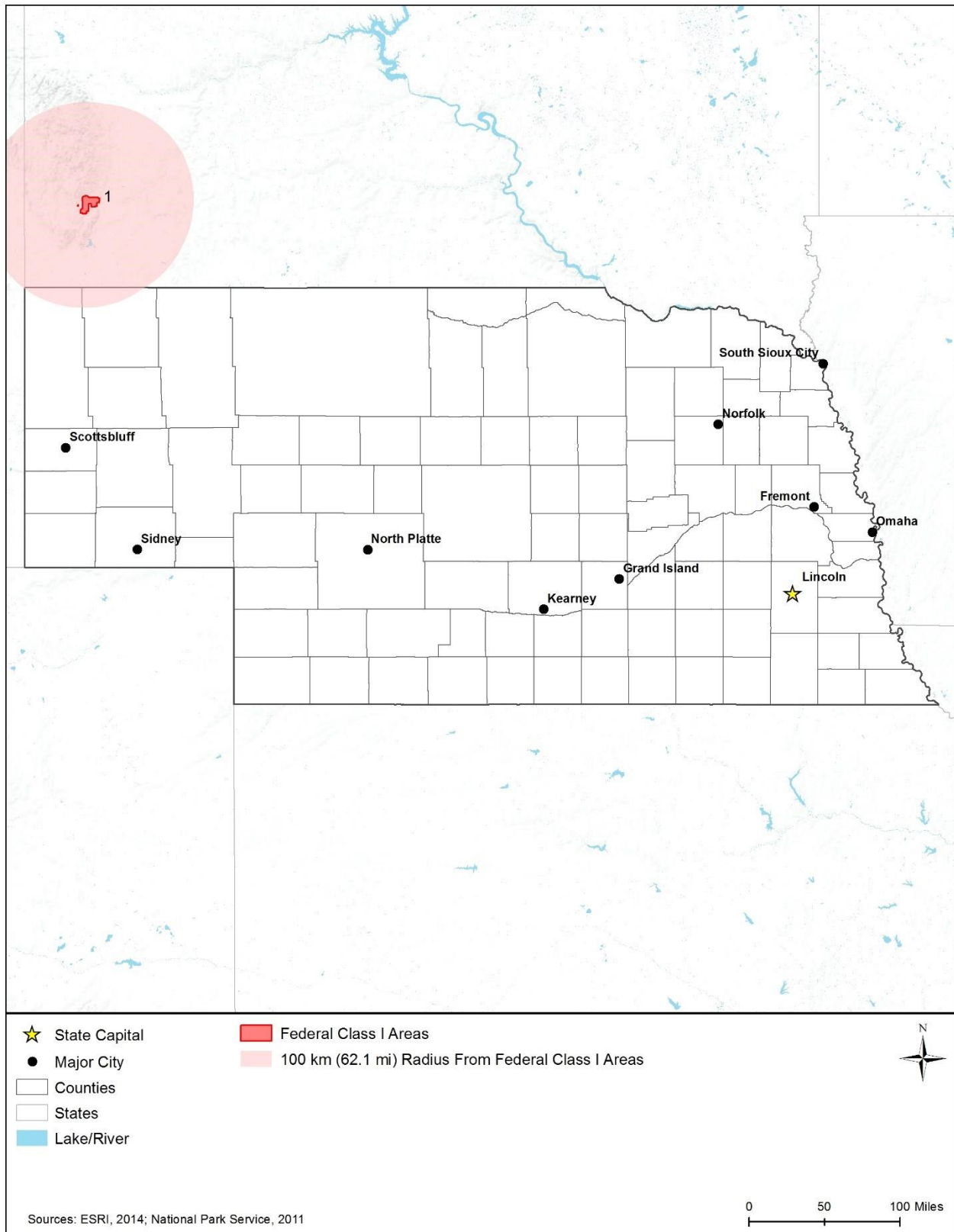


Figure 12.1.12-2: Federal Class I Areas with Implications for Nebraska

12.1.13. Noise and Vibration

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

12.1.13.1. Definition of the Resource

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

The effects of noise can be classified into three categories:

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

Ground-borne vibrations, which in many instances can be caused by tools or equipment that generate noise, can also result from roadway traffic, rail traffic, and industrial activities as well as from some construction-related activities such as blasting, pile-driving, vibratory compaction, demolition, and drilling. Unlike noise, most ground-borne vibrations are not typically experienced every day by most people because the existing environment does not include a significant number of perceptible ground-borne vibration events.

Fundamentals of Noise and Vibrations

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. The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015g). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA, 2016a).

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

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

Figure 12.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.



Source: (Sacramento County Airport System, 2015)
Prepared by: Booz Allen Hamilton

Figure 12.1.13-1: Sound Levels Typical of Sounds

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.

Related to noise, vibration is a fluctuating motion described by displacement with respect to a reference point. Depending on the intensity, vibrations may create perceptible ground shaking and the displacement of nearby objects as well as rumbling sounds. Table 12.1.13-1 lists vibration source levels produced by typical construction machinery and activities at a distance of 25 feet in units of vibration decibels (VdB). The vibration thresholds for human perceptibility and potential building damage are 65 and 100 VdB, respectively (Federal Transit Authority, 2006).

Table 12.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)

Equipment ^a	VdB at 25 feet away
Pile Driver (impact type)	104-112
Pile Driver (sonic or vibratory type)	93-105
Vibratory Roller	94
Hoe Ram	87
Large Bulldozer	87
Caisson Drilling	87
Loaded Trucks	86
Jackhammer	79
Small Bulldozer	58

Source: (Federal Transit Authority, 2006)

VdB = vibration decibels

^a The types of equipment listed in this table are included for reference purposes only. It is possible that not all equipment types listed here would be used in the deployment and operation of the Proposed Action.

12.1.13.2. 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.

Nebraska has several statewide noise regulations, which are compiled under the Nebraska Revised Statutes. For instance, Chapter 60 Section 6,368 empowers the Director of Environmental Quality to promulgate noise regulations as stated by the Nebraska Revised Statutes (Nebraska Legislature, 2013). The regulations mainly apply to motor vehicle functions such as engine running and muffling. Table 12.1.13-2 provides a brief summary of these regulations.

Table 12.1.13-2: Relevant Nebraska Noise Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
60-6,286	Department of Motor Vehicles (DMV)	Requires the use of a muffler in good working order for motor vehicles driven on highways.
60-6,370	DMV	Establishes maximum noise limits for motor vehicles during operation.
60-6,371	DMV	Prohibits the tampering of originally manufactured noise-abatement devices on motor vehicles.

Source: (Nebraska Legislature, 2013)

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

12.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Nebraska varies widely based on the area and environment of the area. The population of Nebraska can choose to live and interact in areas that are large cities, suburban neighborhoods, rural communities, and national and state parks.

illustrates noise values for typical community settings and events that are representative of what the population of Nebraska may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Nebraska. As such, this section describes the areas where the population of Nebraska can potentially be exposed to higher than average noise levels.

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

Interior, 2008). The urban areas that are likely to have the highest ambient noise levels in the state are Omaha and Lincoln.

- **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 on the type of aircraft and associated engine (FAA, 2012). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports is in proximity to urban communities, resulting in noise exposure from aircraft operations (arrivals/departures) to the 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 Nebraska, Eppley Airfield (OMA) has annual operations of more than 82,000 flights (FAA, 2015h). These operations result in increased ambient noise levels in the surrounding communities. See Section 12.1.7.10, Airspace, and Figure 12.1.7-5 for more information about airports in the state.
- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (FHWA, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015d). See Section 12.1.1, Infrastructure, and Figure 12.1.1-1 for more information about the major highways in the state.
- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (Federal Transit Authority, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (FRA, 2015b). Nebraska has a major passenger rail corridor with the Nebraskan section of the California Zephyr extending from Omaha to McCook (NDOR, 2012b). See Section 12.1.1, Infrastructure, and Figure 12.1.1-1 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, which are regions that are given legal safeguards in order to maintain biological diversity and natural resources (NPS, 2013c). These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014d). Nebraska has five NPS areas and five NNLs (NPS, 2015a) (NPS, 2014b). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 12.1.8, Visual Resources, and Figure 12.1.8-1 for more information about national and state parks for Nebraska.

12.1.13.4. Sensitive Noise Receptors

Noise-sensitive receptors include residences, schools, medical facilities, places of worship, libraries, churches, nursing homes, concert halls, playgrounds, and parks. Sensitive noise receptors are typically areas where the intrusion of noise can disrupt the use of the environment. A quiet urban area usually has a typical noise level in the daytime of 50 dBA, and 40 dBA during the evening. Noise levels in remote wilderness and rural nighttime areas are usually 30 dBA (BLM, 2014b). Most cities and towns in Nebraska 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 Nebraska.

12.1.14. Climate Change

12.1.14.1. Definition of the Resource

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

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012c). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO₂-equivalent¹³⁵ (MT CO₂e), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO₂ only, the units are in million metric tons (MMT) CO₂. Where the document references emissions of multiple GHGs, the units are in MMT CO₂e.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" with "Atmospheric concentrations of CO₂ increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005" (IPCC, 2007). The atmospheric concentration of CH₄ and N₂O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this Final PEIS (see Section 12.2.14, Environmental Consequences). Existing climate conditions in the

¹³⁵ CO₂e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMT CO₂e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMT CO₂e = (million metric tons of a gas) * (GWP of the gas)" (USEPA, 2015d).

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 and drought; and 3) severe weather events.

12.1.14.2. 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. Nebraska has not established goals and regulations to reduce GHG emissions to combat climate change.

The Council on Environmental Quality (CEQ) published draft National Environmental Policy Act (NEPA) guidance on the consideration of the effects of climate change and greenhouse gas in February of 2010. Revised draft guidance was published in December 2014 and in August 2016 (after publication of the Draft PEIS) CEQ published its final guidance. This guidance is applicable to all federal agency actions and is meant to facilitate compliance within the legal requirements of NEPA. The CEQ guidance describes how federal agency actions should evaluate GHG and climate change effects in their NEPA reviews, using GHG emissions as a proxy for assessing a proposed action's potential effect on climate change. CEQ defines GHGs to include CO₂, CH₄, N₂O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which is in accordance with Section 19 (m) of *Executive Order 13693*. The final CEQ guidance suggests that agencies consider “(1) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions (e.g. to include, where applicable, carbon sequestration); and (2) the effects of climate change on a proposed action and its environmental impacts.” The final guidance recommends that agencies quantify an action's projected direct and indirect GHG emissions when data inputs are reasonably available to support calculations. The final guidance states that “agencies should be guided by the principle that the extent of the analysis should be commensurate with the quantity of the projected GHG emissions and take into account available data and GHG quantification tools that are suitable for and commensurate with the proposed agency action.” In addition, CEQ recommends agencies evaluate project emissions and changes in carbon sequestration and storage, when appropriate, in assessing a proposed action's potential climate change impacts. The analysis should assess direct and indirect climate change effects of a proposed project including connected actions, the cumulative impacts of its proposed action, and reasonable alternatives. CEQ advises that climate change effects on the environmental consequences of a proposed action should be described based on available studies, observations, interpretive assessments, predictive modeling, scenarios, and other empirical evidence. The temporal bounds should be limited by the expected lifetime of the proposed project. Mitigation and adaptation measures should be considered in the analysis for effects that occur immediately and in the future.

Nebraska Greenhouse Gas Emissions

Estimates of Nebraska's total GHG emissions vary. The Department of Energy's (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as methane (CH₄) and nitrous oxide (NO_x), but not at the state level (EIA, 2015e). The USEPA also collects and disseminates national-level GHG emissions data, but by economic

sector, not by state (USEPA, 2014c). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

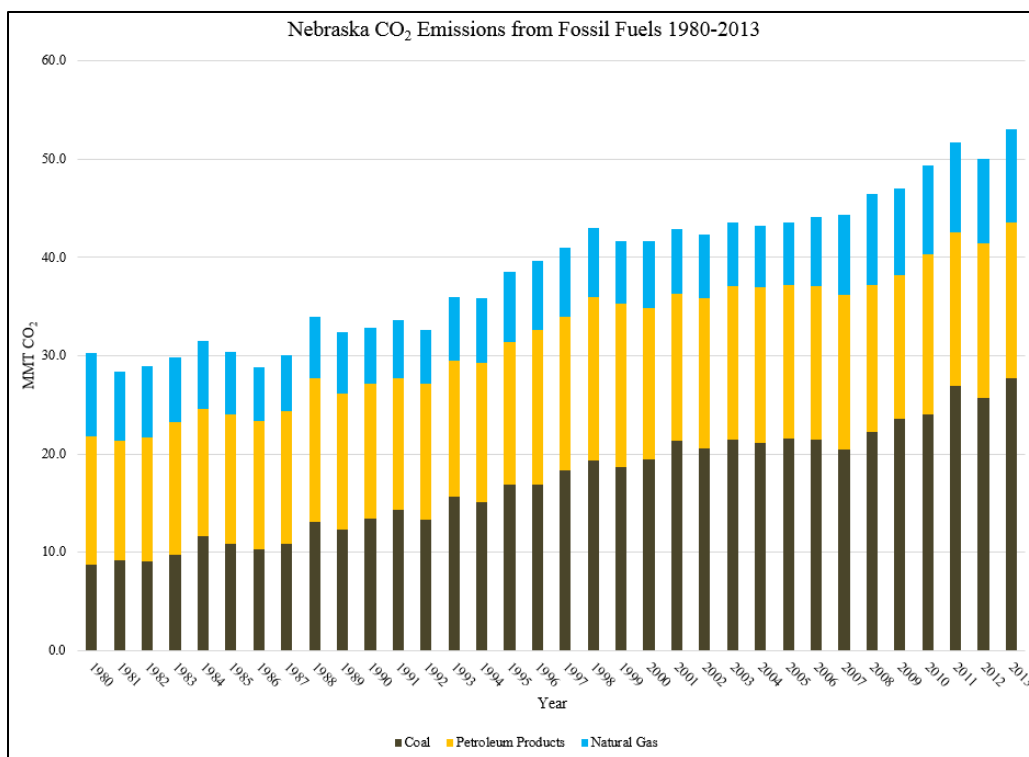
For the purposes of this Final PEIS, the EIA data on CO₂ emissions are used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH₄, they are described and cited.

According to the EIA, Nebraska emitted a total of 52.1 MMT of CO₂ in 2014, with electric power being the highest emitter, consisting almost entirely of emissions from coal at 24.0 MMT. The transportation sector was the next highest at 13.9 MMT (Table 12.1.14-1) (EIA, 2015f). Annual emissions between 1980 and 2013 are presented in Figure 12.2.14-1. Between 1980 and 2014, Nebraska's CO₂ emissions increased by over 71 percent, or 21.8 MMT. Most of these increases came from emissions from coal, with emissions from natural gas and petroleum products remaining relatively constant, although natural gas emission in the industrial sector did increase from 2.7 MMT in 1980 to 4.8 MMT in 2014. In 2014, Nebraska was 36th overall for CO₂ emissions (EIA, 2015g).

**Table 12.1.14-1: Nebraska CO₂ Emissions from Fossil Fuels
by Fuel Type and Sector, 2014**

Fuel Type (MMT)		Source (MMT)	
Coal	26.1	Residential	2.7
Petroleum Products	16.5	Commercial	2.0
Natural Gas	9.5	Industrial	9.2
		Transportation	13.9
		Electric Power	24.3
TOTAL	52.1	TOTAL	52.1

Source: (EIA, 2015f)



Source: (EIA, 2015f)

Figure 12.1.14-1: Nebraska CO₂ Emissions by Source 1980-2013

The majority of Nebraska’s GHG emissions is CO₂. These emissions are the result of fossil fuel combustion. Other major GHGs emitted in Nebraska are CH₄, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF₆) and perfluorocarbons (EIA, 2015e).

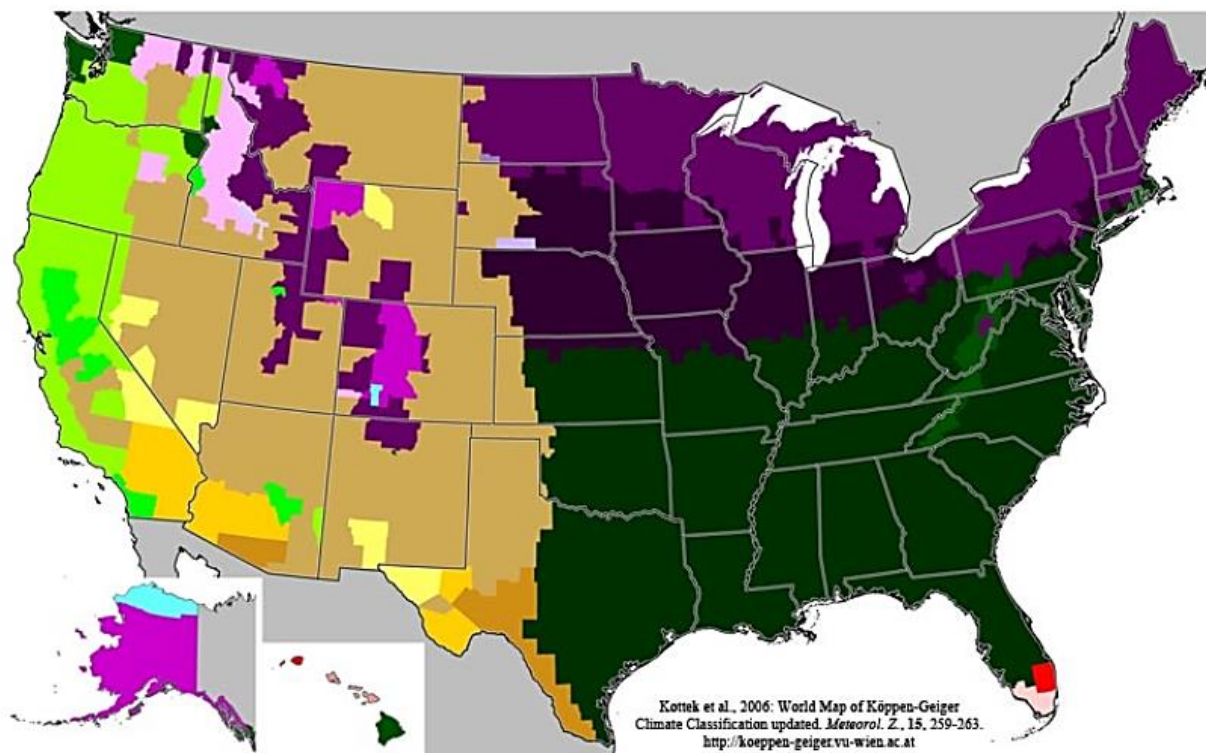
Nebraska does not have an official state-level inventory. Total U.S. GHG emissions were 6,673 MMTs (14.7 trillion pounds) in 2013 (USEPA, 2015l). Nebraska chemical and machinery manufacturing contributes to the majority of GHG emissions in the industrial sector due to the energy intensive industries around the region. The state has a large meatpacking factory and several pharmaceuticals, pesticides, and fertilizers factories. Nebraska is also a large ethanol producer but produces most of its ethanol for other states. Unlike the majority of U.S. states, Nebraska allows conventional motor gasoline without added ethanol (EIA, 2015e).

12.1.14.3. Environmental Setting: Existing Climate

The National Weather Service defines climate as the “The composite or generally prevailing weather conditions of a region, throughout the year, averaged over a series of years.” (NWS, 2009). 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, 2009). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence

or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2006).

Across the U.S., the five most common climate groups are (A), (B), (C), (D), and (E). The majority of Nebraska falls into climate group (D) (See Figure 12.1.14-2). Climates classified as (D) are “moist continental mid-latitudinal climates,” with “warm to cool summers and cold winters” (NWS, 2009). 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, 2009). 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, 2009) (NWS, 2011). Although the majority of Nebraska falls into climate group (D), western regions of the state are located within the climate group (B). Climates classified as (B) are dry climates, “in large continental regions of the mid-latitudes often surrounded by mountains” (NWS, 2009). “The most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation” (NWS, 2009). Nebraska has two sub-climate categories, which are described in the following paragraphs.



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

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

Dfa – The Köppen-Geiger climate classification system classifies areas of northern, central, eastern, and southern Nebraska as Dfa. Climates classified as Dfa are characterized by warm and humid temperatures, with hot summers and regular precipitation throughout the year. In this climate classification zone, the secondary classification (f) indicates substantial precipitation during all seasons. In this climate classification zone, the tertiary classification (a) indicates hot summer months, with warmer temperatures averaging above 71.6 °F (NWS, 2009) (NWS, 2011).

Bsk – The Köppen-Geiger climate classification system classifies western regions of the state, such as Scottsbluff, as Bsk. Climates classified as Bsk, are generally mid-latitude and dry. Evaporation in Bsk climates typically exceeds precipitation (NWS, 2011). Average temperatures in Bsk climate zones are less than 64° F (NWS, 2009).

This section discusses the current state of Nebraska’s climate with regard to air temperature, precipitation, and extreme weather events (e.g., flooding, tornadoes, severe hailstorms, and wind) in the state’s two climate regions, Dfa, and Bsk.

Air Temperature

Nebraska is located in the central U.S., “within a transition zone between semi-humid and semi-arid environments” (Dutcher, 2015). During winter months, temperatures in Nebraska can be very frigid. The lowest temperature ever recorded in the state was negative 47° F in Oshkosh on December 22, 1989. Approximately 90 percent of weather stations in Nebraska have records that date back to the 1890’s and have recorded “at least one day where the minimum temperature dropped to negative 30° F or lower” (Dutcher, 2015). By comparison, the highest temperature to occur in Nebraska was on July 15, 1934 and July 17, 1936 with a record temperature of 118° F. (Dutcher, 2015)

The following paragraphs describe annual temperatures as they occur in the various climate classification zones:

Dfa – Lincoln, the capital of Nebraska, is within the climate classification zone Dfb. The average annual temperature in Lincoln is approximately 51.6° F; 26.8° F during winter months; 75.2° F during summer months; 51.3° F during spring months; and 52.7° F during autumn months (NOAA, 2015b).

Bsk – Scottsbluff, located in western Nebraska, is within the climate classification zone Bsk. The average annual temperature in Scottsbluff is approximately 48.8° F; 27.8° F during winter months; 71.1° F during summer months; 47.4° F during spring months; and 48.7° F during autumn months (NOAA, 2015b).

Precipitation

Nebraska is located in the central U.S., “within a transition zone between semi-humid and semi-arid environments” (Dutcher, 2015). The average annual precipitation in Nebraska is approximately 23 inches per year (Dutcher, 2015). In the southeastern corner of Nebraska, the average annual precipitation is approximately 34 inches, while in the northwestern corner of Nebraska, average annual precipitation drops to approximately 15 inches. Summer months

(May, June, and July) “are typically the 3 wettest months of the year, accounting for an average of 40 percent of the annual total” (Dutcher, 2015). December, January, and February are typically the 3 driest months of the year, accounting for approximately 7 percent of the annual total. (Dutcher, 2015)

Although average annual precipitation values are recorded at weather stations throughout Nebraska, it is important to note that precipitation values throughout state can vary drastically throughout the year, making annual averages misleading. As an example, Nebraska commonly experiences periods of extensive drought or moisture “during relatively short time frames of 5 years or less” (Dutcher, 2015). The greatest 24-hour precipitation total occurred on July 8 through 9, 1950, with a record accumulation of 13.15 inches (SCEC, 2015). The greatest 24-hour snowfall total occurred on December 21, 2006 with a record accumulation of 27 inches (SCEC, 2015).

The following paragraphs describe annual precipitation as it occurs in the various climate classification zones:

Dfa – Lincoln, the capital of Nebraska, is within the climate classification zone Dfb. The average annual precipitation accumulation is approximately 28.95 inches; 2.36 inches during the winter months; 11.24 inches during the summer months; 8.93 inches during the spring months; and 6.42 inches during the autumn months (NOAA, 2015b).

Bsk – Scottsbluff, located in western Colorado, is within the climate classification zone Bsk. The average annual precipitation accumulation is approximately 15.79 inches; 1.52 inches during the winter months; 5.98 inches during the summer months; 5.31 inches during the spring months; and 2.98 inches during the autumn months (NOAA, 2015b).

Severe Weather Events

Severe weather events in Nebraska are very common, “with an average of 57 tornado reports per year,” based on a period between 1950 and 2009 (Dutcher, 2015). In Nebraska’s panhandle, there is an average of four to eight hail events per year, with the majority of storms occurring in the southwestern panhandle. By comparison, eastern Nebraska averages two hailstorm days per year, with an increase of four “hail days per year at the eastern edge of the panhandle” (Dutcher, 2015). One of Nebraska’s most historic hailstorms occurred on June 22, 2003 during which hail as large as 7.0 inches in diameter and 18.75 inches in circumference fell over Aurora (Dutcher, 2015) (SCEC, 2015). The largest hailstones weighed 1.34 pounds (SCEC, 2015). Until recently, this hailstorm produced the largest hailstones ever recorded in the U.S. (Dutcher, 2015).

Severe flooding is also common to Nebraska, with the most common types of flooding being flash floods, river floods, burn scars and/or debris flows, ice and/or debris jams, snowmelt, dry wash, and dam breaks/levee failures. One of Nebraska’s most destructive flooding events occurred in 1950, between May and July, in south central and southeast regions of the state. In total, 4 major floods occurred, claiming 25 lives and causing more than \$1 billion in damages (NWS, 2015).

During another flooding event, precipitation along much of the southern and eastern Missouri River basin caused heavily saturated soils during the summer of 1993. A main contributor to this flooding event was that precipitation was both persistent and heavy, particularly between March and July. Along the Missouri River basin, rain fell every day between March 14 and July 29. As a result, several levees overtopped causing two deaths and over \$71 million in damages. In addition, this flood caused over 5.8 million acres of cropland, and resulted in \$512 million in cropland damages (NWS, 2015).

12.1.15. Human Health and Safety

12.1.15.1. Definition of the Resource

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the construction, 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 implementation 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 RF emissions or vehicle traffic. Vehicle traffic is evaluated in Section 12.1.1, Infrastructure. Infrastructure. RF emissions are discussed in Section 2.4, RF Emissions.

There are unique infectious diseases throughout the continental US, such as Valley Fever (CDC, 2016)¹³⁶. Because of the great variety of diseases, as well as all of the variables associated with contracting them, this Final PEIS will not be evaluating infectious diseases. For information on infectious diseases, please visit the Centers for Disease Control and Prevention website at www.cdc.gov.

12.1.15.2. 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 Nebraska, this resource area is regulated by the Nebraska Department of Labor (NEDOL), and the NDEQ. Nebraska does not have an OSHA-approved “State Plan,” so private and public sector occupational safety and health programs are enforced by OSHA. Occupational and public health are regulated by the Nebraska Department of Health and Human Services (NEDHHS).

¹³⁶ Valley fever is caused by breathing in the spores of the fungus *Coccidioides*, which lives in the soil of infected areas. Valley fever primarily occurs in the southwest and California, although it has recently been found in parts of Washington State.

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

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

State Law/Regulation	Regulatory Agency	Applicability
Nebraska Administrative Code: Title 128	NDEQ	Identifies requirements for the identification, listing, and management of hazardous waste, including requirements for generators, permitting, and land disposal restrictions.
Nebraska Administrative Code: Title 118	NDEQ	Describes groundwater sample collection and analysis methods, classification, regulation of point sources, and remedial action protocols.
Nebraska Administrative Code: Title 230, Chapter 6	NEDOL	Requires inspection, consultations, and occupational safety and health programs for worksite employers with high frequency rates of work-related injuries.

Source: (NDEQ, 2016) (NDEQ, 2006) (Department of Labor, 2017)

12.1.15.3. Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites.

Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks may also be performed at dangerous heights or in confined spaces, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazards and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016b). 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 (IFC, 2007a).

Trenches and confined spaces – Installation and maintenance of underground utilities in urban areas or utility manholes¹³⁷ are examples of when trenching or confined space work could occur. Installation of telecommunication activities involves laying conduit and limited trenching

¹³⁷ 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.

(generally 6 to 12 inches in width) would occur. Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics (OSHA, 2016c).

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

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 (OSHA, 2016c).

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 (IFC, 2007b). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such as diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 12.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area (OSHA, 2016c).

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 on outdoor structures or asbestos tiles and insulation in equipment sheds. The general public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work (OSHA, 2016c).

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

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

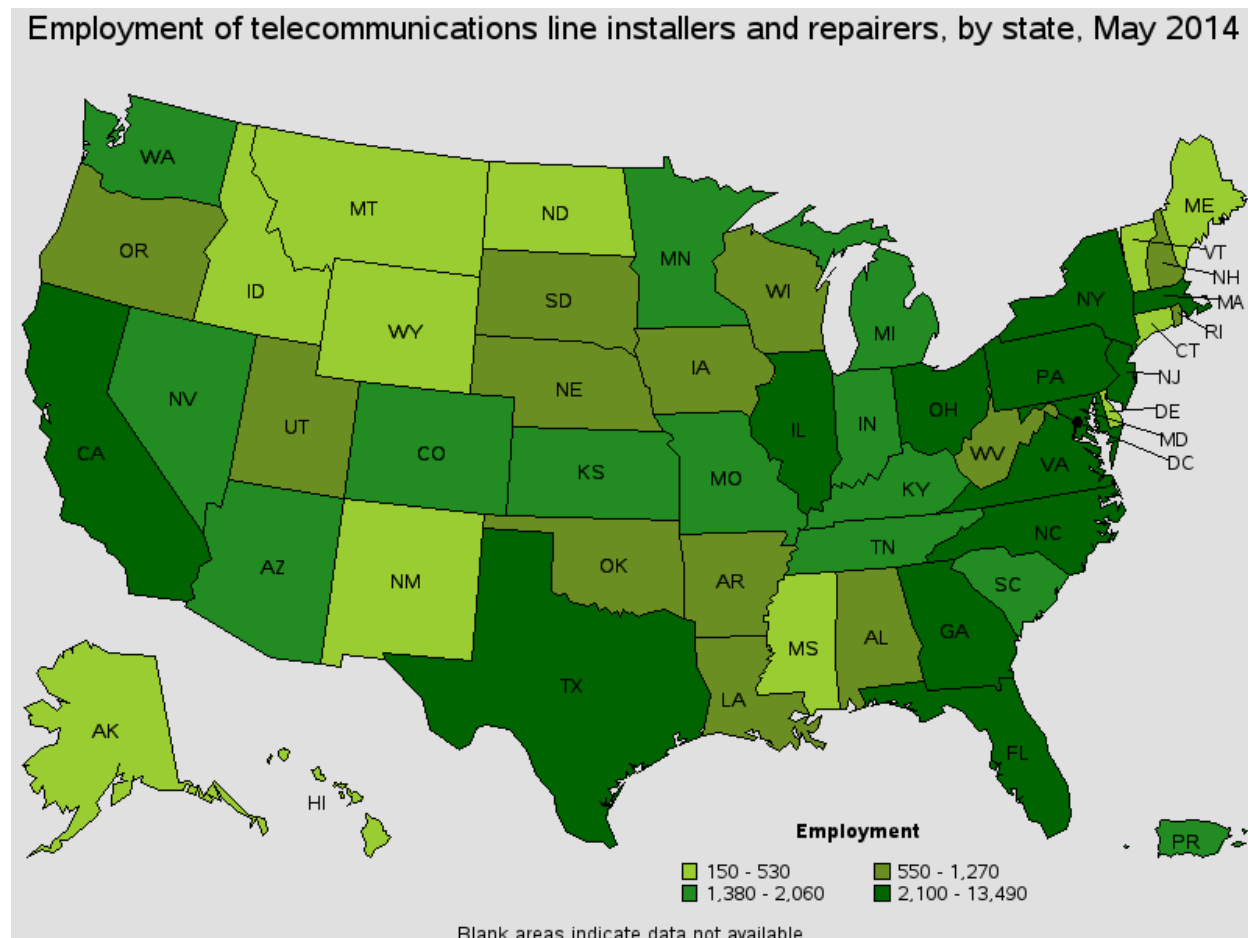
Telecommunication Worker Occupational Health and Safety

The BLS uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as 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 1,240 telecommunication equipment installers and repairers, and 550 telecommunication line installers and repairers (Figure 12.1.15-1) working in Nebraska (BLS, 2015c). In 2013, the most recent year data are available, Nebraska had one case of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2015d). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2014a).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (five due to violence and other injuries by persons or animals; three due to transportation incidents; and seven due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013). This represents 45 percent of the broader information industry fatalities (40 total), and less than one percent of total occupational fatalities (4,585 total). In the broader installation, maintenance, and repair occupations (SOC code 49-

0000), there were 26 total fatalities in Nebraska between 2003 and 2013, with the highest fatality year being 2007 with 5 fatalities (De-Campos, Mamedov, & Huang, 2009).



Source: (BLS, 2015e)

Figure 12.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. Nebraska has not recorded incidents of injuries from the public to these sites (NEDHHS, 2013a). Environmental and public health data are reported at the federal level through the Center for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, between 1999 and 2013, there were 59 fatalities due to a fall from, out of, or through a building or structure; 10 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 10 fatalities due to exposure to electric transmission lines in Nebraska (CDC, 2015a). Among the general public, trespassers

entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

12.1.15.4. Contaminated Properties at or near Telecommunication Sites

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

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program¹³⁸ or listed on the National Priorities List, as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and Brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

Nebraska's Superfund Program, managed by the NDEQ, provides technical assistance to the USEPA during the investigation and remediation of federal Superfund sites in Nebraska (NDEQ, 2015i). As of October 2015, Nebraska had 40 RCRA Corrective Action sites,¹³⁹ 142 brownfield sites, and 13 proposed or final Superfund/NPL sites (NDEQ, 2015j) (NDEQ, 2015k). Based on an October 2015 search of USEPA Cleanups in My Community (CIMC) database, there is one Superfund site (Omaha Lead in Omaha, NE) in Nebraska where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists (USEPA, 2013b).

Brownfield sites in Nebraska may enroll in the state Voluntary Cleanup Program, which allows property owners or prospective buyers to voluntarily clean contaminated sites (NDEQ, 2015l). One brownfield site in Nebraska is the Omaha Riverfront Redevelopment Project in Omaha, NE. This 130-acre site contains many abandoned or underutilized industrial properties, including a landfill, which were capped to prevent human contact (NDEQ, 2002). The cleanup of metals and Polychlorinated Biphenyls in groundwater and soil was completed in 2003 (NDEQ, 2015m).

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

¹³⁸ 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 A (USEPA, 2011a).

¹³⁹ Data gathered using USEPA's CIMC search on October 8, 2015, for all sites in Nebraska, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013b).

(EPCRA) of 1986. The TRI database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The “releases” do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of October 2015, Nebraska had 181 TRI reporting facilities. The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, Nebraska released 26.3 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the food, beverage, and tobacco industries. This accounted for 0.64 percent of nationwide TRI releases, ranking Nebraska³⁸ of 56 U.S. states and territories based on total releases per square mile (USEPA, 2014d).

Another USEPA program is the NPDES, which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of November 12, 2015, Nebraska had 59 major NPDES permitted facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015m).

The National Institute of Health (NIH), U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to “visually explore data from the USEPA’s TRI and Superfund Program” (National Institute of Health, 2015a). Figure 12.1.15-2 provides an overview of potentially hazardous sites in Nebraska.

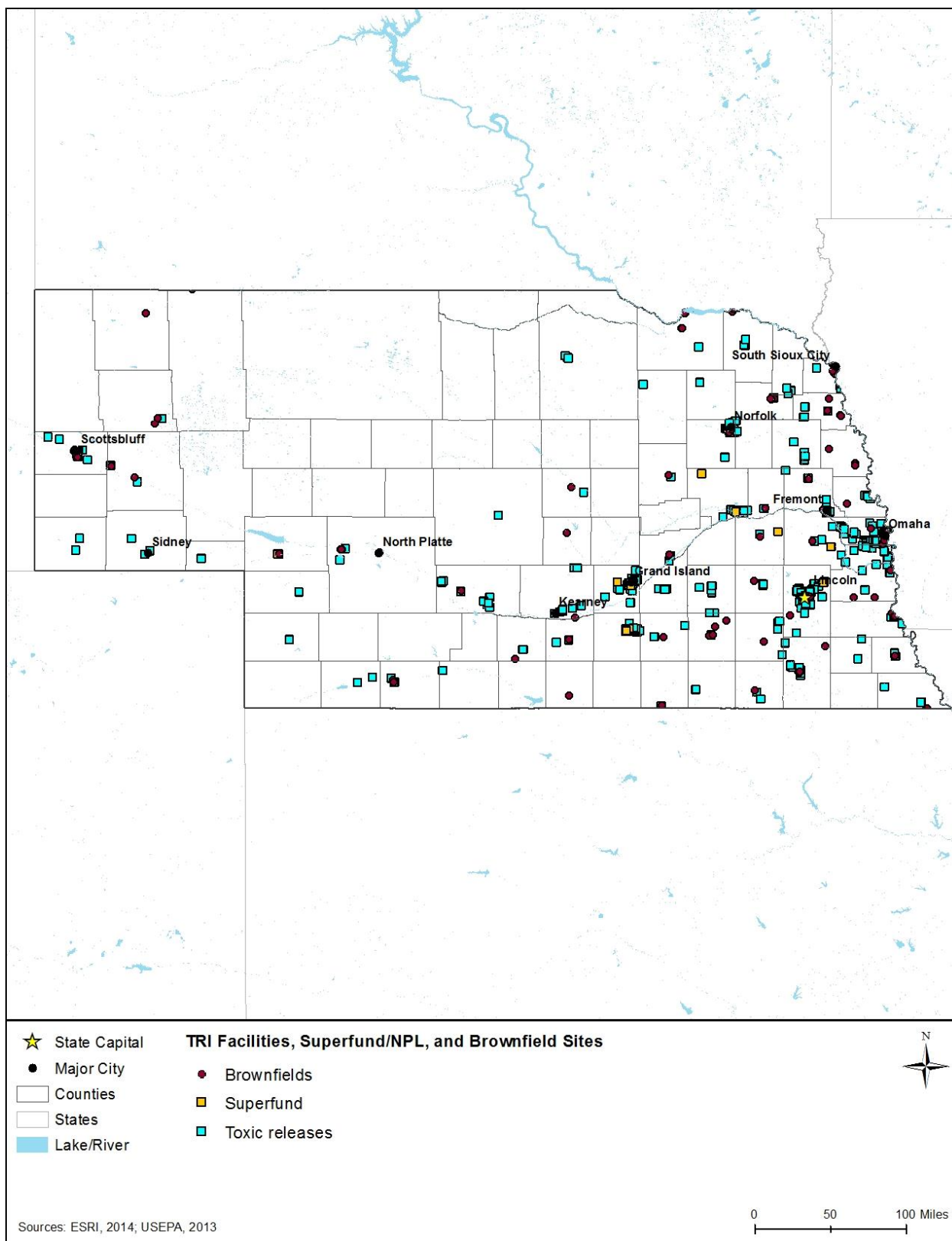


Figure 12.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Nebraska

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 include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (BLM, 2011b). Gradual settling or sudden sinking of the Earth's surface, also known as subsidence, presents additional risks and is further discussed in Section 12.1.4, Geology. In 2015, the Nebraska mining industry ranked 38th for non-fuel minerals (primarily Portland cement, sand and gravel, crushed stone, and lime), generating a value of \$382M (USGS, 2017b). As of January 2015, there were no high priority AMLs (sites posing health and safety hazards) in Nebraska (BLM, 2015b).

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of October 2015, there are 50 USEPA-regulated telecommunications sites in Nebraska (USEPA, 2015n). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Nebraska had 34 total fatalities between 2003 and 2013 from exposure to "harmful substances or environments," although these were not specific to the telecommunications industry or telecommunications occupations (BLS, 2015d). By comparison, the BLS reported three fatalities in 2011 and three fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 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 (BLS, 2014b).

Public Health and Safety

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

The NEDHHS monitors health status to identify problems, and investigates health problems in communities in Nebraska. The department is also responsible for educating the public about health issues and developing policies to protect community health efforts (NEDHHS, 2013b). At the federal level, the Center for Disease Control and Prevention, National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography. According to the National Environmental Public Health Tracking Network, no injury or fatality data have been reported for due to acute toxic substance release incidents in Nebraska (CDC, 2015b).

Spotlight on Nebraska Superfund Sites: Omaha Lead

Omaha Lead is a 27 square mile Superfund site in downtown Omaha, NE, located along the bank of the Missouri River. Historically, the site was used as a lead-smelting and refining facility for 125 years, releasing lead-containing particulates from smokestacks into the atmosphere. Lead particulates deposited on the ground surrounding the site, affecting more than 40,000 properties, 125,880 residents, and 14,117 children under the age of 7. In 1998, the Omaha City Council alerted the USEPA of children in the city with high levels of lead in their blood. In 1999, the USEPA tested residential soils and discovered levels of lead greater than the USEPA's 400 milligrams per kilogram (mg/kg) screening level (Figure 12.1.15-3). Since 1999, the USEPA has tested childcare facilities and over 35,000 residential properties, responding to all properties testing above the 400 mg/kg screening value. The USEPA classifies lead as a human carcinogen, because it can accumulate in the body and become toxic at high concentrations and after long-term exposure. The lead contamination found in surface soils still poses a high risk to children 6 years old and younger within the area. (USEPA, 2015o)



Figure 12.1.15-3: Track Hoe Excavating Contaminated Surface Soil

Source: (USEPA, 2011b)

12.1.15.5. Environmental Setting: Natural and Manmade Disaster Sites

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

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.

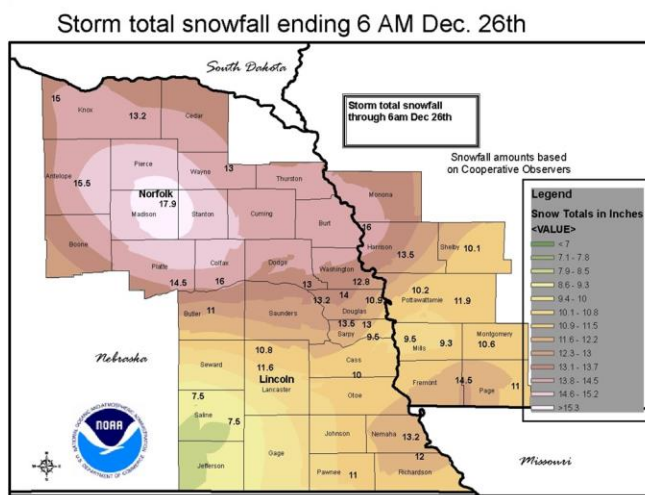
Telecommunication Worker Occupational Health and Safety

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, NEDOL 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 103 NRC-reported incidents for Nebraska in 2015 with known causes, six were attributed to natural disaster (e.g., flooding or other natural phenomenon), while 97 were attributed to manmade disasters (derailment, dumping, equipment failure, operator error, over pressuring, transport accident, or trespasser) or other indeterminate causes (U.S. Coast Guard, 2015). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural and manmade disasters.

Spotlight on Nebraska Natural Disaster Sites: 2009-2010 Winter Storms

Between December, 2009 and January, 2010, three significant winter storms impacted eastern Nebraska. The first storm hit December 7, 2009, with snowfall totals of 6 to 15 inches, wind speeds of 30 to 50 miles per hour (mph), and numerous road closures. The second storm, referred to as the “Christmas Blizzard,” hit December 24-26, 2009, with wind gusts between 40 and 50 mph, blizzard conditions, and snowfall between 10 and 18 inches. On January 6, 2010, a third storm added 3 to 6 inches of snowfall, similar winds, and dangerously cold wind chill values. Snowdrift and visibility from the combined storms left most roads impassable for several days, and set records for cumulative snowfall totals, duration with snowfall on the ground, and coldest temperatures (NOAA, 2010). The resulting damage from the 2009-2010 winter storms led to a major disaster declaration in Nebraska, with public assistance grants totaling \$6.5M (FEMA, 2015b). Freezing temperatures, heavy winds, and snow accumulation from storms such as these create hazardous conditions to workers attempting to restore power and services, assuming workers can even mobilize in such conditions.



Source: (NOAA, 2010)

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. For example, during the Christmas Blizzard in 2009, a van got stuck in snow and ice on a railroad crossing, after driving through the crossing device. The van was struck by a freight train, injuring the five occupants of the vehicle (U.S. Coast Guard, 2015). In 2014, Nebraska reported 3 weather-related fatalities (1 due to flooding and 2 due to tornadoes) and 29 injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year (NWS, 2015).

12.2. ENVIRONMENTAL CONSEQUENCES

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

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance 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.

12.2.1. Infrastructure

12.2.1.1. Introduction

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

12.2.1.2. Impact Assessment Methodology and Significance Criteria

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

Table 12.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	<i>No effect</i> 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor delays to access to care and emergency services that do not impact health outcomes.	<i>No impacts</i> 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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

12.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the 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 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., NDOR, airport authorities, and railway companies) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 12.2.1-1, such impacts would be *less than significant* due to the temporary nature of the deployment activities, even if such impacts would be realized at one or more isolated locations. Such impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

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

The capacity of local health, public safety, and emergency response services would experience *less than significant impacts* at the programmatic level during deployment or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare – and that is if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 12.2.1-1, potential negative impacts would be *less than significant* at the programmatic level. 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 12.2.1-1, any potential impacts would be *less than significant* at the programmatic level 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* at the programmatic level given the short-term nature of the deployment activities.

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

Nebraska's primary Public Safety LMR network providing Statewide LMR coverage and supporting its 9-1-1 system is the Nebraska SRS operating in the VHF band (RadioReference.com, 2015a). There are 1,500 commercial towers in Nebraska (FCC, 2015b).

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.¹⁴⁰ Anticipated impacts would be *less than significant* at the programmatic level due to the limited extent and temporary nature of the deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The activities proposed by FirstNet would have *less than significant* impacts at the programmatic level on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

¹⁴⁰ 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.

12.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

Activities Likely to Have No Impacts at the Programmatic Level

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

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would have *no impacts* to infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
 - **New Build – Submarine Fiber Optic Plant:** At the programmatic level, the installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. Impacts to infrastructure resources associated with the construction of landings and/or facilities on shore or the banks of water bodies that accept the submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to infrastructure at the programmatic level. The section below addresses potential impacts to infrastructure if construction of new boxes, huts, or other equipment is required near or adjacent to local infrastructure assets.

- Satellites and Other Technologies
 - o 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 likely 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.
 - o 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 at the Programmatic Level

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
 - o New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs),¹⁴¹ 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 at the programmatic level as they activity would be temporary and minor.
 - o 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.
 - o 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.
 - o 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. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of

¹⁴¹ Points of Presence are connections or access points between two different networks or different components of one network.

water bodies that accept submarine cable, depending on the exact site location and proximity to existing infrastructure.

- o 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
 - o 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.
 - 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 result in localized impacts to that tower such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site-specific plans.
 - o 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* at the programmatic level as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), and would be regionally based around the on-grid phase 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. Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. At the programmatic level, 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 and therefore, *less than significant*.

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.

12.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.¹⁴²

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. 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, at the programmatic level, it is anticipated that there would be *no impacts* to infrastructure resources associated with routine inspections of the Preferred Alternative,

¹⁴² As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

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 at the programmatic level could 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 as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

12.2.2. Soils

12.2.2.1. Introduction

This section describes potential impacts to soil resources in Nebraska 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.

12.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 12.2.2-1. The categories of impacts are defined, at the programmatic level, 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 12.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

12.2.2.3. Description of Environmental Concerns

Soil Erosion

Soil erosion is an environmental concern of nearly every construction activity that involves ground disturbance. Construction erosion typically only occurs in a small area of land with the actual removal of vegetative cover from construction equipment or by wind and water erosion. Of concern in Nebraska and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment could impair water and habitat quality, and potentially affect aquatic plants and animals (NRCS, 2000). Areas exist in Nebraska that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Albolls, Aquentes, Aquepts, Aquolls, Fluvents, Orthents, Psamments, Udolls, Ustepts, Usterts, and Ustolls suborders, which are found throughout the state (Figure 12.1.2-3).

Based on the impact significance criteria presented in Table 12.2.2-1, building of some of FirstNet's network deployment sites could cause *potentially significant* erosion at locations with highly erodible soil and steep grades. However, for the majority of projects, impacts to soils would be expected to be *less than significant* at the programmatic level, given the short-term and temporary duration of the activities.

To the extent practicable, FirstNet would attempt to minimize ground disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures as practicable and feasible, 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 12.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet project sites, potential impacts would be *less than significant* and could be further reduced with implementation of 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. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 12.1.2.3, Soil Suborders). Based on impact significance criteria presented in Table 12.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be *less than significant* at the programmatic level due to the extent of susceptible soils (approximately 11

percent) in the state and due to the limited scale of the deployment activities in any one location. Heavy equipment could cause perceptible compaction and rutting of susceptible soils, but could be minimized with implementation of BMPs and mitigation measures.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 12.1.2.4, Soil Suborders). The most compaction susceptible soils in Nebraska are Albolls, Aquents, Aquepts, and Aquolls suborders, which are found generally along streams and rivers, and in the northern parts of the state (Figure 12.1.2-3). These suborders constitute approximately 11 percent of Nebraska's land area.¹⁴³ The potential for compaction or rutting impact would be generally low at FirstNet network deployment sites where other soil types predominate. Potential Impacts of the Preferred Alternative

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

12.2.2.4. 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 at the Programmatic Level

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**
 - o **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 would have *no impact* on soil resources because it would not produce perceptible changes to soil resources.
 - o **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 because there would be no ground disturbance. If

¹⁴³ This percentage was calculated by dividing the acres of soils that fall within the suborders listed above by the total soil land cover for the state.

physical access is required to light dark fiber, it likely would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.

- Satellites and Other Technologies
 - o 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 have *no impact* on soil resources because those activities would not require ground disturbance.
 - o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have *no impact* on soil resources.

Activities with the Potential to Have Impacts at the Programmatic Level

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
 - o 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.
 - o 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.
 - o 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.
 - o New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in or near bodies of water could potentially impact soil resources at or near the landings or facilities on the shores or banks that accept the submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur

due to heavy equipment use during these activities depending on the duration of the construction activity.

- 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 POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.
- Wireless Projects
 - 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, and 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 abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads, and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be *less than significant* at the programmatic level as the activity would

likely be short term, localized to the deployment locations, and those locations would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. At the programmatic level, it is anticipated that there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be *less than significant* at the programmatic level due to the temporary nature and small scale of operation activities with the potential to create impacts (as detailed 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.

12.2.2.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal 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* at the programmatic level, due to the small scale and short term nature of the deployment. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, at the programmatic level, it is anticipated that there would be *no impacts* to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, *less than significant* soil compaction and rutting impacts could result at the programmatic level, 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 at the programmatic level, as described above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to soil resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.2, Soils.

12.2.3. Geology

12.2.3.1. Introduction

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

12.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 12.2.3-1. As described in Section 12.2, Environmental Consequences, the categories of impacts, at the programmatic level, 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 geological resources addressed in this section are presented as a range of possible impacts.

Table 12.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA

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

12.2.3.3. Description of Environmental Concerns

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

Seismic Hazard

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

As discussed in Section 12.1.3.8, areas of greatest seismicity in Nebraska are concentrated in the northcentral and northwest portions of the state (Figure 12.1.3-5). Based on the impact significance criteria presented in Table 12.2.3-1, at the programmatic level, seismic impacts from deployment or operation of the Proposed Action would have *no impact* on seismic activity; however, seismic impacts to the Proposed Action could be *potentially significant* if FirstNet's deployment locations were within high-risk earthquake hazard zones. Given the potential for minor earthquakes in parts of Nebraska, 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 Nebraska, as they do not occur in Nebraska; therefore, volcanoes do not present a hazard to the state.

Landslides

As discussed in Section 12.1.3.8, the potential for widespread landslides in Nebraska is minimal; Boyd and Knox Counties in northeastern Nebraska account for nearly half of the landslides recorded in Nebraska since 1982. Based on the impact significance criteria presented in Table 12.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level 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 disturbances to the landscape or heavy precipitation events both increase the likelihood of landslide events in Nebraska. 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. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, some amount of infrastructure could be subject to landslide hazards, in which case

BMPs and mitigation measures (see Chapter 19) could help avoid or minimize the potential impacts.

Land Subsidence

As discussed in Section 12.1.3.8, portions of Nebraska are vulnerable to land subsidence due to karst topography, particularly in the eastern part of the state. Based on the impact significance criteria presented in Table 12.2.3-1, at the programmatic level, 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 or mine collapse, 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 or where mine collapse is possible. As discussed in Section 12.1.3.8 and shown in Figure 12.1.3-7, land subsidence is not considered a major risk in Nebraska although land subsidence due to sinkhole formation has occurred in isolated areas. Where infrastructure may be subject to land subsidence hazards, BMPs and mitigation measures, as discussed in Chapter 19, could help avoid or minimize the potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources are not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 12.2.3-1, impacts to mineral and fossil fuel resources are unlikely as the Proposed Action could only be *potentially significant* if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable, FirstNet would avoid construction in areas where these resources exist.

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 12.2.3-1, impacts to paleontological resources could be *potentially significant* if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 12.1.3.6., the Ashfall Fossil Beds State Historical Park in northeastern Nebraska (Figure 12.1.3-4) preserves animals that were buried during a series of volcanic eruptions from the Rocky Mountains to the west about 10 MYA, and abundant fossil deposits of Miocene fossils are preserved in the Agate Fossil Beds National Monument (24 to 5 MYA); however, it is unlikely that deployment would take place in either location. 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. Site-specific analysis may be required depending on the site

conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Implementation of 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 12.2.3-1, impacts could be *potentially significant* if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and *less than significant* as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures (see Chapter 19) could be implemented to help avoid or minimize the potential impacts.

12.2.3.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including 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 at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

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.

- o 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
 - o 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 at the Programmatic Level

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
 - o 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.
 - o 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.
 - o 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.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water is not expected to impact geologic resources including marine paleontological resources. However, 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.
 - o 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
 - o 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 disturbances 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.
 - 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 ground disturbance. However, if additional power units are needed, structural hardening, and physical security measures may require ground disturbance, such as grading, or excavation activities, and 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.
 - o 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
 - o Satellite-Enabled Devices and Equipment: In most cases, the installation of permanent equipment on existing structures or the use of portable devices that use satellite technology would not impact geologic resources because those activities would not require ground disturbance. However, where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects are likely to be small scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small scale. As a result, these impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

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

The operation of the Preferred Alternative could be affected by geologic hazards including seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level 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, landslide, or land subsidence. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.3.5. Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal 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 result in *no impacts* to geologic resources (or from geologic hazards) at the programmatic level 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* at the programmatic level due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as the deployment would be temporary and likely would attempt to avoid locations that are subject to increased seismic activity, landslides, and land subsidence. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* to geologic resources (or from geologic hazards) as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.3, Geology.

12.2.4. Water Resources

12.2.4.1. Introduction

This section describes potential impacts to water resources in Nebraska 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.

12.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 12.2.4-1. As described in Section 12.2, Environmental Consequences, the categories of impacts, at the programmatic level, are defined as *potentially significant*, *less than significant with mitigation incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA
Floodplain degradation*	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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

12.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 1203(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 or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Of the assessed waters, 58% of Nebraska's rivers and streams, and 90% of Nebraska's lakes, reservoirs, and ponds are impaired (see Table 12.1.4-2, Figure 12.1.4-3). Designated uses of the impaired rivers and streams and lakes include agriculture water supply, aquatic life, and primary contact recreation (USEPA, 2015b). Groundwater quality within the state is generally good (Moody, Carr, Chase, & Paulson, 1986).

Deployment activities could contribute pollutants in a number of ways but the primary manner is increased sediment in surface waters. Vegetation removal on site exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a SWPPP would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), and local regulations, cause a threat to the human environment, biodiversity, or ecological

integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality.

Therefore, based on the impact significance criteria presented in Table 12.2.4-1, water quality impacts would likely be *less than significant* at the programmatic level and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching¹⁴⁴ 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. Any contaminated 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. Additionally, construction activities would need to comply with Nebraska dewatering requirements.

Due to average thickness of most Nebraska aquifers, there is little potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 12.2.4-1, there would likely be *less than significant* impacts at the programmatic level on groundwater quality within most of the state. In areas where groundwater is close to the surface, then site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Furthermore, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on humans, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 12.2.4-1, floodplain degradation impacts would be potentially *less than significant* at the programmatic level since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would occur inside the 500-year floodplain, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable

¹⁴⁴ 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).

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,¹⁴⁵ or occur only during an emergency.

Examples of activities that would have *less than significant* impacts at the programmatic level include:

- 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 would reduce the risk of additional impacts to floodplain degradation (see Chapter 19, BMPs and Mitigation Measures).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could change drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms, could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 12.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered *less than significant* at the programmatic level.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- When stormwater is contained on site and does not flow to or impact surface waterbodies offsite on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to

¹⁴⁵ 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, 2014k)

drainage patterns would be *less than significant* at the programmatic level. BMPs and mitigation measures could be implemented to further reduce 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. Both the Platte River Recovery Implementation Program and the Colorado River Basin Recover Program may apply to water-related projects in the state of Nebraska. Under these two programs, water-related activities that may require a Section 404 Clean Water Act permit, a special use permit from the USFS, or those that receive federal funding are subject to Section 7 of the ESA.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 12.2.4-1. At the programmatic level, 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) basis are likely to have *less than significant* impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have *less than significant* impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the Proposed Action would not likely alter flow characteristics or change the hydrologic regime, *less than significant* impacts to flow alteration are anticipated. BMPs, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 12.1.4.7, the majority of Nebraska's drinking water (over 80 percent) comes from groundwater, and approximately 94 percent of the total groundwater use in the state is for agricultural irrigation (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 in 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.
- Use of pesticides, herbicides, or insecticides during or after construction of a commercial, industrial, or recreational use.

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* at the programmatic level 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.

12.2.4.4. 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 at the programmatic level 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 at the Programmatic Level

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 at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

- o 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
 - o 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.
 - o 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 at the Programmatic Level

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
 - o 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.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment could be required to shoreline environments prior to installation to fully assess potential impacts to lake or river coastal environments.
 - o 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.
- o 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
 - o 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
 - o 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 further 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.
 - 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 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.
 - o 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.

- o 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* due to the small scale of expected FirstNet activities in any particular location. 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* at the programmatic level 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* at the programmatic level as there would be no ground disturbing activity and it is likely routine maintenance activities would be conducted along exiting roads and utility rights-of-way. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. At the programmatic level, there would be *no impacts* to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control 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.

12.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal 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 at the programmatic level. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be *less than significant* impacts to water resources at the programmatic level associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It

is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods of time, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be *less than significant* at the programmatic level. Site maintenance, including mowing or herbicides, is anticipated to 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 the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.4, Water Resources.

12.2.5. Wetlands

12.2.5.1. Introduction

This section describes potential impacts to wetlands in Nebraska 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.

12.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 12.2.5-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level

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 1204 of the CWA.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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: ^b change in function(s) ^c 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

^a “Magnitude” is defined based on the type of wetland impacted, using USACE wetland categories (USACE, 2014). Category 1 are the highest quality, highest functioning wetlands

^b Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type

^c Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

12.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, vibrations, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be *less than significant* given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Based on the impact significance criteria presented in Table 12.2.5-1, at the programmatic level, the deployment activities would most likely have *less than significant* direct impacts on wetlands. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and local regulations. If any of the proposed deployment activities were to occur near high quality wetlands (as identified in Section 12.1.5.4), *potentially significant* impacts could occur at the programmatic level. High quality wetlands may be found throughout the state, and are not always included on state maps. In areas where high quality wetlands may be present, then site-specific analysis, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Potential Other Direct Effects

Direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 12.2.5-1, construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity,

ecological integrity, or water quality) could cause *potentially significant* impacts. In addition, introduction and establishment of invasive species to wetlands within a watershed or multiple watersheds could be *potentially significant*. Other direct effects to 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 timeframe of deployment activities and the application of federal, state, and local wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. To minimize any potential impacts to wetlands, BMPs, and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in Nebraska 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 from construction activities 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:¹⁴⁶ Changes in Function(s)¹⁴⁷ 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* at the programmatic level 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. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of functions related to wetlands in Nebraska that could potentially be impacted from construction-related deployment activities include:

- **Flood Attenuation:** Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they could lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.
- **Bank Stabilization:** By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- **Water Quality:** Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- **Nutrient Processing:** Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- **Wildlife Habitat:** Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- **Recreational Value:** Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- **Groundwater Recharge:** Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

¹⁴⁶ 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.

¹⁴⁷ 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.

According to the significance criteria defined in Table 12.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered potentially *less than significant* at the programmatic level. Since the majority of wetlands in Nebraska are not considered high quality, deployment activities could have *less than significant* indirect impacts on wetlands in the state, at the programmatic level. BMPs and mitigation measures would be implemented, as feasible and practicable to reduce potential impacts to all wetlands.

In areas of the state with high quality wetlands, there could be *potentially significant* impacts at the project level that would be analyzed on a case-by-case basis. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. If avoidance were not possible, BMPs and mitigation measures would help to mitigate impacts.

12.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations 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 at the Programmatic Level

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
 - o 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 likely to have *no impact* on wetlands since there would be no ground disturbance.
 - o 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 wetlands, it is anticipated that this activity would have *no impact* on wetlands.

Activities with the Potential to Have Impacts at the Programmatic Level

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
 - o 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.
 - o 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.
 - o 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.
 - o 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.
 - o 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 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 (see Chapter 19) could reduce impact intensity.

- Wireless Projects
 - o 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 (see Chapter 19) could reduce impact intensity.
 - 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 wetlands. However, if additional power units are needed, structural hardening, and physical security measures may require ground disturbance, such as grading, or excavation activities, and impacts to wetlands could occur. Implementing BMPs and mitigation measures (see Chapter 19) could reduce impact intensity.
 - o 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. 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 abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and/or indirect impacts to wetlands,

depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be *less than significant* at the programmatic level due to the small amount of land disturbance (generally less than once acre) and the short term timeframe of deployment activities. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Depending on the proximity to wetlands, it is anticipated that there could be ongoing other potential direct impacts to wetlands if heavy equipment is used for routine operations or if maintenance application of herbicides occurs to control vegetation along ROWs and near structures.. 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 *less than significant* at the programmatic level due to the limited nature of deployment activities. It is also anticipated that routine maintenance activities would be conducted on existing roads and utility ROW. 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.

12.2.5.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal 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 at the programmatic level. 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* at the programmatic level due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

It is anticipated that there would be *less than significant* impacts at the programmatic level 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* impacts to wetlands at the programmatic level due to the limited nature of site maintenance activities, including mowing and application of herbicides. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on wetlands, as explained above. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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 as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.5, Wetlands.

12.2.6. Biological Resources

12.2.6.1. Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Nebraska 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.

12.2.6.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on terrestrial vegetation, wildlife, fisheries, and aquatic habitats were evaluated using the significance criteria presented in Table 12.2.6-1. The categories of impacts are defined, at the programmatic level, 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 12.2.6.3, 12.2.6.4, and 12.2.6.5, respectively, are presented as a range of possible impacts. Refer to Section 12.2.6.6 for impact assessment methodology and significance criteria associated with threatened and endangered species in Nebraska.

Table 12.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level

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 BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	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 Nebraska 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	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 Nebraska 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	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 Nebraska 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, resulting in injury or mortality.		Effects realized at one location.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MBTA and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	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 Nebraska 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	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 Nebraska for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	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 Nebraska.		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

12.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Nebraska are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are permanent or temporary loss or disturbance of individual plants. Based on the impact significance criteria presented in Table 12.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, these events are expected to be relatively small in scale and therefore would have *less than significant* impacts at the programmatic level. The implementation of BMPs and mitigation measures and avoidance measures would help to minimize or altogether avoid potential impacts to plant population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. Areas near urban areas such as Lincoln and Omaha, have experienced extensive land use changes. However, a large portion of the state is prairie grasslands.

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. In general, these impacts are expected to be *less than significant* at the programmatic level due to the short-term, localized nature of the deployment activities. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures could be recommended and consultation with appropriate resource agencies, if required, would be undertaken to minimize or avoid potential impacts. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Comments received on other regional Draft PEIS documents for the Proposed Action expressed concerns related to the potential impacts to vegetation from RF emissions. Some studies have indicated the potential for adverse effects to vegetation from RF emissions. As explained in Section 2.4, Radio Frequency Emissions, as well as the Wildlife portion of this Biological Resources Section, additional, targeted research needs to be conducted to more fully document the nature and effects of RF exposure, including the potential impacts to vegetation.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Increasing or decreasing hydrology in an area as an indirect effect, could lead to moisture stress and/or mortality of plant species that are adapted to specific hydrologic regimes. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment, though BMPs and mitigation measures could help to minimize or avoid the potential impacts. Overall, these impacts are expected to be *less than significant* at the programmatic level due to the short-term and small-scale nature of deployment activities.

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.

Nebraska passed the state statute referred to as the Noxious Weed Control Act in 2012 that regulates the importation, movement, sale, possession, cultivation, and distribution of certain invasive plants, and most recently updated the noxious weed list in 2014 (25 Nebraska Administrative Code [NAC] 10-001). The Nebraska Department of Agriculture is responsible for maintaining the statewide prohibited noxious weed list and updates to that list, as necessary.

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. A total of 12 state-listed noxious weeds are regulated in Nebraska (25 NAC 10-001 2014). Per the Noxious Weed Control Act, every person who owns or controls land in Nebraska that contains noxious weeds is required to control noxious weeds to prevent establishment, provide eradication, or reduce further propagation or spread of such weeds. Even if natives are not completely eliminated, the ecosystem often becomes much less diverse (USFWS, 2012b).

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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to terrestrial vegetation.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, the same type of Proposed Action infrastructure could result in a range impacts, from *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology,¹⁴⁸ and the nature as well as the extent of the habitats affected.

Activities Likely to Have No Impacts at the Programmatic Level

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* at the programmatic level 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

¹⁴⁸ Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

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

Activities with the Potential to Have Impacts at the Programmatic Level

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
 - o 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. Impacts may vary depending on the location and extent of land/vegetation clearing and excavation activities, but could include direct or indirect injury of individual plants; habitat loss, alteration, or fragmentation; and invasive species effects.
 - o 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 location and extent of land/vegetation clearing and excavation activities, but could include direct or indirect injury of individual plants; habitat loss, alteration, or fragmentation; and invasive species effects.
 - o 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.

- o 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 occur as a result of land clearing, excavation activities, and heavy equipment use as a result of the construction of landings and/or facilities to accept submarine cables on the shore or banks of water bodies. Impacts may vary depending on the exact site location and proximity to terrestrial vegetation communities, but could include direct or indirect injury to plants; habitat loss, alteration, or fragmentation; and invasive species effects.
- o 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
 - o 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.
 - 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 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.
 - o 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.
 - o 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; 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 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* at the programmatic level due to the small scale of expected FirstNet 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.

At the programmatic level, it is anticipated that there would be *no impacts* to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may result in *less than significant* effects due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation; however, impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level 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* at the programmatic level 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 at the programmatic level to terrestrial vegetation associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. The impacts can vary greatly among species, vegetative community, and geographic region, but are expected to remain *less than significant* at the programmatic level due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to terrestrial vegetation as a result of the No Action Alternative.. Environmental conditions would therefore be the same as those described in Section 12.1.6.3, Terrestrial Vegetation.

12.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Nebraska 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 (USEPA, 2012d).

Based on the impact significance criteria presented in Table 12.2.6-1, at the programmatic level, *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. Therefore, impacts are generally expected to be *less than significant* at the programmatic level, as discussed further below (except for birds which would be *less than significant with BMPs and mitigation measures incorporated*).

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

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Nebraska. Mammals use roads to access mating or nesting sites, as preferred habitat in right-of-ways, source of vegetation along roadways, or as a means of travel (FHWA, 2011b). Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur.

Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

If tree-roosting bats, and particularly maternity colonies, are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small and would be dependent on the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to help avoid disturbance to bats.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and could violate MBTA and BGEPA. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), night-migrating birds, heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (Gehring, Kerlinger, & and Manville, 2011).

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for 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, D. 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 Nebraska are not likely to be widespread or affect populations of species as a whole due to the small size of the likely FirstNet actions, however, DOI comments dated October 11, 2016¹⁴⁹ state that communication towers are “currently estimated to kill between four and five million birds per year,” although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts (Regulations.gov, 2016). Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights (FAA, 2016a) (FAA, 2016b) (FCC, 2017). See Chapter 19, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to birds from tower lighting. Site-specific analysis and/or consultation with FWS may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If siting considerations and BMPs and mitigation measures are implemented (Chapter 19), potential impacts could be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures (including possible “take”) developed in consultation with USFWS.

Reptiles and Amphibians

Nebraska’s reptile and amphibian species occur in a wide variety of habitats across the state, with some having widespread distribution and others being limited to a smaller region or locations in the state. 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.

¹⁴⁹ See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

Terrestrial Invertebrates

Ground disturbance or land clearing activities as well as use of heavy equipment could result in direct injury or mortality to terrestrial invertebrates. However, deployment activities are expected to be temporary and isolated, thereby limiting the potential for direct mortality and likely affecting only a small number of terrestrial invertebrates. The terrestrial invertebrate populations of Nebraska 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 urban areas such as Lincoln and Omaha, have experienced extensive land use changes. However, a large portion of the state is prairie grasslands.

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.

In general, potential effects of vegetation and habitat loss, alteration, or fragmentation are expected to be *less than significant* at the programmatic level because of the small-scale nature of expected deployment activities, as FirstNet would attempt to avoid these areas. These potential impacts are described for Nebraska's wildlife species below. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential effects of vegetation and habitat loss, alteration, or fragmentation are described for Nebraska's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Nebraska and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., elk, white-tailed deer) 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., squirrels, rabbits) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by implementing BMPs and mitigation measures.

Birds

The direct removal of most migratory bird nests is prohibited under the MBTA. The USFWS and the NGPC 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 and vibration 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, D. et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine¹⁵⁰ 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., whooping crane). BMPs and mitigation measures (see Chapter 19), including nest avoidance during construction-related activities, could help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Nebraska's amphibians and reptiles typically consist of wetlands and, in some cases as with the timber rattlesnake, the surrounding upland forest. Impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected FirstNet activities in any particular location. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 19) could help to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 12.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Nebraska amphibian and reptile populations, though BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential impacts.¹⁵¹

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 12.2.6.6, Threatened and Endangered Species and Species of Concern.

¹⁵⁰ 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.

¹⁵¹ See Section 12.2.5, Wetlands, for a discussion of BMPs for wetlands.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, potential impacts are expected to remain *less than significant* at the programmatic level (except for birds and bats due to potential exposure to RF emissions, see below) due to the short-term nature and limited geographic scope of expected activities, as FirstNet would attempt to avoid these areas, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) 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, vibrations, 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 at the programmatic level (except for bats, see below).

There are no published studies that document physiological or other *adverse effects* to bats from radio frequency (RF) exposure. However, because bats are similar ecologically and physiologically to birds, they have the potential to be affected by RF exposure in similar ways to birds (see the birds subsection below). One study demonstrated that foraging bats avoided areas exposed to varying levels of electromagnetic radiation compared with control sites, and attributed this behavior to the increased risk of overheating and echolocation interference caused by electromagnetic field exposure (Nicholls & Racey, 2009) . As stated below, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville II, 2015) (Manville II, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 19, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in

IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, D. et al., 1997). The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur.

Research indicates that RF exposure may adversely affect birds. A comment letter on the Draft Programmatic Environmental Impact Statement for this region, presented by Dr. Albert Manville, former USFWS agency lead on avian-structural impacts, summarizes the state of scientific knowledge of the potential effects of RF exposure on wildlife, particularly migratory birds; the comment letter is presented in its entirety in Appendix G. RF exposure may result in adverse impacts on wildlife, although a distinct causal relationship between RF exposure and responses in wild animal populations has not been established. Further, important scientific questions regarding the mechanisms of impact, the exposure levels that trigger *adverse effects*, and the importance of confounding factors in the manifestation of effects, among other questions, remain unanswered (Manville II, 2016b) (Appendix G).

Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian and mammalian subjects, including embryonic mortality in bird eggs, genetic abnormalities, cellular defects, tumor growth, and reproductive and other behavioral changes in adult birds and rodents (Wyde, 2016) (Levitt & Lai, 2010) (DiCarlo, 2002) (Grigor'ev, 2003) (Panagopoulos, 2008).

Few studies of the effects of RF exposure on wild animal populations have been conducted due to the difficulty of performing controlled studies on wild subjects. Those that have been conducted are observational in nature (i.e., documenting of reproductive success and behavior in birds near RF-emitting facilities). These studies lack controls on exposure levels or other potentially confounding factors. Nevertheless, findings from these studies indicate reduced survivorship at all life stages; physiological problems related to locomotion and foraging success; and behavioral changes that resulted in delayed or unsuccessful mating in several species of nesting birds (Balmori, 2005) (Balmori, 2009) (Balmori & Hallberg, 2007) (Manville II, 2016b) (Appendix G). Balmori (2005) documented effects as far as 1,000 feet from an RF source consisting of multiple cellular phone towers. Another study of wild birds conducted by Engels et al. (2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise,¹⁵² which can disrupt migration or send birds off course, potentially resulting in reduced survivorship.

Experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on birds and other wildlife and the implications of those effects on wildlife populations over the long term (Manville II, 2015) (Manville II, 2016b) (Appendix G). Such studies should be conducted over multiple generations and include controls to more clearly establish causal relationships, identify potential chronic effects, and determine threshold exposure levels. FirstNet recognizes that RF exposure may adversely impact wildlife, particularly birds that nest, roost, forage, or otherwise spend considerable time in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet

¹⁵² Urban electromagnetic noise is a term used to describe an area with a concentration of cell phone towers and users, which by sheer volume and level of use, creates a zone of electromagnetic noise.

would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 19, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure 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 at the programmatic level.

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* at the programmatic level.

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. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the small-scale and localized nature of expected activities, as FirstNet would attempt to avoid these areas. Potential effects to migration patterns of Nebraska's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Terrestrial Mammals

Large game animals (e.g., elk, white-tailed deer) 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.¹⁵³

Any clearance, drilling, and construction activities needed for network deployment, including noise and vibrations 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* at the

¹⁵³ A location chosen by an animal for hibernation

programmatic level due to the small scale of expected FirstNet activities in any particular location. BMPs and mitigation measures (see Chapter 19) could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, as a group, shorebirds (e.g., sandpipers) undertake some of the longest-distance migrations of all animals. Nebraska is located within the Central Flyway, which spans the Rocky Mountains, Great Plains, arid Southwest, and western Gulf Coast. The Central Flyway extends from northern Canada and Arctic islands south to Central and South America. The Central Flyway resembles an hourglass shape, with a wider path at the northern and southern portions in the United States and narrowing over the state of Nebraska, where the Platte River is considered one of the nation's most important spring migrating staging areas for several species. According to the National Audubon Society, a total of 25 IBAs have been identified in Nebraska, covering more than 425,000 acres, including breeding,¹⁵⁴ migratory stop-over, feeding areas, and a variety of habitats and wintering rounds (NAS, 2015b). These IBAs are widely distributed throughout the state, although the largest concentration of IBAs are located along the Missouri, Platte, and Niobrara Rivers in the northern, central, and eastern portions of the state. 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* at the programmatic level. Additionally, there is some evidence in the scientific literature that RF emissions could affect bird migration. (Engels, et. al., 2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise, which can disrupt migration or send birds off course, potentially resulting in reduced survivorship. It is unlikely that the limited amount of infrastructure, the amount of RF emissions generated by Project infrastructure, and the temporary nature of the deployment activities would result in impacts to large populations of migratory birds, but more likely that individual birds could be impacted. Chapter 19, BMPs and Mitigation Measures, provides a list of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential effects to migratory pathways.

Reptiles and Amphibians

Several species of mole salamanders and the northern leopard frog are known to seasonally migrate in Nebraska. These amphibians often travel by the hundreds on their migration pathway that often crosses roadways. Mole salamanders are typically found in burrows in the forest floor (UNL, 2015b). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

¹⁵⁴ Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015d)

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* at the programmatic level due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a list 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 proposed deployment activities would be expected to have *no impacts* to terrestrial invertebrates. *No effects* to migratory patterns of Nebraska'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. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the short-term and limited nature of expected activities, as FirstNet would attempt to avoid these areas. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and calving grounds for large mammals, such as the elk and white-tailed deer, has the potential to negatively affect body condition and reproductive success of mammals in Nebraska. For example, elk use certain types of habitats that allow for more effective defense of their calves from predators. There are no published studies that document *adverse effects* to bats from RF exposure. As stated above, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville II, 2015) (Manville II, 2016b) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 19, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small scale and impacts

are expected to be *less than significant*. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual, vibrations, and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, D. et al., 1997). Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian subjects, including embryonic mortality in bird eggs and reproductive changes in adult birds (Wyde, 2016) (Levitt & Lai, 2010) (DiCarlo, 2002) (Grigor'ev, 2003) (Panagopoulos, 2008). Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in embryonic mortality (DiCarlo, 2002) (Manville, A.M., II, 2007). These studies suggest that RF emissions at low levels (far below the existing exposure guidelines for humans) (see Section 2.4.2, RF Emissions and Humans) may be harmful to wild birds; however, given the controlled nature of the studies and potential exposure differences in the wild, it is unclear how this exposure would affect organisms in the wild.

As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 19, BMPs and Mitigation Measures) to help reduce bird mortalities associated with both RF emissions and tower collisions. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

The majority of FirstNet deployment or operation activities are likely to be small scale in nature. BMPs and mitigation measures as defined through consultation with USFWS for compliance with MBTA or BGEPA, or another appropriate regulatory agency, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 12.2.6.6, Threatened and Endangered Species.

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 the spring and travels to its nesting site.

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though BMPs would help to avoid or minimize the potential impacts. Overall, impacts to reptiles and amphibians are expected to be *less than significant* at the programmatic level due to the limited extent and temporary nature of the deployment.

Terrestrial Invertebrates

The FirstNet deployment or operation activities are not expected to impact terrestrial invertebrates. 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 Nebraska Invasive Species Council addresses invasive species of all types, including noxious weeds as previously mentioned.

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, potential impacts are expected to be *less than significant* at the programmatic level.

Potential invasive species effects to Nebraska's wildlife are described below.

Terrestrial Mammals

In Nebraska, feral swine could adversely impact several native large and small mammals, including, waterfowl, and deer (Invasive.org, 2010). They feed on reptiles and amphibians, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans.

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to terrestrial mammals as a result of the introduction of invasive species

Birds

Invasive plant and pest species directly alter the landscape or habitat to a condition that is more favorable for an invasive species, and less favorable for native species and their habitats. For example, mute swans are found in Nebraska; research on mute swans in New York indicates they 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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to birds as a result of the introduction of invasive species

Reptiles and Amphibians

There are no regulated invasive reptiles and amphibians in Nebraska; however, invasive species such as the red-eared slider (*Trachemys scripta elegans*), a turtle species, have been found in the state. This species is highly adaptable and could threaten native wildlife by competing with them for food sources and also spread disease (Invasive Species Specialist Group, 2010). 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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to reptiles and amphibians as a result of the introduction of invasive species

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects pose a large threat to forest and agricultural resources (USFS, 2013). Species such as the Japanese beetle and mountain pine beetle are of particular concern in Nebraska 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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to terrestrial invertebrates as a result of the introduction of invasive species

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected.

Activities Likely to Have No Impacts at the Programmatic Level

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 at the programmatic level under the conditions described below:

under the conditions described below:

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

Activities with the Potential to Have Impacts at the Programmatic Level

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**
 - o **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 and vibrations, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects depending on the project location and extent of disturbance.
 - o **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 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.
 - o **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 and vibration 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.
 - o **New Build – Submarine Fiber Optic Plant:** The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore or banks of water bodies to accept submarine cables could potentially impact wildlife (see Section 12.2.4, Water Resources, for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality, habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical time periods, effects to migratory patterns as well as reproductive effects and indirect injury/mortality could occur.

- o 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
 - o 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.
 - 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 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.
 - o Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to wildlife on roadways from vehicular movement. If external generators are used, noise and vibration 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 and potential impacts, 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 or vibrations. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the above-mentioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be *less than significant* at the programmatic level given the small scale of likely individual FirstNet projects with the exception of impacts to birds and bats, which are expected

to be *less than significant with BMPs and mitigation measures incorporated*. 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. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. 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 wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

At the programmatic level, it is anticipated that there would be *less than significant* impacts to wildlife resources associated with routine inspections of the Preferred Alternative). At the programmatic level, 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. In particular, collisions with new cell towers that may be installed as part of the Preferred Alternative could increase avian mortality. As stated above, these impacts would likely be limited to individual wildlife species. DOI comments dated October 11, 2016¹⁵⁵ stated that communication towers are "currently estimated to kill between four and five million birds per year", although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts (Regulations.gov, 2016). Therefore, impacts to birds may result in *less than significant* impacts with BMPs and mitigation measures added. 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

¹⁵⁵ See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and therefore would likely be *less than significant* at the programmatic 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.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As described above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level 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* at the programmatic level because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. See Chapter 19, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts at the programmatic level 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 the No Action Alternative.

Environmental conditions would therefore be the same as those described in Section 12.1.6.4, Terrestrial Wildlife.

12.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Nebraska are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012d).

Based on the impact significance criteria presented in Table 12.2.6-1, *less than significant* impacts would be anticipated at the programmatic level given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable but minimal for some FirstNet projects, individual behavior of fish species would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations

of species as a whole; fish species would be expected to swim to a nearby location, depending on the nature of the deployment activity.

Indirect Injury/Mortality

Water quality impacts from exposure to contaminants from accidental spills from vehicles and equipment, and erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could result in changes to habitat, food sources, or prey resulting in indirect mortality/injury to fish and aquatic invertebrates. Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. These impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures to protect water resources (see Chapter 19) 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* at the programmatic level, 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 (see Chapter 19) 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* at the programmatic level, though BMPs and mitigation measures (see Chapter 19) could help to further avoid or minimize the potential impacts.

Invasive Species Effects

The potential to introduce invasive plants within construction zones could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet deployment activities could result in short-term or temporary changes to specific project sites and these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers, therefore impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected FirstNet activities in any particular location. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize the potential for introducing invasive species

during implementation of the Proposed Action as well as minimize effects to aquatic environments as a result of the introduction of invasive species

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts at the Programmatic Level

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
 - o Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibrations, 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.
 - o 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
 - o Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance.
 - o 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 at the Programmatic Level

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**
 - o **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. Disturbance, including noise and vibrations, associated with the above activities could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects depending on the project location and extent of disturbance.
 - o **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 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.
 - o **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.
 - o **New Build – Submarine Fiber Optic Plant:** The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore or banks or water bodies 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 and vibrations, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
 - o **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
 - o 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.
 - 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 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.
 - o 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.
 - o 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 above-mentioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be *less than significant* at the programmatic level 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 above mentioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

At the programmatic level, 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* at the programmatic level 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 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 at the programmatic level 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* at the programmatic level 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 at the programmatic level 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 but are expected to remain *less than significant* despite this potential variability due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to fisheries and aquatic habitats as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.6.5, Fisheries and Aquatic Habitats.

12.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Nebraska associated with deployment and operation of the Proposed Action and alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 12.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as *may affect, likely to adversely affect*; *may affect, not likely to adversely affect*; and *no effect*. These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* and are described in general terms below (USFWS, 1998):

- *No effect* means that no listed resources would be exposed to the action and its environmental consequences.
- *May affect, not likely to adversely affect* means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any *adverse effects* to the species or habitat. Insignificant effects relate to the size of the impact and include those effects that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those extremely unlikely to occur.
- *May affect, likely to adversely affect* means that listed resources are likely to be exposed to the action or its environmental consequences and would respond in a negative manner to the exposure.

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 12.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level

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 <i>likely to adversely affect</i> 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 <i>likely to adversely affect</i> 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 <i>adverse effect</i> on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012d).

Based on the impact significance criteria presented in Table 12.2.6-2, any direct injury or mortality of a listed species at the individual-level could be *potentially significant* as well as any impact that has more than a negligible potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Nebraska are described below.

Terrestrial Mammals

Direct mortality or injury to the federally listed Northern long-eared bat could occur if tree clearing activities occurred during the roosting season (i.e., approximately April-November) and bats were present. 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 this species; when disturbed by noise, vibrations, or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 2015g). Impacts would likely be isolated, individual events and therefore *may affect*, but are not *likely to adversely affect*, a listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Birds

Two endangered and two threatened bird species are identified in Nebraska. The least tern, piping plover, red knot, and whooping crane may be found in riverine environments of the Platte, Missouri, Loup, and Niobrara Rivers (USFWS, 1990) (USFWS, 2003) (Nebraska Bird Library, 2015a) (USFWS, 2007). Depending on the project types and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts *may affect, but are not likely to adversely affect*, listed species as FirstNet would attempt to avoid deployment activities in areas where listed species occur. If proposed project sites are unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Fish

Two endangered fish are federally listed in Nebraska. The pallid sturgeon can be found in the Missouri River and portions of the Platte and lower Niobrara Rivers (Nebraska Rare Species, 2014), while the Topeka shiner is presumed to exist in small clean pools in streams in northern Nebraska (USFWS, 2010a). Direct mortality or injury to the endangered fish species could occur from vessel/boat strikes or entanglements resulting from the Proposed Action are unlikely as the majority of FirstNet deployment projects would not occur in the aquatic environment. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

No federally listed amphibians or reptiles occur in Nebraska. Therefore, no injury or mortality effects to federally threatened and endangered reptiles or amphibian species are expected as a result of the Proposed Action.

Invertebrates

Three endangered invertebrates are federally listed in Nebraska. The American burying beetle has been identified along the Platte River (USFWS, 1991) and the Salt Creek tiger beetle is found along specific creeks near Lincoln in eastern Nebraska (USFWS, 2014f). The scaleshell mussel was once thought to exist in Cedar County, but has not been confirmed in over 100 years (USFWS, 2010b). 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.

Potential impacts *may affect, but would not likely adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

One endangered and three threatened plants are federally listed in Nebraska. The blowout penstemon (*Penstemon haydenii*) grows in disturbed transition areas of Nebraska's Sandhills (USFWS 2015k), the Colorado butterfly plant and Ute ladies'-tresses are predominantly wetland and meadow species of north or west Nebraska (USFWS, 2010c) (USFWS, 2015l) (USFWS, 2015m). The western prairie fringed orchid grows in moist, disturbed plans of eastern parts of the state (USFWS, 2015n). 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. FirstNet would attempt to avoid areas where these species may occur; therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. 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, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Nebraska are described below.

Terrestrial Mammals

Noise, vibrations, 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 however, they are anticipated to be small-scale and localized. FirstNet would attempt to avoid these areas where listed species occur. Therefore, potential impacts *may affect*, but are not *likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Birds

The piping plover nests in Nebraska on open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers (USFWS, 2003). The least tern also nests in Nebraska, specifically the Platte and Missouri Rivers have been known to host breeding populations (USFWS, 1990). The majority of FirstNet deployment activities would not occur on riverbanks; therefore, impacts to these bird species are not anticipated. Noise, vibrations, light, and other human disturbance within nesting areas could cause nesting birds to abandon their nests, relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. However, FirstNet would attempt to avoid these areas where listed species occur. Therefore, potential impacts *may affect*, but are not *likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

No federally listed amphibians or reptiles would be affected by the Proposed Action in Nebraska. Therefore, no reproductive effects to federally threatened and endangered reptiles or amphibian species are expected as a result of the Proposed Action.

Fish

Deployment activities in the Missouri River, Platte River, and Niobrara River basins resulting in increased disturbance (e.g., humans, noise, vibrations), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 12.2.4, Water Resources, for a discussion of potential impacts to water resources). Impacts to reproduction for the pallid sturgeon and Topeka shiner are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality from ground disturbing activities could cause stress resulting in lower productivity for the federally listed scaleshell mussel known to occur in Nebraska. Impacts to habitat, including loss and fragmentation, and reduced food supply could result in reduced survival and reproduction for the American burying beetle and the Salt Creek tiger beetle. Impacts associated with deployment activities are expected to result in *less than significant* changes to water quality. Potential impacts to federally listed invertebrate species *may affect*, but are not *likely to adversely affect*, those species, as FirstNet would attempt to avoid these areas where listed species occur. 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. Additionally, FirstNet would likely attempt to avoid known locations of listed plants. If avoidance was not possible, 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.

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, fish, invertebrates, and plants with known occurrence in Nebraska are described below.

Mammals

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect breeding and foraging sites of the federally listed terrestrial mammals, resulting in reduced

survival and productivity. However, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed terrestrial mammals. Ground disturbing activities could impact food sources for the federally listed terrestrial mammals. Further, increased human disturbance, noise, vibrations, and vessel traffic could cause stress to listed species, causing them to abandon breeding locations or alter migration patterns. Terrestrial mammals have the capacity to divert from sound sources during feeding and migration. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

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 Nebraska (USFWS 2015i). Disturbance in stopover, foraging, or breeding areas (visual, noise, or vibrations) 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. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts *may affect*, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

No federally listed reptiles or amphibians are found in Nebraska. Therefore, no behavioral effects to federally threatened and endangered reptile or amphibian species are expected as a result of the Proposed Action.

Fish

Changes in water quality as a result of ground disturbing activities could impact food sources for the pallid sturgeon and Topeka shiner. Further, increased human disturbance, noise, vibrations, and vessel traffic could cause stress to these fish species causing them to abandon spawning locations or altering migration patterns. Behavioral changes to the pallid sturgeon and the Topeka shiner are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts *may affect*, but are not *likely to adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures,

as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for the federally listed scaleshell mussel and Salt Creek tiger beetle resulting in lower productivity. Reduction in suitable small invertebrates that the American burying beetle uses to feed its larvae could impact survival. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts *may affect*, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an *adverse effect* and could be *potentially significant*. Depending on the species or habitat, the *adverse effect* threshold would vary for geographic extent. FirstNet activities are generally expected to be small-scale in nature, therefore large-scale impacts are not expected; however, it is possible that small-scale changes could lead to *potentially significant adverse effects* for certain species. For example, impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically.

Terrestrial Mammals

There is no designated critical habitat occurs for terrestrial mammals in Nebraska. 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

In Nebraska, critical habitat for the piping plover is designated and found for nesting sites in wetland areas of the Missouri river in north western parts of the state (USFWS, 2003). Critical habitat for the whooping crane has been designated in riverine habitats of the Platte River in Central Nebraska (Figure 12.1.6-3) (USFWS, 2011). Land clearing, excavation activities, and other ground disturbing activities in these regions of Nebraska could lead to habitat loss or degradation, which could lead to *adverse effects* to the piping plover and whooping crane depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts *may affect*, but would likely not adversely affect, designated critical habitat. BMPs and mitigation

measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

There are no listed species or designated critical habitat for reptiles or amphibians in Nebraska. 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

Designated critical habitat for the Topeka shiner occurs in Nebraska (Figure 12.1.6-3) (USFWS, 2015d). The loss or degradation of designated critical habitat is unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Critical habitat has been federally designated for the Salt Creek tiger beetle in specific creeks in Lancaster and Saunders Counties in eastern Nebraska (Figure 12.1.6-3) (USFWS, 2014f). Creeks that support the species are saline with muddy banks and wetlands for the beetle to inhabit. Land clearing, excavation activities, and other ground disturbing activities in these regions of Nebraska could lead to habitat loss or degradation, which could lead to *adverse effects* to the Salt Creek tiger beetle depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat. 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 occurs for plants in Nebraska. 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 effect* to *may affect, but not likely to adversely affect* depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. 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 at the Programmatic Level

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 and vibrations 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 have *no effect* on 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 affect protected species, it is anticipated that this activity would have *no effect* on protected species.

Activities with the Potential to Affect Listed Species at the Programmatic Level

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**
 - o **New Build –Buried Fiber Optic Plant:** Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential effects to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise and vibrations, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
 - o **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 effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
 - o **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 and vibration 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.
 - o **New Build – Submarine Fiber Optic Plant:** The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore or banks or water bodies to accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 12.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. If activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
 - o **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
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could affect threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
 - 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; 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.
 - o 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 and vibration 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, blimps, or piloted aircraft could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects,

behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. These impacts *may affect, but are not likely adversely affect* protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the above-mentioned deployment impacts. The threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

It is anticipated that operational impacts *may affect, but are not likely to adversely affect* threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, *may affect, but are not likely to adversely affect* threatened and endangered species, as they would be conducted infrequently and in compliance with BMPs and mitigation measures developed through consultation with the appropriate resource agency.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. Listed species *may be affected, but are not likely to be adversely affected*. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species *may be affected, but are not likely to be adversely affected*, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. 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. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that activities *may affect, but are not likely to adversely affect*, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of

wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effects* to threatened and endangered species as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

12.2.7. Land Use, Recreation, and Airspace

12.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Nebraska 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.

12.2.7.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on land use, recreation, and airspace resources were evaluated using the significance criteria presented in Table 12.2.7-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Table 12.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Measures Incorporated	Less than Significant	No Impact
	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
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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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, vibration, or other impacts)	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Measures Incorporated	Less than Significant	No Impact
that make recreational activity less desirable)	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
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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

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.

12.2.7.3. Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 12.2.7-1, *less than significant* impacts would be anticipated at the programmatic level given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 12.2.7-1, *less than significant* impacts would be anticipated at the programmatic level 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 12.2.7-1, *less than significant* impacts would be anticipated at the programmatic level 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 and vibration impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 12.2.7-1, *less than significant* impacts would be anticipated at the programmatic level as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

Use of Airspace

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. Impacts could include air routes or flight paths, available flight altitudes, disruption of normal flight patterns, and restrictions to flight activities. Construction of new towers or alternations to existing towers could obstruct navigable airspace depending on the tower location. Use of aerial technologies could result in SUA considerations.

Based on impact significance criteria presented in Table 12.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, First Net activities are expected to have *less than significant* impacts at the programmatic level to airspace resources.

12.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action, 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 at the Programmatic Level

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

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
 - Land Use: See *Activities Likely to Have Impacts* below.
 - Recreation: See *Activities Likely to Have Impacts* below.
 - Airspace: *No impacts* to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
 - Land Use: It is anticipated that there would be *no impacts* to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
 - Recreation: See *Activities Likely to Have Impacts* below.
 - Airspace: It is anticipated that there would be *no impacts* to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
 - **New Build – Aerial Fiber Optic Plant:** Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
 - Land Use: See *Activities Likely to Have Impacts* below.

- Recreation: See *Activities Likely to Have Impacts* below.
- Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 ft. 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 bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
 - Land Use: See *Activities Likely to Have Impacts* below.
 - Recreation: See *Activities Likely to Have Impacts* below.
 - Airspace: The installation of cables in or near bodies of water and construction of landings/facilities on shores and banks of water bodies would have *no impact* flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
 - Land Use: See *Activities Likely to Have Impacts*, below.
 - Recreation: See *Activities Likely to Have Impacts*, below.
 - Airspace: *No impacts* to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
- Wireless Projects
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.

- Land Use: There would be *no impacts* to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
- Recreation: See *Activities Likely to Have Impacts* below.
- Airspace: See *Activities Likely to Have Impacts* below.
- o 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 ft. AGL or do not trigger any of the other FAA obstruction to airspace criteria. For potential impacts associated with Deployable Aerial Communications Architecture see *Activities Likely to Have Impacts*, below.
- Satellites and Other Technologies
 - o 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.
 - o 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 at the Programmatic Level

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**
 - o **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.
 - o **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: *No impacts* are anticipated - see previous section
 - Recreation: Installation of fiber optic cable in existing conduits occurs in previously disturbed areas, which may include areas used for recreational purposes. It is possible that access to recreational lands or activities may be restricted during the deployment phase or a portion of the operations phase.
 - Airspace: *No impacts* are anticipated – see previous section.
 - o **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.
 - o **New Build – Submarine Fiber Optic Plant:** Installing cables in or near bodies of water and the constructing landings and/or facilities on shores and banks of water bodies to accept submarine cable.
 - Land Use: Deployment activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the

- impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
- Recreation: Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
 - Airspace: *No impacts* are anticipated – see previous section.
 - o 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
 - o 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 ft. AGL or meets other criteria. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of Nebraska's airports.
 - 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.
 - 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
 - o Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
 - Land Use: *No impacts* are anticipated – see previous section.
 - Recreation: *No impacts* are anticipated – see previous section.
 - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 ft. and near Nebraska 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
 - o 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: *No impacts* are anticipated – see previous section.
 - Airspace: *No impacts* are anticipated – see previous section.

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. At the programmatic level, potential impacts to airspace are expected to be *less than significant* due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network partners), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the

facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. The degree of change in the visual environment (see Section 12.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. The use of deployable aerial communications architecture could temporarily add new air traffic or aerial navigation hazards. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. 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.

12.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal 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 at the programmatic level. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer

periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be *less than significant* at the programmatic level 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, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, at the programmatic level, it is anticipated that there would be *no impacts* to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. 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* at the programmatic level, due to the temporary nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 12.1.7, Land Use, Recreation, and Airspace.

12.2.8. Visual Resources

12.2.8.1. Introduction

This section describes potential impacts to visual resources in Nebraska 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.

12.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 12.2.8-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, 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 12.2.8-1: Impact Significance Rating Criteria for Visual Resources at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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.

12.2.8.3. Description of Environmental Concerns

Adverse Change in Aesthetic Character of Scenic Resources or Viewsheds

A primary concern during and following construction of structures, towers, roads or other permanent features is the long-term disruption of scenery and viewsheds. In Nebraska, residents and visitors travel to visit Signal Butte 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.

Based on the impact significance criteria presented in Table 12.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered *potentially significant* if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. The majority of FirstNet deployment activities would not cause negative impacts to the aesthetic character to a noticeable degree. However, some projects, such as towers, facilities, or infrastructure could cause a negative impact on the aesthetic character of local viewsheds depending on their size and location. However, given the small scale of likely FirstNet activities, impacts are expected to be *less than significant* at the programmatic level.

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 12.2.8-1, 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*. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.8.4. 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 with implementation of BMPs and mitigation measures* depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

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 at the programmatic level under the conditions described below:

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

Activities with the Potential to Have Impacts at the Programmatic Level

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**
 - o **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
 - o **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.
 - o **New Build – Submarine Fiber Optic Plant:** The installation of cables in and 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 shore to accept submarine cable.
 - o **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**
 - o **New Wireless Communication Towers:** Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a NPS unit or other sensitive area. If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within

unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- 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 and would not likely result in additional impacts to visual resources. However, if additional power units are needed, structural hardening, or physical security measures may require ground disturbance or removal of vegetation, and impacts to the aesthetic character of scenic resources or viewsheds could occur.
- o 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 lighting.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be *less than significant* at the programmatic level due to the temporary and small-scale nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be *less than significant with BMPs and mitigation measures incorporated* during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal 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* at the programmatic level as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be *less than significant* at the programmatic level. These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to visual resources as a

result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.8, Visual Resources.

12.2.9. Socioeconomics

12.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Nebraska 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.

12.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 12.2.9-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Indiscernible impact to property values and/or rental fees.	<i>No impacts</i> 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Indiscernible economic change.	No change to tax revenues, wages, major industries, or direct spending.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is <i>potentially significant</i> , but with	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Geographic Extent	Regional impacts observed throughout the state/territory.	mitigation is <i>less than significant</i> .	Effects realized at one or multiple isolated cities/towns.	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 in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

12.2.9.3. Description of Environmental Concerns

This section discusses at a high level the types of socioeconomic impacts that could result from deployment of the NPSBN. Socioeconomic impacts could be negative or positive. Subsections below address socioeconomic impacts in four general areas, following the breakdown of the significance rating criteria in the table above:

- Impacts to Real Estate;
- Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

In addition to the specific impacts noted below, the Proposed Action would likely have broad, beneficial impacts to all four areas in times of disaster, by improving the response of public safety personnel. Reduced damages and faster recovery would result. This would support property values; maintain corporate income, personal income, and government revenues; preserve jobs; and reduce disruptions to populations.

Impacts to Real Estate

Deployment of the NPSBN has the potential to improve property values in areas that have reduced property values due to below average public safety communication services. Improved services would reduce response times and improve responses. These effects would reduce the potential for economic losses and thus support investments in property and greater market value for property. Any increases in property values are most likely in areas that have low property values and below average public safety communication services. Increases are less likely in areas that already have higher property value. As discussed in Affected Environment, property values vary across Nebraska. Median values of owner-occupied housing units in the 2009–2013 period ranged from over \$146,000 in the greater Omaha area, to below \$90,000 in the Hastings area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond et al., 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond et al., 2013). These studies all focused on residential properties. One study

identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing *no effect* beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, *may affect* property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to \$7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and *less than significant* at the programmatic level. 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's 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* at the programmatic level. 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 across Nebraska. The average unemployment rate in 2014 was 3.3 percent, considerably lower than the national rate of 6.2 percent. Only one county in the northeastern portion of Nebraska had an unemployment rate above the national average. All other counties have unemployment rates below the national average (that is, better employment performance).

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system designers may be located in one or a few specific offices. While such employment

concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 12.2.9-1 because they would not constitute a “high level of job creation at the state or territory level.”

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they can find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria 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.

12.2.9.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 12.2.9-1.

Activities Likely to Have No Impacts at the Programmatic Level

- **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 at the Programmatic Level

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
 - o 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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* at the programmatic level
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- 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 would have the following types of socioeconomic impacts:
 - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond et al., 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be *less than significant* at the programmatic level.
 - 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* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond et al., 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o 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 vibrations, 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* at the programmatic level.

- 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
 - o 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* at the programmatic level.
 - 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* at the programmatic level, as described above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be *less than significant* at the programmatic level. 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 at the Programmatic Level

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* at the programmatic level.
- 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* at the programmatic level as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the state. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and therefore *less than significant* at the programmatic level.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. The potential adverse impacts of new wireless communication towers on property values would be avoided under the Deployable Technologies Alternative. These potential impacts are anticipated to be *less than significant* at the programmatic level as described above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be *less than significant* at the programmatic level.

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, vibrations, 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* at the programmatic level as they would be limited to a relatively small number of sites within the state. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to socioeconomics as a result of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 12.1.9, Socioeconomics.

12.2.10. Environmental Justice

12.2.10.1. Introduction

This section describes potential impacts to environmental justice in Nebraska 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.

12.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 12.2.10-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level

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 <i>adverse effects</i> on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

12.2.10.3. Description of Environmental Concerns

Effects associated with other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment” (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise and Vibrations, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, vibrations, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond et al., 2013). See Socioeconomics Environmental Consequences for additional discussion. The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* “adverse” and “disproportionately high” in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on *adverse effects*. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and EMS; 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 ft.) of a communications tower (Bond et al., 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this Final PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 12.1.10.4) as having moderate potential or high potential for environmental justice populations

would particularly warrant further screening. As discussed in Section 12.1.10.3, Nebraska's population has a lower percentage of minorities than the region and a considerably lower percentage than the nation, and lower rates of poverty than the region or nation. Nebraska has many areas with high and moderate potential for environmental justice populations. The distribution of these areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some of the state's most sparsely populated areas, such as the northern regions, on the border with South Dakota. The proportion of Nebraska's area that is categorized as having high potential for environmental justice populations is relatively low compared to many states. Further analysis using the data developed for the screening analysis in Section 12.1.10.4 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, 2015g) (USEPA, 2014e).

Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

12.2.10.4. 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 at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

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.

- o 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
 - o 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.
 - o 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 at the Programmatic Level

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, vibrations, 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
 - o 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, vibrations, and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
 - o New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - o 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, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- o 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, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- 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 requires construction activities that could temporarily generate noise, vibrations, and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond et al., 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - o 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, vibrations, and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - o 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, vibrations, 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, vibrations, 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* at the programmatic level, 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, furthermore, site-specific analysis could evaluate site conditions and the impacts of the type of deployment, and could satisfy requirements associated with any other permits or permissions necessary to perform the work. 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

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, vibrations, and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, vibrations, 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* at the programmatic level because they would be temporary in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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, vibrations, 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* at the programmatic level as operations are expected to be temporary in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to environmental justice communities as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.10, Environmental Justice.

12.2.11. Cultural Resources

12.2.11.1. Introduction

This section describes potential impacts to cultural resources in Nebraska 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.

12.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 12.1.1-1. The categories of impacts are defined at the programmatic level as an *adverse effect*; *mitigated adverse effect*; *effect, but not adverse*; and *no effect*. These impact categories are comparable to those defined in 36 *CFR* § 800, Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (NPS, 1983), and the United States (U.S.) National Park Service's *National Register Bulletin: How to Apply the National Register Criteria for Evaluation* (NPS, 2002). 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 12.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect ^a	Effect, but Not Adverse	No Effect
Physical damage to and/or destruction of historic properties ^b	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> 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.	<i>Adverse effect</i> 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	Effect Level			
		Adverse Effect	Mitigated Adverse Effect ^a	Effect, but Not Adverse	No Effect
Loss of character defining attributes of historic properties	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

^a Whereas mitigation measures for other resources discussed in this Final PEIS may be developed to achieve an impact that is “*Less than significant with mitigation incorporated*,” historic properties are considered to be “non-renewable resources,” given their very nature. As such, any and all unavoidable *adverse effects* to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

^b Per NHPA, a “historic property” is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project’s APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian Tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

12.2.11.3. Description of Environmental Concerns

Physical Damage to and/or Destruction of Historic Properties

One of the primary environmental concerns during deployment activities is damage to or destruction of historic and cultural resources. Deployment involving ground disturbance has the potential to damage or destroy archaeological sites, and the attachment of communications equipment to historic building and structures has the potential to cause damage to features that are historically significant.

Based on the impact significance criteria presented in Table 12.1.1-1, direct deployment impacts could be *potentially adverse* 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 Nebraska, 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 adverse* 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. Adverse impacts such as these could be avoided or minimized through implementation of BMPs and mitigation measures (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 adverse impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to Native Americans. It is anticipated that FirstNet would identify potential impacts to such areas through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

12.2.11.4. Potential Effects of the Preferred Alternative

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

Deployment Effects

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 effect* to *potentially adverse* effects at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Effects at the Programmatic Level

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 effect* on 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 effect* 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 effect* on cultural resources. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have *no effect* 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 *no effect* on 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 effect* on cultural resources.

Activities with the Potential to Have Effects at the Programmatic Level

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 effects on cultural resources include the following:

- Wired Projects
 - o 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.
 - o 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.
 - o 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 the shore or bank of water bodies to accept 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 Nebraska has numerous maritime archaeological sites associated with 19th century expansion), and the associated structures could have visual effects on historic properties.
 - o 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 effect* 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 be potentially *adverse effects* on cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
 - o 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
 - o 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.

- 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 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 Omaha that have larger numbers of historic public buildings.
- o Deployable Technologies: Implementation of deployable technologies could result in potential *adverse effects* to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities *could effect, but not adversely effect*, cultural resources as the potential *adverse effects* would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed, if necessary. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Effects

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no effect* to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions *could effect but*

would not likely adversely effect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage, as necessary, in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.11.5. Alternatives Effect Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Effects

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities *could effect, but not adversely effect*, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage, as necessary, in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Effects

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, at the programmatic level, 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, at the programmatic level, 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, as necessary, in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effects* on cultural resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.11, Cultural Resources.

12.2.12. Air Quality

12.2.12.1. Introduction

This section describes potential impacts to Nebraska's air quality from deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Nebraska's air quality were evaluated using the significance criteria presented in Table 12.2.12-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, 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 Nebraska's air quality addressed in this section are presented as a range of possible impacts.

Table 12.2.12-1: Impact Significance Rating Criteria at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 <i>de minimis</i> 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

12.2.12.3. Description of Environmental Concerns

Increased Air Emissions

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be above and beyond what is typically generated in a given area and may alter ambient air quality. Deployment activities may involve the use of vehicles, heavy equipment, and other equipment that could emit exhaust and create fugitive dust in localized areas. During operations, routine maintenance and other use of generators at tower facilities may emit exhaust for specific durations (maintenance) or unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be *less than significant* at the programmatic level due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Nebraska that are in maintenance or nonattainment for one or more criteria pollutants (Figure 12.1.12-1) (see Section 12.1.12, Air Quality).

Based on the significance criteria presented in Table 12.2.12-1, air emission impacts would likely be *less than significant* at the programmatic level 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. At the programmatic level, *Less than significant* emissions could occur for any of the criteria pollutants within attainment areas in Nebraska; however, NAAQS exceedances are not anticipated. 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. However, given nonattainment areas are present in Nebraska, FirstNet may complete some activities in these areas, in which case BMPs would help to avoid or minimize potential impacts.

12.2.12.4. Potential Impacts of the Preferred Alternative

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

Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

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 at the Programmatic Level

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* at the programmatic level 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.
- o 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.
 - o 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 the shore or banks of water bodies to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
 - o 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
 - o 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 conducting 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.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If additional power units, structural hardening, and physical security measures require grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
 - o Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure

replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be *less than significant* at the programmatic level due to the limited nature of the deployment. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Major communications infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *less than significant* impacts at the programmatic level 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 (primarily from dust), however, they would be *less than significant* at the programmatic level as they would still be limited in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alternative 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* at the programmatic level 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* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

12.2.13. Noise and Vibration

12.2.13.1. Introduction

This section describes potential noise and vibration impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Nebraska. 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.

12.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise and vibration impacts of the Proposed Action were evaluated using the significance criteria presented in Table 12.2.13-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, 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 and vibration impacts to Nebraska addressed in this section are presented as a range of possible impacts.

Table 12.2.13-1: Impact Significance Rating Criteria for Noise and Vibrations at the Programmatic Level

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Noise and vibration levels resulting from project activities would exceed natural sounds, but would not exceed typical noise or vibration levels from construction equipment or generators.	Natural sounds would prevail. Noise and vibrations generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

12.2.13.3. Description of Environmental Concerns

Increased Noise and Vibration Levels

The Proposed Action has the potential to generate noise and vibrations during construction and operation of various equipment used for deployment. These noise and vibration levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise and vibrations could cause impacts on residential areas, or other facilities that are sensitive to noise and vibrations, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment.

Based on the significance criteria presented in Table 12.2.13-1, noise and vibration impacts would likely be *less than significant* at the programmatic level 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 and vibration sources be deployed/operated long-term in the same area. Noise and vibration 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 and vibration effects during construction or operation. BMPs and mitigation measures could be followed to limit impacts on nearby noise and vibration-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 and vibration impacts due to construction and operations at various receptors.

12.2.13.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise and vibration 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 at the Programmatic Level

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 or vibration 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 and vibrations 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 or vibration 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 and vibrations would be emitted during installment of this equipment. Noise and vibrations 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 or vibration 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 or vibration sensitive- resources, it is anticipated that this activity would have *no impact* on those resources.

Activities with the Potential for Noise and Vibration Impacts at the Programmatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could create noise and vibration 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 or vibration 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 and vibration levels from the use of vehicles and machinery.
- o 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 temporary increases in noise and vibration levels from the use of heavy equipment and machinery.
 - o 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 or vibration levels if the activity required the use of heavy equipment for grading or other purposes.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate noise or vibrations if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on the shore or banks of bodies of water to accept submarine cable could result in short-term and temporarily increased noise and vibration levels to local residents and other noise and vibration sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: Noise and vibrations 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 and vibration impacts would not occur. Heavy equipment used to grade and construct access roads could generate increased levels of noise or vibrations over baseline levels temporarily.
 - Wireless Projects
 - o 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 and vibrations. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could also increase noise and vibration levels.
 - o 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. Vibration impacts are expected to be negligible.
 - o Deployable Technologies: The type of deployable technology used would dictate the types of noise or vibrations generated. For example, mobile equipment deployed via heavy trucks could generate noise and vibrations 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 and vibrations during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise and vibrations from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be *less than significant* at the programmatic level due to the temporary duration of deployment activities. Additionally, pre-existing noise and vibration levels would be achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be *less than significant* at the programmatic level 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 and vibrations. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration 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 and vibration impacts could result as explained above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise and vibration 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 Alternative 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 and vibration impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise and vibrations 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 and vibration impacts on residences or other noise or vibration-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise and vibrations during all phases of flight. Aerial technologies would have the highest level of noise and vibration impact if they are required to fly above residential areas, areas with a high concentration of noise or vibrations-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* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise and vibrations in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise and vibration impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration 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 and vibration 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 at the programmatic level on any residential areas or other noise or vibration-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise and vibration levels would quickly return to baseline levels. See Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise

or vibrations from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

12.2.14. Climate Change

12.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Nebraska associated with deployment and operation of the Proposed Action and Alternatives. S 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. 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.

12.2.14.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on climate and potential climate change impacts on the Proposed Action's installations and infrastructure were evaluated using the significance criteria presented in Table 12.2.14-1. The categories of impacts are defined, at the programmatic level, 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, 2016).

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, 2016). 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 12.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with Mitigation Measures Incorporated	Less than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	See discussion in Section 12.2.14.5 Potential Impacts of the Preferred Alternative	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No increase in GHG emissions or related changes to the climate as a result of project activities.
	Geographic Extent			Global impacts observed.	NA
	Duration or Frequency			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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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

12.2.14.3. Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. For an average of 7 days per year, maximum temperatures reach more than about 95 °F in the Northern Plains. These high temperatures are projected to occur much more frequently with days over 100 °F projected to double in number in the Northern Plains even in a low emissions scenario. Increases are also expected in the number of nights with minimum temperatures higher than 60 °F in the north part of the plains. These increases in extreme heat will have many negative consequences, including increases in surface water losses, heat stress, and demand for air conditioning (USGCRP, 2014a).

Air Temperature

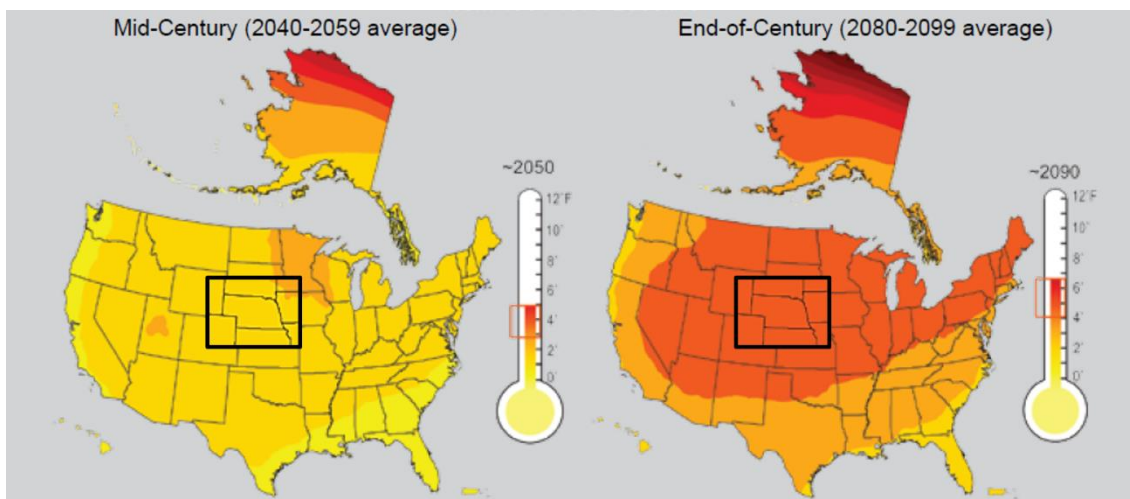
Figure 12.2.14-1 and Figure 12.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Nebraska from a 1969 to 1971 baseline.

Dfa – Figure 12.1.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Nebraska under a low emissions scenario would increase by approximately 4° F, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Nebraska would increase by approximately 6° F (USGCRP, 2009).

Figure 12.2.14-2 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 Nebraska, temperatures would increase by 9° F in the western portion of the region and by approximately 10° F in the eastern portion of the region (USGCRP, 2009).

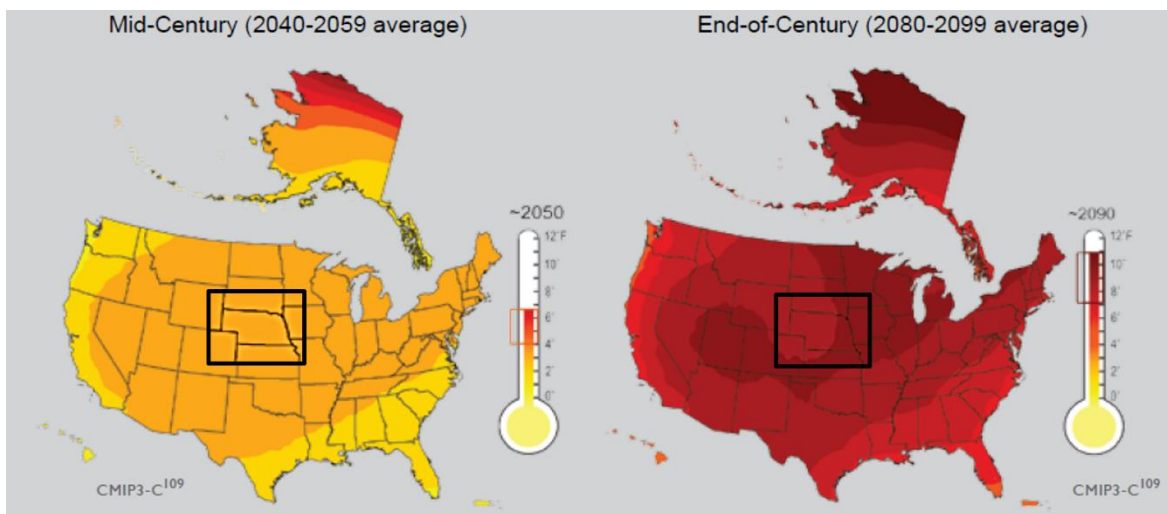
Bsk – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Dfa region under a low emissions scenario (USGCRP, 2009).

Under a high emissions scenario by mid-century temperatures are projected to increase at the same rate as the Dfa region while at the end of the century temperatures are projected to increase by approximately 9° F (USGCRP, 2009).



Source: (USGCRP, 2009)

Figure 12.2.14-1: Nebraska Low Emission Scenario Projected Temperature Change



Source: (USGCRP, 2009)

Figure 12.2.14-2: Nebraska High Emission Scenario Projected Temperature Change

Precipitation

Winter and spring precipitation is projected to increase in the northern states of the Great Plains region relative to a 1971-2000 average. In central areas, changes are projected to be small relative to natural variations. Projected changes in summer and fall precipitation are also small except for summer drying in the central Great Plains. The number of days with heavy precipitation is expected to increase by mid-century, especially in the Northern Plains (USGCRP, 2014a).

Total seasonal snowfall has generally increased in the northern Great Plains although snow is melting earlier in the year and more precipitation is falling as rain versus snow. Overall snow

cover has decreased in the Northern Hemisphere, due in part to higher temperatures that shorten the time snow spends on the ground (USGCRP, 2014b).

In the majority of Nebraska, there is an expected decrease in the number of consecutive dry days under a low emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario in southeastern Nebraska there is a projected increase in the number of consecutive dry days. An increase in consecutive dry days can lead to drought (USGCRP, 2014a).

Figure 12.2.14-3 and Figure 12.2.14-4 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 12.2.14-3 shows seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions means more than 70 percent cuts from current levels by 2050 (USGCRP, 2014c).

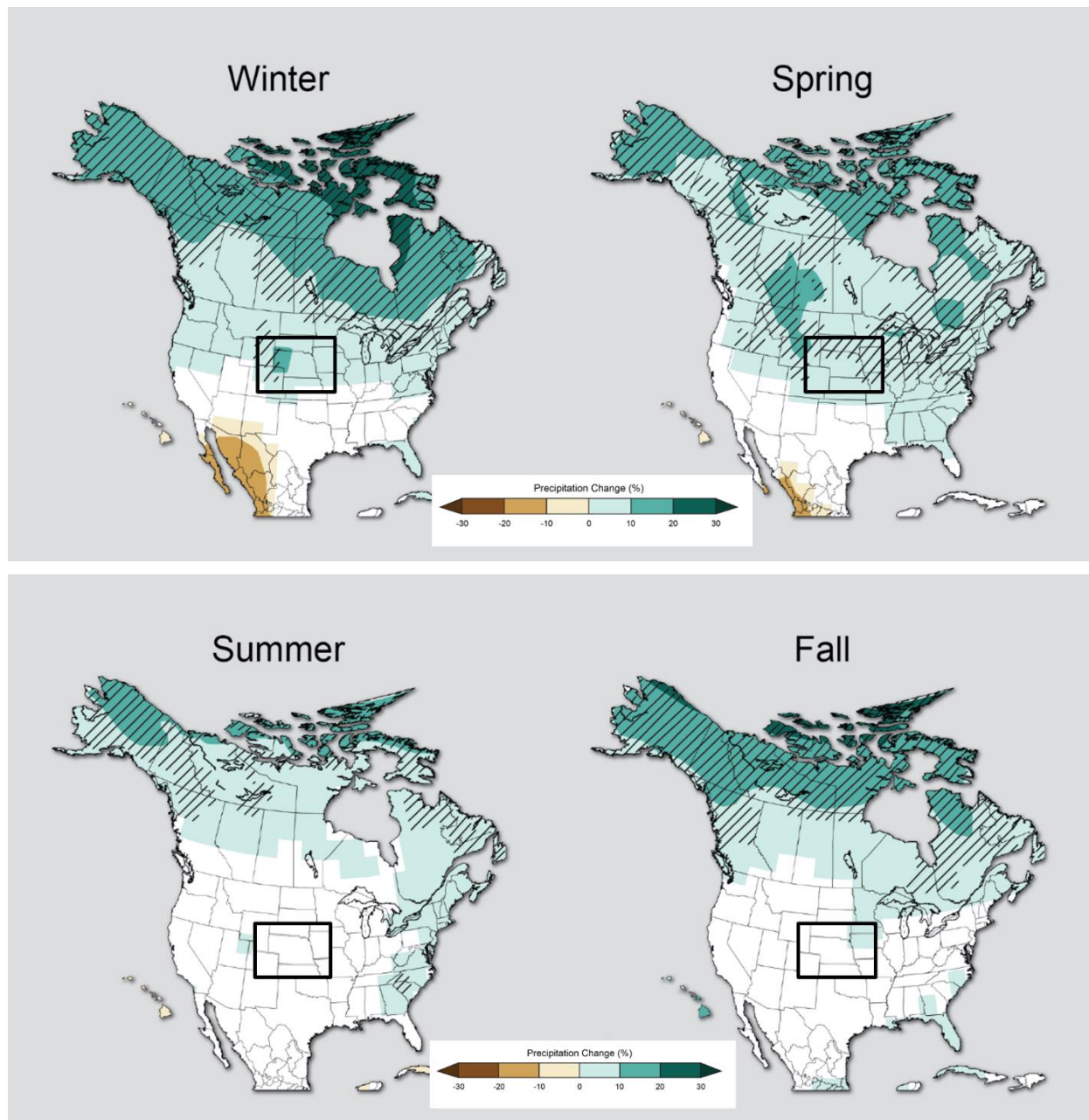
Figure 12.2.14-3 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014c)

Dfa - Figure 12.2.14-3 shows that in a rapid emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in the eastern portion of this region and by 20 percent in the western portion of the Dfa region in winter. In spring precipitation for the entire state of Nebraska is expected to increase by 10 percent. However, there are no expected changes in precipitation in summer or fall other than fluctuations due to natural variability (USGCRP, 2014c).

Figure 12.2.14-4 shows that if emissions continue to increase, winter precipitation could increase as much as 20 or 30 percent depending on the portion of the region over the period 2071 to 2099. In spring, precipitation in this scenario could increase as much as 20 percent. In summer, precipitation is expected to decrease 10 or 20 percent depending on the portion of the Dfa region of Nebraska. No significant change to fall precipitation is anticipated over the same period (USGCRP, 2014c).

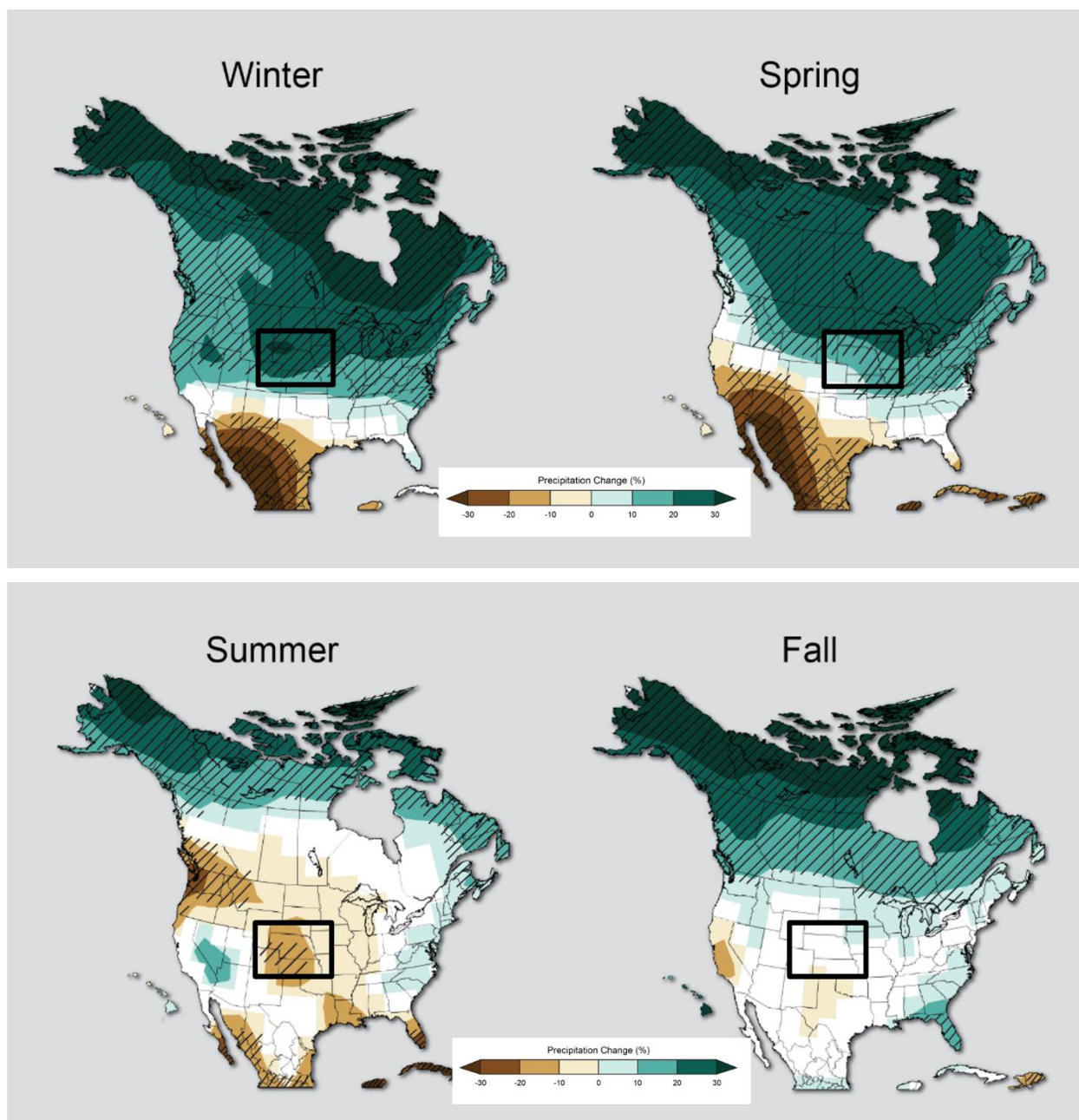
Bsk – Precipitation changes for the Bsk region are consistent with projected changes for the Dfa region of Nebraska in a low GHG emissions scenario (USGCRP, 2014c).

Under a high emissions scenario, precipitation is expected to increase at the same rate as the Dfa region during winter. In spring, precipitation is expected to increase 10 or 20 percent depending on the portion of the region. Summer precipitation is expected to decrease by 20 percent in the Dfa region of Nebraska under a high emissions scenario. There are no expected changes in precipitation in fall under this scenario (USGCRP, 2014c).



Source: (USGCRP, 2014c)

Figure 12.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario



Source: (USGCRP, 2014c)

Figure 12.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

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, 2014b).

12.2.14.4. Description of Environmental Concerns

Greenhouse Gas Emissions

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts, and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO₂ emissions from fossil fuels.

Based on the impact significance criteria presented in Table 12.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

Climate Change

Climate change may impact project-related effects by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. Climate change is expected to have multiple ecosystem effects in Nebraska as temperatures rise, growing seasons extend, snowpack contributions to river flow alter, and extreme droughts and rainfall increase. Over time these effects will exceed the natural variability of the Great Plains region, with implications for both natural and cultivated ecosystems and their dependent economies (UNL, 2014).

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 Nebraska at risk for flooding, climate change is projected to increase flood first through the increased frequency and severity of torrential downpours which in turn may exacerbate the potential for flash flooding (USGCRP, 2014b). This may put FirstNet infrastructure at risk. Climate change may expose areas of Nebraska to increased intensity and duration of heat waves (USGCRP, 2014b) particularly in large population centers with the significant urban heat islands

such as Omaha. Extended periods of extreme heat may increase general demand on the electric grid, impede the operation of the grid in the Great Plains states (Department of Energy, 2015), and overwhelm the capacity onsite equipment needed to keep microwave and other transmitters cool. For areas of Nebraska 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, 2014b). Increases in river flood magnitudes have already been observed in Nebraska and are anticipated to increase in the future (UNL, 2014).

12.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

Given this assessment is programmatic and does not include any site-specific locations or deployment technology, it is impossible to determine the actual GHG emissions associated with any of the action alternatives. This information could only be captured once the site-specific information is determined. However, an assessment of potential impacts is provided in this section based on the potential emissions associated with the various activities that could occur as a result of the implementation of the Preferred Alternative in Nebraska, 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action, the following are likely to have *no impacts* to climate change at the programmatic level 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.
- **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.

- o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts at the Programmatic Level

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
 - o 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.
 - o 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.
 - o 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.
 - o New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
 - o 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
 - o 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.

- o 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
 - o COWs, COLTs, SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts 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* at the programmatic level due to the limited and localized nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative, at the programmatic level, could be *potentially significant to less than significant with BMPs and mitigation measures incorporated* because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to anticipating *adverse effects* of climate change and taking appropriate 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. 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.

12.2.14.6. Alternatives Impact Assessment

The following section assesses potential impacts to climate associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be *less than significant* at the programmatic level based on the defined significance criteria, since activities would be temporary and short-term. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, and SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be *less than significant* at the programmatic level. 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* at the programmatic level due to the limited duration of deployment activities.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, 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* at the programmatic level on the deployed technology due to the temporary nature of deployment. If there are no permanent structures, particularly near coastal areas, there would be little to *no impacts* as a result of sea-level rise. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to GHG emissions or climate as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.14.

12.2.15. Human Health and Safety

12.2.15.1. Introduction

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

12.2.15.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on human health and safety were evaluated using the significance criteria presented in Table 12.2.15-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, 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 12.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory)		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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 Man-Made Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	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

12.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that are inherently dangerous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 12.2.15-1, occupational injury impacts could be *potentially significant* if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like 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 or 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).

1. Engineering controls;
2. Work practice controls;
3. Administrative controls; and then
4. Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes,¹⁵⁶ 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

¹⁵⁶ Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016a)

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, 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 (OSHA, 2015c).

The NEDOL, Workforce Development is authorized by OSHA to administer a state program to oversee employee safety in public or private sector workplaces. Therefore, NEDOL, Workforce Development defers 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 12.2.15-1, human health impacts could be significant if FirstNet

deployment sites are near contaminated properties or abandoned or active mine lands. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA CIMC database and U.S. Department of Interior's Abandoned Mine Lands inventory, through the NDEQ, 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 Nebraska 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, NDEQ may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRA's help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRA's 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 intends 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 impacting 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 affects the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure.

Based on the impact significance criteria presented in Table 12.2.2-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a *less than significant* beneficial impact at the programmatic level, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. Therefore, FirstNet partner(s) would develop disaster response plans that outline specific steps employees should take in the event of a natural or manmade disaster.

12.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts at the Programmatic Level

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 at the Programmatic Level at the Programmatic Level

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.

- o 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.
- o 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.
- o New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in and near bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shore to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- o 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**
 - o **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.
 - 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. 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**
 - o 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
 - o Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, and historic environmental contamination), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure, and release of hazardous chemicals and hazardous waste. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be *less than significant* at the programmatic level due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *less than significant* impacts at the programmatic level 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 would 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* at the programmatic level due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures,

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

12.2.15.5. Alternatives Impact Assessment

The following section assesses potential impacts to human health and safety associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal 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 at the programmatic level 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* at the programmatic level due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level 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* at the programmatic level because of the small scale of likely FirstNet activities; activities associated with routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to human health and safety as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.15, Human Health and Safety.

NE APPENDIX A – BIOLOGICAL RESOURCES

Table A-1: NNHP S1 Ranked Natural Community Types in Nebraska

Vegetative Community Type	EPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Peachleaf willow woodland	Western High Plains	Panhandle	Occurs in the primary floodplain of rivers where the water table is relatively close to the surface. Temporarily flooded forested areas over sandy loam soils. Willows dominant with red-osier dogwood, buffalo currant, understory predominantly reed canarygrass.	Known from a single site in the Pine ridge in Dawes County.
Mesic bur oak forest and woodland	Central Great Plains, Western Corn Belt Plains	Eastern Nebraska	Woodland of nearly co-dominant hackberry and oak, with honey locust, black walnut, or cottonwood sometimes present. Occurs on nearly level terraces of relatively small, permanent streams with silty loams and silty clay loams.	On terraces of Salt Creek, Big Blue, and Big Nemaha Rivers.
Paper birch springbranch canyon forest	Northwestern Great Plains; Nebraska Sandhills	Sandhills and Central Nebraska	Found primarily in spring-fed tributary canyons, referred to as springbranch canyons, and lower slopes of bluffs of Niobrara River. Paper birch and ironwood are dominant trees, with minimal shrub layer and sparse herbaceous layer.	Endemic. Springbranch canyons of central Niobrara River in Cherry and Brown Counties.
American lotus aquatic wetland	Western Corn Belt Plains; perhaps introduced in Central Great Plains and Nebraska Sandhills	Eastern Nebraska	Naturally occurred in backwater channels and oxbows of Missouri River, currently occurs in artificial impoundments. Currently occurs in areas with a variety of hydrologic regimes, including permanently to seasonally flooded sites.	Known from one natural occurrence along the Missouri River Valley in Thurston County. Also occurs in several artificial ponds in the state.

Vegetative Community Type	EPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Eastern cordgrass wet prairie	Central Great Plains, Western Corn Belt Plains	Eastern Nebraska	Occurs on nearly level floodplains of rivers and streams, often as strips along stream channels. Soils are often waterlogged much of the year. Vegetation cover is fairly dense, consisting primarily of grasses and sedges.	Southeastern portion of the state.
Eastern saline marsh	Western Corn Belt Plains	Eastern Nebraska	Occupies swales and floodplain depressions and stream terraces with standing water most of the year. Saltmarsh bulrush and salt-tolerant grasses dominant, low species diversity.	Restricted to Lancaster and southern Sanders Counties in Salt Creek, Little Salt Creek, and Rock Creek drainages.
Eastern saline meadow	Western Corn Belt Plains	Eastern Nebraska	Found in shallow depressions and level ground of floodplains and stream terraces. This community contains meadow areas and salt flats, with salt-tolerant grasses and herbs including saltgrass, foxtail barley, marsh-elder, saltwort, prairie cordgrass, and seepweed.	Restricted to Lancaster and southern Sanders Counties in Salt Creek, Little Salt Creek, and Rock Creek drainages.
Eastern sedge wet meadow	Western Corn Belt Plains	Eastern Nebraska.	Occurs in semi-permanently flooded areas on nearly level floodplains, often in bands surrounding marshy channels. Vegetation is often quite dense, predominantly grasses and sedges or pale bulrush. Perennial herbs are often common and conspicuous such as hemp dogbane, water-horehound, winged loosestrife, and blue vervain.	In floodplain of Missouri River and its tributaries.

Vegetative Community Type	EPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Playa wetland	Western High Plains, Central Great Plains, Northwestern Glaciated Plains, Northwestern Great Plains, Nebraska Sandhills, Western Corn Belt Plains	Sandhills and Central Nebraska	Shallow depressions on level ground that is temporarily flooded due to ponded rain water and surface runoff. Annual herbaceous plants and grasses are dominant in exposed mud flats. Species composition and extent of community varies annually and between sites. Thick clay pan and frequent water fluctuation prevent many perennial bulrushes and cattails.	Throughout the state but most common in the south-central and southwestern parts.
Prairie fen	Central Great Plains	Eastern Nebraska	Dominated by grasses, sedges, bald spikerush, boneset, orange jewelweed, and marsh fern. Associated with sandstone slopes and groundwater discharge.	Known only from Little Blue River valley in Jefferson County.
Spikerush vernal pool	Northwestern Great Plains, Nebraska Sandhills, Western Corn Belt Plains	Panhandle; Sandhills and Central Nebraska	Occurs in small, relatively deep basin-like depressions in streambeds or adjacent to ponds and marshes. Dominant plants include spikerushes, and submerged plants such as water starwort and water-thread pondweed.	Known from far northwestern and north-central Nebraska; potentially occurs statewide.
Wheatgrass playa grassland	Central Great Plains, Western Corn Belt Plains, Northwestern Great Plains	Sandhills and Central Nebraska; Panhandle; Eastern Nebraska	This community is found in areas with nearly level ground and very shallow depressions in uplands with clay pan soil layer below. Dominant vegetation includes perennial grasses, sedge, spikerush, with some herbaceous broadleaf species mixed. Species diversity is low to moderate.	Known from loess plains in Rainwater Basin region of south-central and southwestern Nebraska. Possibly also present in extreme northwest and Todd Valley of east-central Nebraska.

Vegetative Community Type	EPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Lowland tallgrass prairie	Central Great Plains, Western Corn Belt Plains	Eastern Nebraska	Occurs primarily in floodplains and on river and stream valley terraces. Water table generally approximately 1 meter below the surface, standing water sometimes present. Dense grass vegetation 1 to 2 meters tall, often dominated by big bluestem, prairie cordgrass, or Indian grass. Shrubs occasionally present (dogwood, wild plum, and wolfberry).	Restricted to the eastern quarter of the state, along rivers and stream valleys within tallgrass prairie region.

Sources: (NGPC, 2011) (Rolfsmeier & Steinauer, 2010)

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACS	American Community Survey
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AML	Abandoned Mine Lands
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BNSF	Burlington Northern and Santa Fe Railway
CAA	Clean Air Act
CCD	Common Core of Data
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGP	Construction General Permit
CIMC	Cleanups in My Community
CIO	Chief Information Officer
CO	Carbon Monoxide
CO2	Carbon Dioxide
COLT	Cell On Light Truck
COLT	Cell On Light Trucks
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
CWS	Community Water Systems
DEQ	Department of Environmental Quality
DMV	Department of Motor Vehicles
DNR	Department of Natural Resources
DOE	Department of Energy

Acronym	Definition
EDACS	Enhanced Digital Access System
EIA	Energy Information Agency
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right to Know Act
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FLM	Federal Land Manager
FLPMA	Federal Land Policy and Management Act of 1976
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Regions
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MDI	Methylene Diphenyl Diisocyanate
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMT	Million Metric Tons
MSFCA	Magnuson-Stevens Fisheries Conservation Act
MSL	Mean Sea Level
N ₂ O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NASAO	National Association of State Aviation Officials

Acronym	Definition
NDA	Nebraska Department of Aeronautics
NDEQ	Nebraska Department of Environmental Quality
NDOR	Nebraska Department of Roads
NE	Nebraska
NEDHHS	Nebraska Department of Health and Human Services
NEDOL	Nebraska Department of Labor
NEO	Nebraska State Energy Office
NEPA	National Environmental Policy Act
NESCA	Nongame and Endangered Species Conservation Act
NFIP	National Flood Insurance Program
NGPC	Nebraska Game and Parks Commission
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NNHP	Nebraska Natural Heritage Program
NNL	National Natural Landmarks
NOTAM	Notices To Airmen
NOX	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPPD	Nebraska Public Power District
NPS	National Park Service
NPSC	Nebraska Public Service Commission
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NSHS	Nebraska State Historical Society
NTFI	National Task Force On Interoperability
NTNC	Non-Transient Non-Community
NWI	National Wetlands Inventory
N-WIN	Nebraska Wireless Interoperable Network

Acronym	Definition
NWR	National Wildlife Refuges
OAA	Omaha Airport Authority
OCIO	Office of the CIO
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
ORION	Omaha Regional Interop Network
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PGA	Peak Ground Acceleration
POP	Points of Presence
PPE	Personal Protective Equipment
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SASP	State Aviation System Plan
SCEC	State Climate Extremes Committee
SDS	Safety Data Sheets
SF6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO2	Sulfur Dioxide
SO3	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
SRS	Statewide Radio System
STARCOMM	Siouxland Tristate Area Radio Communications
SUA	Special Use Airspace
SWPPP	Storm Water Pollution Prevention Plan

Acronym	Definition
THPO	Tribal Historic Preservation Office
TNC	Transient Non-Community Systems
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
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WMA	Wildlife Management Areas
WMD	Wetland Management District
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II

REFERENCES

The citations in this Final PEIS reflect the most recent information on the referenced site at the time the document was written.

- 25 NAC 10-001. (2014). *Nebraska Administrative Code (NAC). Title 25, Chapter 10, Noxious Weeds Regulations*. Retrieved from http://www.sos.ne.gov/rules-and-regs/regsearch/Rules/Agriculture_Dept_of/Title-25_Bureau_of_Plant_Industry/Chapter-10.pdf
- 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>
- Advisory Council on Historic Preservation. (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>
- Agenbroad, L. (1973). Clovis Projectile Point Occurrences in Northwestern Nebraska. *Transactions of the Nebraska Academy of Sciences and Affiliated Societies, Paper* 363(2), 5-7.
- Ahlbrandt, T., & Fryberger, S. (1979). *Eolian Deposits in the Nebraska Sand Hills*. U.S. Geological Survey. Retrieved October 2015, from <http://pubs.usgs.gov/pp/1120a-c/report.pdf>
- American Trails. (2015, August 14). *National Trails Training Partnership*. Retrieved September 15, 2015, from <http://www.americantrails.org/resources/feds/NatTrSysOverview.html>
- Amtrak. (2015a, October). *West Train Routes*. Retrieved October 9, 2015, from Amtrak: <http://www.amtrak.com/west-train-routes>
- Amtrak. (2015b, April 6). *Amtrak System Timetable*. Retrieved from Amtrak: <https://www.amtrak.com/ccurl/194/703/System-Timetable-Spring-Fall-2015.pdf>
- Association of American Railroads. (2014, July). *Association of American Railroads - Freight Railroads in Nebraska*. Retrieved February 24, 2016, from https://www.aar.org/Style%20Library/railroads_and_states/dist/data/pdf/Nebraska%202012.pdf
- Balmori, A. (2005). Possible Effects of Electromagnetic Fields from Phone Masts on a Population of WhiteStork (*Ciconia ciconia*). *Electromagnetic Biology and Medicine*, 24: 109-119.
- Balmori, A. (2009). Electromagnetic Pollution from Phone Masts Effects on Wildlife. *Pathophysiology. Electromagnetic Fields (EMF) Special Issue*, 16 (2-3): 191-199.
- Balmori, A., & Hallberg, O. (2007). The Urban Decline of the House Sparrow (*Passer domesticus*): A Possible Link with Electromagnetic Radiation. *Electromagnetic Biology and Medicine*, 26: 141-151.
- Berven, K. A., & Grudzien, T. A. (1990). Dispersal in the Wood Frog (*Rana sylvatica*): Implications for Genetic Population Structure. *Evolution*, 2047-56. doi:<http://doi.org/10.2307/2409614>
- BIA. (2015, August). *Tribal Leaders Directory*. Retrieved October 2015, from 2015 Fall/Winter Edition: <http://www.bia.gov/cs/groups/xois/documents/document/idc1-028053.pdf>

- BLM. (1984). *Manual 8400 - Visual Resource Management*. Washington: Department of the Interior, Bureau of Land Management.
- BLM. (2004, December 3). *8100-The Foundations for Managing Cultural Resources*. Retrieved September 28, 2015, from http://www.blm.gov/style/medialib/blm/wo/Information_Resources_Management/policy/blm_manual.Par.71969.File.dat/8100.pdf
- BLM. (2005a, March 11). *Land Use Planning Handbook -H-1601-1*. DC, Washington, USA. Retrieved from http://www.blm.gov/style/medialib/blm/ak/aktest/planning/planning_general.Par.65225.File.dat/blm_lup_handbook.pdf
- BLM. (2005b). *Land Use Planning Handbook*. BLM Handbook H-1601-1. Retrieved March 2016, from http://www.blm.gov/wo/st/en/prog/planning/nepa/webguide/document_pages/land_use_planning.html
- BLM. (2011a, January 13). *Newcastle Field Office Land Use Planning*. Retrieved October 12, 2015, from www.blm.gov/wy/st/en/field_offices/Newcastle/nfoplan.html
- BLM. (2011b, August 23). *Types of Hazards*. Retrieved from http://www.blm.gov/ca/st/en/prog/aml/safe_edu/_types_of_hazards.html
- BLM. (2012, June 28). *VRM System*. Retrieved October 7, 2015, from http://www.blm.gov/wo/st/en/prog/Recreation/recreation_national/RMS/2.html
- BLM. (2014a, May 7). *BLM Land Use Planning Frequently Asked Questions*. Retrieved from BLM -National: http://www.blm.gov/wo/st/en/prog/planning/planning_overview/frequently_asked_questions.html#3
- BLM. (2014b, August). *DRECP Noise and Vibration*. Retrieved July 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
- BLM. (2015a). *Federal Land Policy and Management Act*. Retrieved October 7, 2015, from <http://www.blm.gov/flpma/>
- BLM. (2015b, January 22). *Abandoned Mine Lands Inventory*. Retrieved 2015, from http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/abandoned_mine_site.html
- BLS. (2013). *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>
- BLS. (2014a, December 4). *Table 1. Incidence rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2013*. Retrieved from <http://www.bls.gov/news.release/osh.t01.htm>
- BLS. (2014b). *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>
- BLS. (2015a, May). *U.S. Bureau of Labor Statistics*. Retrieved from May 2015 State Occupational Employment and Wage Estimates Nebraska: http://www.bls.gov/oes/current/oes_ne.htm
- BLS. (2015b). *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, file staadata.zip. Retrieved April 2015, from <http://www.bls.gov/lau/rdsenp16.htm>
- BLS. (2015c, March 25). *May 2014 State Occupational Employment and Wage Estimates Nebraska*. Retrieved September 25, 2015, from Occupational Employment Statistics: http://www.bls.gov/oes/current/oes_ne.htm
- BLS. (2015d, April 22). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved October 8, 2015, from Injuries, Illnesses, and Fatalities: http://www.bls.gov/iif/state_archive.htm#NE
- BLS. (2015e, March 25). *Occupational Employment and Wages, May 2014: 49-9052 Telecommunications Line Installers and Repairers*. Retrieved September 19, 2015, from <http://www.bls.gov/oes/current/oes499052.htm>
- BLS. (2015f, September 21). Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data. *Injuries, Illnesses, and Fatalities*. Retrieved September 18, 2015, from Census of Fatal Occupational Injuries (2011 forward): <http://www.bls.gov/iif/oshcfoi1.htm>
- Bond et al. (2013). *Towers, Turbines, and Transmission Lines: Impacts on Property Value*. (S. Bond, S. Sims, & P. Dent, Eds.) Chichester, West Sussex, United Kingdom: Wiley-Blackwell.
- Calhoun, A. J., & DeMaynadier, P. G. (2007). *Science and Conservation of Vernal Pools in Northeastern North America: Ecology and Conservation of Seasonal Wetlands in Northeastern North America*. CRC Press. Retrieved September 2015, from http://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/Ch12_ScienceConservationofVernalPools.pdf
- CDC. (2015a, December 1). CDC WONDER: Underlying Cause of Death, 1999-2013 Results. Retrieved December 1, 2015, from <http://wonder.cdc.gov/>
- CDC. (2015b, September 25). *National Environmental Public Health Tracking Network*. Retrieved October 9, 2015, from <http://ephtracking.cdc.gov/showHome.action>
- CDC. (2016, December 12). Retrieved from Valley Fever (Coccidioidomycosis): <https://www.cdc.gov/fungal/diseases/coccidioidomycosis/index.html>
- 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. (2016). *Final Guidance on Greenhouse Gases and Climate Change*. Retrieved June 2014, from https://ceq.doe.gov/guidance/ceq_guidance_nepa-ghg-climate_final_guidance.html
- Chapman, S., Omernik, J., Freeouf, J., Huggins, D., McCauley, J., Freeman, C., . . . Schleppe, R. (2001). *Ecoregions of Nebraska and Kansas*. Reston, Virginia: U.S. Geological Survey.
- Charpentier, V., & Inizan, F.-A. J. (2002). Fluting in the Old World: The Neolithic Projectile Points of Arabia. *Lithic Technology*, 27(1), 39-46. 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>

- City of Omaha. (2014). *Permits & Inspection Division*. Retrieved October 2015, from http://www.cityofomaha.org/planning/permits/images/stories/bldg_development/Permits%20and%20Inspections%20General%20Information.pdf
- Cowardin et al. (1979). *Classification of wetlands and deepwater habitats of the United States*, FWS/OBS-79/31. Retrieved April 4, 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
- De-Campos, A., Mamedov, A., & Huang, C.-h. (2009). Short-Term Reducing Conditions Decrease Aggregation. *Soil Science Society of America Journal*, 550-559. Retrieved November 2013, from <http://www.sciencedaily.com/releases/2009/04/090408140204.htm>
- Department of Energy. (2015). *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions*. Washington, DC: Department of Energy. Retrieved December 15, 2015
- Department of Labor. (2017). Retrieved from Title 230 - Department of Labor. Chapter 6 - Workplace Safety Consultation Program: http://www.sos.ne.gov/rules-and-regs/regsearch/Rules/Labor_Dept_of/Title-230/Chapter-6.pdf
- 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.
- DiCarlo, A. N. (2002). Chronic Electromagnetic Field Exposure Decreases HSP70 Levels and Lowers Cytoprotection. *Cellular Biochemistry*, 447-454.
- Duddleson, R. J. (2008, May). Plains Woodland Pottery: A Use-Alteration Perspective. *Plains Anthropologist*, 53(206), 179-197. Retrieved October 2015, from <http://www.jstor.org/stable/25670988>
- Dutcher, A. (2015). *Nebraska: Home of the Whopper*. Retrieved from Nebraska's Climate the Cocorahs State Climate Series: http://www.cocorahs.org/Media/docs/ClimateSum_NE.pdf
- eBird. (2015a). *eBird Range Map--Bald Eagle*. Retrieved from http://ebird.org/ebird/map/baleag?bmo=1&emo=12&byr=2011&eyr=2015&__hstc=75100365.64b7254677ac8cc5c8f21aa17c0b9689.1442877327577.1442877327577.1442877327577.1&__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
- Edinger, G. J., Evans, D. J., Gebauer, S., Howard, T. G., Hunt, D. M., & Olivero, A. M. (2014, March). *Ecological Communities of New York State*. Retrieved March 19, 2015, from A revised and expanded edition of Carol Reschke's Ecological Communities of New York State.: <http://www.dec.ny.gov/animals/97703.html>
- EIA. (2015a, October). *Electricity*. Retrieved November 2015, from U.S. Energy Information Administration: <http://www.eia.gov/electricity/data/state/>
- EIA. (2015b, October). *Electricity Data Browser- Nebraska*. 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=00000>

- 1&sec=g&linechart=ELEC.GEN.ALL-NE-99.A&columnchart=ELEC.GEN.ALL-NE-99.A&map=ELEC.GEN.ALL-NE-99.A&freq=A&ctype=linechart<ype=pin&rtype=s&pin=&rse=0&maptype=0
- EIA. (2015c, October). *Nebraska Profile Overview*. Retrieved October 2015, from U.S. Energy Information Administration: <http://www.eia.gov/state/?sid=ne#tabs-4>
- EIA. (2015d). *Nebraska State Energy Profile*. Retrieved October 2015, from U.S. Energy Information Administration: <http://205.254.135.7/state/rankings/?sid=NE%20-%20/series/46#/series/46>
- EIA. (2015e, 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. (2015f, October 26). *State Carbon Dioxide Emissions*. Retrieved February 11, 2016, from <http://www.eia.gov/environment/emissions/state/>
- EIA. (2015g, 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. (2016a). *Glossary - Electricity*. Retrieved from U.S. Energy Information Administration: <https://www.eia.gov/tools/glossary/?id=electricity>
- EIA. (2016b, February 29). *Natural Gas Gross Withdrawals and Production*. Retrieved from EIA Natural Gas: http://205.254.135.7/dnav/ng/ng_prod_sum_a_EPG0_VGM_mmcft_a.htm
- Engels, et. al. (2014, May 15). Anthropogenic Electromagnetic Noise Disrupts Magnetic Compass Orientation in a Migratory Bird. *Nature*. doi:10.1038/nature13290
- Eversoll, D. (2005). *Final Report on USGS/AASG Landslide Loss Estimation Pilot Project*. Retrieved October 2015, from <http://pubs.usgs.gov/of/2006/1032/pdf/Nebraska.pdf>
- 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 July 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. (2012, April 05). *Advisory Circular AC 36-3H*. Retrieved July 22, 2015, from http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC36-3H%20Chg%201.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, June 25). *Airport Data and Contact Information*. Retrieved October 9, 2015, from http://www.faa.gov/airports/airport_safety/airportdata_5010/

- FAA. (2015b, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from http://www.faa.gov/about/office_org/field_offices/fsdo/
- FAA. (2015c). *Aeronautical Information Manual*. Retrieved August 2015, from http://www.faa.gov/air_traffic/publications/media/aim.pdf
- FAA. (2015d). *Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)*. Retrieved July 2015, from Federal Aviation Administration: <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>
- FAA. (2015e, August 6). *FAA Air Traffic Organization Policy, JO 7400.9SZ, Airspace Designations and Reporting Points*. (F. A. U.S. Department of Transportation, Producer) Retrieved September 2015, from FAA, Regulations & Policies, Orders & Notices: http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.list/parentTopicID/10
- FAA. (2015f). *Air Traffic Organization Policy Order JO 7400.8X, Subject: Special Use Airspace*. Federal Aviation Administration, Airspace Policy and Regulations Group. Retrieved July 2015, from http://www.faa.gov/documentlibrary/media/order/7400_8x_2015.pdf
- FAA. (2015g). *FAA TFR List*. Retrieved July 2015, from <http://tfr.faa.gov/tfr2/list.html>
- FAA. (2015h). *Aviation System Performance Metrics (ASPM) Database*. Retrieved 07 22, 2015, from <https://aspm.faa.gov/>
- FAA. (2016a, October 18). *Obstruction Marking and Lighting*. Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_Change_1_Obstruction_Marking_and_Lighting_10062016.pdf
- FAA. (2016b). *Specification for Obstruction Lighting*. Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5345-43GH.pdf
- 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 Assessment for the Antenna Structure Registration Program*. Retrieved from https://apps.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf
- FCC. (2013, November). *Local Telephone Competition: Status as of December 31, 2012*. Retrieved February 2016, from https://apps.fcc.gov/edocs_public/attachmatch/DOC-324413A1.pdf
- FCC. (2014a). *Internet Access Services: 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. (2015c, June 17). *Antenna Structure Registration*. Retrieved June 17, 2015, from Federal Communications Commission: <http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>

- FCC. (2016a, March). *National Broadband Plan Chapter 16 Public Safety*. Retrieved March 29, 2016, from Broadband.gov: <http://www.broadband.gov/plan/16-public-safety/>
- FCC. (2016b, 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
- FCC. (2016d, February 1). *Tower and Antenna Siting*. Retrieved February 10, 2016, from <https://www.fcc.gov/general/tower-and-antenna-siting>
- FCC. (2017, January). *Opportunities to Reduce Bird Collisions with Communications Towers*. Retrieved from https://www.fcc.gov/sites/default/files/Light_Changes_Information_Update_Jan_2017.pdf
- Federal Transit Authority. (2006, May). *Transit Noise and Vibration Impact Assessment*. Retrieved from https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf
- 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 6, 2015, from FEMA: http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl_perc.pdf
- FEMA. (2011). *Missouri River widens at Bellevue Nebraska*. Retrieved October 2015, from <https://www.fema.gov/media-library/assets/images/59721>
- 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. (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 - Nebraska*. Retrieved October 2015, from <http://www.fema.gov/cis/NE.html>
- FEMA. (2014d, May). *Community Rating System*. Retrieved May 2015, from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communities_May_1_2014.pdf
- FEMA. (2015a, April). *Floodplain Management Fact Sheet*. Retrieved May 2015, from <https://www.fema.gov/floodplain-management-fact-sheet>
- FEMA. (2015b). *Nebraska Severe Winter Storms and Snowstorm (DR-1878)*. Retrieved October 27, 2015, from <https://www.fema.gov/disaster/1878>
- Fenneman, N. (1916). *Physiographic Subdivision of the United States*. Retrieved April 2015, from <http://www.pnas.org/content/3/1/17.full.pdf?sid=e445034f-0a21-4857-9861-481199aa66d6>

- 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. (2011a, July 14). *Highway Traffic and Construction Noise*. Retrieved July 27, 2015, from [fhwa.dot.gov](http://www.fhwa.dot.gov):
http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix
- FHWA. (2011b, July 14). *Noise Effect on Wildlife*. Retrieved February 2016, from http://www.fhwa.dot.gov/environment/noise/noise_effect_on_wildlife/effects/wild04.cfm
- 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. (2014, October 21). *Public Road Length*. Retrieved October 9, 2015, from <http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm10.cfm>
- FHWA. (2015a, May 28). *Bridges by State and County 2014*. Retrieved October 9, 2015, from <http://www.fhwa.dot.gov/bridge/nbi/no10/county14b.cfm#ne>
- FHWA. (2015b). *Route Log and Finder List*. Retrieved October 9, 2015, from Federal Highway Administration: <http://www.fhwa.dot.gov/reports/routefinder/#s09>
- FHWA. (2015c). *America's Byways*. Retrieved June 2015, from <http://www.fhwa.dot.gov/byways/>
- FHWA. (2015d, May 28). *Highway Traffic Noise*. Retrieved July 22, 2015, from http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm
- 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>
- FRA. (2015a). *FRA*. Retrieved November 29, 2015, from FRA:
<http://safetydata.fra.dot.gov/OfficeofSafety/Documents/Railroad%20Safety%20Data%20Frequently%20Asked%20Questions.pdf?V=9>
- FRA. (2015b). *Federal Railroad Administration Horn Noise FAQ*. Retrieved July 22, 2015, from <https://www.fra.dot.gov/Page/P0599>
- Fullerton, D., Bush, C., & Pennell, J. (2003). *Map of Surficial Deposits and Materials in the Eastern and Central United States (East of 102° West Longitude)*. U.S. Geological Survey. Retrieved October 2015, from http://pubs.usgs.gov/imap/i-2789/i-2789_p.pdf
- 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., & and Manville, A. M. (2011). "The Role of Tower Height and Guy Wires on Avian Collisions with Communication Towers." *The Journal of Wildlife Management*, 848-855. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/jwmg.99/abstract>.
- Government Printing 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>
- Gregg, M. L. (1990, February). An Early Plains Woodland Structure in the Northeastern Plains. *Plains Anthropologist*, 35(127), 29-44. Retrieved October 2015, from <http://www.jstor.org/stable/25668914>

- Grigor'ev, I. (2003). Biological Effects of Mobile Phone Electromagnetic Field on Chick Embryo (Risk Assessment Using the Mortality Rate). 541-3.
- Gutentag, E., Heimes, F., Krothe, N., Luckey, R., & Weeks, J. (1984). *Geohydrology of the High Plains Aquifer in Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming*. Retrieved October 2015, from <http://pubs.usgs.gov/pp/1400b/report.pdf>
- HABS. (1933a). *View Looking North - M. E. Smith Building, 201 South Tenth Street, Omaha, Douglas County, NE*. Retrieved October 2015, from <http://www.loc.gov/resource/hhh.ne0002.photos/?sp=3>
- HABS. (1933b). *View of the South and East Fronts; Looking Northwest - Lincoln City Hall, 916 "O" Street, Lincoln, Lancaster County, NE*. Retrieved October 2015, from <http://www.loc.gov/resource/hhh.ne0038.photos/?sp=1>
- Harris, E. C. (1979). The Laws of Archaeological Stratigraphy. *World Archaeology*, 11(1), 111-117. Retrieved July 2015, from <http://users.clas.ufl.edu/davidson/Proseminar/Week%2012%20Time/Harris%201979%20laws%20of%20stratigraphy.pdf>
- Harvey, F., Swinchart, J., & Kurtz, T. (2007). *Ground water sustenance of Nebraska's unique Sand Hills peatland fen ecosystems: Abstract*. Retrieved October 2015, from <http://www.ncbi.nlm.nih.gov/pubmed/17335486>
- 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. (2007, April). *Capitol building Lincoln, Nebraska*. Retrieved October 2015, from <http://www.loc.gov/resource/highsm.04814/>
- Hill, D. et al. (1997). Bird Disturbance: Improving the Quality and Utility of Disturbance Research. *Journal of Applied Ecology*, 34(2): 275-288.
- Hoback, W. W., Brust, M. L., Dankert, N., & Nagel, H. (2005). *Ants, butterflies, carrion beetles, and tiger beetles of Nebraska*. University of Nebraska at Kearney: University of Nebraska at Kearney. Retrieved from http://www.lopers.net/student_org/NebraskaInverts/importance.htm
- Idaho State University. (2000). *Environmental Geology*. Retrieved March 20, 2016, from http://geology.isu.edu/wapi/EnvGeo/EG4_mass_wasting/EG_module_4.htm
- IFC. (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>
- IFC. (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>

- Institute of Maritime History. (2015, August). *Rainsford Island Archaeological Survey*. Retrieved August 2015, from <http://www.maritimehistory.org/content/rainsford-island-archaeological-survey>
- Invasive Species Specialist Group. (2010, May 26). *Global Invasive Species Database: Trachemys scripta elegans (reptile)*. Retrieved October 2015, from <http://www.issg.org/database/species/ecology.asp?si=71>
- Invasive.org. (2010). *Wild pig, Sus scrofa (feral type) (Artiodactyla: Suidae)*. Retrieved from <http://www.invasive.org/browse/subinfo.cfm?sub=3874&start=1>
- IPCC. (2007). *Climate Change 2007: Synthesis Report*. Retrieved 2015, 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/>
- ITU-T. (2012). *Series L: Construction, Installation and Protection of Cables and Other Elements of Outside Plant*. International Telecommunication Union, Telecommunication Standardization Sector of ITU, Geneva.
- Kansas Geological Survey. (2000). *High Plains Aquifer Evaluation Project Glossary*. Retrieved October 2015, from <http://www.kgs.ku.edu/HighPlains/atlas/glossary.htm#alluvial> aquifer
- Kottek, M., Grieser, J., Beck, C., Rudolf, B., & Rubel, F. (2006). *World Map of the Koppen-Geiger Climate Classification Updated*. Global Precipitation Climatology Centre. Offenbach: Deutscher Wetterdienst. Retrieved June 2015, from http://koeppen-geiger.vu-wien.ac.at/pdf/Paper_2006.pdf
- Levitt, B., & Lai, H. (2010). *Biological Effects from Exposure to Electromagnetic Radiation Emitted by Cell Tower Base Stations and Other Antenna Arrays*. Environ. Rev. 18. doi:doi:10.1139/A10-018
- Manville II, A. (2015, March 5). Recommendations For Additional Research and Funding to Assess Impacts of Non-ionizing Radiation to Birds and Other Wildlife. Emorandum to Dr. J. McGlade, Science Advisor to United Nations Environment Program, Key Research Needs Affecting Wildlife. 2.
- Manville II, A. (2016a). Impacts to Birds and Bats Due to Collisions and Electrocutions from Some Tall Structures in the United States: Wires, Towers, Turbines and Solar Arrays — State of the Art in Addressing the Problems. In I. Angelici (Ed.), *Problematic Wildlife: a Cross-Disciplinary Approach* (pp. Chap 20, pp 415-442). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-22246-2_20
- Manville II, A. (2016b, July 14). A Briefing Memo: What We Know, Can Infer, and Don't Yet Know About Impacts From Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife — for Public Release. Peer-Reviewed Briefing Memo.
- Manville, A.M., II. (2007, February 2). Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds."
- Mead & Hunt. (2001, May). *Nebraska Historic Buildings Survey - General Aviation in Nebraska*. Retrieved from <http://nlcs1.nlc.state.ne.us/epubs/H6000/B009-2001p1.pdf>
- Mead & Hunt, & Heritage Research, LTD. (2002). *Nebraska Historic Highway Survey*. Lincoln: Nebraska State Historic Society and Nebraska Department of Roads.

- 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 July 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/sea%20level>
- 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>
- Myers, T. (1995, February). Paleoindian Occupation of the Eastern Sand Hills. *Plains Anthropologist*, 40(151), 61-68. Retrieved October 2015, from <http://www.jstor.org/stable/25669314>
- NAS. (2015a). *Central Flyway Migration Corridor*. Retrieved from <http://www.audubon.org/conservation/project/central-flyway-migration-corridor>
- NAS. (2015b). *Important Bird Areas - Nebraska*. Retrieved from <http://netapp.audubon.org/IBA/State/US-NE>
- NASA. (2013, July). Final Environmental Impact Statement: Sounding Rockets Program at Poker Flat Research Range. Wallops Island, VA. Retrieved July 1, 2016, from <http://netpublic.grc.nasa.gov/main/NASA%20SRP%20at%20PFRR%20FEIS%20Volume%20I.pdf>
- NASAO. (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.aspx>
- National Conference of State Legislatures. (2015, February). *Federal and State Recognized Tribes*. Retrieved October 2015, from <http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#ne>
- National Fish Habitat Board. (2010). *Through a Fish's Eye: The Status of Fish Habitats in the United States 2010*. Retrieved from <http://www.habitat.noaa.gov/pdf/fishhabitatreport.pdf>
- National Institute of Health. (2015a, June). *What is TOXMAP?* Retrieved September 21, 2015, from <http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html>
- National Recreation Trails. (2015). *National Recreation Trails Database*. Retrieved November 3, 2015, from <http://www.americantrails.org/NRTDatabase/trailList.php?usrTrailName=&usrTrailState=MO&usrTrailCounty=&usrTrailUse=>
- National Register of Historic Places. (1991). *Carnegie Libraries in Nebraska, 1899 to 1922*. Lincoln: Nebraska State Historic Preservation Office.
- National Register of Historic Places. (2014). *Historic and Architectural Resources of the Detroit-Lincoln-Denver Highway in Nebraska*. Lincoln: Nebraska State Historic Preservation Office.
- National Wild and Scenic Rivers System. (2015). *Nebraska*. Retrieved October 2015, from <http://www.rivers.gov/nebraska.php>
- National Wildlife Federation. (2015). *Ecoregions*. Retrieved July 1, 2015, from <http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecoregions.aspx>
- Naugle, R. C., Montag, J. J., & Olson, J. C. (2014). *Nebraska*. Lincoln and London: University of Nebraska Press.
- NCED. (2015). *State of Nebraska and All Easements*. Retrieved October 2015, from National Conservation Easement Database:

- http://conservationeasement.us/reports/easements?report_state=Nebraska&report_type=All
- NDA. (2014). *2014 Annual Report*. Retrieved October 9, 2015, from <http://www.aero.nebraska.gov/2014annualreport.pdf>
- NDA. (2016). *Nebraska Invasive Species Advisory Council*. Retrieved February 2016, from http://www.nda.nebraska.gov/ag_contacts/invasive_species.html
- NDEQ. (2002). *Redeveloping the Waterfront*. Retrieved October 2015, from <http://www.deq.state.ne.us/Newslett.nsf/3ecf497d0d2a105686256a86006d77b3/f3f87f72295ff5f506256bd400640410>
- NDEQ. (2006, March 27). *Title 118 – Ground Water Quality Standards*. Retrieved from http://www.sos.ne.gov/rules-and-regs/regsearch/Rules/Environmental_Quality_Dept_of/Title-118.pdf
- NDEQ. (2008, September 5). Retrieved from State Water Quality Certification for National Pollutant Discharge Elimination System Vessel General Permit and Recreational Vessel Permit, in waters of the State of Nebraska: https://www3.epa.gov/npdes/pubs/401_nebraska.pdf
- NDEQ. (2012, December). *Waste Disposal in Nebraska*. Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/YourEnvi.nsf/Pages/WasteMap>
- NDEQ. (2013). *2013 Nebraska Water Monitoring Programs Report*. Retrieved October 2015, from <http://deq.ne.gov/Publica.nsf/pages/WAT212>
- NDEQ. (2014, July 30). *2014 Ambient Air Monitoring Network Plan*. Retrieved October 15, 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/Publica.nsf/xsp/.ibmmodes/domino/OpenAttachment/Publica.nsf/9941A507164917A386257D25005F5788/Attach/2014%20Ambient%20Air%20Monitoring%20Plan%20-%20draft.pdf>
- NDEQ. (2015a, October). *Nebraska Water Quality: A Brief Overview*. Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://www.deq.state.ne.us/NDEQProg.nsf/WaterHome.xsp>
- NDEQ. (2015b, October). *National Pollutant Discharge Elimination System - NPDES Program*. Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/NDEQProg.nsf/OnWeb/NPDES>
- NDEQ. (2015c, October). *Wastewater Treatment Facility Operator Certification Program (OCP)*. Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/NDEQProg.nsf/OnWeb/WTFOCT>
- NDEQ. (2015d, October). *Onsite Wastewater Program (Septic Systems, Private Lagoons)*. Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/NDEQProg.nsf/OnWeb/Onsite>
- NDEQ. (2015e, October). *Integrated Waste Management (IWM) Program*. Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/NDEQProg.nsf/OnWeb/IWM>
- NDEQ. (2015f, October). *Solid waste: How do we manage it?* Retrieved October 2015, from Nebraska Department of Environmental Quality: <http://deq.ne.gov/NDEQProg.nsf/OnWeb/WasteIntro>
- NDEQ. (2015g, July 6). *Title 129 - Nebraska Air Quality Regulations*. Retrieved October 15, 2015, from Nebraska Department of Environmental Quality: http://deq.ne.gov/RuleAndR.nsf/pages/PDF/%24FILE/TITLE129_7.6.2015.pdf

- NDEQ. (2015h, September 09). *Nebraska Air Quality 2014*. Retrieved October 15, 2015, from Nebraska Department of Environmental Quality:
<http://deq.ne.gov/Publica.nsf/PubsForm.xsp?documentId=A12A5ADA6CCE1C1686257A47004E0633&action=openDocument>
- NDEQ. (2015i). *Superfund Program*. Retrieved October 2015, from
<http://deq.ne.gov/NDEQProg.nsf/OnWeb/SF>
- NDEQ. (2015j). *RCRA Environmental Indicator Status*. Retrieved October, from
http://www3.epa.gov/region07/waste/rcra_ei_status.htm
- NDEQ. (2015k). *Superfund NPL Site Management Assistance Program*. Retrieved October 2015, from <http://deq.ne.gov/NDEQProg.nsf/OnWeb/SF-MAP>
- NDEQ. (2015l). *Nebraska Voluntary Cleanup Program Overview*. Retrieved October 2015, from
<http://deq.ne.gov/NDEQProg.nsf/OnWeb/VCP>
- NDEQ. (2015m, March). *Nebraska Voluntary Cleanup Program Public Record*. Retrieved October 2015, from <http://deq.ne.gov/NDEQProg.nsf/OnWeb/VCPPR>
- NDEQ. (2016, July 6). Retrieved from Title 128 - Nebraska Hazardous Waste Regulations, Chapter 2 - Definition of Solid Waste and Hazardous Waste:
<http://www.deq.state.ne.us/RuleAndR.nsf/pages/128-Ch-2>
- NDOR. (2003, December 23). *NE Transit Corridors Study*. Retrieved October 9, 2015, from
<http://www.transportation.nebraska.gov/docs/ntrac-final.pdf>
- NDOR. (2012a). *Bicycle Map of Nebraska*. Retrieved October 13, 2015, from
<http://www.transportation.nebraska.gov/docs/bicycle-guide-current-2.pdf>
- NDOR. (2012b, January 1). *Rail Section: Nebraska Railroad Map*. Retrieved October 19, 2015, from <http://www.transportation.nebraska.gov/rpt/rail.htm>
- NDOR. (2015a, October). *About Us*. Retrieved October 9, 2015, from
<http://roads.nebraska.gov/about/>
- NDOR. (2015b). *NDOR Nebraska's Scenic Byways*. Retrieved from
<http://www.transportation.nebraska.gov/info/ne-byways.htm>
- Nebraska Bird Library. (2015a). Red Knot. *Red Knot*. Retrieved from
<http://www.nebraskabirdlibrary.org/charadriiforms/scolopacidae/red-knot/>
- Nebraska CIO. (2015, October 13). *Public Communications (Nebraska CIO Website)*. Retrieved October 13, 2015, from <http://www.cio.nebraska.gov/network-serv/publicsafety/index.html>
- Nebraska Department of Revenue. (2015, October 12). *Nebraska Administrative Code, Title 350, Chapter 14 - Agricultural Land and Horticultural Land Assessment Regulations*. Retrieved October 12, 2015, from http://www.revenue.nebraska.gov/PAD/legal/regs/14-Ag_Hort_Land_Assessment.html
- Nebraska DNR. (2013). *Flood Hazard Mitigation Plan*. Retrieved October 2015, from
<https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/flood-hazmit-plan.pdf>
- Nebraska DNR. (2014). *Annual Evaluation of Availability of Hydrologically Connected Water Supplies*. Retrieved October 2015, from <http://dnr.nebraska.gov/iwm/2015-fab-report>
- Nebraska Forest Service. (2015). *Nebraska Forest Service Properties*. Retrieved October 13, 2015, from <http://nfs.unl.edu/nfs-properties>
- Nebraska Government. (2014). *Nebraska Department of Aeronautics 2014 Annual Report*. Retrieved October 2015, from Nebraska Department of Aeronautics:
<http://www.aero.nebraska.gov/2014annualreport.pdf>

- Nebraska Government. (2015). *Nebraska Department of Aeronautics Permits*. Retrieved October 2015, from Nebraska Government: <http://www.aero.nebraska.gov/permittobuild.html>
- Nebraska Invasive Species Program. (2015). *Nebraska Invasive Species*. Retrieved from <http://neinvasives.com/species/>
- Nebraska Legislature. (2005, June 2). *Nebraska Archaeological Resources Preservation Act*. Retrieved October 12, 2015, from <http://nebraskalegislature.gov/FloorDocs/99/PDF/Slip/LB211.pdf>
- Nebraska Legislature. (2007, September 1). *Nebraska Revised Statutes of 1943. Chapter 37. Game and Parks. Article 8. Nongame and Endangered Species Conservation Act*. Retrieved from <http://ternandplover.unl.edu/download/legislation/NebraskaNongameandEndangeredSpeciesConservationActLegislation.pdf>
- Nebraska Legislature. (2011, May 18). *Legislative Bill 165*. Retrieved October 12, 2015, from <http://nebraskalegislature.gov/FloorDocs/102/PDF/Slip/LB165.pdf>
- Nebraska Legislature. (2013). *Nebraska Revised Statutes*. Retrieved October 19, 2015, from <http://nebraskalegislature.gov/laws/browse-statutes.php>
- Nebraska Legislature. (2015a). *Nebraska: The Cornhusker State*. Retrieved October 2015, from <http://nebraskalegislature.gov/pdf/bluebook/25-38.pdf>
- Nebraska Legislature. (2015b). *Nebraska Revised Statutes Chapter 03 Aeronautics*. Retrieved October 2015, from <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=03>
- Nebraska Legislature. (2015c, January 1). *Nebraska Blue Book*. Retrieved October 12, 2015, from <http://nebraskalegislature.gov/pdf/bluebook/bluebook.pdf>
- Nebraska Legislature. (2017a, April 24). *Nebraska Revised Statutes Chapter 86: Telecommunications and Technology*. Retrieved from <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=86>
- Nebraska Legislature. (2017b, April 24). *Nebraska Revised Statutes Chapter 66: Oils, Fuels and Energy*. Retrieved from <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=66>
- Nebraska Legislature. (2017c, April 24). *Nebraska Revised Statutes Chapter 46*. Retrieved from <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=46>
- Nebraska Legislature. (2017d, April 24). Retrieved from Nebraska Revised Statutes Chapter 3: <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=3>
- Nebraska Legislature. (2017e, April 24). Retrieved from Nebraska Revised Statutes Chapter 82: <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=82>
- Nebraska Legislature. (2017f, April 24). Retrieved from Nebraska Revised Statutes Chapter 72: <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=72>
- Nebraska Legislature. (2017g, April 24). Retrieved from Nebraska Revised Statutes Chapter 12: <http://nebraskalegislature.gov/laws/browse-chapters.php?chapter=12>
- Nebraska Mutual Aid*. (2015, October 13). Retrieved October 13, 2015, from <https://www.radioreference.com/apps/db/?aid=1829>
- Nebraska Office of the CIO. (2015, October 13). *Nebraska Statewide Radio System (SRS) Informational Page*. Retrieved October 13, 2015, from http://www.cio.nebraska.gov/network-serv/publicsafety/statewide-radio/statewide_radio.html
- Nebraska Ornithologists' Union. (2016). *Birds of Nebraska - 461 Species*. Retrieved from <http://www.noubirds.org/birds/birds.aspx>

- Nebraska Rare Species. (2014). *Pallid Sturgeon*. Retrieved February 2016, from <http://rarespecies.nebraska.gov/portfolio/pallid-sturgeon/>
- Nebraska State Historical Society. (1990). *Historic Contexts in Nebraska, Topical Listing: Fourth Revised Edition*. Lincoln: Nebraska State Historic Preservation office.
- Nebraska State Historical Society. (2009, December 10). *Nebraska National Register Sites in Platte County*. Retrieved from <http://www.nebraskahistory.org/histpres/nebraska/platte.htm>
- Nebraska State Historical Society. (2015). *Sites/Facilities*. Retrieved October 12, 2015, from <http://www.nebraskahistory.org/sites/index.shtml>
- Nebraska Tourism Commission. (2015). *Browse Destinations by City*. Retrieved October 2015, from <http://visitnebraska.com/cities>
- Nebraska Wireless Interoperable Network Council. (2011). *Nebraska Wireless Interoperable Network (N-WIN) Council Annual Report*. N-WIN.
- NEDHHS. (2013a, June). *Nebraska Public Water Supply Program Summary Report 2013*. Retrieved October 2015, from Department of Health and Human Services: <http://dhhs.ne.gov/publichealth/Documents/PublicWaterSupplyAnnualReport.pdf>
- NEDHHS. (2013b, April 24). *About Public Health*. Retrieved October 9, 2015, from http://dhhs.ne.gov/publichealth/Pages/public_health_about.aspx
- NEMA. (2014). *State of Nebraska Hazard Mitigation Plan*. Retrieved October 2015, from <http://www.nema.ne.gov/pdf/hazmitplan.pdf>
- 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>
- NGPC. (2005a). *Guide to Nebraska's Wetlands and their Conservation Needs*. Retrieved October 2015, from http://outdoornebraska.gov/wp-content/uploads/2015/10/NebraskaWetlandsGuide_03182016.pdf
- NGPC. (2005b). *Guide to Nebraska's Wetlands and their Conservation Needs*. Retrieved October 2015, from <https://outdoornebraska.ne.gov/wildlife/programs/wetlands/pdf/wetlandsguide.pdf>
- NGPC. (2011). *Nebraska Natural Legacy Project - State Wildlife Action Plan*. Nebraska Game and Parks Commission. Retrieved from <http://outdoornebraska.gov/wp-content/uploads/2015/09/NebraskaNaturalLegacyProject2ndEdition.pdf>
- NGPC. (2013a). *Nebraska's Threatened and Endangered Species - Salt Creek Tiger Beetle*. Retrieved from <http://rarespecies.nebraska.gov/wp-content/uploads/sites/2/2014/01/Salt-Creek-Tiger-Beetle.pdf>
- NGPC. (2013b, June 5). *Tankin' on TV this week*. Retrieved February 23, 2016, from <http://magazine.outdoornebraska.gov/2013/06/tanking/>
- NGPC. (2014). *Why Hunt the Husker State?* Retrieved February 2016, from NEBRASKAland: <http://magazine.outdoornebraska.gov/2014/08/hunt-nebraska/>
- NGPC. (2015a). *Platte River Canoe Trail*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/trails/WaterTrails/CanoeTrails/pdf/PlatteRiver.pdf>
- NGPC. (2015b). *Lower Missouri River Canoe Trail*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/trails/WaterTrails/CanoeTrails/pdf/LowerMissouri.pdf>
- NGPC. (2015c). *Niobrara River Water Trail*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/trails/WaterTrails/pdf/Niobrara%20River%202010%20Guide.pdf>

- NGPC. (2015d). *Lake McConaughy Campground and Beach Information*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/parks/guides/parksearch/addons/lakemac/funfacts.asp>
- NGPC. (2015e). *Wetlands of Nebraska*. Retrieved October 2015, from https://outdoornebraska.ne.gov/wildlife/programs/projectwild/pdf/PPT_pdfs/Wetlands%20of%20Nebraska.pdf
- NGPC. (2015f). *Nebraska Fish Species*. Nebraska Game and Parks Commission. Retrieved from http://data.outdoornebraska.gov/datasets/ed23db261db34eeebbbab4066af4d77b_61
- NGPC. (2015g). *Search for a State Park Area*. Retrieved October 2015, from <https://maps.outdoornebraska.gov/parksearch/>
- NGPC. (2015h). *Park Areas in the Panhandle Region*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/parks/guides/parksearch/getregion.asp?District=1>
- NGPC. (2015i). *Park Areas in the Sandhills Region*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/parks/guides/parksearch/getregion.asp?District=2>
- NGPC. (2015j). *Park Areas in the Northeast Region*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/parks/guides/parksearch/getregion.asp?District=3>
- NGPC. (2015k). *Park Areas in the Southwest Region*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/parks/guides/parksearch/getregion.asp?District=4>
- NGPC. (2015l). *Park Areas in the Southcentral Region*. Retrieved October 2015, from <http://outdoornebraska.ne.gov/parks/guides/parksearch/getregion.asp?district=6>
- NGPC. (2015m, October 13). *Cowboy Recreation and Nature Trail*. Retrieved October 13, 2015, from http://outdoornebraska.ne.gov/trails/cowboy_trail/CBT_gen_info.asp
- NGPC. (2015n). *Nebraska Water Trails*. Retrieved October 13, 2015, from <http://outdoornebraska.ne.gov/WaterTrails/>
- NGPC. (2015o, October 13). *Wildlife Management Areas*. Retrieved October 13, 2015, from <http://outdoornebraska.ne.gov/wildlife/places/clearcrk.asp>
- NGPC. (2015p, October 13). *Wildlife Management Areas: Sacramento-Wilcox*. Retrieved October 13, 2015, from <http://outdoornebraska.ne.gov/wildlife/places/sac-wilcox.asp>
- NGPC. (2016, February 22). *Biodiversity - Mollusks and Crayfish*. Retrieved February 2016, from <http://outdoornebraska.gov/biodiversitymollusksandcrayfish/>
- Nicholls, B., & Racey, P. (2009, July 16). *The Aversive Effect of Electromagnetic Radiation on Foraging Bats—A Possible Means of Discouraging Bats from Approaching Wind Turbines*. (U. o. Raphaël Arlettaz, Ed.) doi:10.1371/journal.pone.0006246
- 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). *A Winter to Remember*. Retrieved October 9, 2015, from http://www.crh.noaa.gov/Image/oax/news/newsletter_May10.pdf
- NOAA. (2015a). *Flood in Nebraska*. Retrieved July 2015, from <http://www.floodsafety.noaa.gov/states/ne-flood.shtml>
- NOAA. (2015b). *National Oceanic and Atmospheric Administration*. Retrieved from Data Tools: 1981 - 2010 Normals: <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>
- NPRB. (2015a, October). *About the Board*. Retrieved October 2015, from Nebraska Power Review Board: <http://www.powerreviewboard.nebraska.gov/abouttheboard.html>

- NPRB. (2015b, October). *Electric Deregulation Activities in Nebraska*. Retrieved October 2015, from Nebraska Power Review Board:
<http://www.powerreviewboard.nebraska.gov/deregulation.html>
- NPRB. (2015c, October). *Regulations*. Retrieved October 2015, from Nebraska Power Review Board: <http://www.powerreviewboard.nebraska.gov/regulations.htm>
- NPS. (1983). *Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines*. Retrieved from https://www.nps.gov/history/local-law/arch_stnds_0.htm
- NPS. (1995, 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. (2000). *Geologic Glossary*. Retrieved August 2015, from
<https://www.nature.nps.gov/geology/usgsnps/misc/glossaryDtoI.html#G>
- NPS. (2002). *How to Apply the National Register Criteria for Evaluation*. Retrieved from
<https://www.nps.gov/nr/publications/bulletins/nrb15/>
- 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: Nebraska*. Retrieved October 13, 2015, from <https://www.nature.nps.gov/nnl/state.cfm?State=NE>
- NPS. (2013a, December 10). *Geologic Hazards*. Retrieved September 1, 2015, from Geologic, Energy, and Mineral Resources: <http://www.nature.nps.gov/geology/hazards/>
- NPS. (2013b, November 2). *National Register of Historic Places: NPS Focus*. Retrieved February 2016, from
<http://focus.nps.gov/nrhp/SearchResults/ba6cf66972f44b74a9ed3e22ec6abf96?page=56&view=list>
- NPS. (2013c, February 15). *Geologic Heritage Terms*. Retrieved September 18, 2015, from
http://www.nature.nps.gov/geology/geoheritage/geologic_heritage_terms.cfm
- 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, October 22). *National Natural Landmarks Program*. Retrieved April 21, 2015, from www.nature.nps.gov/nnl/state.cfm?State=NE
- NPS. (2014c, June 20). *Prohibition of Unmanned Aircraft in National Parks*. Retrieved June 2015, from <https://www.nps.gov/gaar/learn/news/prohibition-of-unmanned-aircraft-in-national-parks.htm>
- NPS. (2014d, June 16). *National Park Service Science of Sound*. Retrieved July 22, 2015, from
<http://www.nature.nps.gov/sound/science.cfm>
- NPS. (2015a). *National Park Service, Find A Park - Nebraska*. Retrieved October 2015, from
http://www.nps.gov/policy/PolMemos/PM_14-05.htm
- NPS. (2015b, April 15). *National Historic Landmarks Survey: National Park Service: Listing of National Historic Landmarks By State*. Retrieved October 12, 2015, from National Historic Landmarks Program: National Historic Landmarks in Nebraska:
<http://www.nps.gov/nhl/find/statelists/ne/NE.pdf>
- NPS. (2015c, April 27). *National Historic Landmarks Program*. Retrieved April 28, 2015, from
<http://www.nps.gov/nhl/INDEX.htm>
- NPS. (2015d). *Signal Butte*. Retrieved October 12, 2015, from
http://www.nps.gov/nr/travel/scotts_bluff/signal_butte.html

- NPS. (2015e, February 18). *National Historic Landmarks Program*. Retrieved May 2016, from <https://www.nps.gov/nhl/>
- NPS. (2015f, October 10). *Nebraska*. Retrieved October 12, 2015, from <http://www.nps.gov/state/ne/index.htm>
- NPS. (2015g, October 11). *California National Historic Trail*. Retrieved October 13, 2015, from <http://www.nps.gov/cali/index.htm>
- NPS. (2015h, October 12). *Lewis and Clark National Historic Trail: Lewis and Clark Visitor Centers-Nebraska*. Retrieved October 12, 2015, from <http://www.nps.gov/lecl/planyourvisit/leclvcnebraska.htm>
- NPS. (2015i, October 12). *California National Historic Trail: Chimney Rock*. Retrieved October 12, 2015, from <http://www.nps.gov/cali/planyourvisit/site2.htm>
- NPS. (2015j, October 12). *Agate Fossil Beds National Monument: Learn About the Park: Nature: Natural Features & Ecosystems: Geologic Formations*. Retrieved October 13, 2015, from <http://www.nps.gov/agfo/learn/nature/geologicformations.htm>
- NPS. (2015k, October 12). *Homestead National Monument of America*. Retrieved October 13, 2015, from <http://www.nps.gov/home/planyourvisit/basicinfo.htm>
- NPS. (2015l, October 11). *Missouri National Recreational River*. Retrieved October 13, 2015, from <http://www.nps.gov/mnrr/index.htm>
- NPS. (2015m). *Wilderness*. Retrieved September 2015, from <http://wilderness.nps.gov/faqnew.cfm>
- NPS. (2015n). *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. (2015o). *National Park Service*. Retrieved 2015, from <http://www.nps.gov/nr/>
- NPS. (2016, June). *National Historic Landmarks Program*. Retrieved from <https://www.nps.gov/nhl/learn/intro.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. (2010, June 23). *Terrestrial Communities of Nebraska*. Retrieved from [https://efotg.sc.egov.usda.gov/references/public/NE/Nebraska_Biology_Tech_Note_65_\(Terrestrial_Natural_Communities_of_Nebraska\).pdf](https://efotg.sc.egov.usda.gov/references/public/NE/Nebraska_Biology_Tech_Note_65_(Terrestrial_Natural_Communities_of_Nebraska).pdf)
- NRCS. (2011). *Ogallala Aquifer Initiative*. Retrieved October 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1048827.pdf
- 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). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved Nov 16, 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf
- NRCS. (2015f). *Hydric Soils -- Introduction*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961
- NRCS. (2015g). *Erosion*. Retrieved September 2015, from <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/erosion/>
- NRCS. (2015h). *Atrazine*. Retrieved October 2015, from <http://www.nrdc.org/living/chemicalindex/atrazine.asp>
- NRCS. (2016, February). *Amending Soil Properties with Gypsum Products*. Retrieved February 2016, from Conservation Practice Standard: https://efotg.sc.egov.usda.gov/references/public/AL/333_cps_Amending_Soil_Properties_with_Gypsum_Products.pdf
- 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. (2006). *JetStream Max: Addition Köppen-Geiger Climate Subdivisions*. Retrieved from National Oceanic and Atmospheric Administration: http://www.srh.noaa.gov/jetstream//global/climate_max.htm
- NWS. (2009, June 25). *Glossary*. Retrieved from National Oceanic and Atmospheric Administration: <http://w1.weather.gov/glossary/index.php?letter=c>
- NWS. (2011, October 21). *JetStream - Online School for Weather - Addition Climate Subdivisions*. Retrieved from National Oceanic and Atmospheric Administration: http://www.srh.noaa.gov/jetstream//global/climate_max.htm
- NWS. (2015). *National Weather Service*. Retrieved from Flooding in Nebraska: <http://www.floodsafety.noaa.gov/states/ne-flood.shtml>

- Olcott, P. G. (1995a). *Carbonate-Rock Aquifers, HA 730-M*. Retrieved May 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_m/M-text4.html
- OMA. (2015a, October). *Mission Statement*. Retrieved October 9, 2015, from <http://www.flyoma.com/airport-authority/mission-statement>
- OMA. (2015b, October). *Facts and Statistics*. Retrieved October 9, 2015, from <http://www.flyoma.com/airport-authority/facts-statistics>
- 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 Management System Tools: <https://www.osha.gov/SLTC/etools/safetyhealth/comp3.html#Safe Work Practices>
- OSHA. (2015c). *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 Management 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, March 28). *Regulations (Standards - 29 CFR)*. Retrieved from Occupational Safety & Health Administration: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867
- OSHA. (2016c). *Restoring Communications Systems*. Retrieved February 16, 2016, from Infrastructure Repair and Restoration: <https://www.osha.gov/SLTC/etools/hurricane/communications.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). *Nebraska*. Retrieved October 2015, from http://paleoportal.org/index.php?globalnav=time_space§ionnav=state&state_id=33
- Panagopoulos, D. M. (2008). Mobile Telephony Radiation Effects on Living Organisms. In .. H. Buress (Ed.), *Mobile Telephones* (pp. 107-149). Nova Science Publishers, Inc.
- Pauketat, T. R. (2012). *The Oxford Handbook of North American Archaeology*. New York, New York: Oxford University Press, Inc.
- ProximityOne. (2015). *State Population Projections, Outlook 2030*. Retrieved March 2015, from <https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/>
- 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 13). *State of Nebraska Radio reference*. Retrieved October 13, 2015, from <http://www.radioreference.com/apps/db/?stid=31>
- RadioReference.com. (2015b, October 13). *State of Nebraska Radio System*. Retrieved October 13, 2015, from <https://www.radioreference.com/apps/db/?sid=6699>
- RadioReference.com. (2015c, October 13). *Omaha Regional Interoperability Network (Orion)*. Retrieved October 13, 2015, from Omaha Regional Interoperability Network (ORION)
- RadioReference.com. (2015d, October 13). *RACOM-IA,SD,MN,NE,IL,WI*. Retrieved October 13, 2015, from <https://www.radioreference.com/apps/db/?sid=1006>
- RadioReference.com. (2015e, October 13). *Siouxland Tri-state Area Regional Communications*. Retrieved October 13, 2015, from <http://www.radioreference.com/apps/db/?sid=4417>
- RadioReference.com. (2015f, October 13). *Lancaster County (Nebraska)*. Retrieved October 13, 2015, from <http://www.radioreference.com/apps/db/?ctid=1705>
- RadioReference.com. (2015g, October 13). *Douglas County (Nebraska)*. Retrieved October 13, 2015, from <http://www.radioreference.com/apps/db/?ctid=1678>
- RadioReference.com. (2015h, October 13). *Dawes County (Nebraska)*. Retrieved October 13, 2015, from <http://www.radioreference.com/apps/db/?ctid=1673>
- recreation.gov. (2015). *U.S. Army Corps of Engineers*. Retrieved October 13, 2015, from <http://www.recreation.gov/campgroundDirectoryListByAgencyID.do>
- Regulations.gov. (2016, October 11). Retrieved from <https://www.regulations.gov/document?D=FIRSTNET-2016-0003-0026>
- Rogers, D. J., Olshansky, R., & Rogers, B. R. (2004). *Damage to Foundations From Expansive Soils*. Missouri University of Science and Technology. Retrieved March 23, 2015, from http://web.mst.edu/~rogersda/expansive_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf
- Rolfsmeier, S. B., & Steinauer, G. (2010, #mar#). *Terrestrial Ecological Systems and Natural Communities of Nebraska. (Version IV - March 9, 2010)*. Nebraska Natural Heritage Program, Nebraska Game and Parks Commission. Retrieved from <http://outdoornebraska.ne.gov/wildlife/programs/legacy/pdfs/Terrestrial%20Ecological%20Systems.pdf>
- Rothstein, A. (1936). *Sod houses. Alliance, Nebraska*. Retrieved October 2015, from <http://www.loc.gov/resource/fsa.8b28203/>
- Sacramento County Airport System. (2015). *Sacramento County Airport System Noise Page*. Retrieved June 10, 2015, from http://www.sacramento.aero/scas/environment/noise/noise_101/
- SCEC. (2015). *State Climate Extremes Committee*. (N. O. Administration, Producer) Retrieved 2015, from National Climatic Data Center: <http://www.ncdc.noaa.gov/extremes/scec/records>
- Scholz, G., Gerdorn, J., Huston, T., Keelan, T., Hanna, B., Shukert, M., . . . Wozniak, R. (2002, March). *Nebraska Planning Handbook*. Retrieved October 12, 2015, from <http://www.npza.org/docs/NebrPlanningHndbk.pdf>

- 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#T>
- Society of Architectural Historians. (2015). *Overview of Nebraska*. Retrieved October 2015, from Society of Architectural Historians Archipedia: <http://sah-archipedia.org/essays/NE-01>
- South Dakota Game, Fish, and Parks. (2015). *Lewis & Clark Recreation Area*. Retrieved October 2015, from <http://gfp.sd.gov/state-parks/directory/lewis-and-clark/>
- State of Nebraska. (2013). *Title 163, Nebraska Administrative Code, Chapter 5*. Retrieved October 2015, from http://www.sos.ne.gov/rules-and-regs/regsearch/Rules/Game_and_Parks_Commission/Title-163/Chapter-5.pdf
- State of Nebraska. (2015). *Nebraska State Symbols*. Retrieved October 2015, from <http://nebraskaccess.ne.gov/statesymbols.asp>
- State of Nebraska Radio Systems-Trunked Systems. (2015, October 13). Retrieved October 13, 2015, from <https://www.radioreference.com/apps/db/?stid=31&tab=trs>
- StateParks.com. (2015). *Nebraska's Parks*. Retrieved from <http://www.stateparks.com/ne.html>
- Studies, N. (2015). *Native Nebraska Timeline*. Retrieved October 2015, from http://www.nebraskastudies.org/0200/media/0204_0103timeline_b/NativeTimeline.html
- Swift, B. L., Clarke, K. J., Holevinski, R. A., & Cooper, E. M. (2013, December). *Status and Ecology of Mute Swans in New York State - Draft Final Report*. Retrieved 2015, from http://www.dec.ny.gov/docs/wildlife_pdf/muteswanreport.pdf
- Thies, R. M., & Witty, T. A. (1992, June). The Archaic of the Central Plains. *Revista de Arqueología Americana*, 5(1), 137-165. Retrieved October 2015, from <http://www.jstor.org/stable/27768314>
- 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
- Tobin, B., & Weary, D. (2004). *Digital Engineering Aspects of Karst Map*. Retrieved October 2015, from http://pubs.usgs.gov/of/2004/1352/data/USA_karst.pdf
- Toom, D. L. (2004, August). Northeastern Plains Village Complex Timelines and Relations. *Plains Anthropologist*, 49(191), 281-297. Retrieved October 2015, from <http://www.jstor.org/stable/25670760>
- Trimble, D. (1980). *The Geologic Story of the Great Plains*. Retrieved October 2015, from <http://pubs.usgs.gov/bul/1493/report.pdf>
- U.S. Bureau of Justice Statistics. (2011a, 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, October 14). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Retrieved October 14, 2015, from <http://www.census.gov/quickfacts/table/PST045215/30,3137000,31>
- U.S. Census Bureau. (2013, September). *Individual State Descriptions: 2012*. Retrieved from <http://www2.census.gov/govs/cog/2012isd.pdf>
- U.S. Census Bureau. (2015a, May 28). *U.S. Census Bureau*. Retrieved May 21, 2015, from State and County Quickfacts: <http://quickfacts.census.gov/qfd/states/31000.html>
- 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). *Population Estimates Program, 2010-2014 Data*. NST-EST2014-alldata. Retrieved March 2015, from <http://www.census.gov/popest/data/national/totals/2014/NST-EST2014-alldata.html>
- U.S. Census Bureau. (2015d). 2010 Census Summary File 1, Table GCT-PH1, Population, Housing Units, Area, and Density. 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. (2015e). *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/resp.html>
- U.S. Census Bureau. (2015f). *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. (2015g). *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. (2015h). *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. (2015i). *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. (2015j). *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. (2015k). *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. (2015l). *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. (2015m). 2009-2013 American Community Survey 5-Year Estimates, Table DP03: Selected economic characteristics. 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. (2015n). *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. (2015o). *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. (2015p). *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_12_1YR_DP04&prodType=table
- U.S. Census Bureau. (2015q). *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. (2015r). *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. (2015s). *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. (2015t). American Community Survey, 2013 1-Year Estimates, Table S1701: Poverty Status in the Past 12 Months. 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. (2015u). American Community Survey, 2009-2013 5-Year Summary File, Table B03002, Hispanic or Latino Origin by Race. Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015v). American Community Survey, 2009-2013 5-Year Summary File, Table B17021, Poverty Status of Individuals in the Past 12 Months by Living Arrangement. Retrieved April 2015, from <http://dataferrett.census.gov>

- U.S. Census Bureau. (2015w). American Community Survey, 2009-2013 5-Year Summary File, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months. Retrieved May 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2016). *American Community Survey (ACS)*. Retrieved March 2016, 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 July 22, 2015, from <https://www.usbr.gov/uc/envdocs/ea/navajo/appdx-E.pdf>
- U.S. Government Publishing Office. (2010, April 5). *Title 40 Code of Federal Regulations Part 93.153*. Retrieved July 20, 2015, from http://www.ecfr.gov/cgi-bin/text-id?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93_1153&rgn=div8
- U.S. Harbors. (2015). *U.S. Harbors - Nebraska*. Retrieved Dec 7, 2015, from <http://ne.us harbors.com/>
- United States House of Representatives. (2005, October 26). *Ensuring Operability During Catastrophic Events*. (1. S. 109th Congress, Ed.) Retrieved June 6, 2015, from Hearing before the Subcommittee on Emergency Preparedness, Science, and Technology of the Committee on Homeland Security: <http://www.gpo.gov/fdsys/pkg/CHRG-109hhrg34529/pdf/CHRG-109hhrg34529.pdf>
- University of California Museum of Paleontology. (2011, May). *Geologic Time Scale*. Retrieved June 2016, from <http://www.ucmp.berkeley.edu/help/timeform.php>
- University of California, Hastings College of Law. (2010). *Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases, Fourth Edition*. Retrieved August 2015, from <http://gov.uchastings.edu/public-law/docs/ejreport-fourthedition1.pdf>
- 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 Nebraska. (2015, March). *Nebraska Recycling Study*. Retrieved October 2015, from RecycleNebraska: http://recyclenebraska.org/yahoo_site_admin/assets/docs/Recycling_Report_Final_state-wide.126101708.pdf
- University of Virginia 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_updated_noshapefile.zip*. Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- UNL. (2014). *Understanding and Assessing Climate Change - Implications for Nebraska*. Retrieved December 15, 2015, from <http://snr.unl.edu/research/projects/climateimpacts/reportannouncement.asp>
- UNL. (2015a). *Database of Nebraska Landslides*. Retrieved October 2015, from <http://snr.unl.edu/data/geologysoils/landslides/index.aspx>
- UNL. (2015b). *Salamanders of Nebraska*. Retrieved from Amphibians, Lizards, & Reptiles of Nebraska: <http://snr.unl.edu/herpneb/salamander/mainsalamander.asp?salamnaderid=1>

- UNL. (2016). *About the Sandhills*. Retrieved February 2016, from West Central Research and Extension Center: <http://extension.unl.edu/statewide/westcentral/gudmundsen/sandhills/>
- UNL Water. (2015). *Nebraska's Wetland Family*. Retrieved October 2015, from <http://water.unl.edu/wetlands/newetlandfamily>
- US Army Corps of Engineers. (2017, April 24). *Nebraska Regulatory Office*. Retrieved from <http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Nebraska/>
- USACE. (1997, July 1). *Planning and Guidance Letter #97-09: Scenic and Aesthetic Considerations*. Retrieved June 10, 2015
- USACE. (2014, May 1). Retrieved from Ratios for Compensatory Mitigation: <http://www.poa.usace.army.mil/Portals/34/docs/regulatory/HOWWetlandCategoriesRatios.pdf>
- USACE. (2015a). *Harlan County Lake*. Retrieved October 2015, from <http://www.nwk.usace.army.mil/Portals/29/docs/lakesites/harlan/HarlanCounty-Brochure.pdf>
- USACE. (2015b). *Nationwide Permits Regional Conditions Omaha District State of North Dakota*. Retrieved October 15, 2015, from http://www.nwo.usace.army.mil/Portals/23/docs/regulatory/ND/gen/Approved_NDRegConditions2012.pdf
- USBR. (2009). *Red Willow Dam Investigations*. Retrieved October 2015, from <http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=30861>
- USBR. (2015, August 28). *Recreation: Managing Partners*. Retrieved October 28, 2015, from http://www.usbr.gov/gp/lakes_reservoirs/nebraska_lakes.html
- USDA. (2012, October 18). *Table 8. Land: 2012 and 2007*. Retrieved October 18, 2015, from http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Nebraska/st31_1_001_001.pdf
- USDA. (2015a). *Ecoregions of the United States*. Retrieved July 1, 2015, from <http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/#>
- USDA. (2015b). *Plant Pests and Diseases*. Retrieved from https://www.aphis.usda.gov/wps/portal/aphis/ourfocus/planthealth?1dmy&urile=wcm%3Apath%3a%2FAPHIS_Content_Library%2FSA_Our_Focus%2FSA_Plant_Health%2FSA_Domestic_Pests_And_Diseases
- USDA. (2015c). *Federal Emerald Ash Borer (EAB) Quarantine and Authorized Transit map*. Retrieved from https://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/eab_quarantine_map.pdf
- USDA. (2016, August 13). *State Laws and Regulations*. Retrieved from Nebraska State Laws and Regulations: <https://www.invasivespeciesinfo.gov/laws/ne.shtml>
- USDOT. (2015). *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
- USEPA. (1973, July 27). *EPA.gov*. Retrieved August 05, 2015, from National Service Center for Environmental Publications - Impact Characterization of Noise: <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=&F
- USEPA. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Washington, D.C.: EPA.
- 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*, Environmental Protection Agency. Retrieved April 21, 2015, from <http://www.epa.gov/region7/air/nsr/nsrmemos/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. (2011a, December 12). *CERCLA Overview*. Retrieved from EPA Superfund: <http://www.epa.gov/superfund/policy/cercla.htm>
- USEPA. (2011b). *Your Guide to the Omaha Lead Superfund Site*. Retrieved October 9, 2015, from http://www.epa.gov/region07/cleanup/npl_files/ne_omaha_lead_guide.pdf
- USEPA. (2012a, May 2012). *List of 156 Mandatory Class I Federal Areas*. Retrieved April 20, 2015, from <http://www.epa.gov/visibility/class1.html>
- USEPA. (2012b, July 16). *Noise Pollution*. Retrieved August 4, 2015, from <http://www.epa.gov/air/noise.html>
- USEPA. (2012c). *Climate Change Indicators in the United States 2012*. Retrieved 2015, from Environmental Protection Agency: <https://www3.epa.gov/climatechange/pdfs/climateindicators-full-2012.pdf>
- USEPA. (2012d, March 12). *Marine Debris Impacts*. Retrieved Nov 24, 2015, from http://water.epa.gov/type/oceb/marinedebris/md_impacts.cfm
- USEPA. (2013a, August 13). *General Conformity*. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity>
- USEPA. (2013b). *Cleanups in my Community*. Retrieved October 2013, from <http://www2.epa.gov/cleanups/cleanups-my-community>
- USEPA. (2014a, October 21). National Ambient Air Quality Standards (NAAQS). Retrieved April 20, 2015, from <http://www.epa.gov/air/criteria.html>
- 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, 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. (2014d, November 24). *2013 TRI Analysis: State - Nebraska*. Retrieved September 22, 2015, from http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?&pstate=NE&pyear=2013
- USEPA. (2014e). *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). *Nebraska Assessment Data for 2014*. Retrieved October 2015, from http://ofmpub.epa.gov/tmdl_waters10/attains_state.report_control?p_state=NE&p_cycle=2014&p_report_type=A
- USEPA. (2015c). *Sole Source Aquifer Protection Program*. Retrieved October 2015, from Excel Document: <http://catalog.data.gov/dataset/national-sole-source-aquifer-gis-layer/resource/6f7f7431-cb0e-4389-95ff-986b058f8fd7>
- USEPA. (2015d). *Terms & Acronyms Search Page*. Retrieved from https://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do
- USEPA. (2015e). *Level III and Level IV Ecoregions of the Continental United States*. Retrieved from https://archive.epa.gov/wed/ecoregions/web/html/level_iii_iv-2.html
- USEPA. (2015f). *Environmental Justice*. Retrieved July 2015, from <http://www.epa.gov/compliance/environmentaljustice/index.html>
- USEPA. (2015g). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved July 2015, from <http://www2.epa.gov/ejscreen>
- USEPA. (2015h, July 17). *Technology Transfer Network - Basic Information*. Retrieved July 17, 2015, from http://cfpub.epa.gov/oarweb/mkb/basic_information.cfm
- USEPA. (2015i, January 30). *Designations*. Retrieved April 20, 2015, from <http://www.epa.gov/airquality/greenbook/define.html>
- USEPA. (2015j, July 14). *Air Permits*. Retrieved April 20, 2015, from <http://www.epa.gov/region9/air/permit/index.html>
- USEPA. (2015k, April 21). *The Green Book Nonattainment Areas for Criteria Pollutants*. Retrieved April 20, 2015, from <http://www3.epa.gov/airquality/greenbk/index.html>
- USEPA. (2015l, June). *U.S. Greenhouse Gas Emissions*. Retrieved September 22, 2015, from <http://www3.epa.gov/climatechange/science/indicators/ghg/us-ghg-emissions.html>
- USEPA. (2015m, November 12). *Envirofacts - PCS-ICIS*. Retrieved December 1, 2015, from <http://www3.epa.gov/enviro/facts/pcs-icis/search.html>
- USEPA. (2015n, October 14). *Envirofacts Search Results*. Retrieved October 21, 2015, from http://iaspub.epa.gov/enviro/efsystemquery.multisystem?fac_search=primary_name&fac_value=&fac_search_type=Beginning+With&postal_code=&location_address=&add_search_type=Beginning+With&city_name=&county_name=&state_code=ne&TribalLand=0&TribeType=selectTribe
- USEPA. (2015o, March 3). *Region 2 Superfund Photos*. (U.S. Environmental Protection Agency Region II) Retrieved September 25, 2015, from Ringwood Mines/Landfill Site: <http://www.epa.gov/region02/superfund/npl/ringwood/images.htm>
- 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). *Environmental Justice*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/>
- USEPA. (2016c, May 18). *Hazardous Air Pollutants*. Retrieved May 25, 2016, from <https://www.epa.gov/haps>
- USFA. (2015a, June 11). *National Fire Department Census*. Retrieved from <http://apps.usfa.fema.gov/census-download/main/download>

- USFS. (1995). *Landscape Aesthetics: A Handbook for Scenery Management*. Washington: USDA.
- USFS. (2009a, Sept 30). *Chapter 90 Communications 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. (2009b). *Soil-Disturbance Field Guide*. USDA. Retrieved from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFS. (2013, August). *National Strategic Framework for Invasive Species Management*. Retrieved October 2015, from http://www.fs.fed.us/foresthealth/publications/Framework_for_Invasive_Species_FS-1017.pdf
- USFS. (2015a). *Nebraska National Forests and Grasslands*. Retrieved October 13, 2015, from <http://www.fs.usda.gov/nebraska>
- USFS. (2015b). *Nebraska National Forests and Grasslands: About the Forest*. Retrieved October 13, 2015, from <http://www.fs.usda.gov/detail/nebraska/about-forest/offices/?cid=stelprdb5097992>
- USFS. (2015c). *Samuel R. McKelvie National Forest*. Retrieved October 13, 2015, from <http://www.fs.usda.gov/recarea/nebraska/recarea/?recid=30324>
- USFS. (2015d, October 28). *Oglala National Grasslands*. Retrieved October 28, 2015, from <http://www.fs.usda.gov/recarea/nebraska/recarea/?recid=30328>
- USFS. (2015e). *Soldier Creek Wilderness*. Retrieved October 13, 2015, from <http://www.fs.usda.gov/recarea/nebraska/recarea/?recid=80609>
- USFWS. (1990). Recovery Plan for Interior Population of the Least Tern. *Recovery Plan for Interior Population of the Least Tern*.
- USFWS. (1991). American Burying Beetle Recovery Plan. Retrieved from <http://www.fws.gov/southdakotafieldoffice/ABBRRecoveryPlan.pdf>
- USFWS. (1992). *Recovery Plan for the Blowout Penstemon*. Tech. rep., U.S. Fish and Wildlife Service. Retrieved from http://ecos.fws.gov/docs/recovery_plan/920717.pdf
- USFWS. (1998, March). *Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf
- USFWS. (2003). *Recovery Plan for the Piping Plover*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/030916a.pdf
- USFWS. (2007). Recovery Plan for the Whooping Crane. *Recovery Plan for the Whooping Crane*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/070604_v4.pdf
- USFWS. (2009). *Soil-Disturbance Field Guide*. Retrieved September 2015, from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFWS. (2010a, May 7). *Topeka Shiner*. Retrieved February 2016, from <http://www.fws.gov/mountain-prairie/species/fish/shiner/>
- USFWS. (2010b). Recovery Plan for the Scaleshell mussel. *Recovery Plan for the Scaleshell mussel*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/100407_v2.pdf
- USFWS. (2010c). Colorado Butterfly Plant Recovery Outline. *Colorado Butterfly Plant Recovery Outline*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/Colorado%20Butterfly%20Plant%20Recovery%20Outline_Final_May%202010.pdf

- USFWS. (2011). *Whooping Crane (Grus americana) 5-Year Review: Summary and Evaluation*. USFWS. Retrieved from http://www.fws.gov/southwest/es/Documents/R2ES/Whooping_Crane_5-yr_Review_Feb2012.pdf
- USFWS. (2012a, September 4). Piping Plover. Retrieved from <http://www.fws.gov/mountain-prairie/species/birds/pipingplover/>
- USFWS. (2012b, October 17). *What is an Invasive Species?* Retrieved October 2015, from <http://www.fws.gov/invasives/>
- USFWS. (2013a). Birds Protected by the Migratory Bird Treaty Act. *Birds Protected by the Migratory Bird Treaty Act*. Retrieved from <http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtintro.html>
- USFWS. (2013b). Interior Least Tern 5 Year Review. *Interior Least Tern 5 Year Review*. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc4294.pdf
- USFWS. (2014a). *Wildlife and Habitat*. Retrieved February 2016, from Valentine National Wildlife Refuge: http://www.fws.gov/refuge/Valentine/wildlife_and_habitat/index.html
- USFWS. (2014b). Candidate Species-Section 4 of the Endangered Species Act. *Candidate Species-Section 4 of the Endangered Species Act*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/candidate_species.pdf
- USFWS. (2014c). Northern long-eared bat NE memorandum. *Northern long-eared bat NE memorandum*. Retrieved from http://snr.unl.edu/renewableenergy/download/Northern%20long-eared%20bat%20NE%20memorandum_final_update.pdf
- USFWS. (2014d). Rufa Red Knot Background Information and Threats Assessment. Retrieved from http://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FIN AL.pdf
- USFWS. (2014e). Revised Recovery Plan for the Pallid Sturgeon *Scaphirhynchus albus*. *Revised Recovery Plan for the Pallid Sturgeon Scaphirhynchus albus*. Retrieved from <http://www.fws.gov/mountain-prairie/species/fish/pallidsturgeon/RecoveryPlan2014.pdf>
- USFWS. (2014f, May 5). *U.S. Fish and Wildlife Service Revises Critical Habitat for the Salt Creek Tiger Beetle*. Retrieved February 2016, from http://www.fws.gov/mountain-prairie/pressrel/2014/05052014_Service_Revises_Critical_Habitat_for_the_SCTB.php
- 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. (2015b, January 26). *Data Limitations, Exclusions and Precautions*. Retrieved May 11, 2015, from <http://www.fws.gov/wetlands/Data/Limitations.html>
- USFWS. (2015c). *Listed species believed to or known to occur in Nebraska*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=NE&status=listed
- USFWS. (2015d). Critical Habitat in Nebraska. *Critical Habitat in Nebraska*. Retrieved from <http://ecos.fws.gov/crithab/>
- USFWS. (2015e). *Candidate species believed to or known to occur in Nebraska*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=NE&status=candidate

- USFWS. (2015f). Species Profile for Northern long-eared Bat (*Myotis septentrionalis*). Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JE>
- USFWS. (2015g). Northern Long-eared Bat Fact Sheet. *Northern Long-eared Bat Fact Sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/nleb/nlebFactSheet.html>
- USFWS. (2015h). Species Profile for Red Knot (*Calidris canutus rufa*). Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0DM>
- USFWS. (2015i). *Species Profile for Salt Creek Tiger beetle (Cicindela nevadica lincolniana)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=I0QR
- USFWS. (2015j). *Species Profile for Scaleshell Mussel (Leptodea leptodon)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=F00W#status
- USFWS. (2015k). Species Profile for Blowout penstemon (*Penstemon haydenii*). *Species Profile for Blowout penstemon (Penstemon haydenii)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2EX
- USFWS. (2015l). Species Profile for Colorado Butterfly plant (*Gaura neomexicana* var. *coloradensis*). *Species Profile for Colorado Butterfly plant (Gaura neomexicana* var. *coloradensis*). Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q0VV>
- USFWS. (2015m). Species Profile for the Ute Ladies'-tresses. *Species Profile for the Ute Ladies'-tresses*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2WA
- USFWS. (2015n). Species Profile for Western Prairie Fringed Orchid (*Platanthera praeclara*). *Species Profile for Western Prairie Fringed Orchid (Platanthera praeclara)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2YD
- USFWS. (2015o). *National Wildlife Refuges in the Mountain Prairie Region: Nebraska*. Retrieved October 13, 2015, from <http://www.fws.gov/mountain-prairie/refuges/ne/>
- USFWS. (2016, February 22). *Rainwater Basin Wetland Management District*. Retrieved February 2016, from http://www.fws.gov/refuge/Rainwater_Basin_WMD/
- USGCRP. (2009). *Global Climate Change Impacts in the United States*. New York: Cambridge University Press.
- USGCRP. (2014a). *National Climate Assessment: Great Plains*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/great-plains>
- USGCRP. (2014b). *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. (2014c). *U.S. Global Change Research Program: Precipitation Change*. Retrieved from National Climate Assessment: <http://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change>
- 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. (2003a). *National Landslide Hazards Mitigation Strategy – A Framework for Loss Reduction*. Retrieved September 2013, from <http://pubs.usgs.gov/circ/c1244/c1244.pdf>

- USGS. (2003b). *A Tapestry of Time and Terrain: The Union of Two Maps, Geology and Topography*. Retrieved September 2013, from <http://www.usgs.gov/science/cite-view.php?cite=861>
- 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. (2012a). *Geology: Physiographic 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. (2012b). *Earthquake Glossary - Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/glossary/?term=earthquake>
- USGS. (2012c). *Historic Earthquakes - Near Merriman, Nebraska*. Retrieved October 2015, from http://earthquake.usgs.gov/earthquakes/states/events/1964_03_28_a.php
- USGS. (2012d, December). *The USGS Land Cover Institute*. Retrieved August 2015, from <http://landcover.usgs.gov/classes.php/>
- USGS. (2012e, October 13). *Nebraska Land Cover*. Retrieved October 13, 2015, from <http://landcover.usgs.gov/nebraska.php>
- USGS. (2012f, October 12). *Gap Analysis Program, Protected Areas Database of the United States (PADUS) v. 1.3 Fee*. Retrieved October 12, 2015, from <http://gapanalysis.usgs.gov/padus/>
- USGS. (2013a, January 11). *Chalcedony*. Retrieved from <http://minerals.usgs.gov/minerals/pubs/commodity/gemstones/sp14-95/chalcedony.html>
- USGS. (2013b). *Land Subsidence from Ground-water Pumping*. Retrieved September 2013, from <http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/>
- USGS. (2013c). *Glossary of Glacier Terminology*. Retrieved August 2015, from <http://pubs.usgs.gov/of/2004/1216/text.html#tz>
- USGS. (2014a). *Sedimentary Rocks*. Retrieved July 2015, from <http://geomaps.wr.usgs.gov/parks/rxmin/rock2.html>
- USGS. (2014b). *Geologic Provinces of the United States - Interior Plain Province*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/province/intplain.html>
- USGS. (2014c). *Generalized Geology and Hydrology*. Retrieved October 2015, from <http://ne.water.usgs.gov/ogw/hpwlms/hydsett.html>
- USGS. (2014d). *Measuring the Size of an Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/topics/measure.php>
- USGS. (2014e). *Nebraska Seismicity Map - 1973 to March 2012*. Retrieved October 2015, from <http://earthquake.usgs.gov/earthquakes/states/nebraska/seismicity.php>
- USGS. (2014f, June 3). *Cascadia Subduction Zone*. Retrieved December 2015, from <http://earthquake.usgs.gov/data/crust/cascadia.php>
- USGS. (2014g). *Nebraska 2014 Seismic Hazard Map*. Retrieved October 2015, from <http://earthquake.usgs.gov/earthquakes/states/nebraska/hazards.php>
- USGS. (2014h). *Landslide Overview Map of the Conterminous United States*. Retrieved June 2015, from <http://landslides.usgs.gov/hazards/nationalmap/>
- USGS. (2014i, November). *Water Resources of the United States*. Retrieved July 2015, from <http://www.usgs.gov/water/>

- USGS. (2014j, October 15). *National Atlas of the United States*. Retrieved October 15, 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html
- USGS. (2014k, Feb 24). *Explanations for the National Water Conditions*. Retrieved Nov 22, 2015, from http://water.usgs.gov/nwc/explain_data.html
- USGS. (2015a). *Water Science Glossary of Terms*. Retrieved June 2015, from <http://water.usgs.gov/edu/dictionary.html#B>
- USGS. (2015b). *Paleontology*. Retrieved July 2015, from <http://www.usgs.gov/science/science.php?term=861>
- USGS. (2015c). *Geologic Glossary*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/misc/glossarya.html>
- USGS. (2015d). *Groundwater Atlas of the United States - Kansas, Missouri, and Nebraska*. Retrieved October 2015, from http://pubs.usgs.gov/ha/ha730/ch_d/D-text.html
- USGS. (2015e). *Structural Geology*. Retrieved July 2015, from <http://www2.usgs.gov/science/science.php?thcode=2&code=1117>
- USGS. (2015f). *About U.S. Volcanoes*. Retrieved August 2015, from <http://volcanoes.usgs.gov/about/volcanoes/>
- USGS. (2016). *Elevations and Distances in the United States*. Retrieved Feb 15, 2016, from pubs.usgs.gov/gip/Elevations-Distances/elvadist.html
- USGS. (2017a, February 25). *Mineral Resources On-line Spatial Data*. Retrieved from <https://mrdata.usgs.gov/geology/state/map.html?x=-99.8096890665235&y=41.5274699865557&z=7>
- USGS. (2017b). *Mineral Commodity Summaries 2017*. Reston: USGS. Retrieved from <https://minerals.usgs.gov/minerals/pubs/mcs/2017/mcs2017.pdf>
- Utah State History. (2015, October). *Make Your Own Atlatl and Darts*. Retrieved from Archaeology (Antiquities Section): http://ilovehistory.utah.gov/fun_stuff/how_to_make_an_atlatl.pdf
- Vachon, J. (1938, November). *Houses along the railroad tracks. Omaha, Nebraska*. Retrieved October 2015, from <http://www.loc.gov/resource/fsa.8b14210/>
- Walks, S. H. (2009). The Decline of North American Freshwater Fishes. *BioScience*, <http://www.actionbioscience.org/biodiversity/walsh.html>.
- Wilderness.net. (2015). *Fort Niobrara Wilderness*. Retrieved October 13, 2015, from <http://www.wilderness.net/NWPS/wildView?WID=190>
- Wood, R. W. (1974). Northern Plains Village Cultures: Internal Stability and External Relationships. *Journal of Anthropological Research*, 30(1), 1-16. Retrieved October 2015, from <http://www.jstor.org/stable/3629916>
- World Wildlife Fund. (2015). *What is an Ecoregion?* Retrieved July 1, 2015, from http://wwf.panda.org/about_our_earth/ecoregions/about/what_is_an_ecoregion/
- Wyde, M. (2016). National Toxicology Program Finds Cell Phone Radiation Causes Cancer. Summary Presentation at BioEM 2016 Meeting, Ghent, Belgium, by M. Wyde, Dir. NTP Studies of Cell Phone Radiation, NIEHS, June 8.
- Zouhar, K. et al. (2008). *Wildland fire in ecosystems: fire and nonnative invasive plants*. Ogden UT: USDA Forest Service. Retrieved February 2016, from www.fs.fed.us/rm/pubs/rmrs_gtr042_6.pdf

GIS REFERENCES

- 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 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/>
- 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>
- NRHP. (2015). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (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>
- 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/rdsncp16.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 2015, 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 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 Areas*. (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. (2010). *Water Resources: Surface Water / Watershed*. (GIS Metadata) Retrieved August 2015, from USDA NRCS watershed Boundary Data and Tools: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/watersheds/dataset/>
- 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. (2011). *Geology: Seismic Hazard Map*. (GIS Metadata) Retrieved April 2015, from http://services.arcgis.com/VTyQ9soqVukalItT/arcgis/rest/services/USPGA_Seismic_Hazard/FeatureServer
- 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 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/>

