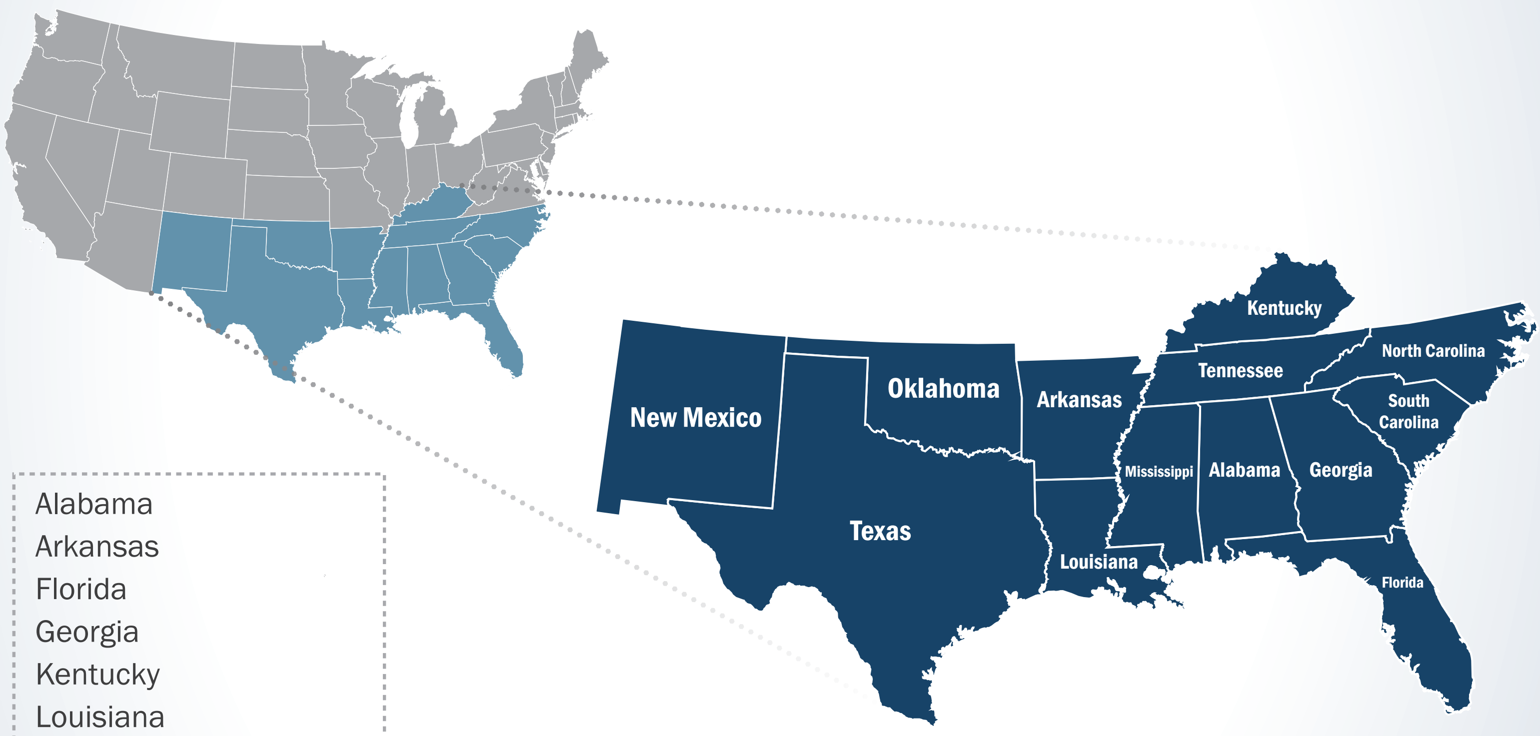
FirstNet®

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

VOLUME 10 - CHAPTER 12



- Alabama
- Arkansas
- Florida
- Georgia
- Kentucky
- Louisiana
- Mississippi
- New Mexico
- North Carolina
- **Oklahoma**
- South Carolina
- Tennessee
- Texas

OCTOBER 2016

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First Responder Network Authority

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Southern United States

VOLUME 10 - CHAPTER 12

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

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12. OKLAHOMA

Oklahoma was populated for centuries by American Indian tribes with a rich cultural history. From 1830 to 1906, Oklahoma was used by the federal government to resettle displaced American Indian tribes and the area was known as "Indian Territory." In 1907, Oklahoma became the 46th state to join the Union (Oklahoma Department of Libraries, 2005). Oklahoma is bordered by Kansas and Colorado to the north, Missouri and Arkansas to the east, Texas to the south, and New Mexico to the west. This chapter provides details about the existing environment of Oklahoma as it relates to the Proposed Action.

General facts about Oklahoma are provided below:

- **State Nickname:** The Sooner State
- **Land Area:** 68,595 square miles; **U.S. Rank:** 19 (U.S. Census Bureau, 2015a)
- **Capital:** Oklahoma City
- **Counties:** 77 (U.S. Census Bureau, 2015b)
- **2014 Estimated Population:** Over 3.8 million people; **U.S. Rank:** 28 (U.S. Census Bureau, 2015a)
- **Most Populated Cites:** Oklahoma City, Tulsa, and Norman (U.S. Census Bureau, 2015b)
- **Main Rivers:** Red River, Cimarron River, Arkansas river, Canadian River, Washita River, and Verdigris River
- **Bordering Waterbodies:** Red River
- **Mountain Ranges:** Ozark Plateau, Ouachita Mountains, and Wichita Mountains
- **Highest Point:** Black Mesa (4,973 ft) (USGS, 2015a)

12.1. Affected Environment

12.1.1. Infrastructure

12.1.1.1. Definition of the Resource

This section provides information on key Oklahoma 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 Oklahoma's traffic and transportation infrastructure, including road and rail networks and waterway facilities. The Oklahoma's public safety infrastructure could include any infrastructure utilized by a public safety entity[1] as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et seq.) (the Act), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in Oklahoma are presented in more detail in Section 12.1.1.4. Section 12.1.1.5 describes Oklahoma's public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Oklahoma's utilities, such as power, water, and sewer, is presented in Section 12.1.1.6.

12.1.1.2. Specific Regulatory Considerations

Multiple Oklahoma 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 Oklahoma Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Oklahoma Statutes: Title 63 Public Health and Safety; Oklahoma Code of Regulations: Title 145 Oklahoma Department of Emergency Management (ODEM)	ODEM	Prepares for, responds to, recovers from and mitigates against disasters and emergencies; maintains, updates and exercises the State Emergency Operations Center which serves as a command center for reporting emergencies and coordinating state response activities; delivers service to Oklahoma cities, towns and counties through the network of local emergency managers.
Oklahoma Statutes: Title 17 Corporation Commission; Title 45 Mines and Mining; Title 52; Oil and Gas; Oklahoma Code of Regulations: Title 165 Corporation Commission	Corporation Commission	Regulates oil and gas drilling, utilities, and telephone companies.
Oklahoma Statutes: Title 3 Aircraft and Airports; Title 47 Motor Vehicles; Title 66 Railroads; Title 69 Roads, Bridges and Ferries; Oklahoma Code of Regulations: Title 730 Department of Transportation	Oklahoma Department of Transportation (ODOT)	Provides a safe, economical, and effective transportation network for the people, commerce, and communities of Oklahoma; manages construction, maintenance, and regulation of the state's transportation infrastructure.

12.1.1.3. Transportation

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

The Oklahoma Department of Transportation (ODOT) has jurisdiction over freeways and major roads, airports, railroads, mass transit, and ports in the state; local counties have jurisdiction for smaller streets and roads. The mission of the ODOT is to "provide a safe, economical, and effective transportation network for the people, commerce, and communities of Oklahoma" (ODOT, 2015).

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

- 112,940 miles of public roads (FHWA, 2014) and 23,147 bridges (FHWA, 2015a);
- 3,599 miles of rail network that includes passenger rail and freight (ODOT, 2012);
- 384 aviation facilities, including airstrips and heliports (FAA, 2015a); and
- No major ports or harbors.

Road Networks

As identified in Figure 12.1.1-1, the major urban centers of the state from north to south are Joplin-Miami, Tulsa-Muskogee-Bartlesville, Oklahoma City-Shawnee, and Dallas-Fort Worth (U.S. Department of Commerce, 2013c). Oklahoma has three major interstates connecting its major metropolitan areas to one another, as well as to other states. Travel outside the major metropolitan areas is conducted on interstates, and state and county roads. Table 12.1.1-2 lists the interstates and their start/end points in Oklahoma. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015b).

Table 12.1.1-2: Oklahoma Interstates

Interstate	Southern or western terminus in OK	Northern or eastern terminus in OK
I-35	TX line near Thackerville	KS line near Braman
I-40	TX line in Texola	AR line in Muldrow
I-44	Rt-277/287 in Wichita Falls	MO line in Quapaw

In addition to the Interstate System, Oklahoma has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 12.1.1-1 illustrates the major transportation networks, including roadways, in Oklahoma. Section 12.1.8, Visual Resources, describes the National and State Scenic Byways found in Oklahoma from an aesthetic perspective.

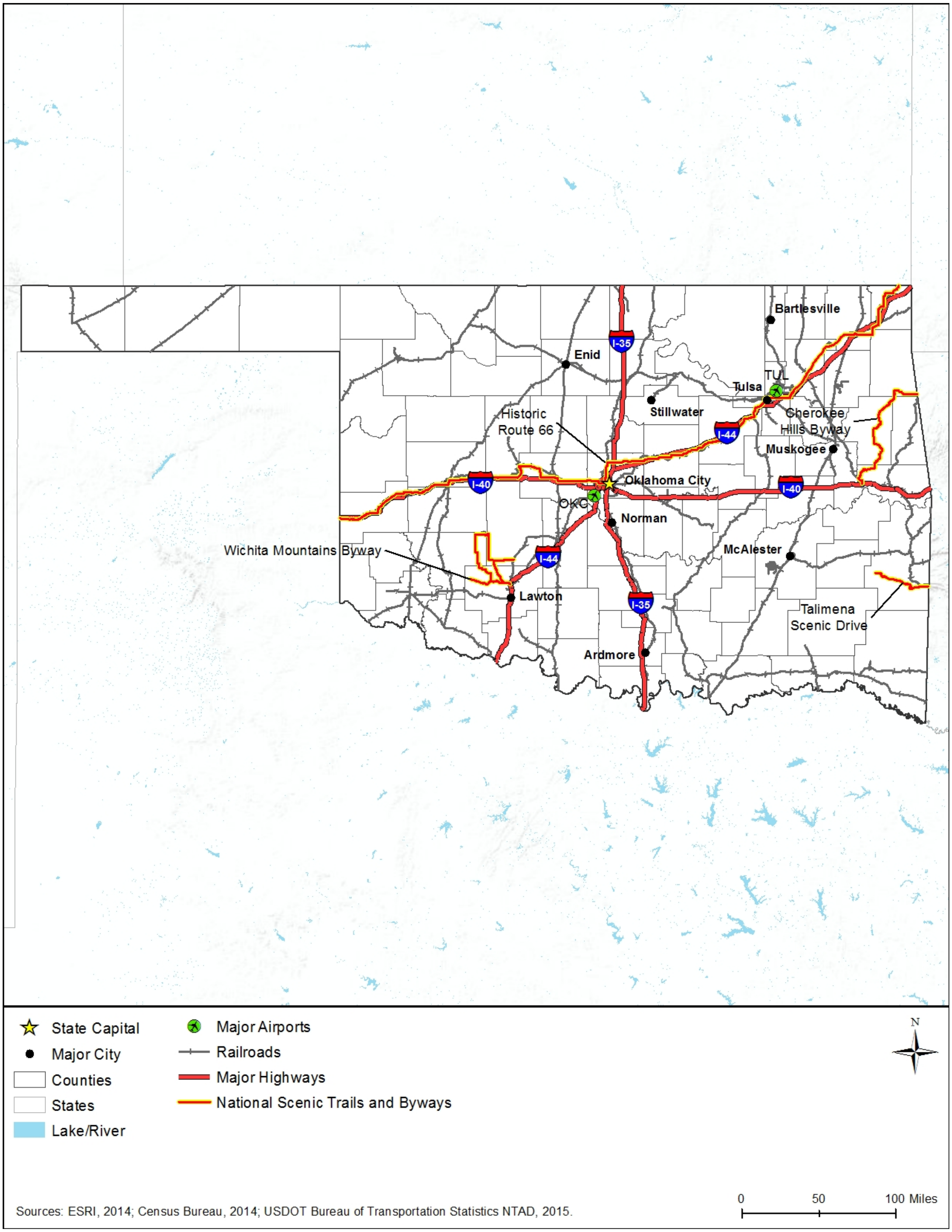

Figure 12.1.1-1: Oklahoma Transportation Networks

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

- Cherokee Hills Byway: 84 miles in eastern Oklahoma;
- Historic Route 66: 1,408.6 miles through Arizona, Illinois, New Mexico, and Oklahoma;
- Talimena Scenic Drive: 54 miles through Arkansas and Oklahoma; and
- Wichita Mountains Byway: 93 miles in southwestern Oklahoma.

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by ODOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Oklahoma has two State Scenic Byways that crisscross the entire state (TravelOK, 2015), the Mountain Pass Scenic Byway and the Mountain Gateway Scenic Byway.[2]

Airports

Air service to the state is provided by Will Rogers World Airport (OKC) and Tulsa International Airport (TUL). OKC is owned by the City of Oklahoma City and managed by the Oklahoma City Airport Trust (OKC, 2015). In 2014, OKC served 3,834,009 passengers and moved 63,825,087 pounds of freight (OKC, 2014). TUL is operated by the Tulsa Airports Improvement Trust (TUL, 2015a). In 2014, TUL served 2,840,324 passengers and moved 58,627 pounds of cargo (TUL, 2015b). In 2015, OKC and TUL had 217,527 annual operations combined (GCR, 2015a) (GCR, 2015b) (FAA, 2015i). 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 Oklahoma.

Rail Networks

Oklahoma 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 Oklahoma.

Amtrak runs one line through Oklahoma: the Heartland Flyer. The Heartland Flyer runs every day between Oklahoma City and Fort Worth, making five stops in Oklahoma. In 2010, Amtrak served more than 81,000 passengers in Oklahoma (ODOT, 2012). Table 12.1.1-3 provides a complete list of Amtrak lines that run through Oklahoma.

Table 12.1.1-3: Amtrak Train Routes Serving Oklahoma

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Oklahoma
Heartland Flyer	Oklahoma City, OK	Fort Worth, TX	4 hours 14 minutes	Oklahoma City, Norman, Purcell, Paul's Valley, Ardmore

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

Twenty-one freight rail companies operate in Oklahoma on 3,599 miles of track, which makes the state number 18 in the nation in terms of the miles of railroad track in the state (ODOT,

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

2012). Three Class I freight railroads own and operate 2,360 miles of track in Oklahoma: BNSF Railway, Union Pacific Railroad, and Kansas City Southern Railway (ODOT, 2012). In 2010, the three Class I railroads operating in Oklahoma originated 183,238 carloads and terminated 323,422 carloads of freight in the state (ODOT, 2012). Eighteen Class III freight railroads operate in Oklahoma; in 2010, these Class III railroads originated 69,869 carloads and terminated 116,658 carloads of freight in Oklahoma (ODOT, 2012).

Harbors and Ports

Oklahoma has two small commercial ports. The Port of Muskogee is at the convergence of the Arkansas, Grand, and Verdigris Rivers within the eastern portion of the state. "[The Port of Muskogee links Oklahoma with inland ports on the Mississippi, Ohio, and Illinois Rivers and with seaports worldwide via the Gulf of Mexico… In 2011, the Port of Muskogee served almost 550 barges carrying over 835 thousand tons of cargo" (World Port Source, 2016a). The Tulsa Port of Catoosa along the Verdigris River in northeastern Oklahoma. "The Tulsa Port of Catoosa supports year-round ice-free barge service and accessibility to the worldwide shipping industry through the Navigation System, the Arkansas River, and the Miscopy River to the Gulf of Mexico" (World Port Source, 2016b).

12.1.1.4. Public Safety Services

Oklahoma public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 12.1.1-4 presents Oklahoma's key demographics including 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 12.1.1-4: Key Oklahoma Indicators

Oklahoma Indicators	
Estimated Population (2014)	3,878,051
Land Area (square miles) (2010)	68,594.92
Population Density (persons per sq. mile) (2010)	54.7
Municipal Governments (2013)	594

Sources: (U.S. Census Bureau, 2015c) (U.S. Census Bureau, 2015ag) (National League of Cities, 2007)

Table 12.1.1-5 presents Oklahoma's public safety infrastructure, including fire and police stations. Table 12.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 12.1.1-5: Public Safety Infrastructure in Oklahoma by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,062
Law Enforcement Agencies [b]	481
Fire Departments [c]	742

[a] Data collected by the U.S. Fire Administration in 2015.
[b] Number of agencies from state and local law enforcement include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.
[c] Data collected by the U.S. Fire Administration in 2015.
Sources: (U.S. Census Bureau, 2015ag) (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011)

Table 12.1.1-6: First Responder Personnel in Oklahoma by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	1,800
Fire and Rescue Personnel [b]	15,758
Law Enforcement Personnel [c]	13,151
Emergency Medical Technicians and Paramedics [d e]	3,460

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

12.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Oklahoma; 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, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems providing voice, data, and video services (BLS, 2016). Figure 12.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications (FCC, 2016a).

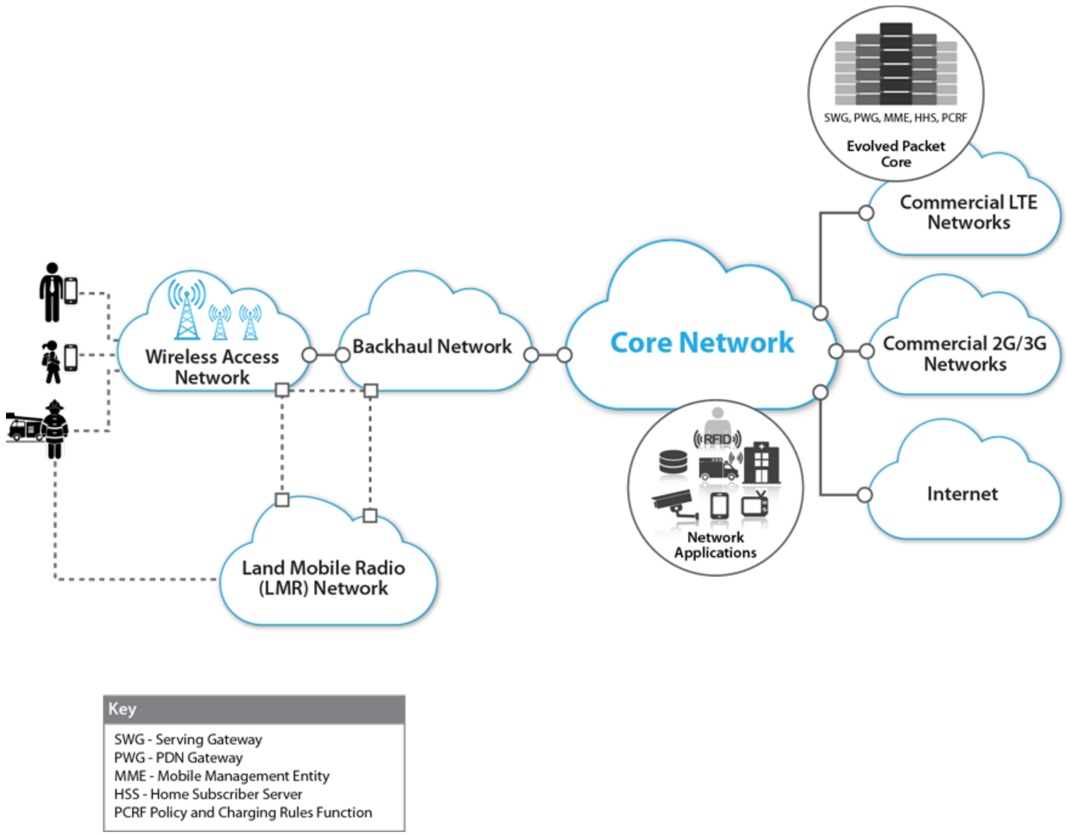

Figure 12.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale, which is national (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information. Chief among these factors impacting information sharing are: network coverage gaps, land mobile radio system infrastructure diversity, insufficient budgets, and diverse radio frequencies.

Communication interoperability has been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and specifically in Oklahoma.

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

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

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

Like most states, Oklahoma's public safety LMR network environment is facing transition and reflects the challenges of the need for greater system capabilities, as well as improved LMR interoperability and modernization investment in digital technology. These increasing capabilities require continued investment in the state's 800 MHz statewide system, ongoing LMR maintenance and upgrades, and improving the interoperability of the states' public safety LMR infrastructure (through transition from fragmented Very High Frequency (VHF)[3] and Ultra High Frequency (UHF)[4] legacy systems to the digital P25 common standard).

Oklahoma's statewide public safety communication needs are supported by the Oklahoma Wireless Integrated network (OKWIN), a digital P25 system providing service on 800 MHz. The system provides coverage to 70 percent of the state's population (OKWIN, 2015a).

OKWIN is structured as a partnership involving the Oklahoma Department of Public Safety (DPS) and five separate cities: Edmond, Norman, Tulsa, Owasso, and Shawnee. All of the wireless infrastructure equipment is owned and operated by the OKWIN partners (OKWIN, 2015a).

Statewide/Multi-County Public Safety Networks

According to the DPS, OKWIN's coverage spans the Texas border (along Interstate 44), to the Missouri border, and along Route 35 (south of Oklahoma City) to Love County (OKWIN, 2015a). Figure 12.1.1-3 depicts OKWIN's 800 MHz tower site locations across the state (OKWIN, 2015b).

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

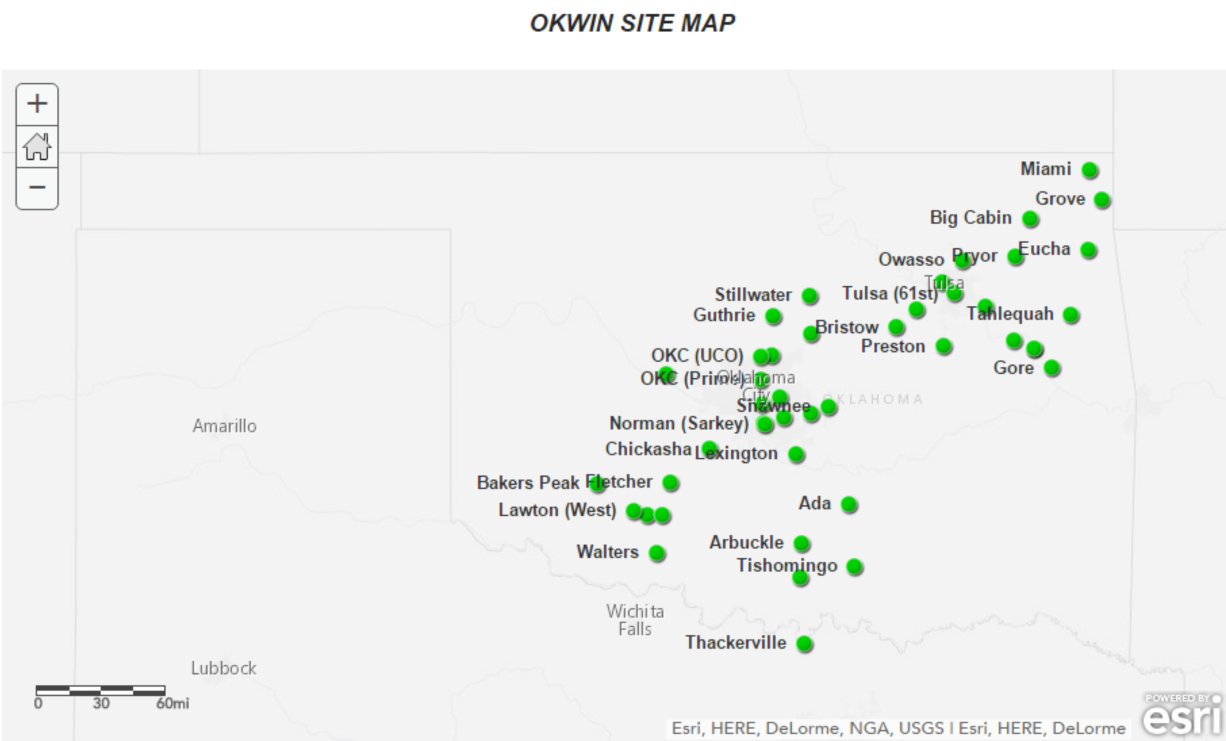

Figure 12.1.1-3: OKWIN Tower Site Location Map

Source: (OKWIN, 2015b)

The OKWIN system provides wireless communications to more than 520 state, county, and local agencies, and to 40,000 handheld and mobile radios currently operating on the system; according to Oklahoma's DPS (OKWIN, 2015a).

The OKWIN P25 digital system is linked to the legacy analog system. The state's plan is to retire the older analog systems over time and the OKWIN system will be an upgraded, 100% digital P25 network (RadioReference.com, 2015a). The OKWIN system supports statewide and regional interoperability communications through talkgroups such as Northeast Oklahoma Mutual Aid, as well as supporting agency specific public safety interoperability talkgroups such as Medical Mutual Aid (RadioReference.com, 2015a).

County/City Public Safety Networks

In Oklahoma, county and local public safety communications have been supported by a diverse set of systems and frequencies including VHF, UHF, 700 MHz, and 800 MHz across the state's counties and cities. There continues to be high diversity in the types and frequencies of LMR systems adopted by county and local public safety departments, in spite of the increased adoption of OKWIN.

There are three public safety digital P25 systems operational in Oklahoma and Table 12.1.1-7 below lists these LMR systems and their operating frequencies. All three systems operate on 800 MHz, thereby facilitating interoperability across these systems (Project 25.org, 2015).

Table 12.1.1-7: Oklahoma Mississippi Public Safety P25 Networks

Oklahoma P25 Public Safety Systems	Frequency Band
Broken Arrow Communications Regional Network P25	800 MHz
Oklahoma Wireless Interoperable Network (OKWIN)	800 MHz
University of Oklahoma Medical Center Police	800 MHz

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

The Broken Arrow Communications Regional Network P25 system provides public safety LMR communications for multiple talkgroups including Wagoner County (sheriff, fire/EMS, and mutual aid), Bixby County (police and fire dispatch), and Coweta City (police and fire dispatch). In addition, it links to the counties of Jenks and Glenpool (RadioReference.com, 2015b).

The University of Oklahoma Medical Center Police digital P25 system provides police dispatch communications in Oklahoma City for the Oklahoma University Police supporting the medical center (RadioReference.com, 2015c).

Oklahoma County, where Oklahoma City is located, is supported predominately by VHF and UHF analog LMR systems serving the county and cities with selective use of OKWIN. The network is employed for uses such as linking from VHF and UHF talkgroups to the statewide OKWIN system, and/or medical helicopter EMS transport communications (RadioReference.com, 2015d).

In Tulsa, local city and county public safety communications operate predominately on legacy VHF and UHF systems (with selective use of the OKWIN system). However, the digital 800 MHz P25 OKWIN system is used by the sheriff's department, emergency management department, and the American Red Cross (RadioReference.com, 2015e).

The cities within Tulsa County represent a mix of public safety agencies which have adopted the digital 800 MHz system. Tulsa police, Collinsville police and fire, Owasso police and fire, and Sand Springs police and fire all operate on the OKWIN system; whereas in Glenpool fire/EMS is on VHF, and Jenkes police and fire are on UHF (RadioReference.com, 2015e).

Public Safety Answering Points

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 181 PSAPs in Oklahoma serving Oklahoma's 77 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Oklahoma'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 Oklahoma'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

Oklahoma'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 12.1.1-8 presents the number of providers of switched access[5] lines, Internet access[6], and mobile wireless services including coverage.[7]

Table 12.1.1-8: Telecommunications Access Providers and Coverage in Oklahoma, as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines [a]	152	97.5% of households [b]
Internet access [c]	3	44% of households
Mobile Wireless [d]	14	95% of population

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

[b] Household coverage data provided by the FCC in "Universal Service Monitoring Report" as a Voice Penetration percentage (percentage of household with a telephone in the unit) and is current as of 2013.

[c] 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. Household coverage is provided in Table 13 (FCC, 2014a).

[d] Mobile wireless provider data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). The process of the data collection is explained in the broadband footnote.''
Sources: (FCC, 2014a) (FCC, 2014b) (NTIA, 2014) (FCC, 2013)

Table 12.1.1-9 shows the wireless providers in Oklahoma along with their geographic coverage. The following seven maps: Figure 12.1.1-4 to Figure 12.1.1-10 show the combined coverage for the top two providers; U.S. Cellular and Cellular Network Partnership's (CNP) coverage; Sprint and T-Mobile's coverage; Cricket Wireless, Sprocket Wireless, and Pioneer Telephone Cooperative Inc.'s coverage; PTCI, Southwest Oklahoma Internet, Wichita Online Inc., and Atlink Wifi's coverage; Provalue.Net, Rhino Communications, and Pine Telephone Company's coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.

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

Table 12.1.1-9: Wireless Telecommunications Coverage by Providers in Oklahoma

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	95.29%
Verizon Wireless	63.29%
U.S. Cellular	58.65%
Sprint	39.71%
CNP	37.38%
T-Mobile	15.13%
Sprocket Wireless	12.86%
Pioneer Telephone Cooperative, Inc.	11.00%
Atlink Wifi	9.21%
Cricket Wireless	8.26%
PTCI	7.81%
Wichita Online, Inc.	6.76%
Southwest Oklahoma Internet	6.44%
Rhino Communications	5.37%
Pine Telephone Company	5.34%
ProValue.Net	5.06%
Other[a]	37.84%

[a] Other: Provider with less than 5 percent coverage area. Providers include: Arbuckle Wireless; Cross Cable LLC; Dominion Communications LLC; Plainsnet, LLC; KanOkla Communications, Inc.; HTS Wireless; Wavelinx; Omega 1; Valliant Telephone Company; The Junction Internet LLC; Hinton CATV Company; Cowboy.net; Cimarron Telephone Company; Airosurf Communications; Central Cellular LLC/COTC Connections; Valnet; Martineer Wireless; AirLink Internet Services LLC; The Pottawatomie Telephone Company, Inc.; Rural iNet; Resonance Broadband; Vaxeo Technologies; Del Nero Communications Management, LLC; NEOKNET; Phoenix Communications; and OWTC Cellular.

Source: (NTIA, 2014)

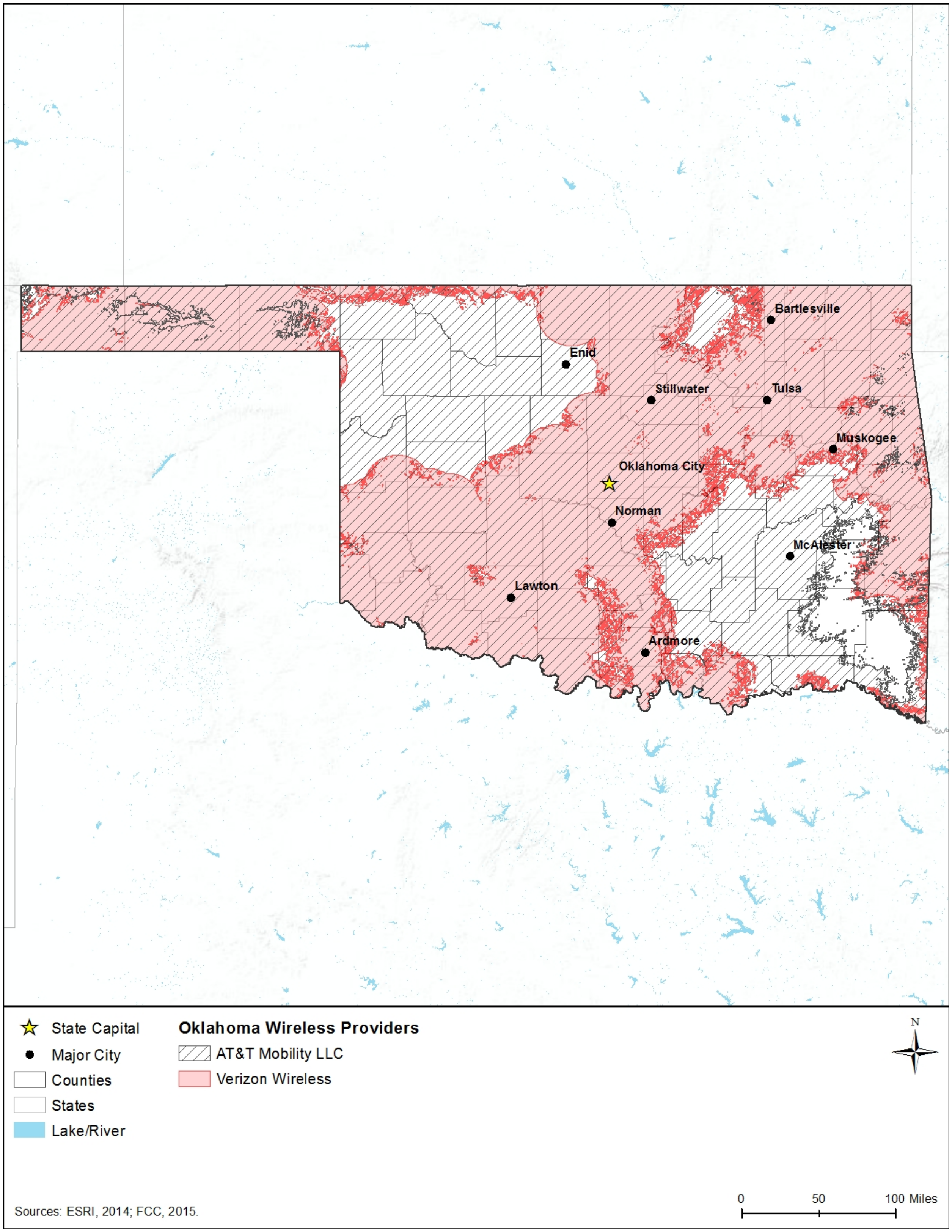

Figure 12.1.1-4: Top Wireless Providers Availability in Oklahoma

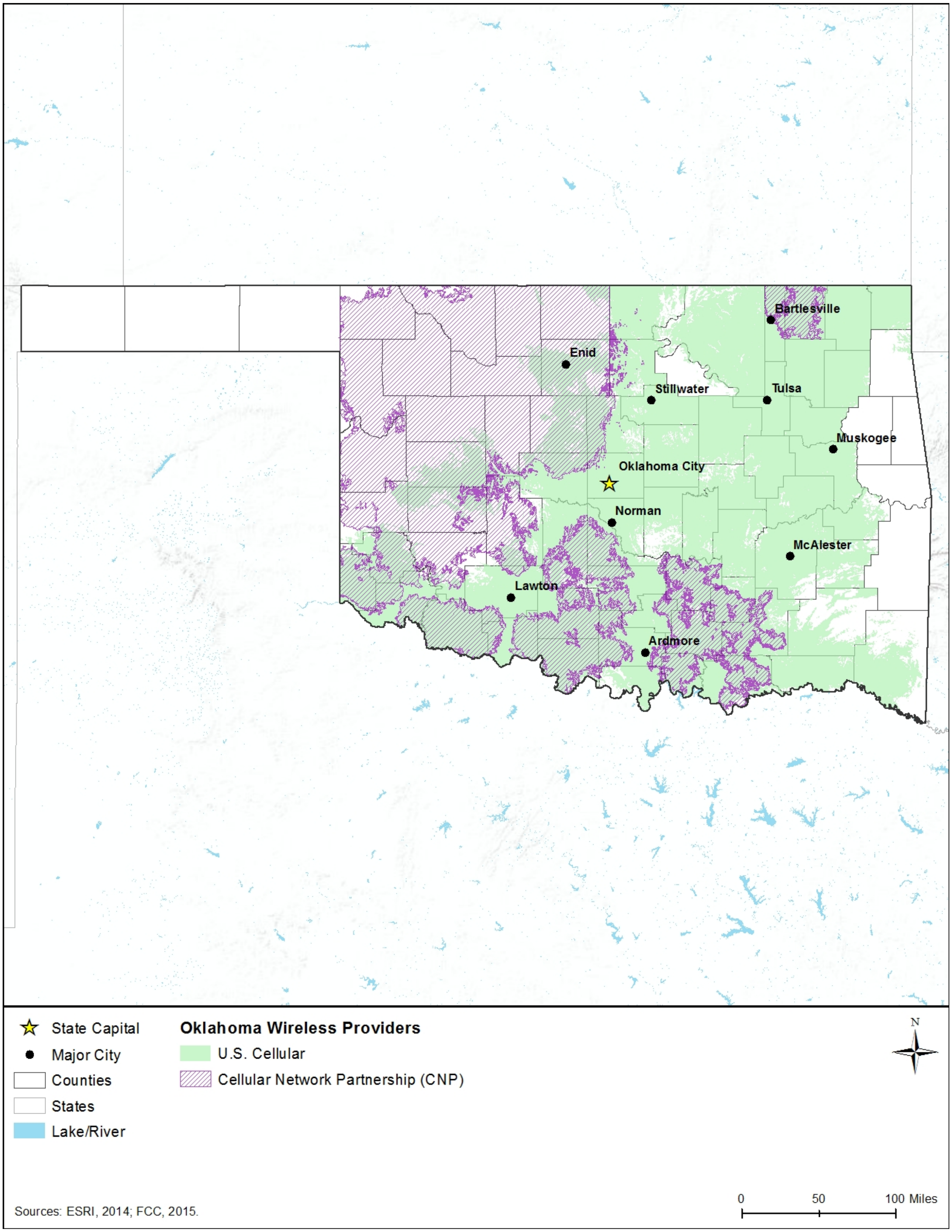

Figure 12.1.1-5: U.S. Cellular and CNP Wireless Availability in Oklahoma

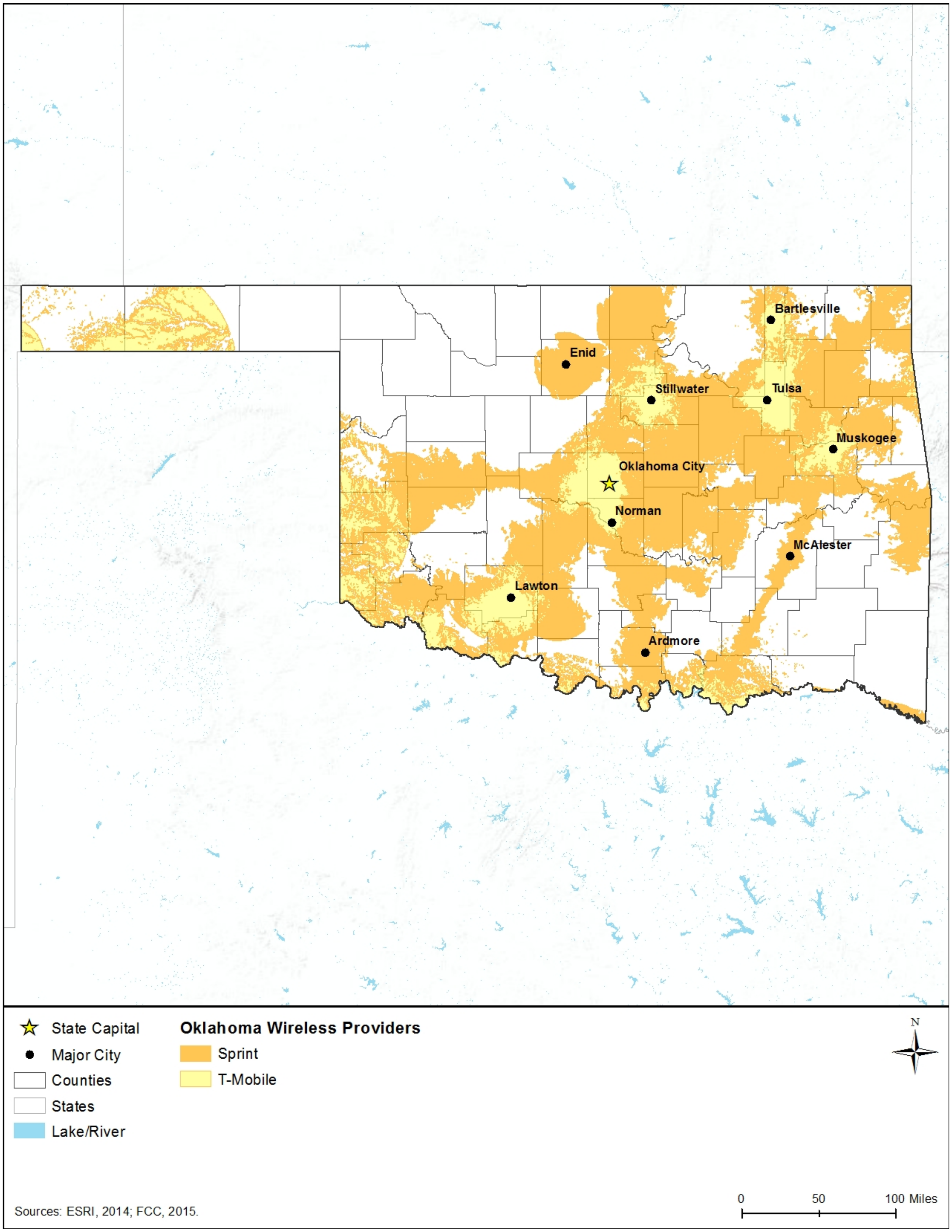

Figure 12.1.1-6: Sprint and T-Mobile Wireless Availability in Oklahoma

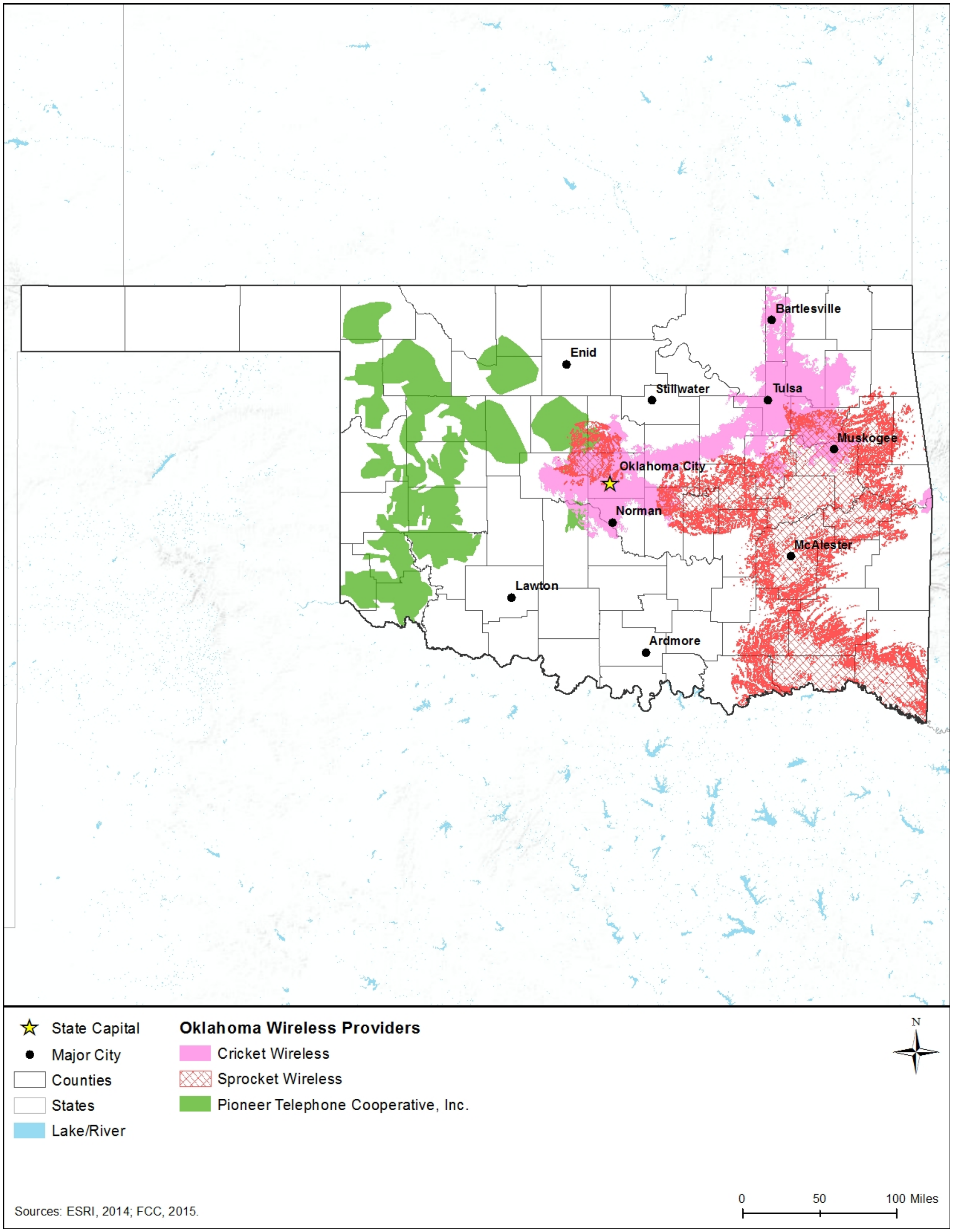

Figure 12.1.1-7: Cricket Wireless, Sprocket Wireless, and Pioneer Telephone Cooperative, Inc. Wireless Availability in Oklahoma

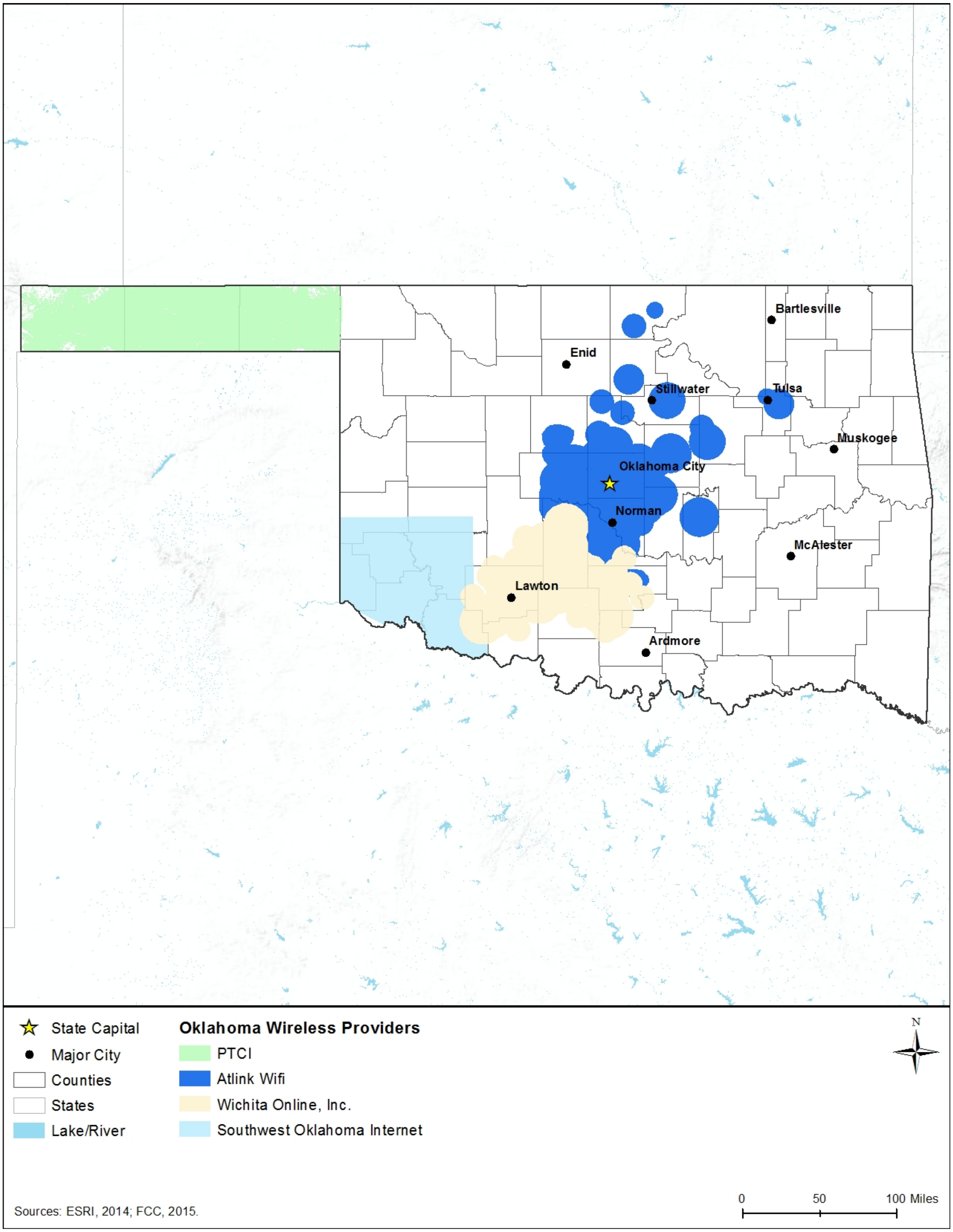

Figure 12.1.1-8: Atlink Wifi, PTCI, Southwest Oklahoma Internet, and Wichita Online Inc. Wireless Availability in Oklahoma

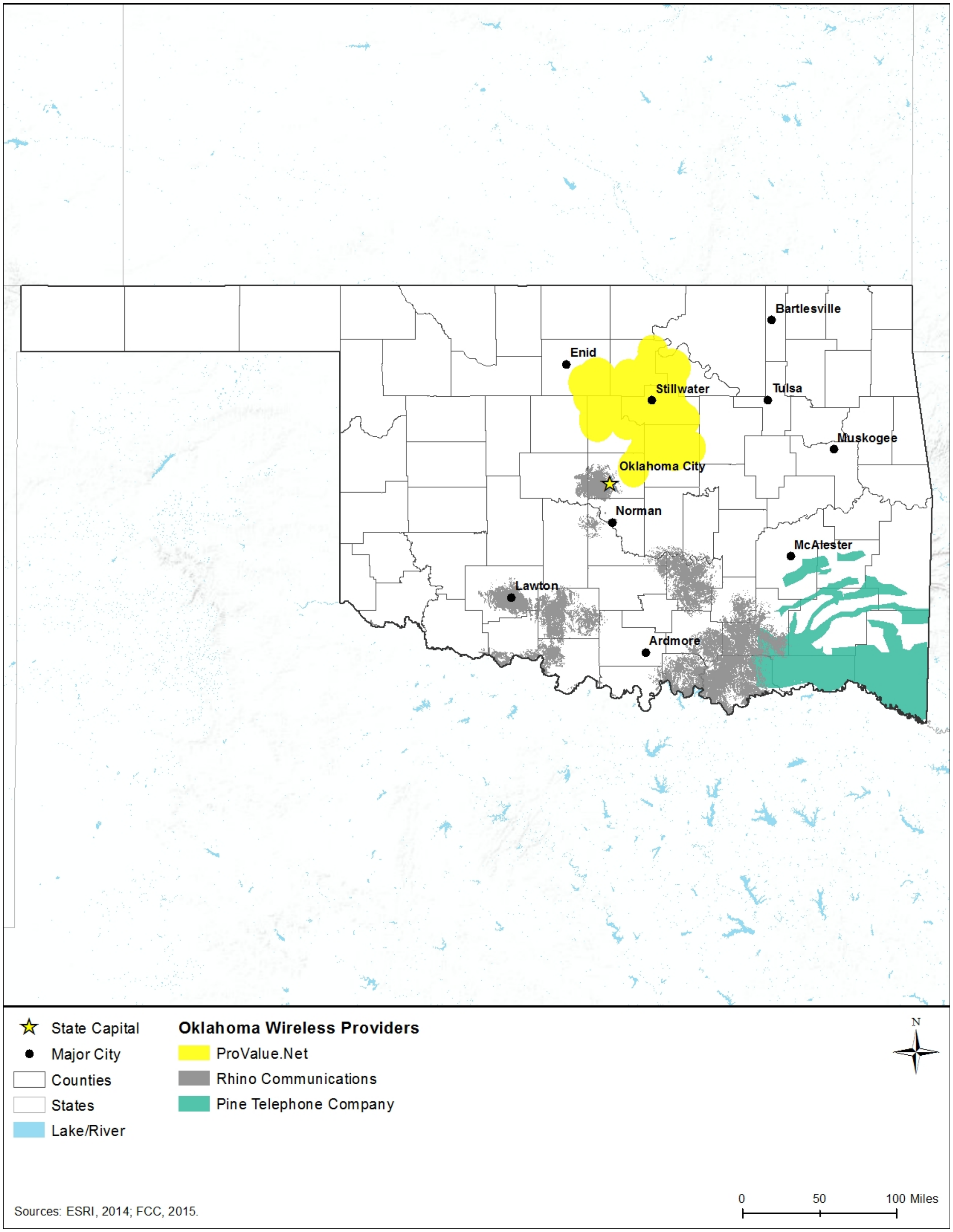

Figure 12.1.1-9: Rhino Communications, Pine Telephone Company, and ProValue.Net Wireless Availability in Oklahoma

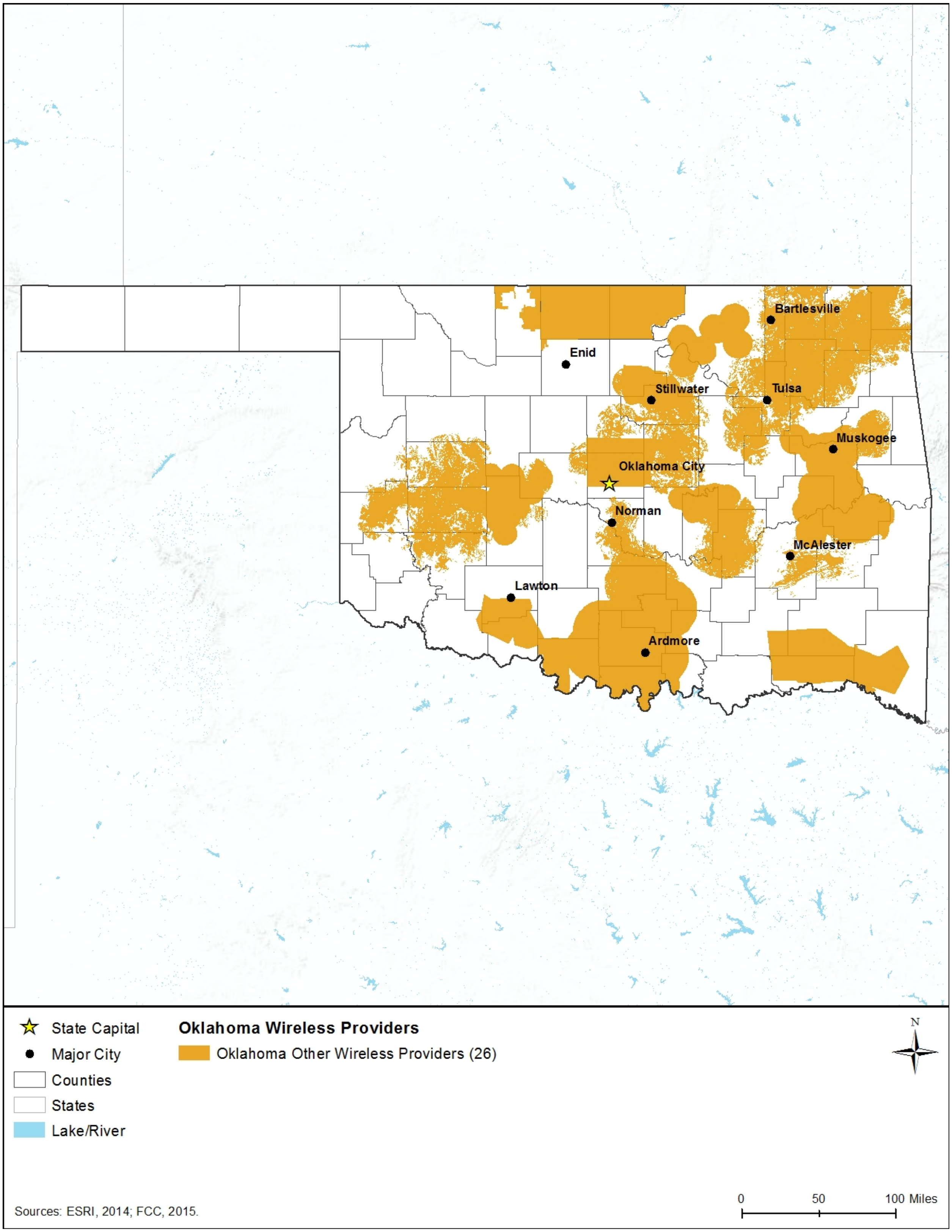

Figure 12.1.1-10: Other Providers Wireless Availability in Oklahoma

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 12.1.1-11 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 12.1.1-11: Types of Towers

Telecommunications tower infrastructure proliferates throughout Oklahoma, although tower infrastructure is concentrated in the higher and more densely populated areas of Oklahoma; Bartlesville, Enid, Stillwater, Tulsa, Muskogee, Oklahoma City, Norman, McAlester, Lawton, and Ardmore. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).[8] Table 12.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Oklahoma by tower type, and Figure 12.1.1-12 presents the location of those structures, as of June 2016.

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

Table 12.1.1-10: Number of Commercial Towers in Oklahoma by Type

Constructed[a] Towers[b]		**Constructed Monopole Towers**	
100 ft. and over	677	100 ft. and over	1
75 ft. – 100 ft.	856	75 ft. – 100 ft.	0
50 ft. – 75 ft.	466	50 ft. – 75 ft.	35
25 ft. – 50 ft.	415	25 ft. – 50 ft.	76
25 ft. and below	49	25 ft. and below	9
Subtotal	**2,463**	**Subtotal**	**121**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100 ft. and over	161	100 ft. and over	0
75 ft. – 100 ft.	130	75 ft. – 100 ft.	3
50 ft. – 75 ft.	19	50 ft. – 75 ft.	2
25 ft. – 50 ft.	10	25 ft. – 50 ft.	4
25 ft. and below	12	25 ft. and below	1
Subtotal	**332**	**Subtotal**	**10**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100 ft. and over	8	100 ft. and over	0
75 ft. – 100 ft.	91	75 ft. – 100 ft.	0
50 ft. – 75 ft.	57	50 ft. – 75 ft.	0
25 ft. – 50 ft.	33	25 ft. – 50.ft.	0
25 ft. and below	4	25 ft. and below	0
Subtotal	**193**	**Subtotal**	**0**
Constructed Tanks[d]			
Tanks	17		
Subtotal	**17**		
Total All Tower Structures		**3,136**	

[a] Planned construction or modification has been completed. Results will return only those antenna structures that the FCC has been notified are physically built or planned modifications/alterations to a structure have been completed (FCC, 2015b).
[b] Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).
[c] Multiple constructed structures per antenna registration (FCC, 2016c).
[d] Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016c).
Source: (FCC, 2015c)

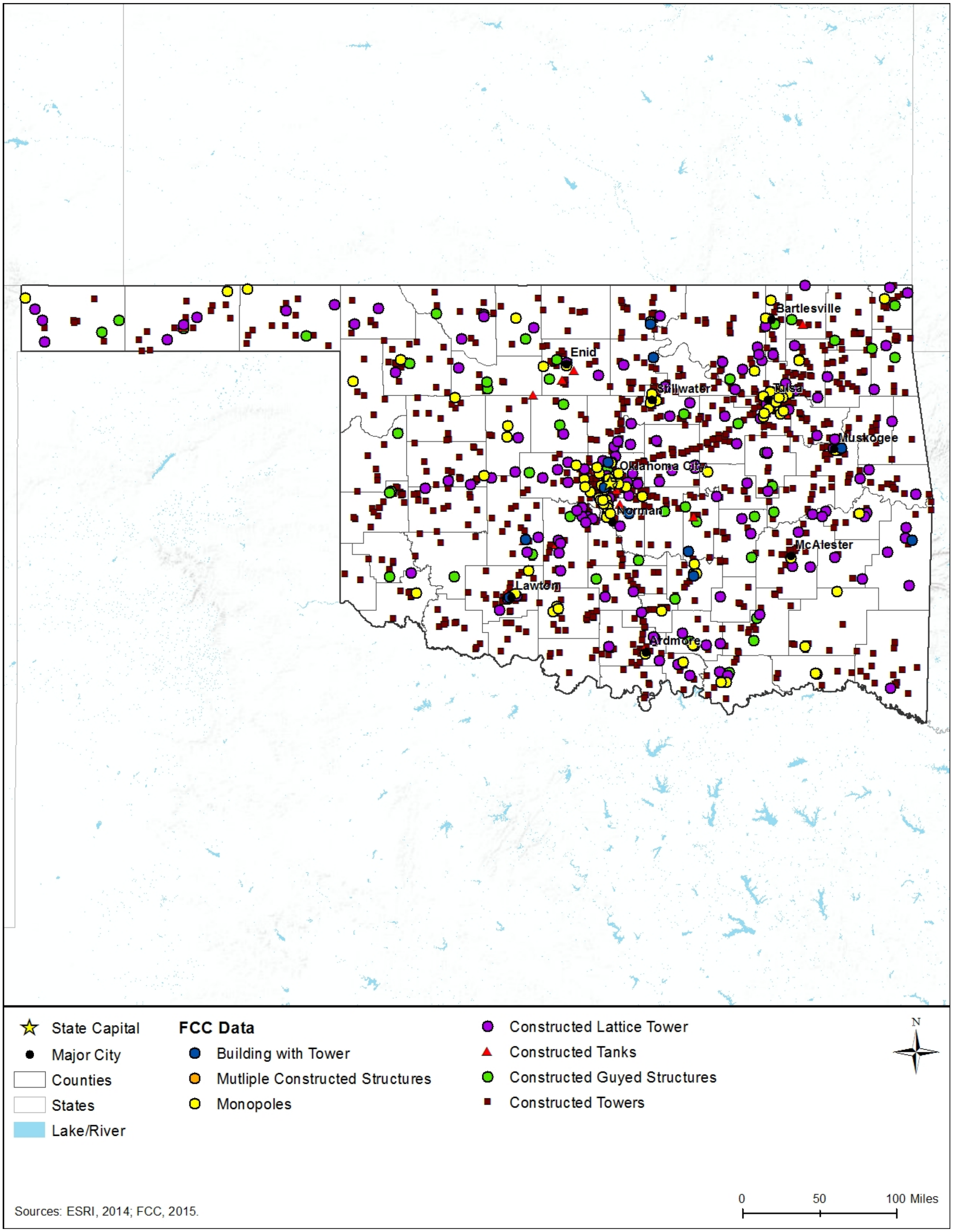

Figure 12.1.1-12: FCC Tower Structure Locations in Oklahoma

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way. A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 12.1.1-13. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions) (FCC, 2000).

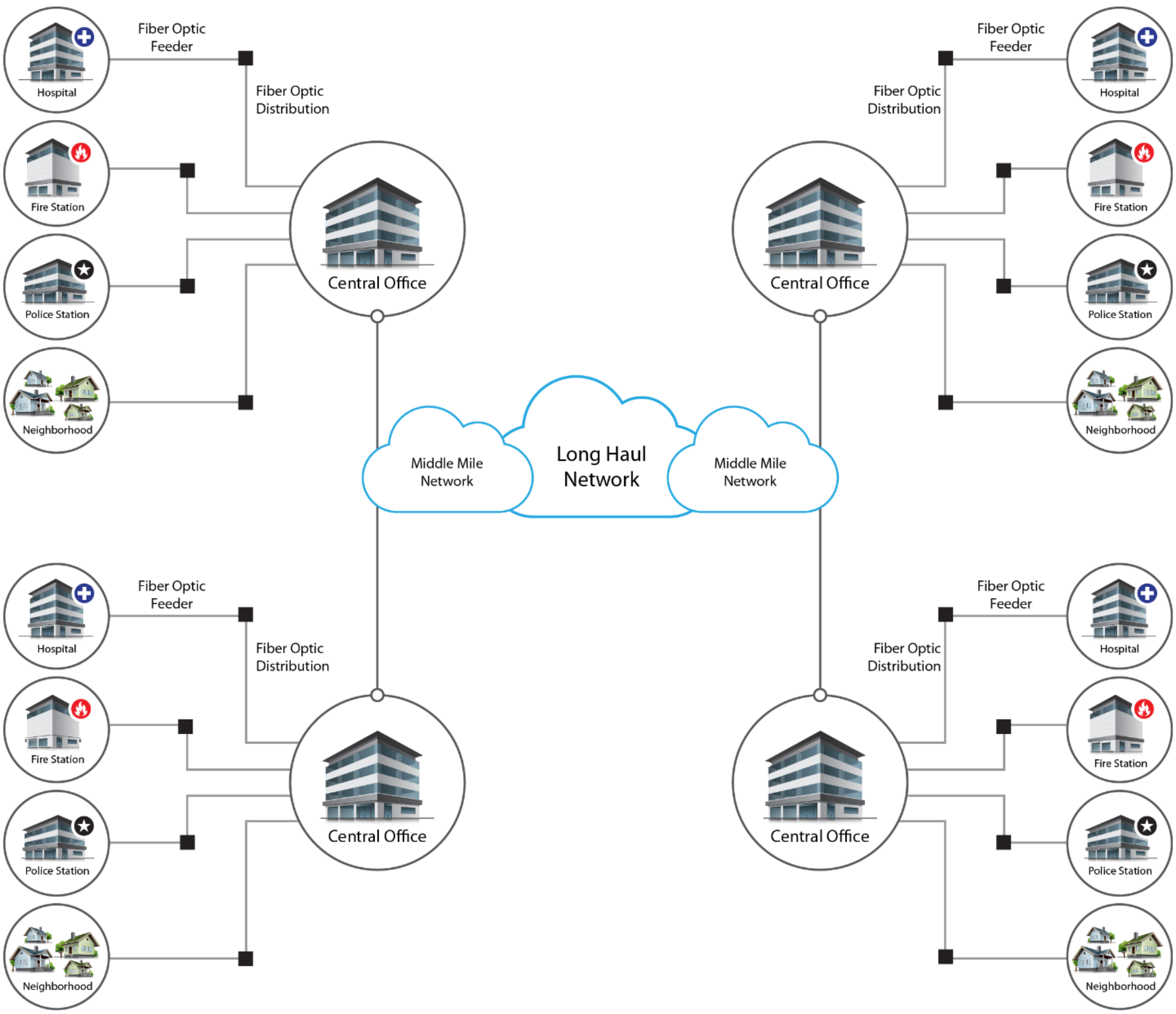

Figure 12.1.1-13: Typical Fiber Optic Network in Oklahoma

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

Last Mile Fiber Assets

In Oklahoma, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Oklahoma there are 61 fiber providers that offer service in the state, as listed in Table 12.1.1-11. Figure 12.1.1-14 shows coverage for Pioneer Telephone Cooperative Inc.'s, Figure 12.1.1-15 shows coverage for AT&T Southwest, and Figure 12.1.1-16 shows coverage for all providers with less than 5 percent coverage area, respectively.

Table 12.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
Pioneer Telephone Cooperative, Inc.	11.95%
AT&T Southwest	5.39%
Other[a]	22.94%

[a] Other: Provider with less than 5% coverage area. Providers include: Dobson Telephone Company, McLoud Division Cox Communications; Valor Telecommunications of Oklahoma, LLC; Cable One; PTCI; Cross Cable LLC; KanOkla Telephone Association, Inc.; Pine Telephone Company; Southwest Oklahoma Telephone Company; Totah Communications, Inc.; Cimarron Telephone Company; Vyve Broadband; TDS Telecom; Hinton Telephone Company; Chickasaw Telephone Company; Oklatel Communications, Inc.; The Pottawatomie Telephone Company, Inc.; Suddenlink Communications; Central Oklahoma Telephone Co. LLC; Salina Spavinaw Telephone Co., Inc.; Oklahoma Western Telephone Company; Santa Rosa Telephone Cooperative, Inc.; Carnegie Telephone Company; Oklahoma Windstream, LLC; SCTelecom; Suddenlink Communications; Cherokee Telephone Company; Shidler Telephone Company; Valliant Telephone Company; Grand Telephone Company; Beggs Telephone Company, Inc.; Taloga Cable; BTC Broadband; Windstream Oklahoma, LLC; FairPoint Communications; Craw Kan Telephone Cooperative Inc.; Elkhart Telephone Co., Inc.; CenturyLink; Medicine Park Telephone Company; Lake Region Electric Cooperative, Inc.; Canadian Valley Telephone Company; Level 3 Communications, LLC; Community Cable & Broadband; Fidelity Cablevision; Broken Bow Cable; Lavaca Telephone Company, Inc.; Wichita Online, Inc.; Seneca Telephone Company; United Telephone; Ozark Telephone Company; TDS Telecom; Central Cellular LLC/COTC Connections; Diamondnet; Vyve Broadband; Get Real Cable; XO Communications Services, Inc. (Affiliated Entity); TW Telecom of Oklahoma LLC; Terral Telephone Company; Cogent Communications, Inc.

Source: (NTIA, 2014)

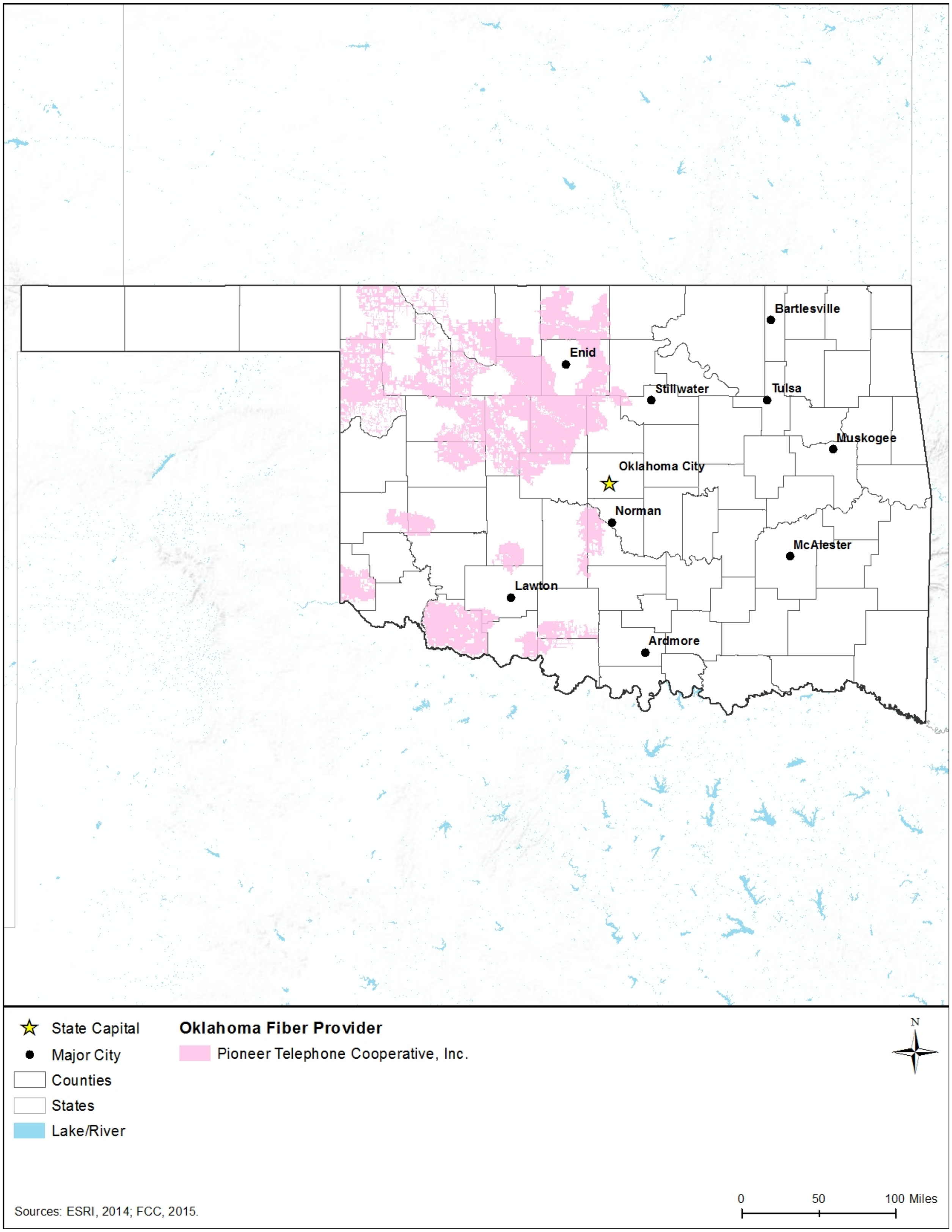

Figure 12.1.1-14: Fiber Availability in Oklahoma for Pioneer Telephone Cooperative, Inc.

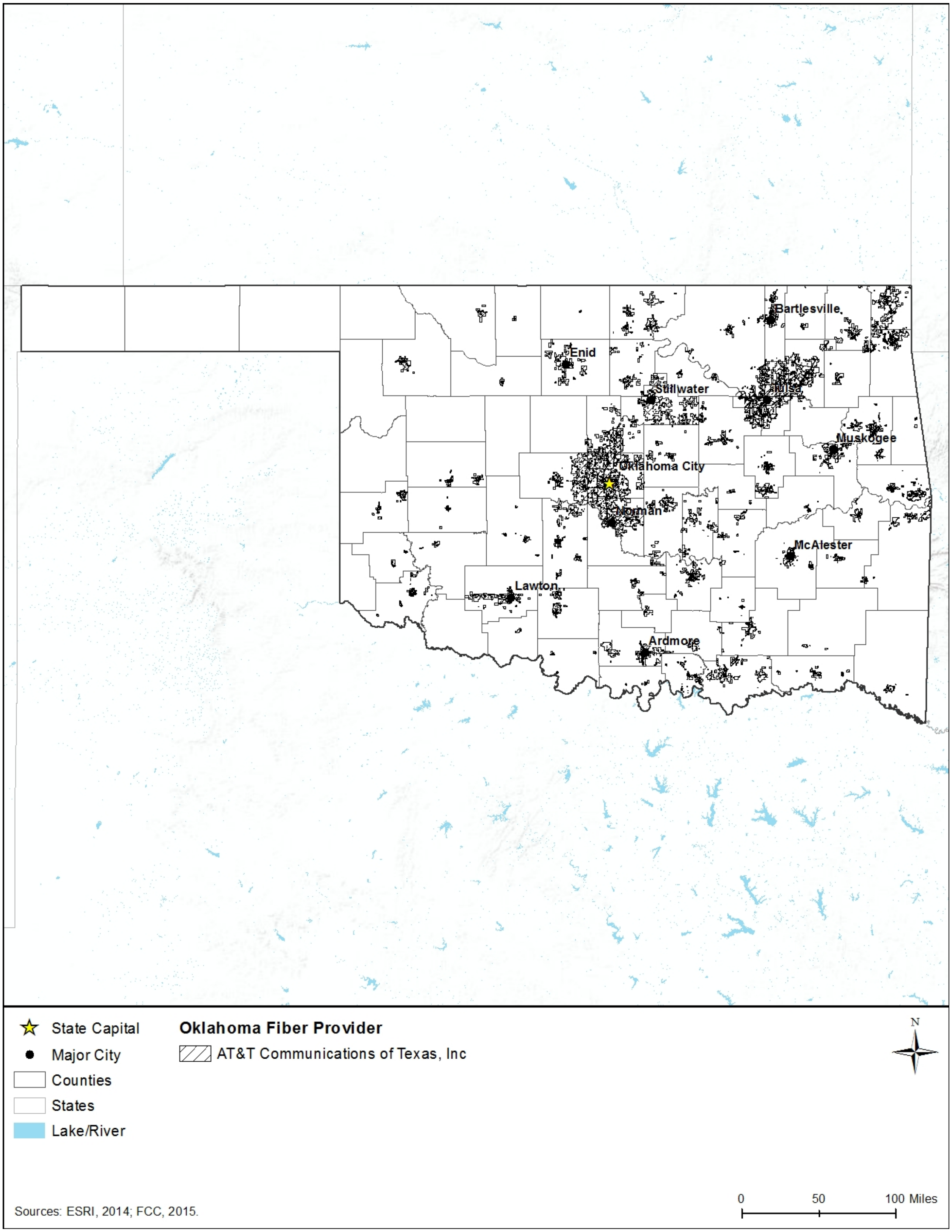

Figure 12.1.1-15: AT&T Southwest's Fiber Availability in Oklahoma

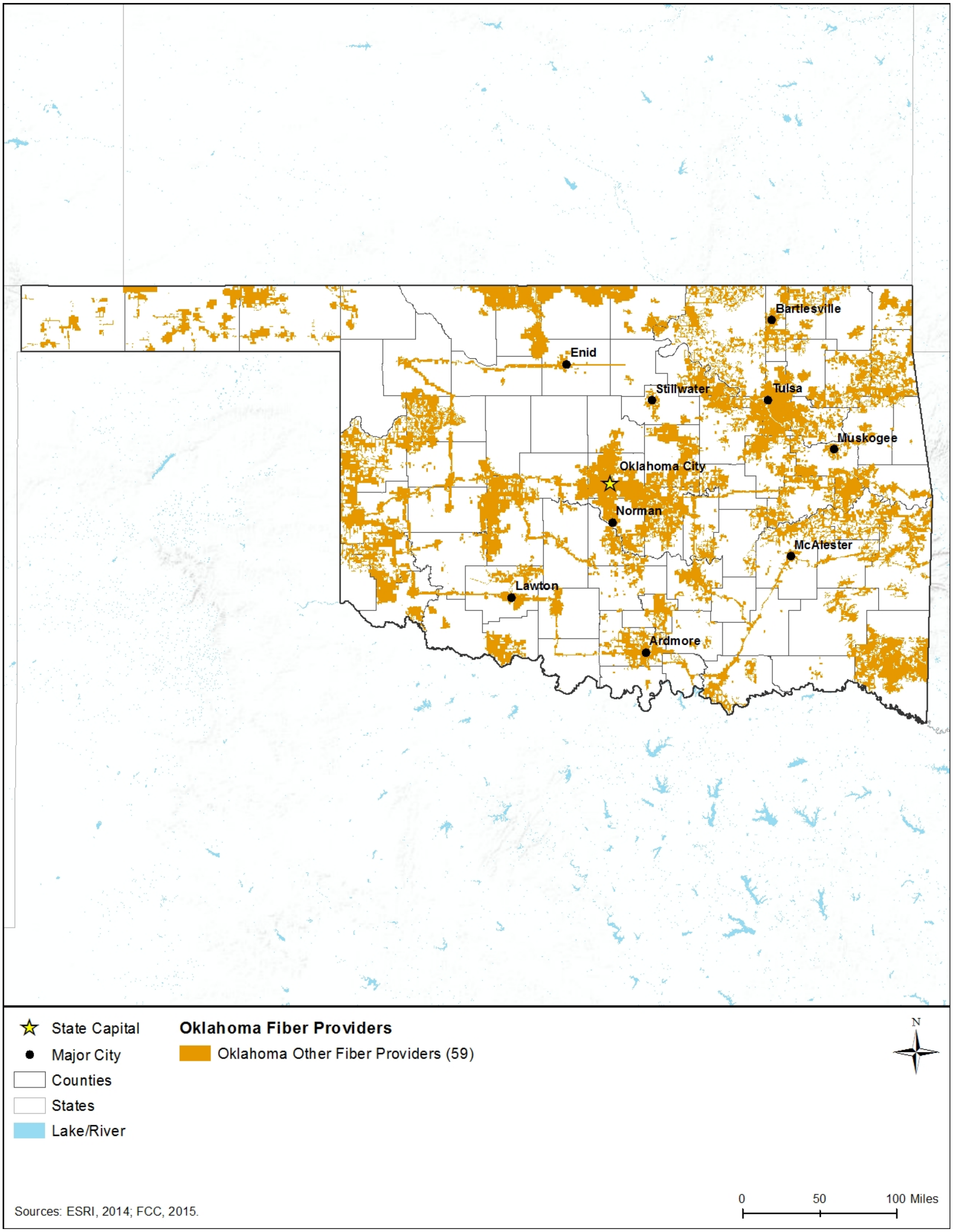

Figure 12.1.1-16: Other Provider's Fiber Availability in Oklahoma

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

"Seven major entities are engaged in electric generation and/or transmission in Oklahoma, of which six own and/or operate all or part of generation facilities within the state" (Oklahoma Corporation Commission, 2015). These providers include: The Empire District Electric Company, Grand River Dam Authority, KAMO Electric Cooperative, Oklahoma Gas & Electric Company, Oklahoma Municipal Power Authority, Public Service Company of Oklahoma, and Western Farmers Electric Cooperative (Oklahoma Corporation Commission, 2015).

Nearly all of Oklahoma's power comes from facilities fueled by one of three sources: natural gas, coal, and wind power (EIA, 2015a). The state produced a total of 70,155,504 megawatthours (MWh)[9] of power in 2014, of which 29,905,952 MWh (42.6 percent) came from coal and 26,641,474 MWh (38 percent) came from natural gas facilities. "Oklahoma is one of the top natural gas-producing states in the nation, accounting for 7.1% of U.S. gross production and 8.4% of marketed production in 2013" (EIA, 2016c). Wind power facilities produced 11,936,833 MWh (17 percent), and "in 2014, Oklahoma ranked fourth (behind California, Iowa, and Texas) in net electricity generation from wind" (EIA, 2015a). Other sources such as biomass and hydroelectric power contributed negligible amounts of electricity (EIA, 2015a). 'In 2014, the industrial sector used 36.1 percent of its energy, while the transportation sector used 28.8 percent. The residential and commercial sectors used just 19.3 percent and 15.8 percent respectively (EIA, 2016c).

[9] One megawatthour is defined as "one thousand kilowatthours or one million watthours." One watthour is "the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour." (EIA, 2016a)

Water

The quality and protection of drinking water in Oklahoma is regulated by the ODEQ, through its Water Quality Division. In doing this, the regulate "facilities that produce and distribute public drinking water" (DEQ, 2015a). These facilities, called Public Water Supplies (PWS) provide service for the 3.7 million customers across the state (DEQ, 2015b). PWSs are broken into three categories, depending on who they supply. There are currently "1,129 systems are classified as community water systems (such as towns and rural water districts), 109 are classified as non-transient, non-community water systems (such as schools or factories), and 374 are classified as non-community water systems (such as rest stops or parks)" (DEQ, 2015b). There are also minor water systems that are regulated by Environmental Complaints and Local Services. When these are included, there are 1,680 PWS in the state. Regarding the sources, most PWSs in the state use either groundwater or purchased water. There are 788 systems in Oklahoma that use groundwater, 705 systems that purchase their water, elsewhere and 187 systems that use surface water as their source (DEQ, 2015b). The Safe Drinking Water Act (SWDA) mandates some actions that must be taken regarding the sources of water for public consumption. The Source Water Assessment Program (SWAP) requires each PWS to submit a Source Water Assessment that includes the identification of the source water, as well as inventory of possible contaminants and the system's susceptibility to them. These assessments are made available to the public (DEQ, 2015c). All Community PWSs have to submit Consumer Confidence Reports (CCR) to their consumers and ODEQ. These CCRs include water system information, sources of the drinking water, a list of definitions, listing of contaminants detected in the last five years, compliance with drinking water regulations, and other educational information (DEQ, 2015d). ODEQ also requires that water facility workers are well trained and certified by ODEQ to perform their duties (DEQ, 2015e).

Wastewater

The management of Oklahoma's wastewater is handled through the permitting of facilities or operations that result in discharge of treated wastewater. The National Pollutant Discharge Elimination System (NPDES) program is the overarching permit authorization system run by the U.S. Environmental Protection Agency (USEPA). ODEQ has had the authority to provide permits in Oklahoma since 1996 (USEPA, 2015i). These permits are available for both industrial and municipal grade facilities (DEQ, 2015r). Known as Oklahoma Pollutant Discharge Elimination System (OPDES) permits, they are used to cover facilities in industries with similar characteristics (DEQ, 2015g) (DEQ, 2015r). For example, general OPDES Permits include industrial permits for coal strip mines, vehicle wash facilities, and concrete batch plants (DEQ, 2015h). ODEQ also trains and licenses the staff of wastewater plants to ensure their competency. "This ensures they have training to properly treat and monitor the outgoing product of the facility to protect human health and the environment" (DEQ, 2015i).

Solid Waste Management

Oklahoma is home to a total of 98 permitted solid waste management facilities. Among these are an assortment of landfills, transfer stations, composting facilities and biomedical waste stations. Landfills make up a significant portion of this number, and include eight construction/demolition landfills, and thirty-seven municipal waste landfills (DEQ, 2015j). There are also four waste tire collection or transportation companies and thirteen landfills that accept non-hazardous industrial wastes (DEQ, 2015k) (DEQ, 2015l). In 2013, the state's landfills brought in 5,304,846 tons of solid waste. This was an increase over the previous year, where the landfills brought in 4,321,608 tons of waste (DEQ, 2015m).

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, 2015b)

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

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

- *Parent Material*: The original geologic source material from the soil formed affects soil aspects, including color, texture, and ability to hold water.
- *Climate*: Chemical changes in parent material occur slowly in low temperatures. However, hot temperatures evaporate moisture, which also facilitates chemical reactions within soils. The highest degree of reaction within soils occurs in temperate, moist climates.
- *Topography*: Steeper slopes produce increased runoff, and, therefore, downslope movement of soils. Slope orientation also dictates the microclimate to which soils are exposed, because different slope faces receive more sunlight than others.
- *Biology*: The presence/absence of vegetation in soils affects the quantity of organic content of the soil.
- *Time*: Soil properties are dependent on the period over which other processes act on them.

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 in Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 12.1.2-1 below.

Table 12.1.2-1: Relevant Oklahoma Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Oklahoma Pollutant Discharge Elimination System Act (OPDES)	ODEQ	Erosion and sediment controls are required as part of the OPDES General Permit for construction activities disturbing one acre or more.

12.1.2.3. Environmental Setting

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

- Central Feed Grains and Livestock Region;
- Central Great Plains Winter Wheat and Range Region;
- East and Central Farming and Forest Region;
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region;
- Southwestern Prairies Cotton and Forage Region; and
- Western Great Plains Range and Irrigated Region.

Within and among Oklahoma's 6 LRRs are 22 Major Land Resource Areas (MLRA),[11] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Oklahoma's MLRAs are presented in Figure 12.1.2-1 and Table 12.1.2-2.

Soil characteristics are an important consideration for FirstNet insomuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota[12] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[13] with wet and dry seasons alternately swell and shrink, which presents integrity risks to structural foundations (Rogers, Olshansky, & Rogers, 2004). Soils can also be affected by a variety of surface uses that loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting[14] (discussed further in the subsections below).

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

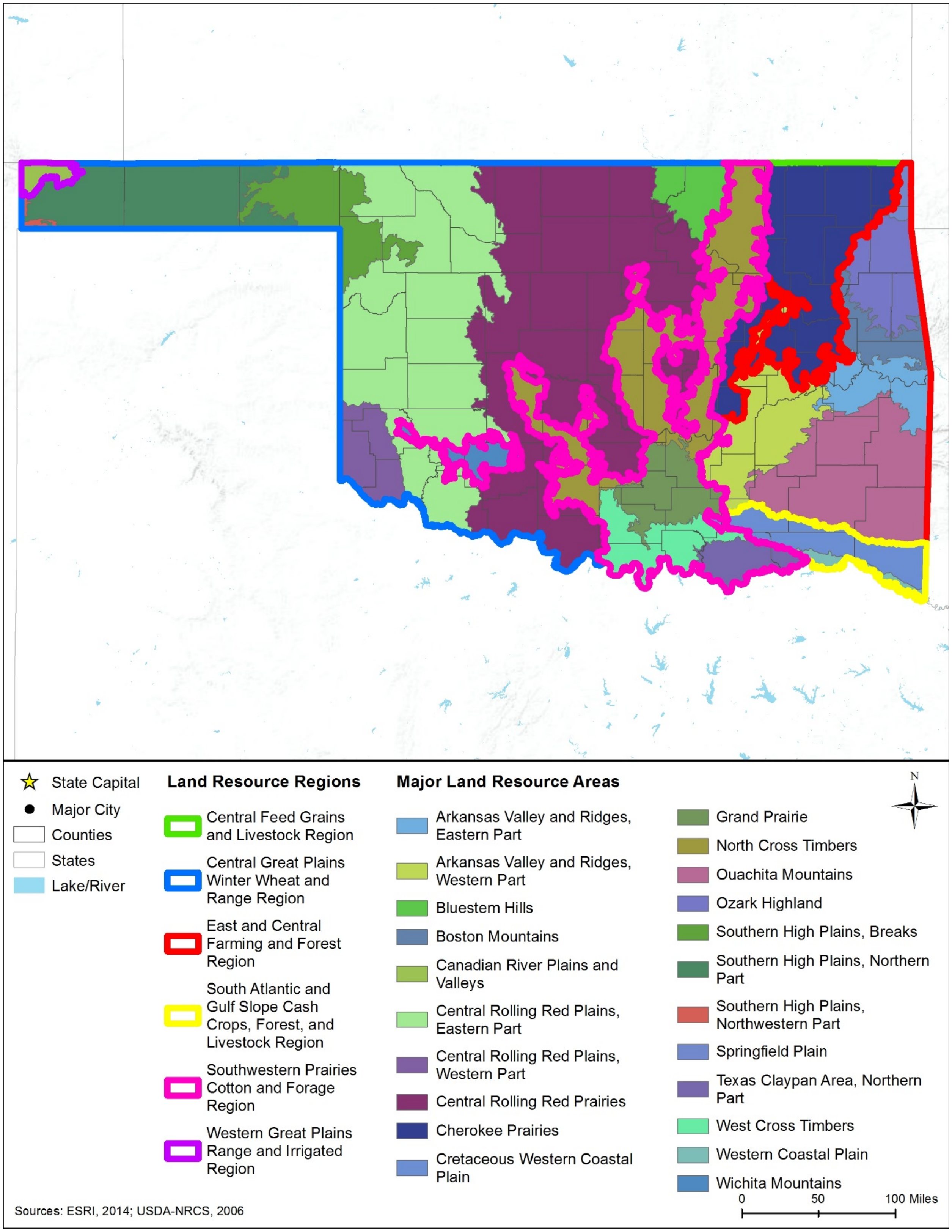

Figure 12.1.2-1: Locations of Major Land Resource Areas in Oklahoma

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

MLRA Name	Region of State	Soil Characteristics
Arkansas Valley and Ridges, Eastern Part	Eastern Oklahoma	Ultisols[a] is the dominant soil order. These soils are well drained and range from shallow to deep.
Arkansas Valley and Ridges, Western Part	Eastern Oklahoma	These soils are primarily Alfisols[b] or Inceptisols,[c] and are deep to very deep.
Bluestem Hills	Northern Oklahoma	Mollisols[d] is the dominant soil order. These loamy or clayey soils range from moderately well drained to somewhat excessively drained, and from very shallow to very deep.
Boston Mountains	Eastern Oklahoma	Inceptisols and Ultisols are the dominant soil orders. These loamy soils[e] are typically well drained. They range from shallow to very deep.
Canadian River Plains and Valleys	Northwestern Oklahoma	Alfisols, Entisols,[f] and Mollisols are the dominant soil orders. These well drained soils are moderately textures or fine textured and range from shallow to deep.
Central Rolling Red Plains, Eastern Part	Central Oklahoma	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These moderately deep to very deep soils are clayey or loamy, and are moderately well drained to well drained.
Central Rolling Red Plains, Western Part	Southwestern Oklahoma	Alfisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These well drained soils are loamy, clayey, or sandy, and range from very shallow to very deep.
Central Rolling Red Prairies	Central Oklahoma	Mollisols is the dominant soil order. These well drained soils are clayey or loamy, and range from shallow to very deep.
Cherokee Prairies	Northeastern Oklahoma	Alfisols and Mollisols are the dominant soil orders, with Vertisols[g] less so. Moderately deep to very deep soils are clayey or loamy; range from poorly drained to well drained.
Cretaceous Western Coastal Plain	Southeastern Oklahoma	Alfisols, Entisols, Inceptisols, and Vertisols are the dominant soil orders. These soils range from shallow to very deep, and range from poorly drained to well drained.
Grand Prairie	South-central Oklahoma	Mollisols and Vertisols are the dominant soil orders. These well drained soils range from very shallow to very deep.
North Cross Timbers	Central Oklahoma	Alfisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These clayey or loamy soils range from somewhat poorly drained to somewhat excessively drained, and from shallow to very deep.
Ouachita Mountains	Southeastern Oklahoma	Inceptisols and Ultisols are the dominant soil orders. These loamy soils range from shallow to very deep. They typically range from somewhat poorly drained to somewhat excessively drained.
Ozark Highland	Northeastern Oklahoma	Alfisols and Ultisols are the dominant soil orders. These soils are moderately well drained to excessively drained and range from shallow to very deep.
Southern High Plains, Breaks	Northwestern Oklahoma	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These well drained soils range from shallow to very deep, and are sandy or loamy.
Southern High Plains, Northern Part	Northwestern Oklahoma	Alfisols and Mollisols are the dominant soil orders. These loamy soils are typically well drained and very deep.
Southern High Plains, Northwestern Part	Northwestern Oklahoma	Alfisols are the dominant soil orders. These well drained soils are typically very deep, and are sandy or loamy.
Springfield Plain	Northeasterm Oklahoma	Alfisols, Mollisols, and Ultisols are the dominant soil orders. Soils are moderately to well drained, and are moderately deep to very deep. They are medium to fine textured.

MLRA Name	Region of State	Soil Characteristics
Texas Claypan Area, Northern Part	Southeastern Oklahoma	Alfisols, Ultisols, and Vertisols are the dominant soil orders. Deep clayey or loamy soils; range from poorly drained to well drained.
West Cross Timbers	Southern Oklahoma	Alfisols and Entisols are the dominant soil orders. These loamy or clayey soils are typically moderately well drained to well drained, and are deep or very deep.
Western Coastal Plain	Southeastern Oklahoma	Alfisols and Ultisols are the dominant soil orders. Clayey or loamy soils typically range from poorly drained to well drained, and are very deep.
Wichita Mountains	Southwestern Oklahoma	Mollisols and Ultisols are the dominant soil orders. These soils range from shallow to deep.

[a] Ultisols: "Soils found in humid environments that are formed from fairly intense weathering and leaching processes. This results in a clay-enriched subsoil dominated by minerals. They have nutrients concentrated in the upper few inches and make up 8% of the world's ice-free land surface." (NRCS, 2015d)
[b] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10% of the world's ice-free land surface." (NRCS, 2015d)
[c] Inceptisols: "Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17% of the world's ice-free land surface." (NRCS, 2015d)
[d] Mollisols: "Soils that have a dark colored surface horizon relatively high in content of organic matter. They are base rich throughout and quite fertile. Mollisols form under grass in climates that have a moderate to pronounced seasonal moisture deficit." (NRCS, 2015d)
[e] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts." (Purdue University Consumer Horticulture, 2006)
[f] Entisols: "Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world's ice-free land surface." (NRCS, 2015d)
[g] Vertisols: "Vertisols have a high content of expanding clay minerals. They undergo pronounced changes in volume with changes in moisture, and have cracks that open and close periodically, and that show evidence of soil movement. Vertisols transmit water very slowly, have undergone little leaching, and tend to be high in natural fertility. They make up about 2% of the world's ice-free land surface." (NRCS, 2015d)

Source: (NRCS, 2006)

12.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy[15]; there are 12 soil orders in the world and they are characterized by both observed and inferred[16] properties, such as texture, color, temperature, and moisture regime. Soil suborders are the next level down, and are differentiated within an order by soil moisture and temperature regimes, as well as dominant physical and chemical properties (NRCS, 2015e). The STATSGO2[17] soil database identifies 13 different soil suborders in Oklahoma (NRCS, 2015a). Figure 12.1.2-2 depicts the distribution of the soil suborders, and Table 12.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[15] Science of naming and classifying organisms or specimens.
[16] "Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)." (NRCS, 2015e)
[17] STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset.

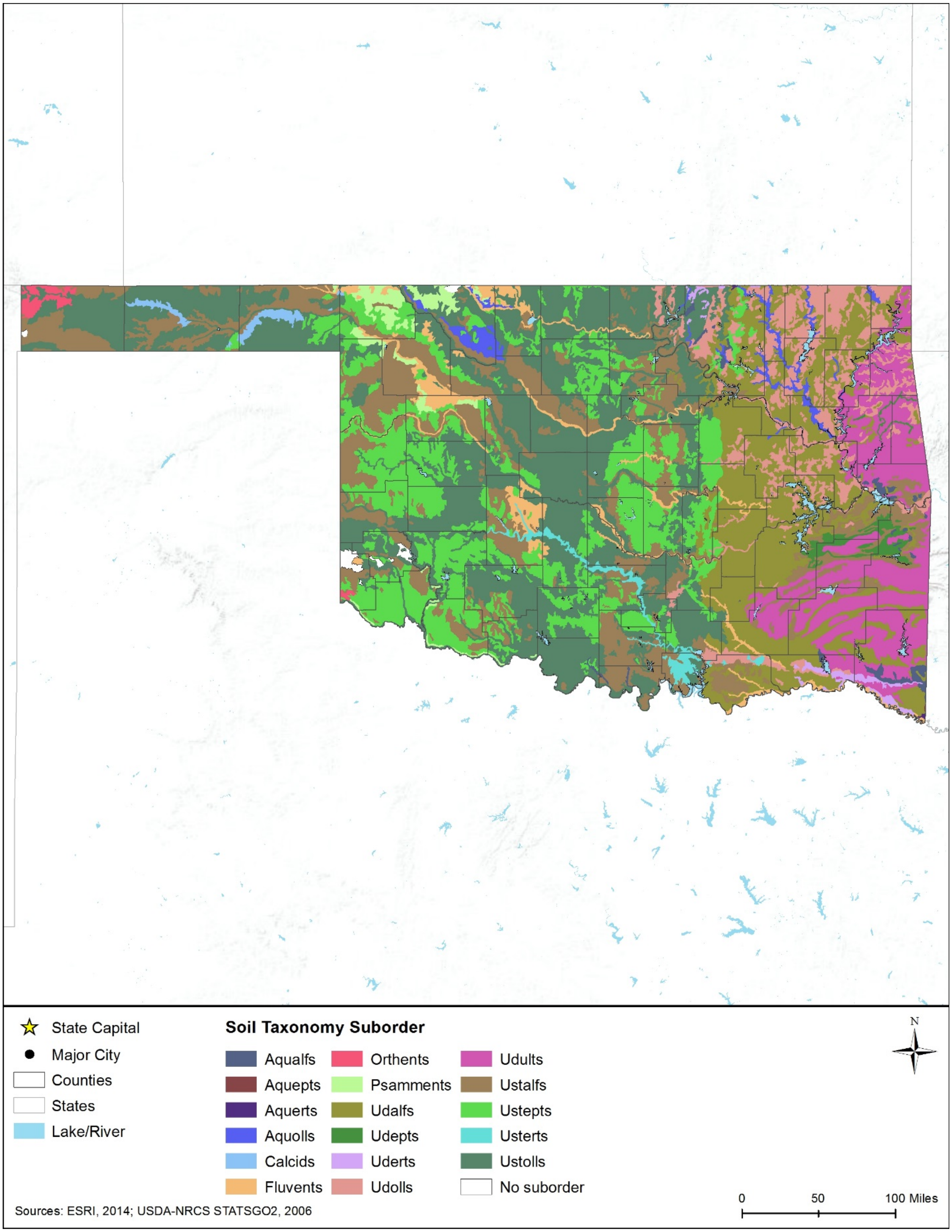

Figure 12.1.2-2: Oklahoma Soil Taxonomy Suborders

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Table 12.1.2-3: Major Characteristics of Soil Suborders[a] Found in Oklahoma, as depicted in Figure 12.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Alfisols	Aqualfs	Generally have warm and aquic (saturated with water long enough to cause oxygen depletion) conditions. Aqualfs are used as cropland for growing corn, soybeans, and rice, and most have some artificial drainage or other water control. Nearly all Aqualfs have likely supported forest vegetation in the past.	Sandy clay loam, Silt loam, Silty clay, Silty clay loam	0-3	Poorly drained to moderately well 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
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.	Silty clay	0-1	Somewhat poorly drained	No	D	High	Very Low	High	Low
Vertisols	Aquerts	Aquerts are wet soils, with prolonged moisture at or near the soil surface. Their natural vegetation includes savanna, grass, and forest. They are used as forest, rangeland, and cropland, although drainage for cropland can be difficult due to poor drainage.	Clay, Silty clay	0-1	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Mollisols	Aquolls	Aquolls support grass, sedge, and forb vegetation, as well as some forest vegetation. However, most have been artificially drained and utilized as cropland.	Clay, Silty clay loam	0-1	Somewhat poorly drained	Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Aridisols	Calcids	Calcids are found in the western U.S., and used primarily as wildlife habitat or rangeland, although some have been utilized as irrigated cropland. They have high levels calcium carbonates that persist due to insufficient precipitation.	Indurated, Very cobbly loam	5-20	Well drained	No	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	Low
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.	Clay loam, Fine sand, Fine sandy loam, Loamy fine sand, Silt loam, Silty clay loam, Stratified fine sand to clay loam, Stratified fine sand to loam, Very fine sandy loam	0-2	Somewhat poorly drained to somewhat excessively drained	No	A, B, C	Low, Medium	High, Moderate, Low	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.	Loam	0-20	Well drained	No	B, C	Medium	Moderate, Low	Medium	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.	Loamy fine sand	1-20	Excessively drained	No	A	Low	High	Low	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Clay, Clay loam, Fine sandy loam, Gravelly clay loam, Loam, Loamy fine sand, Sandy clay loam, Silt loam, Very gravelly clay, Very gravelly clay loam	0-25	Somewhat poorly drained to well drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the Northwest and mixed or hardwood forest in the East. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Fine sandy loam, Gravelly loam	4-30	Well drained	No	D	High	Very Low	High	Low
Vertisols	Uderts	Uderts are found in humid areas, and primarily used as cropland, forest, or pasture. They have low permeability, and water usually must be drained from the surface of cropland.	Clay, Silty clay, Silty clay loam, Unweathered bedrock	0-3	Moderately well drained	No	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	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, Clay loam, Gravelly loam, Loam, Loamy fine sand, Silt loam, Silty clay, Silty clay loam, Unweathered bedrock, Very flaggy silty clay loam	0-30	Moderately well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Ultisols	Udults	Udults are more or less freely drained, relatively humus poor, and have an udic moisture regime. Most of these soils currently support or formerly supported mixed forest vegetation, and many have been cleared and used as cropland (mostly with the use of soil amendments).	Clay, Clay loam, Extremely gravelly silt loam, Gravelly fine sandy loam, Silty clay, Stony clay loam, Very flaggy fine sandy loam	0-45	Moderately well drained to well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Alfisols	Ustalfs	Ustalfs are primarily used for grazing or cropland, and they also support savanna and grassland vegetation. They are found in areas with a marked dry season.	Clay, Clay loam, Fine sand, Fine sandy loam, Gravelly clay, Loam, Loamy fine sand, Loamy sand, Sandy clay loam, Sandy loam, Silt loam, Silty clay, Variable	0-20	Somewhat poorly drained to somewhat excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low
Inceptisols	Ustepts	Ustepts are freely drained soils, typically used as pasture or cropland, although some support forest, rangeland, and wildlife habitat.	Clay, Clay loam, Fine sandy loam, Gravelly loam, Loam, Silt loam, Silty clay, Very fine sandy loam, Very gravelly silt loam, Very gravelly silty clay loam, Weathered bedrock	0-50	Well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
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.	Clay	0-20	Somewhat poorly drained to 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, Clay loam, Cobbly loam, Fine sand, Fine sandy loam, Gravelly clay loam, Loam, Sandy clay loam, Silt loam, Silty clay, Silty clay loam, Stratified loam to clay, Unweathered bedrock, Very cobbly clay loam, Very fine sandy loam, Weathered bedrock	0-20	Somewhat poorly drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low

[a] Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.
[b] Hydric Soil: "A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS, 2015c). Soil suborders constitute a broad range of soil types. Within each suborder, some specific soil types are hydric while others are not.
[c] Based on Runoff Potential, described in Section 12.1.2.5.
Sources: (NRCS, 2015a) (NRCS, 1999)

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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.[18] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 12.1.2-3 provides a summary of the runoff potential for each soil suborder in Oklahoma.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[19] 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). Fluvents, Psamments, Udalfs, and Ustalfs fall into this category in Oklahoma.

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. Fluvents, Orthents, Udalfs, Udolls, Udults, Ustalfs, Ustepts, and Ustolls fall into this category in Oklahoma.

Group C. **Sandy clay loam soils.** This group of soils has "low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure" (Purdue University, 2015). This group has medium runoff potential. Aqualfs, Aquolls, Calcids, Fluvents, Orthents, Udalfs, Uderts, Udolls, Udults, Ustalfs, Ustepts, and Ustolls fall into this category in Oklahoma.

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

12.1.2.6. Soil Erosion

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

[18] 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.

[19] 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)

public safety hazard (NRCS, 1996a). Table 12.1.2-3 provides a summary of the erosion potential for each soil suborder in Oklahoma. Soils with medium to high erosion potential in Oklahoma include those in the Aqualfs, Aquepts, Aquerts, Aquolls, Calcids, Fluvents, Orthents, Udalfs, Udepts, Uderts, Udolls, Udults, Ustalfs, Ustepts, Usterts, and Ustolls suborders, which are found throughout most of the state (Figure 12.1.2-2).

12.1.2.7. Soil Compaction and Rutting

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

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 12.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Oklahoma. Soils with the highest potential for compaction and rutting in Oklahoma include those in the Aqualfs, Aquerts, and Aquolls suborders, which are found primarily in eastern areas of the state (Figure 12.1.2-2).

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 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, Physiographic Regions and Provinces;[20,21]
- Section 12.1.3.4, Surface Geology;

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

- Section 12.1.3.5, Bedrock Geology;[22]
- Section 12.1.3.6, Paleontological Resources;[23]
- Section 12.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 12.1.3.8, Geologic Hazards.[24]

12.1.3.2. Specific Regulatory Considerations

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

Table 12.1.3-1: Relevant Oklahoma Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Oklahoma Adopted Building Codes[a]	Oklahoma Uniform Building Code Commission	Seismic guidelines for building construction.

[a] (Oklahoma Uniform Building Code Commission, 2015)

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

Oklahoma has three major physiographic regions: Atlantic Plain (Coastal Plain Province), Interior Highlands (Ouachita and Ozark Plateaus Provinces), and Interior Plains (Central Lowland and Great Plains Provinces) (USGS, 2003b) (Figure 12.1.3-1). The locations of these regions are shown in Figure 12.1.3-1 and their general characteristics summarized in the following subsections.

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

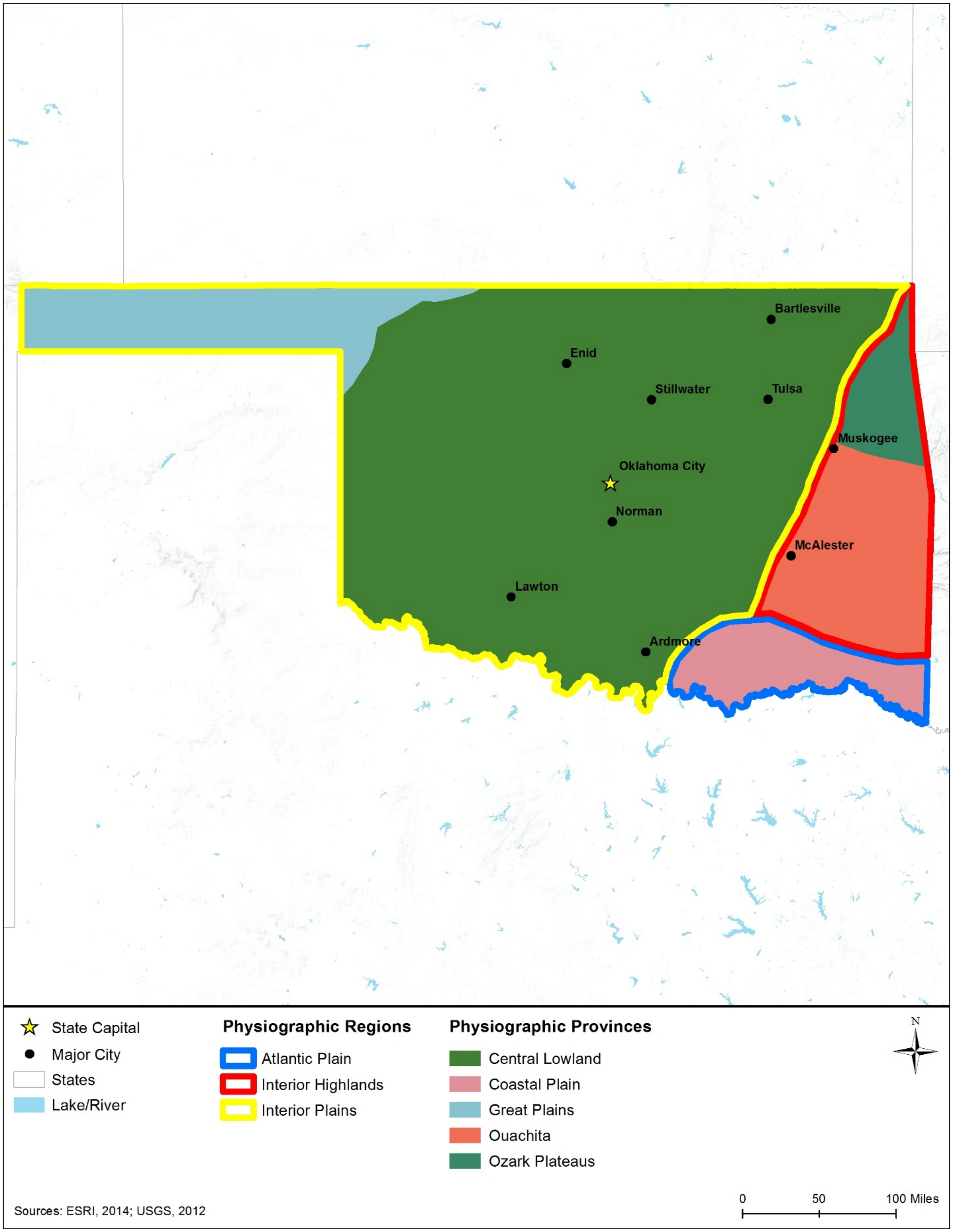

Figure 12.1.3-1: Physiographic Regions and Provinces of Oklahoma

Atlantic Plain Region

The Atlantic Plain Region includes the Continental Shelf and the Gulf and Atlantic Coast plains stretching from New York south to Florida and west to Texas. The Atlantic Plain Region formed through the repetitive rise and fall of the oceans over the last 150 million years. Sedimentary strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the Appalachian Mountains, which began to form 480 to 440 million years ago (MYA), dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain.[25] The area is characterized by gentle topography and a transition zone between the land and sea often having marshes, lagoons, swamps, sand bars, and reefs. Deposits of coastal marine life over millions of years form the basis for rich fossil fuel reserves in the region. (NPS, 2015a)

<u>Coastal Plain Province</u> – As reported above, the Atlantic Plain Region within Oklahoma is composed of one physiographic province the Coastal Plain Province (USGS, 2003b). The Coastal Plain Province is limited to the southeastern portion of the state and is characterized by flat, low-lying topography (USGS, 1996). Within Oklahoma, the Coastal Plain represents the "former extent of a 'paleo' Gulf of Mexico and forms a rim around what is known as the Gulf of Mexico basin" (Oklahoma Geological Survey, 1997). The terrain includes "shallow valleys and [is] underlain by poorly consolidated deposits" (Oklahoma Forestry Services, 2010). Geologic formations become progressively younger moving toward the southeast in Oklahoma and throughout the province (Oklahoma Geological Survey, 1997).

Interior Highlands Region

The Interior Highlands Region includes the elevated portions of Illinois, Missouri, Arkansas and Oklahoma, and stands in contrast to the flat-lying surrounding areas of the Interior Plains and Atlantic Plains Regions. The Interior Highlands are composed of Paleozoic (542 to 241 MYA) sedimentary rocks. Beginning about 340 MYA, these rocks were uplifted and deformed to form a large mountain range, much of which has subsequently eroded. The remnants of this mountain range are seen today in the Ouachita-Ozark Highlands. (USGS, 2014a)

<u>Ouachita Province</u> –The Ouachita Province includes portions of east-central Oklahoma; this province is separated from the Coastal Plain to the south and east by the Fall Line. The Ouachita Province is noted for having parallel ridges and valleys (NPS, 2014a) that increase in height to the west. Ridge elevations are generally between 1,000 and 2,000 feet ASL, though some peaks surpass 2,000 feet ASL (USGS, 2015b). "The highest elevation is 2,666 [feet ASL] on Rich Mountain. Major prominent ridges in the Ouachitas are the Winding Stair, Rich, Kiamichi, Blue, Jackfork, and Blackjack Mountains" (Oklahoma Geological Survey, 2008).

<u>Ozark Plateaus Province</u> – Within the Interior Highlands Region, the Ozark Plateaus Province covers about 40,000 square miles, including northeastern Oklahoma. The Ozark Plateaus Province is a "high, hilly landscape on stratified rocks that is bounded by topographic lowlands"

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

(NPS, 2014a). Within the Ozark Plateaus Province, the highest elevation is Workman Mountain in southeastern Adair County at 1,745 ASL (Oklahoma Geological Survey, 2008). The portion of the Ozark Plateaus within Oklahoma is locally designated as the Springfield Plateau, which is marked by "karst features such as sinkholes and caves" (USGS, 2013a). "The [Springfield] Plateau is underlain by limestones[26] and cherty[27] limestones of Mississippian (359 to 318 MYA) age (USGS, 1995).

Interior Plains Region

The Interior Plains Region extends across much of the interior of the U.S., 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[28] and igneous[29] rocks dating to the Precambrian Era (older than 542 MYA) underlie the entire region. There is minimal topographic relief throughout the region, except for the Black Hills of South Dakota. During the Mesozoic Era, much of the Interior Plains were covered by the oceans, resulting in the formation of sedimentary[30] rocks, which lie on top of the Precambrian basement rocks. Erosion from the Rocky Mountains to the west and the Ozark/Ouachita Mountains to the east, also contributed to the formation of sandstone,[31] mudstone,[32] and clay (USGS, 2014b).

<u>Central Lowland Province</u> – The Central Lowland Province is the largest province in Oklahoma and includes the area west of the Ozark/Ouachita Mountains to near the "Panhandle" in the western portion of the state. Whereas the Great Plains Province is generally at elevations greater than 2,000 feet above sea level (ASL), the Central Lowland Province is entirely below 2,000 feet ASL. The border between the two provinces is an eastward facing escarpment.[33] Within Oklahoma, the Osage section of the Central Lowland Province these topographic features are generally 50 to 200 feet high. "Several of the escarpments are exceptionally high and rugged. One, between Cimarron and Canadian rivers, in western Oklahoma, which marks the outcrop belt of the Blaine formation, extends from the Kansas boundary southeastward halfway across the state and is the most prominent of the several hilly tracts bearing the name Gypsum Hills. (Fenneman, 1922)

<u>Great Plains Province</u> – The Great Plains Province is the westernmost province in Oklahoma and includes all of the Oklahoma Panhandle. "The Great Plains Physiographic Province is an east-tilted surface formed by deposition of sediment eroded from the ancestral Rocky Mountains,

[26] 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, 2015j)
[27] Chert: "A very fine-grained sedimentary rock made of quartz. Usually made of millions of globular siliceous skeletons of tiny marine plankton called radiolarians. Black chert is called flint." (USGS, 2015j)
[28] Metamorphic Rocks: "A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids." (USGS, 2015j)
[29] Igneous Rocks: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)." (USGS, 2015j)
[30] Sedimentary Rock: "Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding." (USGS, 2014d)
[31] Sandstone: "Sedimentary rock made mostly of sand-sized grains." (USGS, 2015j)
[32] Mudstone: "A very fine-grained sedimentary rock formed from mud." (USGS, 2015j)
[33] Escarpment: "A cliff formed by faulting, erosion, or landslides." (USGS, 2015j)

beginning about 65 [MYA]" (USGS, 2014c). As noted above, the Great Plains are generally above 2,000 feet ASL. "Generally along the eastern edge of the High Plains section there is a steep slope down to the Central Lowland. Throughout much of its extent this steep slope is an actual escarpment – the 'break of the plains' – 300 to 600 feet high, at some places straight, at others made irregular by the erosion of streams that head in the plateau and flow eastward." (Fenneman, 1922)

12.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[34] 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).

The Pleistocene Glaciation events of the most recent Ice Age did not directly impact Oklahoma, as glaciers only reached as far south as northeastern Kansas. Meltwater from the Rocky Mountains, however, helped to shape the geomorphology of Oklahoma's modern-day drainage systems. "The rivers' shifting positions are marked by alluvial deposits left as terraces, now tens to hundreds of feet above present-day floodplains… Clay, silt, sand, and gravel from Pleistocene [(2.6 MYA to 11,700 years ago)] and Holocene [(11,700 years ago to present)] rivers and lakes are typically unconsolidated and 25 [to] 100 feet thick. Finding Pleistocene terraces more than 100 [to] 300 feet above modern floodplains attests to the great amount of erosion and down cutting performed by major rivers in the last 1.6 million years. Modern floodplains consist mainly of alluvium[37] deposited during the Holocene." River deposits decrease in grain size moving from west to east across the state. (Johnson, 2008)

Figure 12.1.3-2 depicts a generalized illustration of the surface geology for Oklahoma.

[34] 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).
[35] "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] Alluvium: "Sand, gravel, and silt deposited by rivers and streams in a valley bottom." (USGS, 2015j)

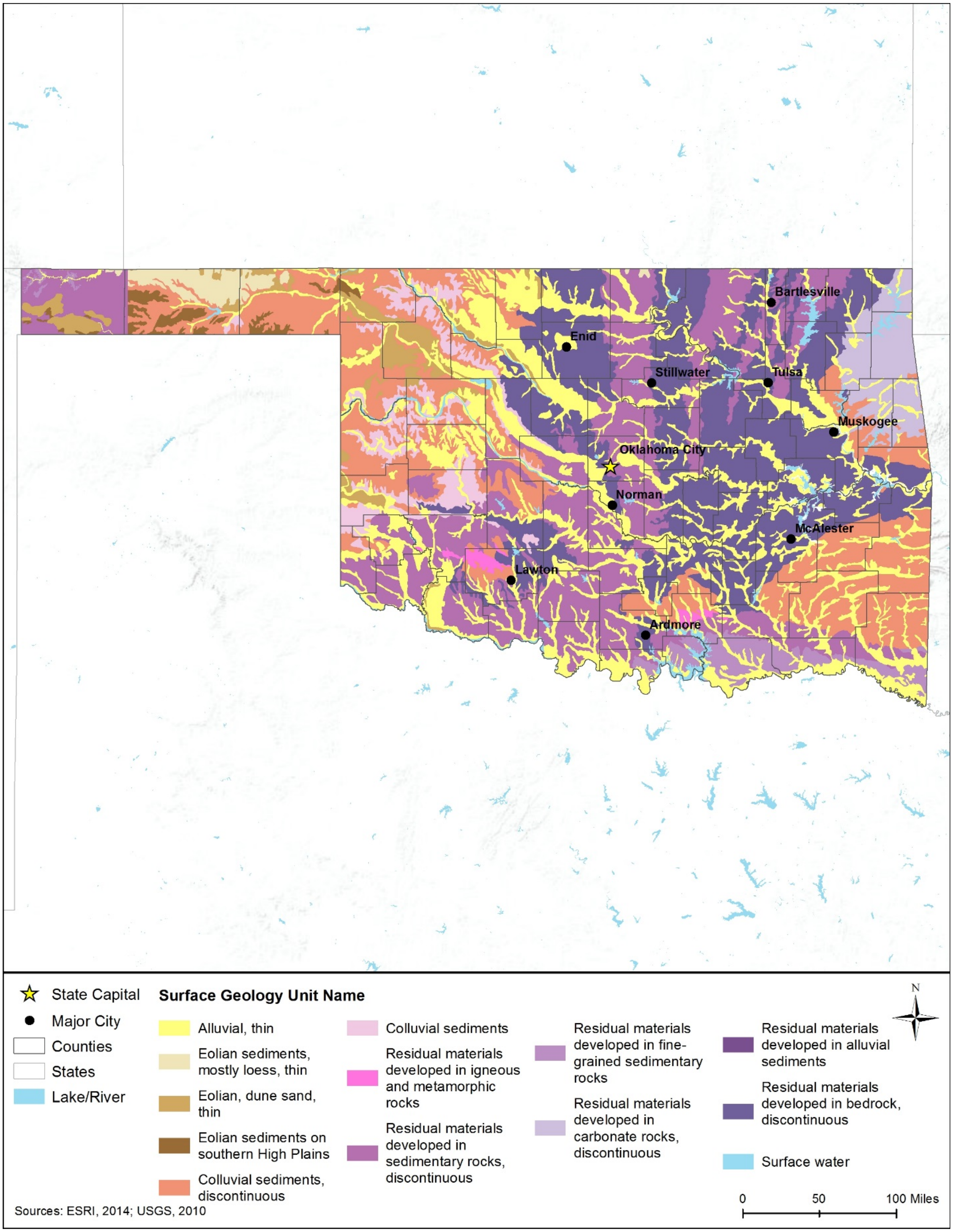

Figure 12.1.3-2: Generalized Surface Geology for Oklahoma

12.1.3.5. Bedrock Geology

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

Oklahoma is underlain by Precambrian (older than 542 MYA) igneous and metamorphic rocks that generally lie at least 1,000 feet beneath the ground surface. In some cases, these basement rocks are more than 30,000 feet beneath the ground surface. At ground level, much of Oklahoma (99 percent) is currently underlain by sedimentary rocks. Igneous rocks appear in the Wichita and Arbuckle Mountains, which are in southwestern and south-central Oklahoma, respectively. Metamorphic outcrops also occur within the eastern Arbuckle Mountains, while eastern Oklahoma's Ouachita Mountains contain metamorphic rocks. "About 46 [percent] of Oklahoma has Permian [(299 to 251 MYA)] rocks exposed at the surface." These are largely within the Central Lowland Province and include red sandstone,[40] shale,[41] and gypsum.[42] About 25 percent of Oklahoma, mostly in the eastern third of the state, is underlain by Pennsylvanian (318 to 299 MYA) marine shale, with interbedded sandstone, limestone, and coal. Tertiary (66 to 2.6 MYA) river and windblown deposits dominate the Oklahoma panhandle, and are generally between 200 and 600 feet in thickness. (Johnson, 2008)

Figure 12.1.3-3 displays the generalized bedrock geology for Oklahoma.

[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, 2015m)
[40] Sandstone: "Sedimentary rock made mostly of sand-sized grains." (USGS, 2015j)
[41] 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, 2015j)
[42] Gypsum: "The mineral form of hydrated calcium sulfate, $CaSO_4$ • 2H2O. (USGS, 2005)

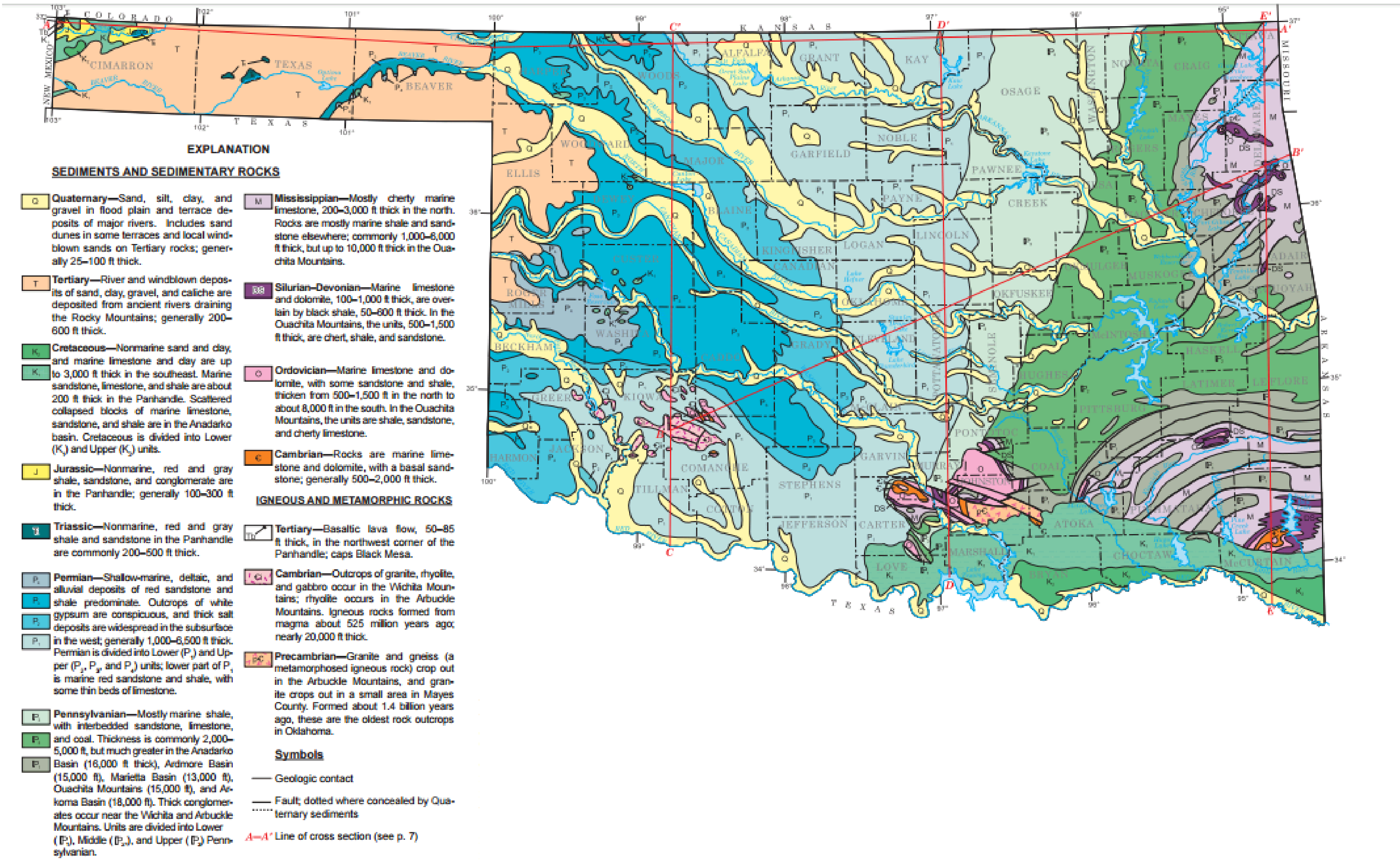

Figure 12.1.3-3: Generalized Bedrock Geology for Oklahoma

Source: (Johnson, 2008)

12.1.3.6. Paleontological Resources

During the Cambrian (542 to 488 MYA) and Ordovician (488 to 444 MYA) Periods, Oklahoma was covered by a shallow sea, resulting in the preservation of brachiopods,[43] trilobites,[44] and bryozoans.[45] Coral, snail, and clam fossils are recorded in Ordovician rocks as well. The shallow sea covered Oklahoma through the Silurian (444 to 416 MYA) and Devonian (416 to 359 MYA) Periods. Brachiopods, trilobites, bryozoans, and crinoids[46] and preserved from these Periods. The early Carboniferous (359 to 299 MYA) was characterized by mountain-building events that also produced deep basins, which contain blastoids, brachiopods, echinoids, corals, trilobites, and other invertebrates. The Ouachita, Arbuckle, and Wichita Mountains all formed during the late Carboniferous Period. Erosion of these mountains caused the formation of deltas and swamps, and preservation of plant fossils. Permian (259 to 251 MYA) fossils include insects in lake deposits of north-central Oklahoma. In the western Oklahoma, Jurassic (200 to 146 MYA) fossils include dinosaur footprints, crocodiles, turtles, and fish. Additionally, *Saurophaganax Maximus*, the Oklahoma state fossil, is recorded in Western Oklahoma (The Paleontology Portal, 2015). During the Cretaceous (146 to 66 MYA) Period, western and southwestern Oklahoma were covered by shallow seas, resulting in the preservation of oysters, giant ammonites, sand dollars, and shark teeth. Additionally, small mammal fossils and the *Sauroposeidon*, a giant sauropod, are recorded from the late Cretaceous. Tertiary (approximately 66 to 2.6 MYA) fossils include horses, camels, mastodons, and rhinoceroses, as well as petrified wood. Snail, clam, and algae fossils are recorded in lake sediments. Quaternary (2.6 MYA to present) fossils include wood, clams, snails, horses, camels, bison, and mammoths (The Paleontology Portal, 2015).

12.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2013, Oklahoma produced 114,486,000 barrels of oil, accounting for over 3.0 percent of total nationwide production. Oklahoma typically ranks among the top five oil-producing states, though its level of production ranked seventh nationwide for August 2015 (EIA, 2014a). Oklahoma's rich oil basins include the Anadarko, Arkoma, and Ardmore basins, which are mostly from the Pennsylvanian (299 to 251 MYA) Period (Oklahoma Geological Survey, 2015).

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

[44] 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)

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

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

In 2014, Oklahoma produced 2,310,114 million cubic feet of natural gas, which accounted for 8.5 percent of total nationwide production. This level of production ranked third nationwide for 2014. Oklahoma's natural gas is mostly produced from the Hugoton Field in the Panhandle portion of the state. Coalbed methane production is prevalent in eastern Oklahoma's Arkoma Basin. (EIA, 2014a)

Minerals

As of 2015, Oklahoma's total nonfuel mineral production was valued at $744M. This level of production ranked 32nd (in terms of dollar value) for non-fuel minerals (primarily crushed stone, Portland cement, and helium) (USGS, 2016a). As of 2011, Oklahoma was the only producer of iodine in the country, and the leading producer of crude gypsum. Other minerals produced in the state include common clay and shale, dimension stone,[47] feldspar, perlite, silica, helium, lime, salt, and Tripoli (USGS, 2015d).

In 2013, Oklahoma produced 1,136,000 short tons of coal. This level of production accounted for 0.1 percent total nationwide coal production, and ranked 21st among coal producing states. Much of Oklahoma's coal production occurs in the northeastern portion of the state along the Cherokee Platform. Presently, there are six underground coalmines and one surface coalmine (EIA, 2014a).

12.1.3.8. Geologic Hazards

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

Earthquakes

Areas of greatest seismicity in Oklahoma are concentrated in the central and southwestern portions of the state. Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface. Earthquakes can produce secondary flooding impacts resulting from dam failure (USGS, 2012a).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale.[48] Subduction zone

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

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

earthquakes occur where Earth's tectonic plates collide. "When tectonic plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth" (Oregon Department of Geology, 2015). Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014i). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale (Oregon Department of Geology, 2015).

Figure 12.1.3-4 depicts the seismic risk throughout Oklahoma; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10% g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g (USGS, 2010).

"Oklahoma is at moderate risk for an earthquake as a result of the state's proximity to the New Madrid Seismic Zone. Seven regions of earthquake activity exist in Oklahoma: the El Reno-Mustang area in central Oklahoma; Love and Carter Counties; an area in southeastern Oklahoma north of the Ouachita Mountains in the Arkoma Basin; the Meers Fault, located near Meers on the eastern edge of the Anadarko Basin; the area around Lindsay in Garvin County; the area near Ada in Pontotoc County; [and] the area in eastern Oklahoma County near Jones." Studies suggest that the Meers Fault could produce an earthquake in excess of magnitude 7.0 (ODEM, 2014). The largest earthquake ever recorded in Oklahoma was magnitude 5.6[49] event that occurred in November 2011 about 44 miles east-northeast of Oklahoma City (USGS, 2015f).

"On average, there are about 50 measurable earthquakes each year in Oklahoma with only a few of these having shaking strong enough to be felt" (ODEM, 2014). In 2014, there were 585 earthquakes of a magnitude 3.0 (on the Richter scale) or greater in Oklahoma (Oklahoma Office of the Secretary of Energy & Environment, 2015a). "The current average rate of earthquakes is approximately 600 times historical averages," which has led seismologists to speculate that the rise in the number of earthquakes could be attributable to human-induced causes such as injection of water into wells (Oklahoma Office of the Secretary of Energy & Environment, 2015b).

Landslides

Landslide hazards in Oklahoma are generally greatest in the eastern third of the state (ODEM, 2014). "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).

[49] The 2014 Oklahoma State Hazard Mitigation Plan estimates this earthquake to be a magnitude 5.7 event, which is slightly different from the USGS source cited in the text. (ODEM, 2014)

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).

Landslide risk is moderate to high in parts of eastern Oklahoma, largely due to increased topographic relief and a wet climate. In Oklahoma, "the threat of landslides is high where natural slopes exceed a gradient of 2:1. 'Rotational slump' is the most common type of landslide that occurs in Oklahoma. Rotational slumps[50] can occur on either excavated slopes or embankments." Most landslides in Oklahoma are limited to rural areas along highways and railways, particularly in Le Flore, Haskell, Latimer, Pittsburg, Coal, Atoka, McIntosh, and Muskogee Counties (ODEM, 2014). Oklahoma's most landslide-prone areas are typically underlain by Pennsylvanian shales (Radbruch-Hall, et al., 1982).

Figure 12.1.3-5 shows landslide incidence and susceptibility throughout Oklahoma.

Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000). In Oklahoma, land subsidence is generally attributable to the presence of karst[51] topography (Figure 12.1.3-6) or mine collapse (ODEM, 2014). Nationwide, the primary causes of land subsidence are attributed to aquifer system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost. More than 80 percent of subsidence in the U.S. is a consequence of over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains. If an aquifer is confined by layers of silt or clay, which do not transport groundwater, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000).

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

[50] Slump: "A type of landslide in which a mass of rock breaks away along a curved surface and rotates more or less intact downslope. The sliding mass of rock is called a slump block." (USGS, 2015j)
[51] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater." (USGS, 2015j)

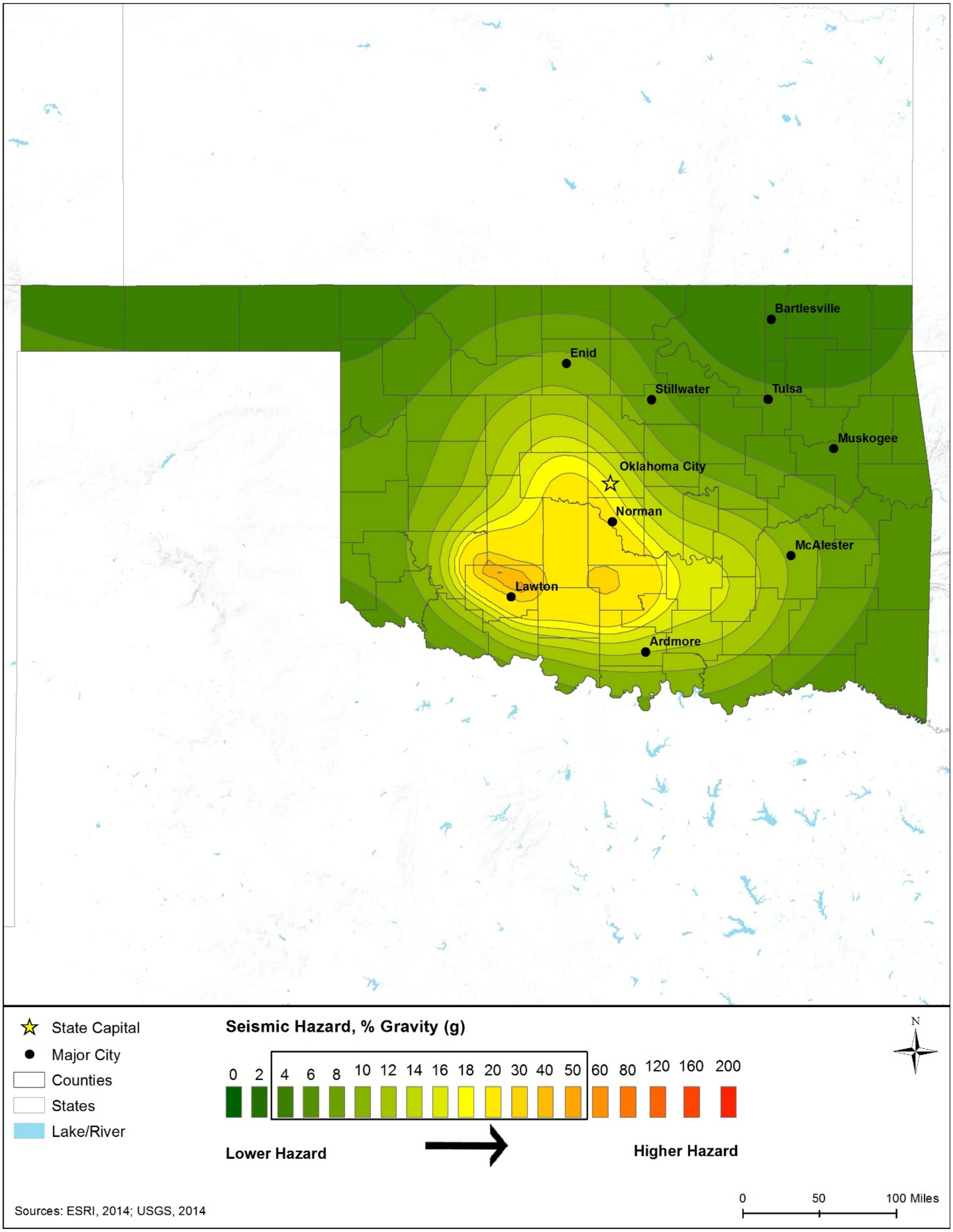

Figure 12.1.3-4: Oklahoma 2014 Seismic Hazard Map

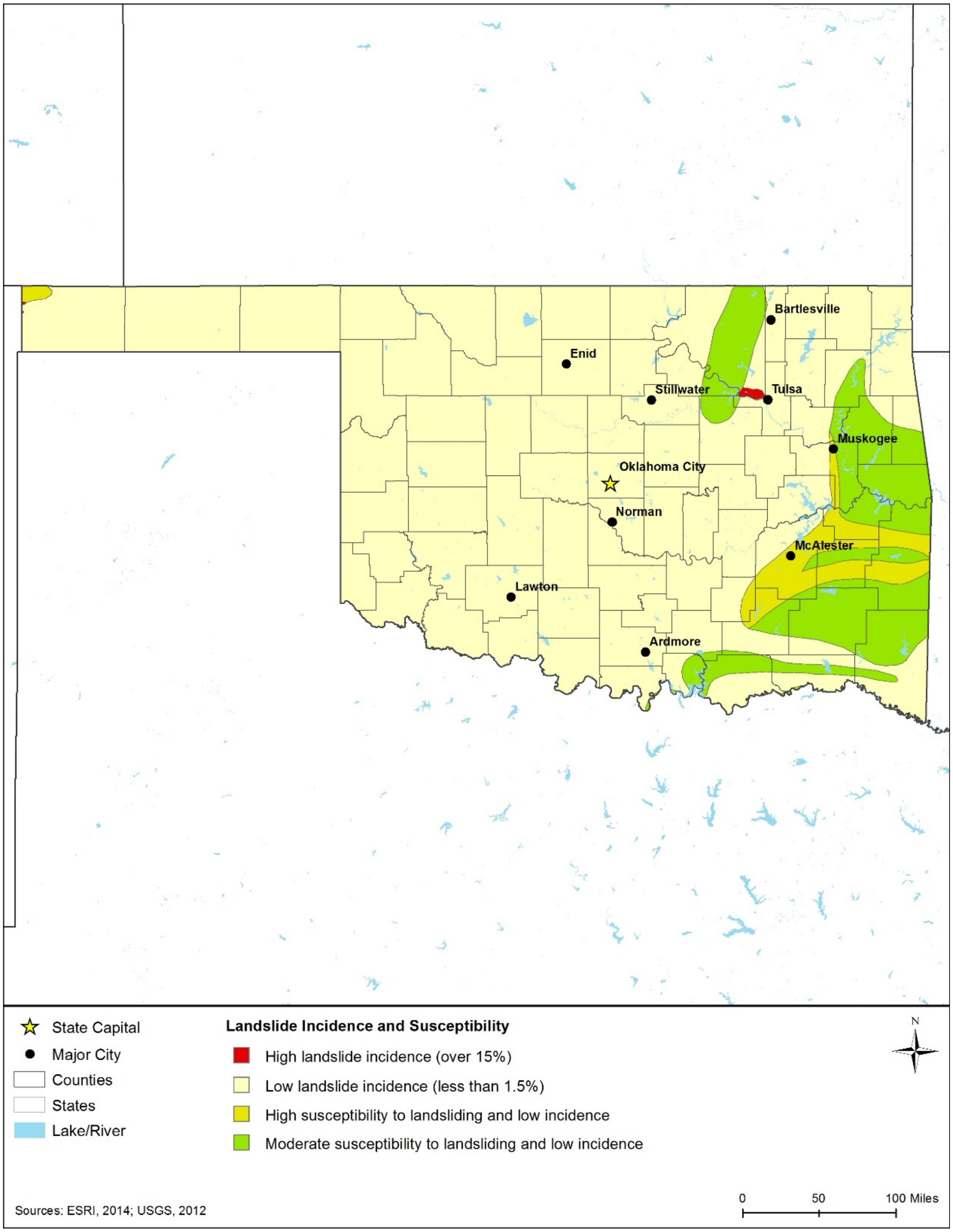

Figure 12.1.3-5: Oklahoma Landslide Incidence and Susceptibility Hazard Map[52]

[52] Susceptibility hazards not indicated in Figure 12.1.3-5 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014k)

In Oklahoma, one potential cause of land subsidence is the collapse of karst. “Karst sinkholes are located primarily within three geographic regions [of Oklahoma]: the Gypsum Hills of western Oklahoma, the Ozark Mountains in northeast Oklahoma, and the Arbuckle Mountains in southcentral Oklahoma” (NRCS, 2012). Karst topography is most prevalent within the eastern half of the state, particularly in Mississippian limestone units in the northeastern corner of the state (Johnson, 2008). Southwestern Oklahoma contains the largest gypsum cave nationwide (Waylen, 2015). Figure 12.1.3-6 shows the location of areas in Oklahoma that are susceptible to land subsidence due to karst topography.

A second cause of land subsidence in Oklahoma is mine collapse. “Subsidence is recognized to occur in the Picher area, as well as in portions of eastern Oklahoma which were active coal mining areas from the late 1800s until the mid-1900s.” Picher is in extreme northeastern Oklahoma. Coal mining also took place in Latimer County (in southeastern Oklahoma) during the early part of the 20th century. “The Oklahoma Conservation Commission recognizes 16 counties at risk for subsidence from abandoned coal mining operations. They are the Atoka, Coal, Craig, Haskell, Latimer, LeFlore, Mayes, McIntosh, Muskogee, Nowata, Okmulgee, Pittsburg, Rogers, Sequoyah, Tulsa, and Wagoner Counties. According to the Oklahoma Geological Survey, 481 mine shafts in Oklahoma are at risk of collapse. (ODEM, 2014)

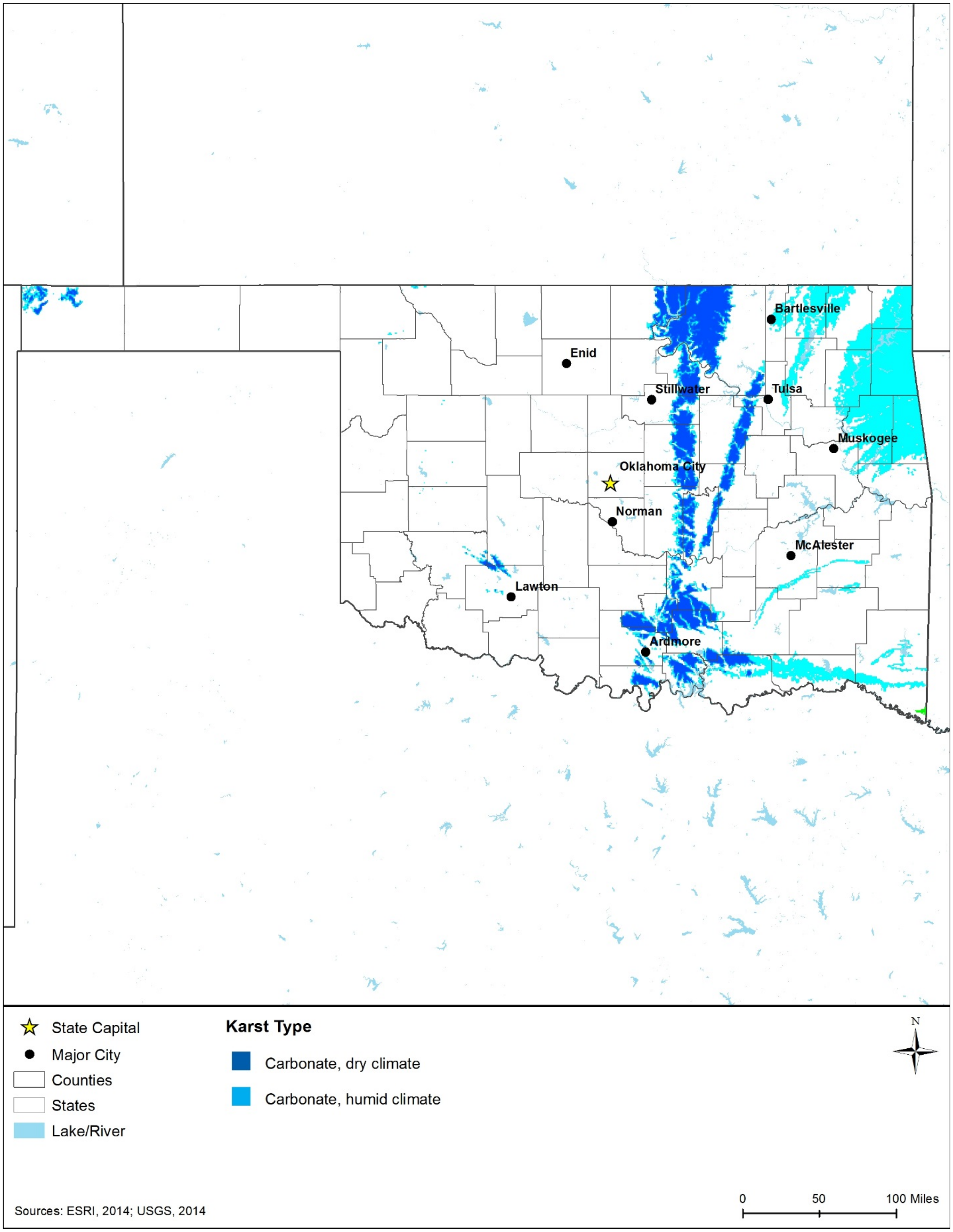

Figure 12.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Oklahoma

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, canals, ditches, estuarine waters, 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, 2014j)

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, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 12.1.4-1 identifies the relevant laws and regulations for water resources in Oklahoma.

Table 12.1.4-1: Relevant Oklahoma Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Title 785, Chapter 45-1 General Provisions	Oklahoma Water Resource Board (OWRB)	Defines Oklahoma water permit requirements.
The Oklahoma Comprehensive Water Plan	OWRB	"The Oklahoma Comprehensive Water Plan (OCWP) contains a wealth of technical data, information, and policy recommendations manifested in an Executive Report, 13 Watershed Planning Region reports, and many additional technical study findings and reports. The OCWP serves as an indispensable resource for making informed decisions impacting water use and management through 2060 and beyond" (OWRB, 2016).
Ownership of Water	OWRB	Landowners retain ownership of all surface and groundwater on their property as long as they are not definite streams.[a] They are also responsible for maintaining water quality of the water that passes through their property. However, owners may not interrupt the flow of a definite stream, as these are considered public waters.
Riparian Rights	OWRB	Owners of property adjacent to surface water streams (public ownership) have the right to use the water, even if they do not have ownership of it.

State Law/Regulation	Regulatory Agency	Applicability
American Rule of Reasonable Use	OWRB	Oklahoma follows the American rule for groundwater use, which allows for only "reasonable" use of groundwater belonging to the property owner.
Stream Water Law	OWRB	Permit and application required to acquire water rights. The permits require information about the proposed use of the water. The applicant must show there is unappropriated water available for use, that there is a present or future need for the water, that the water will be for a beneficial use, and that the proposed use does not interfere with any other existing use of the water source.
Groundwater Law	OWRB	Requires applicant to prove ownership, well locations, type of use, and place of use.
Clean Water Act (CWA) Section 404 permit, Regional Conditions, Oklahoma	USACE – Tulsa District	Designated Critical Resource Waters are Outstanding Resource Waters (ORWs) and their watersheds, and High Quality Waters (HQWs) designated by Oklahoma in Appendix C of the Water Quality Standards (Oklahoma Administrative Code [OAC] 785, Chapter 45). The ORWs include those waters in the supporting watersheds, HQWs do not. Both ORWs and HQWs include adjacent wetlands.
CWA Section 401 certification	ODEQ	Activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from indicating that the proposed activity will not violate state water quality standards.

[a] Oklahoma defines "definite stream" as "a watercourse in a definite, natural channel, with defined beds and banks, originating from a definite source or sources of supply" (Oklahoma State University, 2015).

12.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams. According to the OWRB, "Oklahoma has more than 167,600 miles of rivers and streams, and over 1,400 square miles of lakes, ponds, and reservoirs" (OWRB, 2015). These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, tourism, agriculture, fishing, power generation, and manufacturing across the state (Oklahoma State University, 2015).

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). Oklahoma's waters (lakes, rivers, and streams) are divided into 13 major watersheds, or drainage basins (Figure 12.1.4-1), Beaver-Cache, Blue-Boggy, Central, Eufala, Grand, Lower Arkansas, Lower Washita, Middle Arkansas, Panhandle, Southeast, Southwest, Upper Arkansas, and West Central. Visit https://www.owrb.ok.gov/supply/ocwp/ocwp.php for more information and additional maps about Oklahoma's watersheds, locations, sizes, and water quality (OWRB, 2013).

The Lower Washita Watershed encompasses 6,192 square miles in southern Oklahoma. The Upper Arkansas Watershed encompasses 7,452 square miles in northern Oklahoma. The region is supplied by three major rivers: the Arkansas, Cimarron, and Salt Fork of the Arkansas. Historically, the region's rivers and creeks have periods of low to no flow in any month of the year due to seasonal and long-term trends in precipitation. Large reservoirs have been built on several rivers and their tributaries to provide public water supply, flood control, power generation, and recreation. The West Central Watershed encompasses 5,262 square miles in western Oklahoma and supplied by two major rivers: the Washita River and the Canadian River. The Southwest Watershed encompasses 4,045 square miles in the southwest corner of Oklahoma, supplied by three rivers, the North Fork of the Red River, the Elm Fork of the Red River, and the Salt Fork of the Red River.

The Eufaula Watershed Planning encompasses 3,223 square miles in east-central Oklahoma, supplied by two major streams: the Canadian River and North Canadian River. In the Panhandle Watershed in the northeastern corner of the state, the Arkansas River Watershed extends from the Cimarron River in the panhandle area to the eastern border between Oklahoma and Arkansas. Within Oklahoma, this watershed drains the northern and eastern areas of the state. (OWRB, 2013)

Freshwater

As shown in Figure 12.1.4-1, there are 11 major rivers in Oklahoma: Red River, North Fork of the Red River, Cache Creek, Washita River, North Canadian, Canadian River, Cimarron River, Arkansas River, Illinois River, Verdigris River, and the Grand (Neosho) River. The Beaver/North Canadian River is the longest in Oklahoma at 751 miles in length. The Red River forms the southern border between Oklahoma and Texas, flowing more than 500 miles, and is the second longest river in the state. It is not considered as a water supply source due to water quality constraints (OWRB, 2015). The Cimarron River enters the state twice: once from New Mexico into the panhandle, and once from Kansas in the north central area of the state (OWRB, 2013).

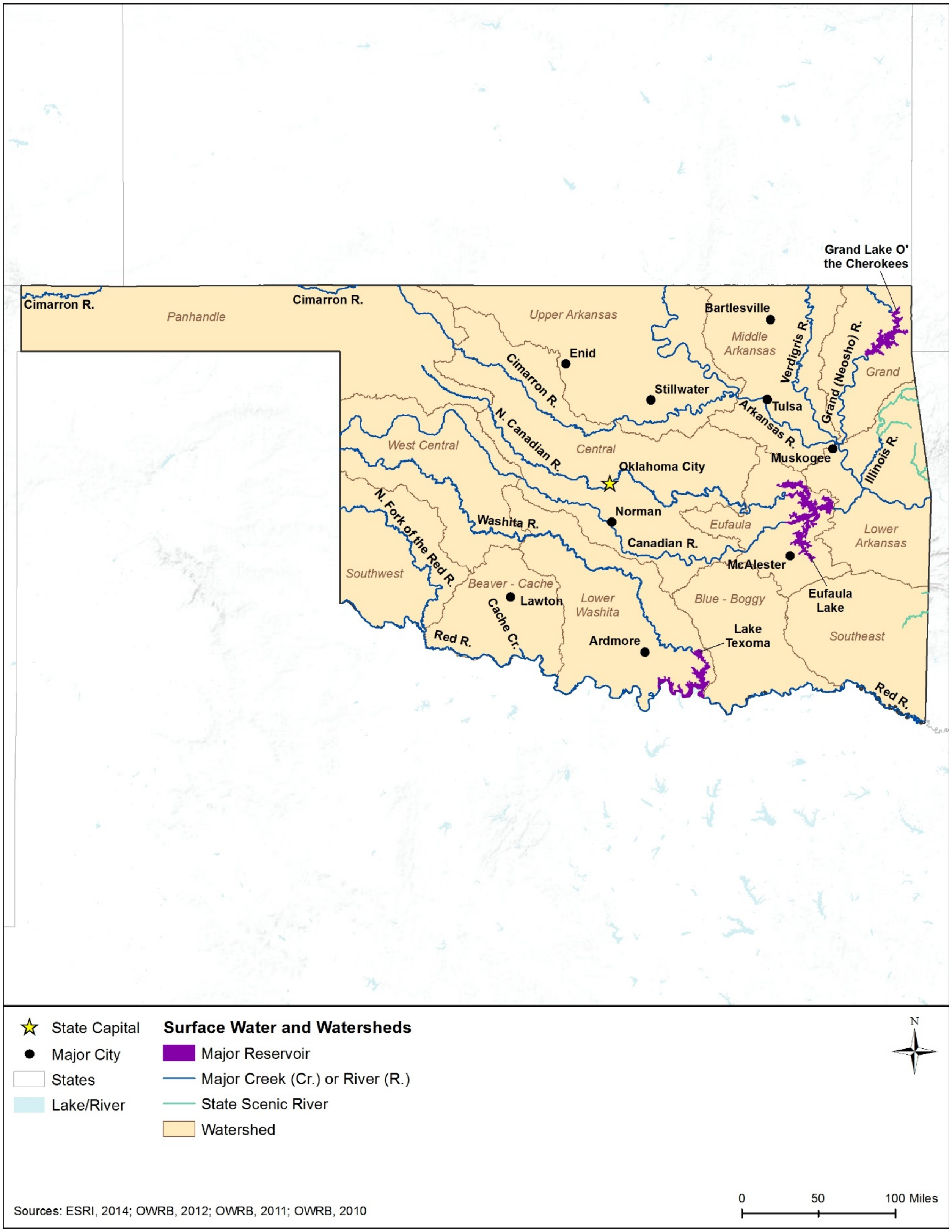

Figure 12.1.4-1: Major Oklahoma Watersheds and Surface Waterbodies

Oklahoma has 34 large lakes, totaling 555,450 acres, and more than 2,300 public and private lakes in the state (DEQ, 2014). Some of the state's large lakes and dammed reservoirs provide flood control, hydropower[53] generation, and drinking water sources (USEPA, 2009).

- The Eufaula Reservoir is located along the Canadian River, and is approximately 159 square miles in size. The dam that creates the reservoir was completed in 1964 to provide a water supply, flood control, and hydroelectric power. The Eufaula Reservoir is the largest lake located entirely in Oklahoma. The lake has an average depth of 23 feet, a maximum depth of approximately 87 feet, and contains over two million acre-feet[54] of water. (USACE, 2015a)
- Lake Texoma is one of the largest reservoirs in the U.S., and is the twelfth largest lake in the U.S. Formed at the meeting of the Red River and the Washita River by the Denison Dam, it covers an area of roughly 139 square miles. Lake Texoma straddles the Oklahoma and Texas border. The lake provides hydroelectric power for several communities near the fabricated lake. The lake drains out to the Red River. (Lake Texoma, 2015)
- Grand Lake o' the Cherokees, also known as Grand Lake, is a fabricated lake in northeastern Oklahoma, which provides hydroelectric power for the Cherokee Nation and other local communities. Grand Lake is fed and drains into the Grand River. The lake covers 72 square miles and has an average depth of 36 feet. (Grand Lake Online, 2015)

12.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Oklahoma does not contain any rivers in the National Wild and Scenic Rivers system (National Wild and Scenic Rivers System, 2015a). The Illinois River, Barren Fork River, Flint Creek, Lee Creek, Little Lee Creek, and Upper Mountain Fork (as shown in Figure 12.1.4-1) are designated as state scenic rivers, covered under the Oklahoma Scenic Rivers Act. This Act designates these rivers and creeks "be preserved as a part of Oklahoma's diminishing resource of free-flowing rivers and streams" (Oklahoma, 1970).

State Designated Critical Resource Waters[55]

Oklahoma has designated several rivers and streams on the eastern side of the state, which they deemed to possess "high aquatic resource quality and value" as Critical Resource Waters. Overall, 30 rivers and streams have been deemed "Outstanding Resource Waters," and 34 rivers and streams have been deemed "High Quality Waters." For more information on critical

[53] Hydropower: "electrical energy produced by falling or flowing water" (USEPA, 2004).

[54] An acre-foot is a volume of water that would cover one acre of land to a depth of one foot; equivalent to 325,851 gallons (OWRB, 2013).

[55] Critical Resource Waters include NOAA-designated marine sanctuaries, National Estuarine Research Reserves, National Wild and Scenic Rivers, critical habitat for Federally listed threatened and endangered species, coral reefs, State natural heritage sites, and outstanding national resource waters or other waters officially designated by a State as having particular environmental or ecological significance and identified by the District Engineer after notice and opportunity for public comment. (ILDNR, 2015).

resource waters, including a map, visit www.swt.usace.army.mil/portals/41/docs/missions/regulatory/wqc/crw.pdf. (USACE, 2012a)

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 Section 303(d) of the Clean Water Act, states are required to assess water quality and report a listing of impaired waters,[56] the causes of impairment, and probable sources. Main sources for these pollutants include agriculture, livestock/animal grazing, mine runoff, and septic systems. For more information on Oklahoma's water quality, visit http://ofmpub.epa.gov/waters10/attains_state.control?p_state=OK&p_cycle=2014. (USEPA, 2015j)

Table 12.1.4-2 summarizes the water quality of Oklahoma's assessed major waterbodies by category, percent impaired, designated use,[57] cause, and probable sources. Figure shows the Section 303(d) waters in Oklahoma as of 2014.

As shown in Main sources for these pollutants include agriculture, livestock/animal grazing, mine runoff, and septic systems. For more information on Oklahoma's water quality, visit http://ofmpub.epa.gov/waters10/attains_state.control?p_state=OK&p_cycle=2014. (USEPA, 2015j)

Table 12.1.4-2, various sources affect Oklahoma's waterbodies, causing impairments. In Oklahoma, almost all of the state's surface waterbodies are impaired. Designated uses of the impaired rivers, streams, and lakes include agriculture, fish and wildlife propagation, and primary contact recreation. Major pollutants affecting these impaired waters include pathogens,[58] turbidity,[59] dissolved oxygen, and mercury.

[56] 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, 2015n).

[57] 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, 2015n).

[58] Pathogens are bacterium, virus, or other microorganism that can cause disease (USEPA, 2015n).

[59] Turbidity is a measure of water clarity; the more particles (soils, organic matter), the cloudier, or higher turbidity (USGS, 2015l).

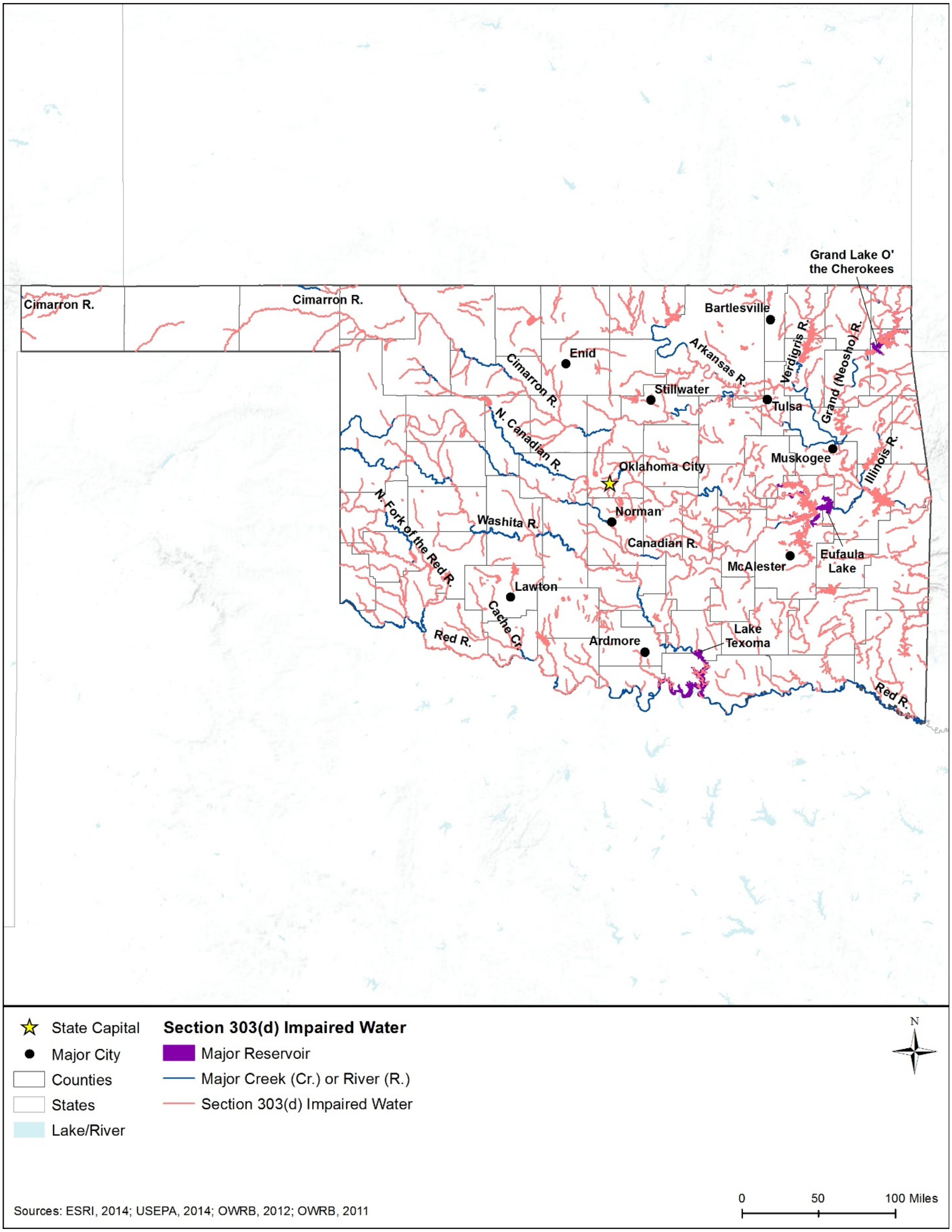

Figure 12.1.4-2: Section 303(d) Impaired Waters of Oklahoma, 2014

Main sources for these pollutants include agriculture, livestock/animal grazing, mine runoff, and septic systems. For more information on Oklahoma's water quality, visit http://ofmpub.epa.gov/waters10/attains_state.control?p_state=OK&p_cycle=2014. (USEPA, 2015j)

Table 12.1.4-2: Section 303(d) Impaired Waters of Oklahoma, 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	17%	77%	agriculture, fish and wildlife propagation, and primary contact recreation	pathogens, turbidity, dissolved oxygen, sulfates, and chloride	agriculture, grazing (livestock), wildlife, and onsite treatment systems (septic systems)
Lakes, Reservoirs, and Ponds	58%	83%	agriculture, fish and wildlife propagation, and primary contact recreation	turbidity, dissolved oxygen/organic enrichment, mercury, and algal growth	mainly unknown sources, mine runoff (resource extraction), wildlife, and agriculture

[a] Some waters may be considered for more than one water type.
[b] Oklahoma has not assessed all waterbodies within the state.
Source: (USEPA, 2015j)

Oklahoma environmental agencies have put out warnings for all Oklahoma lakes regarding blue-green algae. While not usually a health concern, during times of blooms it can pollute the water with toxins. Since the lakes are drinking water sources, these blooms can be a threat to local human health. Activities that promote algae blooms are discouraged in the areas around lakes. (Oklahoma Department of Health, 2015)

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).[60] 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

[60] To search for and locate CFR records, see the Electronic Code of Federal Regulations (e-CFR): www.ecfr.gov.

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).

The only type of floodplain in Oklahoma is riverine and lake floodplains. Riverine and lake floodplains occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In mountainous areas, floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water (FEMA, 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 Oklahoma, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include river flooding and flash flooding from snowmelt from upstream and heavy precipitation events, including remnant moisture from hurricanes and tropical storms (Oklahoma, 2014).

From 1955 through 2008, there have been 41 Federal Disaster Declarations due to flooding in the state. Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. Based on historical flooding and flood disaster declarations, flood problems are most severe in the Red River and Arkansas River watersheds. Major flooding usually occurs during severe storm events and hurricanes that reach into the state (NOAA, 2015b).

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 360 communities in Oklahoma through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Oklahoma had 17 communities participating in the CRS (FEMA, 2014d).[61]

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

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.

Oklahoma's principal aquifers consist of carbonate-rock,[62] and sand and gravel aquifers of alluvial and glacial origin.[63] Approximately 300 towns and cities draw drinking water from Oklahoma's groundwater resources, and it accounts for 43 percent of the total water usage of the state (OWRB, 2014). In general, Oklahoma's groundwater is acceptable for crop irrigation, and for drinking water. However, some aquifers do not produce water that is acceptable for drinking due to high levels of dissolved solids, high salinity or naturally occurring contaminants. Statewide, nitrate contamination from human activities (e.g., animal wastes, sewage, and fertilizers) has impaired groundwater uses (OWRB, 2013). Table 12.1.4-3 provides details on aquifer characteristics in the state. Figure 12.1.4-3 shows Oklahoma's principal and sole source aquifers.

Table 12.1.4-3: Description of Oklahoma's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Ada-Vamoosa aquifer Composed of sandstone	North central part of the state, stretching from the Kansas border west of Norman	Water is suitable for public supply including drinking. Water type ranges from soft to very hard with a median dissolved-solids concentration. Chloride and sulfate concentrations are low.
Central Oklahoma aquifer Composed of fine-grained sandstone, shale, and siltstone	Central Oklahoma, east of Oklahoma City	The water is hard to very hard with high levels of dissolved-solids concentrations. Chloride and sulfate levels are generally small, though fluoride levels make it unsafe for drinking. Used for public supply and domestic purposes.
Rush Springs aquifer Consists of fine grained sandstone	Western central part of the state	Generally, water is suitable for most purposes. Water is very hard with median dissolved-solids concentration. Primary use for water is irrigation. Low levels of chloride and sulfate are present and the water is suitable for public supply though not for drinking water.
Edwards-Trinity aquifer system Generally limestone in the upper part and sand and sandstone in the lower part	Southeastern corner of the state	Water is hard with medium levels of dissolved-solids. Primary water use is for agricultural purposes with some for public supply, industrial, mining, and thermoelectric-power use.

[62] Carbonate-rock aquifers typically consist of limestone with highly variable water-yielding properties (some yield almost no water and others are highly productive aquifers) (Ryder, 1996).

[63] Sand and gravel aquifers of alluvial (sand, silt, or gravel materials left by river waters) and glacial origin are highly productive aquifers in the northern part of the country, consisting of mostly sand and gravel deposits formed by melting glaciers (USGS, 2015k).

Aquifer Type and Name	Location in State	Groundwater Quality
High Plains aquifer Composed of mixture of gravel, sand, silt and clay	Northwest corner on the panhandle	Water is suitable for most purposes though high levels of chloride, sulfate, and fluoride, make in unsuitable in some areas. Water is very hard. Public water suppliers rely on water from this aquifer for drinking water, but major use is for irrigation. Land use over this aquifer is most developed than anywhere in the state.
Arbuckle-Simpson aquifer Consists of limestone, dolomite, and sandstone	South central part of the state, northeast of Ardmore	Generally, water is suitable for all purposes, including drinking. The water is very hard with median levels of dissolved-solids concentrations. Aquifer is primarily used for drinking though in some areas, high levels of chloride and fluoride make the water unsuitable for public supply.
Blaine aquifer Consists of gypsum and dolomite	South central part of the state, north of Ardmore	The water is not suitable for most uses due to high levels of fluoride. Water is very hard and is slightly to moderately salty. Used almost exclusively for irrigation.
Ozark Plateaus aquifer system Consists of limestone and dolomite	Southwestern and northeastern corners of the state	Water is moderately hard to very hard. Generally suitable for most purposes, primarily used for public supply. Other uses include domestic and commercial purposes with small amounts used for agriculture, mining, industry, and thermoelectric-power.

Sources: (Moody, Carr, Chase, & Paulson, 1986) (Ryder, 1996)

Sole Source Aquifers

The USEPA defines sole source aquifers (SSAs) as “an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer” and are areas with no other drinking water sources (USEPA, 2015c). Oklahoma has one designated SSA within the state, as shown in Figure 12.1.4-3. The approximate 500 square mile aquifer provides water to south-central Oklahoma, and is a “source for a number of important springs and streams in the area” (Puls & Ross, 2009). Designating a groundwater resource as an SSA helps to protect the drinking water supply in that area and requires reviews for all federally funded proposed projects to ensure that the water source is not jeopardized (USEPA, 2015c).

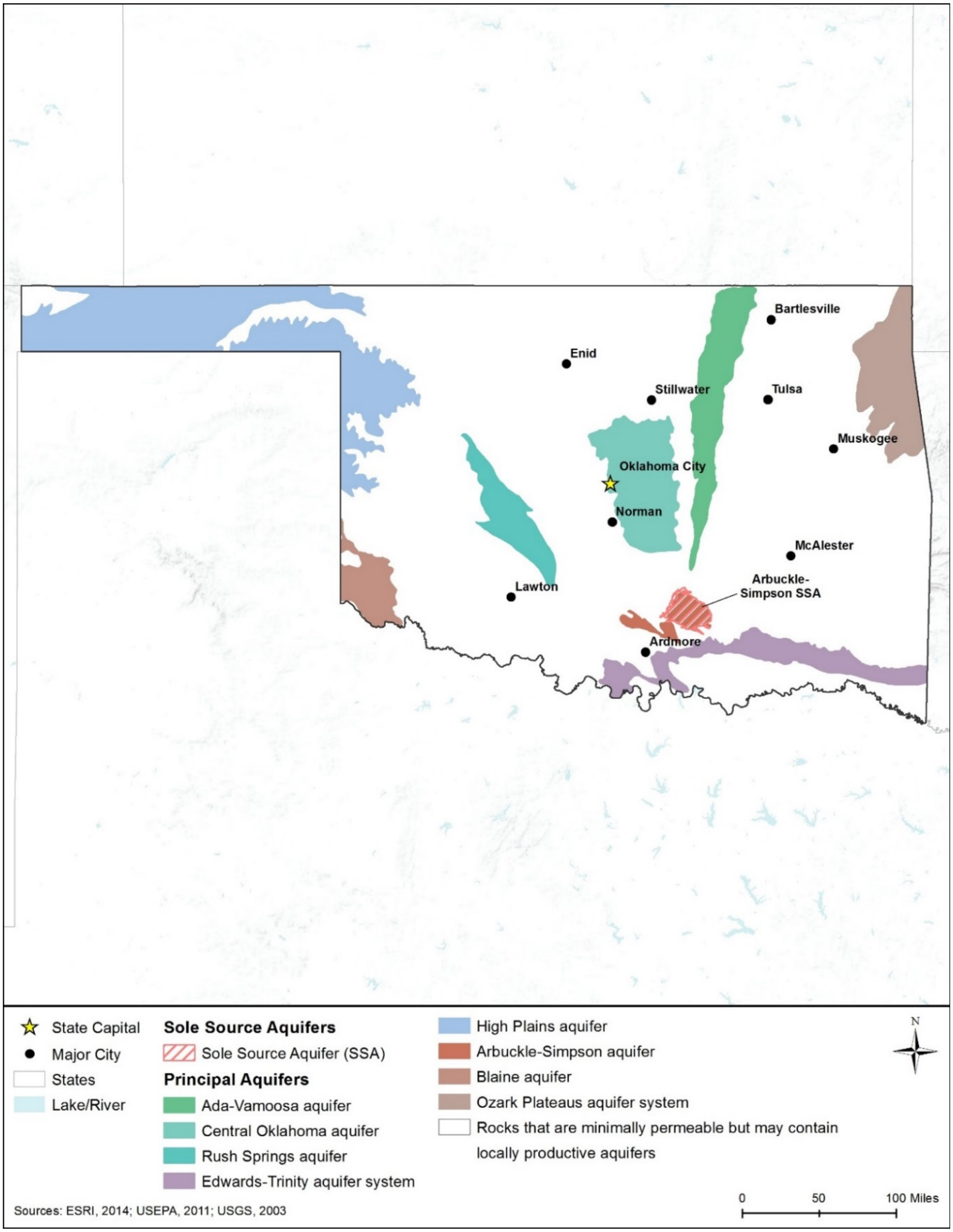

Figure 12.1.4-3: Principal and Sole Source Aquifers of Oklahoma

12.1.5. Wetlands

12.1.5.1. Definition of the Resource

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

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

12.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 12.1.6-1 summarizes major Oklahoma state laws and permitting requirements relevant to the state's wetlands.

Table 12.1.5-1: Relevant Oklahoma Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
Clean Water Act (CWA) Section 404 permit, Regional Conditions, Oklahoma	USACE – Tulsa District	Designated Critical Resource Waters are Outstanding Resource Waters (ORWs) and their watersheds, and High Quality Waters (HQWs) designated by Oklahoma in Appendix C of the Water Quality Standards (OAC 785, Chapter 45). The ORWs include those waters in the supporting watersheds, HQWs do not. Both ORWs and HQWs include adjacent wetlands. Additionally, NWP General Condition (GC) 31 *Pre-Construction Notification* is required for discharge and activities in Pitcher Plant Bogs, and Cypress-Tupelo Swamps.
CWA Section 401 Certification	ODEQ	Activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from indicating that the proposed activity will not violate state water quality standards.

12.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service (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 by (Cowardin, Carter, Golet, & LaRoe, 1979). The Wetlands Classification System includes five major wetland

Systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The District includes three of these Systems, 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 the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the Water Regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except outside the mouths of estuaries." Where wave energy is low, mangroves, or mudflats may be present.
- "The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean and the ocean water is at least occasionally diluted by freshwater runoff from the land."
- "Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt or greater."
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents plants, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent." The system is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types) (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013).

In Oklahoma, the main type of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the state. Riverine and lacustrine wetlands, as defined in Table 12.1.5-2, comprise approximately three percent of the wetlands in the state. Therefore, they are not discussed in this PEIS.

Table 12.1.5-2: uses 2014 NWI data to characterize and map Oklahoma wetlands on a broad-scale.[64] The data is not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be conducted, as appropriate, at the site-specific level once those locations are known. As shown in Figure

[64] 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.

12.1.5-1, palustrine wetlands are found throughout the state. The map codes and colorings in Table 12.1.5-2 correspond to the wetland types in the figures.

Table 12.1.5-2: Oklahoma Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests and hardwood swamps are examples of PFO wetlands.	Throughout the state, more concentrated in the eastern half of the state	661,928
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens,[c] prairie potholes, and sloughs.	Throughout the state	151,381
Palustrine unconsolidated bottom	PUB	PUB and PAB are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Throughout the state	69,898
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,[d] and other miscellaneous wetlands are included in this group.	Throughout the state	35,514
Riverine wetland	R	Riverine systems include rivers, creeks, and streams. They are contained in natural or artificial channels periodically or continuously containing flowing water.	Throughout the state	23,738
Lacustrine wetland	L2	Lacustrine systems are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are generally less than 8.2 feet deep.	Throughout the state	5,587
			TOTAL	**948,046**

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

[b] All acreages are rounded to the nearest whole number. The maps are prepared from the analysis of high altitude imagery. A margin of error is inherent in the use of imagery. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted (USFWS, 2015b).
[c] Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water (Edinger, et al., 2014).
[d] Saline seep is an area where saline groundwater discharges at the soil surface. These wetland types are characterized by saline soils and salt tolerant plants (City of Lincoln, 2015).

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

Palustrine Wetlands

In Oklahoma, palustrine wetlands include the majority of vegetated freshwater wetlands. Moving from northwestern Oklahoma to the southeast, the climate becomes more wet and warm, and as such, the type of freshwater wetlands change. In the northwest, playa wetlands are found in depressions on the high prairie of the Oklahoma panhandle. They typically hold water during growing seasons with high precipitation, and have no outlet for water. Common vegetation in playa wetlands include woollyleaf bursage (*Ambrosia grayi*) and smartweed (*Polygonum sp.)*. Depressional wetlands are found on the prairies throughout the state. Located in areas where drainage patterns have been blocked by wind- or water-deposited soil, they typically hold water throughout the growing season, but may also be dry during drought years. Typical vegetation found in depressional wetlands include cattails (*Typha sp.)* and smartweeds. Forested wetlands are located in the eastern third of Oklahoma, along flood plains that are frequently inundated. Soils are typically permanently saturated, and common vegetation includes rushes (J*uncaceae sp*.) and sedges *(Cyperaceae sp.).* Swamps and bogs, including bald cypress (*Taxodium distichum)* swamps are found in far southeastern Oklahoma. These areas are found on low flood plains, frequently flooded with water. (Oklahoma Conservation Commission, 2000)

Based on the USFWS NWI 2014 analysis, PFO/PSS is the dominant wetland type (70 percent), followed by PEM (16 percent), PUB/PAB (7 percent), and other palustrine wetlands (4 percent) (USFWS, 2014a). There are currently about 948,000 acres of wetlands in the state (USFWS, 2014a). It is estimated approximately 67 percent of Oklahoma’s wetlands have been lost over the past 200 years. In particular, bottomland hardwood forests in Oklahoma have been reduced by nearly 85 percent. (Oklahoma Conservation Commission, 2000)

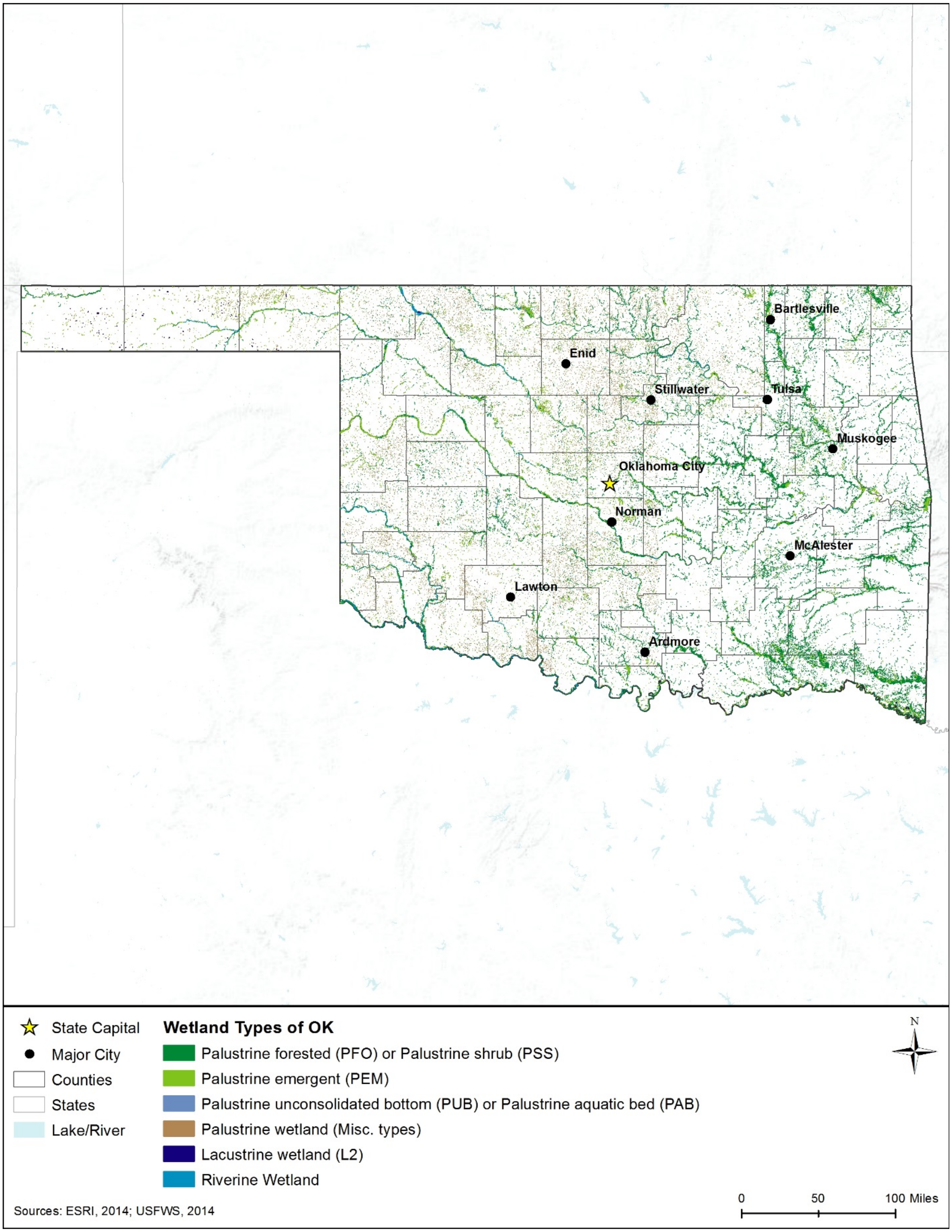

Figure 12.1.5-1: Wetlands by Type in Oklahoma, 2014

12.1.5.4. Environmental Setting: Wetlands of Special Concern or Value

In addition to protections under the national CWA, Oklahoma considers certain wetland communities in Oklahoma are provided additional protection. These include pitcher plant bogs, cypress-tupelo swamps, and wetlands associated with critical resource waters.

Figure 12.1.5-4: Little River National Wildlife Refuge

Source: (Oklahoma Conservation Commission, 2000)

Pitcher Plant Bogs and Cypress-Tupelo Swamps

In Oklahoma, areas classified as Pitcher Plant Bogs or Cypress-Tupelo swamps are protected under the USACE Tulsa District's Nationwide Permit Regional Conditions. Pitcher Plant Bogs are wetlands with an organic surface soil layer, and typically have vegetation including pitcher plants (*Sarracenia sp.*), sphagnum moss (*Sphagnum sp.),* and sundews (*Drosera sp.*). Cypress-Tupelo swamps can be inundated regularly or occasionally by freshwater, and are dominated by bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica)* trees. (USACE, 2012b)

Wetlands Associated with Critical Resource Waters

Under the USACE Tulsa District's Nationwide Permit Regional Conditions, Oklahoma provides additional protection for wetlands associated with Designated Critical Resource Waters (CRWs), which include Outstanding Resource Waters (ORWs) and their watersheds, and High Quality Waters (HQWs) that are designated by the state and listed in Appendix C of the Water Quality Standards (Oklahoma Administrative Code [OAC] 785, Chapter 45). Protections to ORWs and HQWs are extended to their adjacent wetlands. (USACE, 2012b)

Other important wetland sites in Oklahoma include:

- The Oklahoma Department of Wildlife Conservation (ODWC) manages Wildlife Management Areas (WMAs) that include migratory bird refuge areas, Waterfowl Refuge Portions (WRPs), and Wetland Development Units (WDUs). The migratory bird refuges and WRPs are managed as seclusion and rest areas for waterfowl that are free from human disturbance. WDUs are managed as wetlands that are seasonally flooded, many artificially flooded, to maintain and improve wildlife habitat (ODWC, 2015a). To learn more about these areas, visit http://www.wildlifedepartment.com/hunting/wetlands.htm.
- National Wildlife Refuges (NWRs) in Oklahoma include the Little River NWR, in southeastern Oklahoma, which encompasses over 13,500 acres of bottomland hardwood forests. To learn more about NWRs in Oklahoma, visit https://www.fws.gov/refuges/profiles/ByState.cfm?state=OK.
- National Natural Landmarks range in size from 160 acres to close to 32,000 acres, and are owned by U. S. Fish and Wildlife Service, county government, and other private

organizations (NPS, 2015b). Section 12.1.8, Visual Resources, describes Oklahoma's National Natural Landmarks.

- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, and easements managed by natural resource conservation groups such as The Nature Conservancy, Ducks Unlimited, and other unknown holders. 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 72,000 acres in conservation easements in Oklahoma (NCED, 2015).

12.1.6. Biological Resources

12.1.6.1. Definition of the Resource

This section describes the biological resources of Oklahoma. Biological resources include terrestrial[65] vegetation, wildlife, fisheries and aquatic[66] habitats, and threatened[67] and endangered[68] species, as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Due to the topographic variation within the state and its geographic orientation, Oklahoma supports a wide diversity[69] of biological resources ranging from Rocky Mountain foothills in the western Panhandle, tallgrass prairies in central Oklahoma, hardwood forests in the east and south, pine forests and cypress swamps in the southeast, as well as lakes, rivers and streams throughout the state (Woods, 2005). Each of these topics is discussed in more detail below.

12.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Oklahoma are summarized in detail in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 12.1.6-1. Relevant Oklahoma Biological Resources Laws, summarizes major state laws relevant to Oklahoma's biological resources.

Table 12.1.6-1. Relevant Oklahoma Biological Resources Laws and Regulations

Law/Regulation	Regulatory Agency	Summary
Oklahoma Noxious Weed Law (§ 3-220 Oklahoma Statutes)	Oklahoma State Department of Agriculture, Food, and Forestry (ODAFF)	Requires landowners to treat, control, or eradicate all noxious weeds as listed by the state.

65 Terrestrial: "Pertaining to land" (USEPA, 2015d).
66 Aquatic: "Pertaining to water" (USEPA, 2015d).
67 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)).
68 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)).
69 Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015d).

Law/Regulation	Regulatory Agency	Summary
Oklahoma Wildlife Conservation Code (§ 29-1-101 et seq. Oklahoma Statutes)	Oklahoma Department of Wildlife Conservation (ODWC)	Establishes the authority of the ODWC to establish a commission and rules for the protection, restoration, conservation, maintenance, and management of wildlife. Publicizes and encourages the conservation and appreciation of wildlife and other natural resources. Regulates hunting and fishing activities, facilities, and educational outreach.
Oklahoma Wildlife Conservation Code (§ 29-5-412 Oklahoma Statutes)	ODWC	Prohibits possession, transport, capture, wounding, killing, hunting, or attempt to trap any endangered or threatened species, as listed by ODWC.
Feral Swine Control Act (Title 2, Chapter 1, Article 6 of the Oklahoma Statutes)	ODAFF	Allows for a variety of means to reduce the feral swine population in Oklahoma.
Oklahoma Wildlife Conservation Code (§ 29-6-601 Oklahoma Statutes)	ODWC	Deems it unlawful to import, possess, release, cultivate, or transport any noxious aquatic plants as listed.

12.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology[70], soils, climate[71], and water of a given geographic area and correlates with distinct areas identified as ecoregions[72]. 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, but rather depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (World Wildlife Fund, 2015). Ecoregion boundaries often coincide with geographic regions of a state. In Oklahoma, the five main geographic regions include the Panhandle, Western, Central Oklahoma, Northeastern, and Southeastern Oklahoma. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions (USEPA, 2016a). This section provides an overview of the terrestrial vegetation resources for Oklahoma at USEPA Level III (USEPA, 2016a).

As shown in Figure 12.1.6-1, the USEPA divides Oklahoma into twelve Level III ecoregions. The 12 ecoregions support a variety of different plant communities, all predicated on their general location within the state, with several occurring in more than one geographic region.

[70] 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.

[71] 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).

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

Two ecoregions occur in each of the Panhandle, Central, and Western Oklahoma and five occur in both the Northeastern and Southeastern Oklahoma regions. Communities range from hardwood forests in eastern Oklahoma, to prairie communities in central Oklahoma and the Panhandle, Rocky Mountain foothills in the western Panhandle, and pine-covered mountains and cypress swamps in southeastern Oklahoma (Woods, 2005). Table 12.1.6-2 provides a summary of the general abiotic[73] characteristics, vegetative communities, and the typical vegetation found within each of the 12 Oklahoma ecoregions.

Communities of Concern

Oklahoma does not track vegetative communities of concern; however, the Oklahoma Natural Heritage Inventory (ONHI) does track sensitive and at-risk species and threatened ecosystems. The ONHI maintains a statewide inventory and database for site-specific data on Oklahoma's fish, wildlife, and plant diversity. In addition to more common species, the ONHI tracks species that are identified as having special conservation status. The ONHI-ranked species do not have regulatory stature, rather they are used to help determine priorities for future research and conservation actions in the state. Rarity rankings are revised and updated as information and conservation actions evolve. (ONHI, 2015)

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive plants.[74] Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (U.S. Government Publishing Office, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. 7701 *et seq.*). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S. (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2014a), of which three are known to occur in Oklahoma:

- **Terrestrial –** Musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), and Canada thistle (*Cirsium arvense*)

Noxious weeds and other invasive plants pose a large threat to Oklahoma's agricultural, range, and natural resources. Noxious weeds can have adverse ecological and economic impacts to these resources by displacing native species, degrading wildlife habitat, and increasing soil erosion.[75]

[73] Abiotic: "Characterized by absence of life; abiotic materials include non-living environmental media (e.g., water, soils, sediments); abiotic characteristics include such factors as light, temperature, pH, humidity, and other physical and chemical influences." (USEPA, 2016b)

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

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

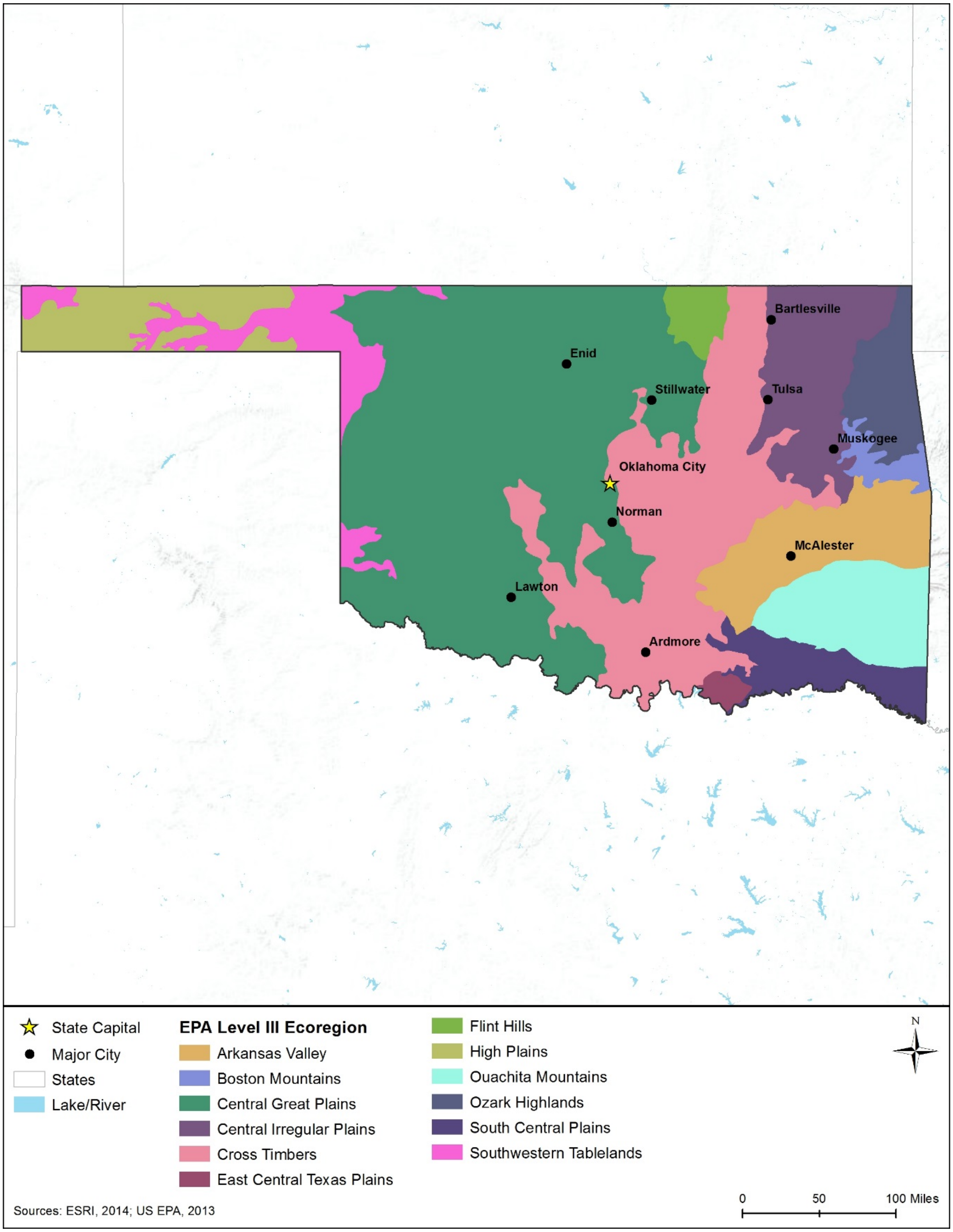

Figure 12.1.6-1. USEPA Level III Ecoregions in Oklahoma

Table 12.1.6-2. USEPA Level III Ecoregions of Oklahoma

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Panhandle				
25	High Plains	A region of smooth to irregular semiarid plains, higher in elevation than the Central Great Plains region. Precipitation is erratic and averages approximately 17 to 20 inches annually. Cropland is extensive in this region.	Shortgrass prairie	**Shrubs** – Prairie sagebrush (*Artemisia frigida*), Skunkbush (*Rhus trilobata*) **Grasses –** Sand bluestem (*Andropogon hallii*), Blue grama (*Bouteloua gracilis*), Buffalograss (*Bouteloua dactyloides*), Sand dropseed (*Sporobolus cryptandrus*)
26	Southwestern Tablelands	This region is characterized by tablelands of dissected plains, breaks, buttes, hills, terraces and is more rugged than nearby regions. This region is semiarid, receiving less precipitation than nearby regions, with averages ranging from 16 to 28 inches per year and does not support as much cropland as nearby regions.	Shortgrass prairie, Mixed grass prairie, Juniper-pinyon woodland	**Hardwood Trees –** Plains cottonwood (*Populus deltoides sp. monilifera*), Common hackberry (*Celtis occidentalis*), Willow (*Salix* spp.), Mulberry (*Sambucus occidentalis*), American elm (*Ulmus americana*), Tamarisk (*Tamarix sp.*) **Conifers –** Juniper (*Juniperus* spp.), Pinyon pine (*Pinus edulis*) **Shrubs** – Prairie sagebrush (*Artemisia frigida*), Mesquite (*Prosopis* spp.) **Grasses –** Blue grama (*Bouteloua gracilis*), Buffalograss (*Bouteloua dactyloides*), Sand dropseed (*Sporobolus cryptandrus*), Little bluestem (*Schizachyrium scoparium*), Side-oats grama (*Bouteloua curtipendula*), Indian grass (*Sorghastrum nutans*)
Geographic Region: Western Oklahoma				
26	Southwestern Tablelands	This region is characterized by tablelands of dissected plains, breaks, buttes, hills, terraces and is more rugged than nearby regions. This region is semiarid, receiving less precipitation than nearby regions, with averages ranging from 16 to 28 inches per year and does not support as much cropland as nearby regions.	Shortgrass prairie, Mixed grass prairie, Juniper-pinyon woodland	**Hardwood Trees –** Plains cottonwood (*Populus deltoides sp. monilifera*), Common hackberry (*Celtis occidentalis*), Willow (*Salix* spp.), Mulberry (*Sambucus occidentalis*), American elm (*Ulmus americana*), Tamarisk (*Tamarix sp.*) **Conifers –** Juniper (*Juniperus spp.*), Pinyon pine (*Pinus edulis*) **Shrubs** – Prairie sagebrush (*Artemisia frigida*), Mesquite (*Prosopis* spp.) **Grasses –** Blue grama (*Bouteloua gracilis*), Buffalograss (*Bouteloua dactyloides*), Sand dropseed (*Sporobolus cryptandrus*), Little bluestem

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
				(*Schizachyrium scoparium*), Side-oats grama (*Bouteloua curtipendula*), Indian grass (*Sorghastrum nutans*)
27	Central Great Plains	This is a region of scattered hills, breaks, low mountains, sandy flats, and sand dunes. Extensive oil and gas fields are located in this region. This region is considered dry-subhumid, with average annual rainfall ranging from 22 to 38 inches.	Mixed grass prairie, Oak savanna	**Hardwood Trees –** Plains cottonwood (*Populus deltoides sp. monilifera*), Willow (*Salix* spp.), Ash (*Fraxinus* spp.), Elm (*Ulmus americana*), Hackberry (*Celtis occidentalis*), Green ash (*Fraxinus pennsylvanica*), Pecan (*Carya illinoensis*), Blackjack oak (*Quercus marilandica*), Post oak (*Quercus stellata*), Hickory (*Carya* spp.) **Conifers –** Eastern redcedar (*Juniperus virginiana*) **Shrubs –** Mesquite (*Prosopis* spp.), Shin oak (*Quercus havardii*), Western soapberry (*Sapindus saponaria*) **Grasses –** Little bluestem (*Schizachyrium scoparium*), Side-oats grama (*Bouteloua curtipendula*), Blue grama (*Bouteloua gracilis*), Indiangrass (*Sorghastrum nutans*), Buffalograss (*Bouteloua dactyloides*)
Geographic Region: Central Oklahoma				
27	Central Great Plains	This is a region of scattered hills, breaks, low mountains, sandy flats, and sand dunes. Extensive oil and gas fields are located in this region. This region is considered dry-subhumid, with average annual rainfall ranging from 22 to 38 inches.	Mixed grass prairie, Oak savanna	**Hardwood Trees –** Plains cottonwood (*Populus deltoides sp. monilifera*), Willow (*Salix* spp.), Ash (*Fraxinus* spp.), Elm (*Ulmus americana*), Hackberry (*Celtis occidentalis*), Green ash (*Fraxinus pennsylvanica*), Pecan (*Carya illinoensis*), Blackjack oak (*Quercus marilandica*), Post oak (*Quercus stellata*), Hickory (*Carya* spp.) **Conifers –** Eastern redcedar (*Juniperus virginiana*) **Shrubs –** Mesquite (*Prosopis* spp.), Shin oak (*Quercus havardii*), Western soapberry (*Sapindus saponaria*) **Grasses –** Little bluestem (*Schizachyrium scoparium*), Side-oats grama (*Bouteloua curtipendula*), Blue grama (*Bouteloua gracilis*), Indiangrass (*Sorghastrum nutans*), Buffalograss (*Bouteloua dactyloides*)
29	Cross Timbers	A hillier region that provides a transition between prairie vegetation to the west and forested regions to the east. Soils are coarse, derived from sandstone, limestone, and shale. Croplands are restricted to valleys near streams.	Oak savanna, Oak woodland, Tallgrass prairie	**Hardwood Trees –** Post oak (*Quercus stellata*), Blackjack oak (*Quercus marilandica*), Hickory (*Carya* spp.), Elm (*Ulmus americana*), Cottonwood (*Populus* spp.), Pecan (*Carya illinoensis*), Hackberry (*Celtis occidentalis*), Willow (*Salix* spp.)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
				Conifer Trees – Eastern red-cedar (*Juniperus virginiana*) **Grasses** – Big bluestem (*Andropogon gerardii*), Little bluestem (*Schizachyrium scoparium*), Switch grass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), Side-oats grama (*Bouteloua curtipendula*), Hairy grama (*Bouteloua hirsuta*)
Geographic Region: Northeastern Oklahoma				
28	Flint Hills	This terrain of this region is characterized by rolling hills with rocky, coarse soils underlain by cherty limestone and shale. Grazing is common in this region with limited croplands. Average annual precipitation ranges from 38 to 42 inches.	Tallgrass prairie	**Hardwood Trees –** Eastern cottonwood (*Populus deltoides*), Hackberry (*Celtis occidentalis*), Elm (*Ulmus americana*), Oaks (*Quercus spp.*) **Shrubs –** Prickly pear (*Opuntia sp.*) **Grasses –** Blue grama (*Bouteloua gracilis*), Side-oats grama (*Bouteloua curtipendula*), Hairy grama (*Bouteloua hirsuta*)
29	Cross Timbers	A hillier region that provides a transition between prairie vegetation to the west and forested regions to the east. Soils are coarse, derived from sandstone, limestone, and shale. Croplands are restricted to valleys near streams.	Oak savanna, Oak woodland, Tallgrass prairie	**Hardwood Trees –** Post oak (*Quercus stellata*), Blackjack oak (*Quercus marilandica*), Hickory (*Carya* spp.), Elm (*Ulmus americana*), Cottonwood (*Populus* spp.), Pecan (*Carya illinoensis*), Hackberry (*Celtis occidentalis*), Willow (*Salix* spp.) **Conifer Trees** – Eastern red-cedar (*Juniperus virginiana*) **Grasses** – Big bluestem (*Andropogon gerardii*), Little bluestem (*Schizachyrium scoparium*), Switch grass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), Side-oats grama (*Bouteloua curtipendula*), Hairy grama (*Bouteloua hirsuta*)
40	Central Irregular Plains	This ecoregion exhibits gently undulating plains with steep ridges (cuestas). Cropland is common, with dwindling coal mining and mineral extraction. Streams are typically meandering, slow-moving, with muddy banks, some of which have been degraded by coal mining.	Tallgrass prairie, Oak-hickory woodland and forest	**Hardwood Trees –** Blackjack oak (*Quercus marilandica*), Post oak (*Quercus stellata*), Boxelder (*Acer negundo*), Silver maple (*Acer saccharinum*), Bur oak (*Quercus macrocarpa*), Hackberry (*Celtis occidentalis*), Elm (*Ulmus americana*), Cottonwood (*Populus* spp.) **Grasses** – Big bluestem (*Andropogon gerardii*), Little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
39	Ozark Highlands	Caves, springs, and spring-fed streams are common throughout this region. Oak-hickory forests are dominant in rugged areas.	Oak-Hickory Forest	**Hardwood Trees** – Black oak (*Quercus velutina*), White oak (*Quercus alba*), Blackjack oak (*Quercus marilandica*), Post oak (*Quercus stellata*), Elm (*Ulmus americana*), Hickory (*Carya* spp.), Sugar maple (*Acer saccharum*), Birch (*Betula sp.*), Sycamore (*Platanus occidentalis*) **Conifer Trees – S**hortleaf pine (*Pinus echinata*)
38	Boston Mountains	A mountainous region characterized by oak-hickory forest cover and streams of exceptional water quality.	Oak-Hickory Forest	**Hardwood Trees** – Sugar maple (*Acer saccharum*), Chinquapin oak (*Quercus muehlenbergii*), Bitternut hickory (*Carya cordiformis*), Mockernut hickory (*Carya tomentosa*), Birch (*Betula sp.*), Sycamore (*Platanus occidentalis*), Cottonwood (*Populus* spp.), Elm (*Ulmus americana*)
Geographic Region: Southeastern Oklahoma				
29	Cross Timbers	A hillier region that provides a transition between prairie vegetation to the west and forested regions to the east. Soils are coarse, derived from sandstone, limestone, and shale. Croplands are restricted to valleys near streams.	Oak savanna, Oak woodland, Tallgrass prairie	**Hardwood Trees –** Post oak (*Quercus stellata*), Blackjack oak (*Quercus marilandica*), Hickory (*Carya* spp.), Elm (*Ulmus americana*), Cottonwood (*Populus* spp.), Pecan (*Carya illinoensis*), Hackberry (*Celtis occidentalis*), Willow (*Salix* spp.) **Conifer Trees –** Eastern red-cedar (*Juniperus virginiana*) **Grasses –** Big bluestem (*Andropogon gerardii*), Little bluestem (*Schizachyrium scoparium*), Switch grass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), Side-oats grama (*Bouteloua curtipendula*), Hairy grama (*Bouteloua hirsuta*)
33	East Central Texas Plains	A region of level to rolling plains and clay flats. Soils are often clay and streambeds often mud and very fine sand. Cropland and pastureland are common. Rainfall averages approximately 42 to 45 inches annually.	Oak savanna, Tallgrass prairie	**Hardwood Trees –** Cottonwood (*Populus* spp.), Sycamore (*Platanus occidentalis*), Willow (*Salix* spp.), Elm (*Ulmus americana*), Ash (*Fraxinus* spp.) **Grasses –** Big bluestem (*Andropogon gerardii*), Little bluestem (*Schizachyrium scoparium*), Switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*)
35	South Central Plains	A region of forested plains and shallow valleys that represent the western edge of the southern coniferous forests. Today 75 percent of this region is forested with a large portion of forest cover attributed to	Oak-Hickory-Pine Forest, Loblolly and Shortleaf Pine Forest, and Southern floodplain forest	**Hardwood Trees** – Southern red oak (*Quercus falcata*), White oak (*Quercus alba*), Black gum (*Nyssa sylvatica*), Sweet gum (*Liquidambar styraciflua*), Shagbark hickory (*Carya ovata*)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
		commercial loblolly and short leaf pine plantations.		**Conifer Trees –** Bald cypress (*Taxodium distichum*), Shortleaf pine (*Pinus echinata*), Loblolly pine (*Pinus taeda*)
36	Ouachita Mountains	This region includes forested low mountains. Commercial loblolly and short leaf pine plantations are the dominant forest cover.	Oak-Hickory-Pine Forest and Loblolly and Shortleaf Pine Forest	**Hardwood Trees –** Southern red oak (*Quercus falcata*), White oak (*Quercus alba*), Hickory (*Carya* spp.), Sycamore (*Platanus occidentalis*), hackberry (*Celtis occidentalis*), Black gum (*Nyssa sylvatica*), Green ash (*Fraxinus pennsylvanica*), Sweetgum **Conifer Trees – S**hortleaf pine (*Pinus echinata*), Loblolly pine (*Pinus taeda*), Eastern red cedar (*Juniperus virginiana*) **Grasses** – Big bluestem (*Andropogon gerardii*), Little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*)
37	Arkansas Valley	This region is topographically diverse with plains, hills, terraces, and scattered mountains. Timber and woodland grazing are common on steeper slopes, with pasturelands and hay crops common on more gently sloped areas.	Oak savanna, Mixed grass prairie, Oak-Hickory-Pine Forest, Southern floodplain forest	**Hardwood Trees** – Post oak (*Quercus stellata*), Blackjack oak (*Quercus marilandica*), Hickory (*Carya* spp.), White oak (*Quercus alba*), Southern red oak (*Quercus falcata*), Sycamore (*Platanus occidentalis*), Hackberry (*Celtis occidentalis*), Ash (*Fraxinus* spp.), Black gum (*Nyssa sylvatica*), Sweetgum (*Liquidambar styraciflua*), Willow (*Salix* spp.), Cottonwood (*Populus* spp.) **Conifer Trees – S**hortleaf pine (*Pinus echinata*), Loblolly pine (*Pinus taeda*), Eastern red cedar (*Juniperus virginiana*)

Sources: (Woods, 2005) (CEC, 2011)

12.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Oklahoma, divided among mammals,[76] birds,[77] reptiles and amphibians,[78] and invertebrates.[79] Terrestrial wildlife consists of those species, and their habitats, that live predominantly on land. Terrestrial wildlife includes common big game species, small game animals, furbearers,[80] nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Oklahoma. A discussion of non-native and/or invasive terrestrial wildlife species is also included within this section. Information regarding the types and location of native and non-native/invasive wildlife is useful for assessing the importance of any impacts to these resources or the habitats they occupy. Oklahoma is home to approximately 106 mammal species, 82 reptile species, 55 amphibian species, and 473 resident and migratory bird species (Oklahoma Biological Survey, 2015a) (ODWC, 2005) (Sam Noble Oklahoma Museum of Natural History, 2015) (Oklahoma Ornithological Society, 2011).

Mammals

Common and widespread mammalian species in Oklahoma include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridana*), woodchuck (*Marmota monax*), coyote (*Canis latrans*), and eastern chipmunk (*Tamias striatus*). Mammals such as the black bear (*Ursus americanus*), swift or kit fox (*Vulpes velox*), spotted skunks (*Spilogale* spp.), and swamp rabbit (*Sylvilagus aquaticus*) are uncommon or rare in Oklahoma due to restricted habitat or secretive behavior (Oklahoma Biological Survey, 2015a). A number of threatened and endangered mammals are located in Oklahoma. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

In Oklahoma, white-tailed deer, elk (*Cervus canadensis*), antelope (*Antilocapra americana*), black bear, and mountain lion (*Puma concolor*) are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game bird. The following species of furbearers may be legally hunted or trapped in Oklahoma: bobcat (*Lynx rufus*), raccoon, river otter (*Lontra canadensis*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), badger (*Taxidea taxus*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), prairie dog (*Cynomys ludovicianus*), opossum, weasel (*Mustela sp.*), beaver (*Castor canadensis*), nutria (*Myocastor coypus*), striped skunk (*Mephitis mephitis*), and coyote (ODWC, 2015j).

[76] 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).

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

[78] 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).

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

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

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

Birds

The number of native bird species documented in Oklahoma varies according to the timing of the data collection effort, changes in bird taxonomy,[81] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., extensive forests, large rivers and lakes, plains, etc.) found in Oklahoma support a large variety of bird species.

Approximately 473 species of resident and migratory birds have been documented in Oklahoma (Oklahoma Ornithological Society, 2011). Among the 473 extant[82] species in Oklahoma, 73 SGCN have been identified, including the Louisiana waterthrush (*Parkesia motacilla*), Kentucky warbler (*Geothlypis formosa*), and Pinyon jay (*Gymnorhinus cyanocephalus*) (ODWC, 2005).

Oklahoma 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 (National Audubon Society, 2015a). Oklahoma is located at the southern portion of the Central Flyway and provides wintering range for many species of ducks and geese. Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations" (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in the entire state during the winter season, though they are more commonly encountered in the northeastern portion of the state (eBird, 2015a). Golden eagles are generally found in a variety of habitat types throughout their range, but generally nest in mountains and cliffs. Golden eagles are not commonly encountered in Oklahoma, but they are occasionally seen in the far western Panhandle region in late winter and spring (eBird, 2015b).

[81] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2013d).
[82] Extant: "A species that is currently in existence (the opposite of extinct)" (USEPA, 2015d).

Several Important Bird Areas (IBAs) have also been identified in Oklahoma, as can be seen in 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 critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental 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. (National Audubon Society, 2016a)

According to the Oklahoma chapter of the National Audubon Society (NAS), a total of four IBAs have been identified in Oklahoma. These IBAs provide breeding ranges,[83] migratory stop-overs, feeding and over-wintering areas, and contain a variety of habitats such as native grasslands, freshwater marsh, bottomland hardwood forest, river floodplains, sandsage brush, oak woodlands, and other wetland/riparian[84] areas (National Audubon Society, 2016b). These IBAs, which cover approximately 143,720 acres, are distributed in the northern portions of Oklahoma and in the Wichita Mountains in the southwestern portion of the state. Two of these IBAs are existing NWRs that contain bottomland hardwood forests and oak woodlands. These habitats are an important migration stop and breeding ground for many waterfowl species.

A number of threatened and endangered birds are located in Oklahoma. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[83] Breeding range: “The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared” (USEPA, 2015d).
[84] Riparian: “Referring to the areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands” (USEPA, 2015d).

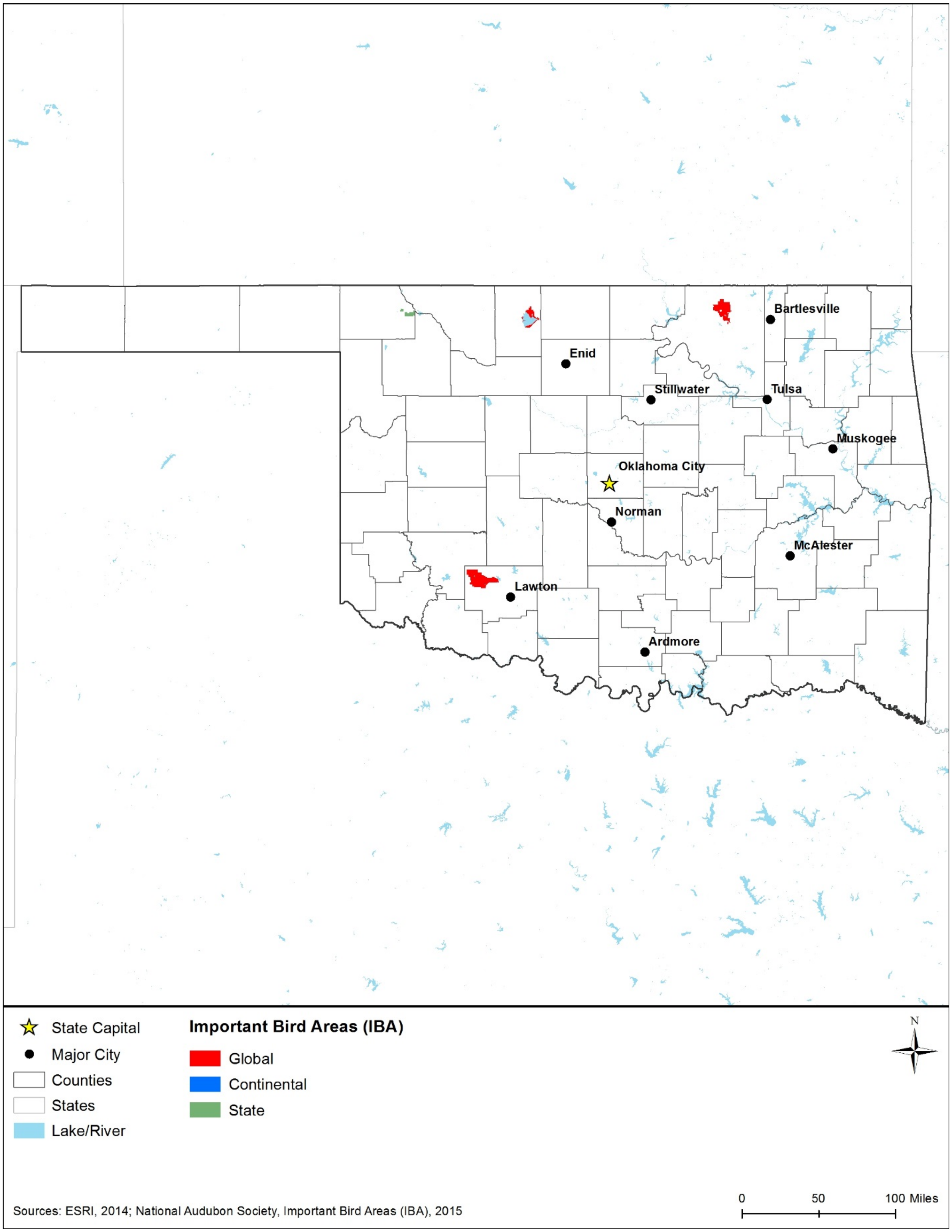

Figure 12.1.6-2: Important Bird Areas in Oklahoma

Reptiles and Amphibians

Approximately 137 native reptile, including the Spiny softshell turtle (*Apalone spinifera*), and amphibian species occur in the state of Oklahoma, including 23 salamanders, 32 frogs and toads, 17 turtles, one alligator, 17 lizards, and 47 snakes. These species occur in a wide variety of habitats from the upland hardwoods in the northeast to the plains and scrublands of the Panhandle. Many of these species are widespread throughout the state. Of the 137 native reptile and amphibian species, eight SGCN have been identified, six of which are salamanders (ODWC, 2005).

In the state of Oklahoma, the following reptiles are legal to harvest in accordance with ODWC state hunting regulations: American bullfrog (*Lithobates catesbeianus*), prairie rattlesnake (*Crotalus viridis*), western diamondback (*Crotalus atrox*), timber rattlesnake (*Crotalus horridus*), and massasauga (*Sistrurus catenatus*). Several additional reptile and amphibian species, including aquatic frogs, aquatic salamanders, may also be taken in accordance with the ODWC state hunting and fishing regulations. All other reptile and amphibian species in the state of Oklahoma, including many salamanders, horned lizard, turtles, and snakes, are classified as nongame species. (ODWC, 2015b)

Invertebrates

Oklahoma is home to an unknown number of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes. These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. No terrestrial invertebrate species have been listed as SGCN in Oklahoma (ODWC, 2005). In the U.S., one-third of all agricultural output depends on pollinators[85]. In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. "As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites" (NRCS, 2009). Several insect families have been studied in greater detail within the state, and have resulted in the documentation of 165 species of dragonflies and damselflies, 198 butterflies, and almost 1,900 moths in Oklahoma (Nelson, J., 2015) (Nelson, J.; Fisher, J., 2014) (Oklahoma Biological Survey, 2014)

One terrestrial invertebrate species is listed as endangered in Oklahoma, the American burying beetle (*Nicrophorus americanus*). Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, discusses this protected species.

Invasive Wildlife Species

As noted above, Oklahoma has enacted a Feral Swine Control Act to reduce the number of feral swine (hogs). Feral swine have resulted in damage to agricultural production and natural habitats, and have the potential to introduce or spread diseases among wildlife, livestock, pets, and humans (Oklahoma Department of Agriculture, Food, and Forestry, 2015). Feral hogs occur

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

throughout Oklahoma, but are more abundant in the southeastern portion of the state and less common in the western and panhandle regions (Oklahoma Agriculture Food and Forestry, 2016).

Invasive insects pose a large threat to Oklahoma's forest and agricultural resources. Several invertebrate species are considered invasive in Oklahoma and present a threat to natural and cultivated plants, croplands, and forests. Species such as the gypsy moth (*Lymantria dispar*), emerald ash borer (*Agrilus planipennis*), and an introduced wood wasp are known to cause irreversible damage to native forests. In addition, quarantines have been enacted in an effort to reduce the spread of many plant pests. Currently, federal quarantines are in place that restrict the transport of plant materials with the potential to contain the emerald ash borer in states adjacent to Oklahoma, which include Missouri and southern Arkansas (USDA, 2015b).

12.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Oklahoma, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Oklahoma landscape with regard to aquatic wildlife are the abundant diverse aquatic habitats provided within the state, ranging from flooded bottomland forests, cypress swamps, coldwater streams, and large rivers and reservoirs. These water bodies provide habitat for a variety of aquatic wildlife.

No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in the state of Oklahoma.[86] Threatened and endangered fish species, as defined by the ESA, do exist within Oklahoma and are discussed in Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Freshwater Fish

The Oklahoma Biological Survey and ODWC have identified 26 families and 180 species of freshwater fish in the state, ranging in size from small darters and minnows to large species, such as gar, paddlefish, and sturgeon (Table 12.1.6-3). Among these species are numerous recreational and game fish, such as yellow perch, channel catfish, sunfishes, bass, and trout. The ODWC has identified 52 of the 180 freshwater fish in Oklahoma as SGCN.[87] (ODWC, 2005) (Oklahoma Biological Survey, 2015b)

[86] NOAA's Essential Fish Habitat Mapper v 3.0 was used to identify "EFH areas of particular concern" and "EFH areas protected from fishing." As of July 2016, the procedure to use this interactive tool is as follows: 1) Visit http://www.habitat.noaa.gov/protection/efh/habitatmapper.html. 2) Select "EFH Mapper" under Useful Links. 3) After closing the opening tutorial, select the "Region" of interest from the drop-down menu. 4) Select the species under "Essential Fish Habitat" to view the areas in the selected region protected for the various life states (i.e., eggs, larvae, juvenile, adult, or all).
[87] The current ODWC list of fish Species of Greatest Conservation Need(SGCN) is posted here: http://www.wildlifedepartment.com/cwcs/CWCS16.htm.

Table 12.1.6-3: Fishes of Oklahoma

Lampreys (Petromyzonidae)	
Chestnut lamprey	*Ichthyomyzon castaneus*
Southern brook lamprey [a]	*Ichthyomyzon gagei*
Sturgeons (Acipenseridae)	
Shovelnose sturgeon [a]	*Scaphirhynchus platorynchus*
Paddlefish (Polydontidae)	
Paddlefish / Spoonbill [a]	*Polyodon spathula*
Gars (Lepisostidae)	
Alligator gar [a]	*Atractosteus spatula*
Spotted gar	*Lepisosteus oculatus*
Longnose gar	*Lepisosteus osseus*
Shortnose gar	*Lepisosteus platostomus*
Bowfin (Amiidae)	
Bowfin	*Amia calva*
Eels (Anguillidae)	
American Eel	*Anguilla rostrata*
Shads (Clupeidae)	
Alabama shad [a]	*Alosa alabamae*
Skipjack herring	*Alosa chrysochloris*
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Dorosoma petenense*
Mooneye (Hiodontidae)	
Goldeye	Hiodon alosoides
Mooneye [a]	Hiodon tergisus
Trouts (Salmonidae)	
Rainbow trout	*Oncorhynchus mykiss*
Brown trout	*Salmo trutta*
Pikes (Esocidae)	
Grass/Redfin pickerel	*Esox americanus*
Northern pike	*Esox lucius*
Chain pickerel [a]	*Esox niger*
Minnows (Cyprinidae)	
Central stoneroller	*Campostoma anomalum*
Largescale stoneroller	*Campostoma oligolepis*
Goldfish	*Carassius auratus*
Bluntface shiner [a]	*Cyprinella camura*
Red shiner	*Cyprinella lutrensis*
Spotfin shiner [a]	*Cyprinella spiloptera*
Blacktail shiner	*Cyprinella venusta*
Steelcolor shiner	*Cyprinella whipplei*
Common carp	*Cyprinus carpio*
Ozark minnow [a]	*Dionda nubila*
Minnows (Cyprinidae) *continued*	
Gravel chub	*Erimystax x-punctatus*
Cypress minnow [a]	*Hybognathus hayi*
Mississippi silvery minnow	*Hybognathus nuchalis*
Plains minnow [a]	*Hybognathus placitus*
Bigeye chub	*Hybopsis amblops*
Pallid shiner [a]	*Hybopsis amnis*
Cardinal shiner [a]	*Luxilus cardinalis*
Striped shiner	*Luxilus chrysocephalus*
Ribbon shiner	*Lythrurus fumeus*
Ouachita shiner [a]	*Lythrurus snelsoni*
Redfin shiner	*Lythrurus umbratilis*
Prairie chub [a]	*Macrhybopsis australis*
Shoal chub	*Macrhybopsis hyostoma*
Silver chub	*Macrhybopsis storeriana*
Redspot chub [a]	*Nocomis asper*
Golden shiner	*Notemigonus crysoleucas*
Emerald shiner	*Notropis atherinoides*
Blackspot shiner [a]	*Notropis atrocaudalis*
Red River shiner [a]	*Notropis bairdi*
River shiner	*Notropis blennius*
Bigeye shiner	*Notropis boops*
Ghost shiner	*Notropis buchanani*
Ironcolor shiner [a]	*Notropis chalybaeus*
Arkansas River shiner [a]	*Notropis girardi*
Wedgespot shiner [a]	*Notropis greenei*
Bluehead shiner [a]	*Notropis hubbsi*
Taillight shiner [a]	*Notropis maculatus*
Kiamichi shiner [a]	*Notropis ortenburgeri*
Carmine shiner	*Notropis percobromus*
Peppered shiner [a]	*Notropis perpallidus*
Chub shiner [a]	*Notropis potteri*
Roseyface shiner	*Notropis rubellus*
Silverband shiner	*Notropis shumardi*
Sand shiner	*Notropis stramineus*
Rocky shiner [a]	*Notropis suttkusi*
Mimic shiner	*Notropis volucellus*
Pugnose minnow	*Opsopoeodus emiliae*
Suckermouth minnow	*Phenacobius mirabilis*
Southern redbelly dace	*Phoxinus erythrogaster*
Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*
Slim minnow	*Pimephales tenellus*
Bullhead minnow	*Pimephales vigilax*
Flathead chub [a]	*Platygobio gracilis*
Creek chub	*Semotilus atromaculatus*

Table 12.1.6-3 (cont.): Fishes of Oklahoma

Suckers (Catastomidae)	
River carpsucker	*Carpiodes carpio*
Quillback	*Carpiodes cyprinus*
Highfin carpsucker	*Carpiodes velifer*
White sucker	*Catostomus commersoni*
Blue sucker [a]	*Cycleptus elongatus*
Creek Chubsucker	*Erimyzon oblongus*
Lake chubsucker	*Erimyzon sucetta*
Northern hogsucker	*Hypentelium nigricans*
Smallmouth buffalo	*Ictiobus bubalus*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black buffalo [a]	*Ictiobus niger*
Spotted sucker	*Minytrema melanops*
River redhorse	*Moxostoma carinatum*
Black redhorse	*Moxostoma duquesnei*
Shorthead redhorse [a]	*Moxostoma macrolepidotum*
Golden rehorse	*Moxostoma erythrurum*
Catfishes (Ictaluridae)	
Black bullhead	*Ameiurus melas*
Yellow bullhead	*Ameiurus natalis*
Brown bullhead [a]	*Ameiurus nebulosus*
Blue catfish	*Ictalurus furcatus*
Channel catfish	*Ictalurus punctatus*
Mountain madtom [a]	*Noturus eleutherus*
Slender madtom	*Noturus exilis*
Stonecat	*Noturus flavus*
Tadpole madtom	*Noturus gyrinus*
Brindled madtom	*Noturus miurus*
Freckled madtom	*Noturus nocturnus*
Neosho madtom [a]	*Noturus placidus*
Flathead catfish	*Pylodictis olivaris*
Cave Fishes (Amblyopsidae)	
Ozark cavefish [a]	*Amblyopsis rosae*
Pirate Perches (Aphredoderidae)	
Pirate perch	*Aphredoderus sayanus*
Pupfishes (Cyprinodontidae)	
Red river pupfish [a]	*Cyprinodon rubrofluviatilis*
Topminnows and Killifishes (Fundulidae)	
Lowland topminnow	*Fundulus blairae*
Northern studfish	*Fundulus catenatus*
Golden topminnow	*Fundulus chrysotus*
Blackstripe topminnow	*Fundulus notatus*
Blackspotted topminnow	*Fundulus olivaceus*
Plains topminnow [a]	*Fundulus sciadicus*
Plains killifish	*Fundulus zebrinus*
Livebearers (Poeciliidae)	
Mosquito fish	*Gambusia affinis*
Silversides (Atherinopsidae)	
Brook silverside	*Labidesthes sicculus*
Inland silverside	*Menidia beryllina*
Sculpins (Cottidae)	
Banded sculpin	*Cottus carolinae*
Temperate Basses (Moronidae)	
White bass	*Morone chrysops*
Yellow bass	*Morone mississippiensis*
Striped bass	*Morone saxatilis*
Hybrid striped bass	*Morone chrysops x saxatilis*
Pygmy Sunfishes (Elassomatidae)	
Banded pygmy sunfish	*Elassoma zonatum*
Sunfishes (Centrarchidae)	
Shadow bass	*Ambloplites ariommus*
Rock bass	*Ambloplites rupestris*
Flier	*Centrarchus macropterus*
Redbreast sunfish	*Lepomis auritus*
Green sunfish	*Lepomis cyanellus*
Warmouth	*Lepomis gulosus*
Orangespotted sunfish	*Lepomis humilis*
Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*
Dollar sunfish	*Lepomis marginatus*
Redear sunfish	*Lepomis microlophus*
Redspotted sunfish	*Lepomis miniatus*
Bantam sunfish	*Lepomis symmetricus*
Smallmouth bass	*Micropterus dolomieu*
Spotted bass	*Micropterus punctulatus*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*

Table 12.1.6-3 (cont.): Fishes of Oklahoma

Perches (Percidae)		**Drums (Sciaenidae)**	
Western sand darter[a]	*Ammocrypta clara*	Freshwater drum	*Aplodinotus grunniens*
Scaly sand darter	*Ammocrypta vivax*		
Crystal darter[a]	*Crystallaria asprella*	**Mullets (Mugilidae)**	
Redspot darter	*Etheostoma artesiae*	Striped mullet	*Mugil cephalus*
Mud darter	*Etheostoma asprigene*		
Greenside darter	*Etheostoma blennioides*		
Bluntnose darter	*Etheostoma chlorosoma*		
Creole darter[a]	*Etheostoma collettei*		
Arkansas darter[a]	*Etheostoma cragini*		
Fantail darter	*Etheostoma flabellare*		
Swamp darter	*Etheostoma fusiforme*		
Slough darter	*Etheostoma gracile*		
Harlequin darter[a]	*Etheostoma histrio*		
Least darter[ab]	*Etheostoma microperca*		
Johnny darter	*Etheostoma nigrum*		
Goldstripe darter[a]	*Etheostoma parvipinne*		
Cypress darter	*Etheostoma proeliare*		
Sunburst/stippled darter	*Etheostoma punctulatum*		
Orangebelly darter[a]	*Etheostoma radiosum*		
Orangethroat darter	*Etheostoma spectabile*		
Speckled darter	*Etheostoma stigmaeum*		
Redfin darter	*Etheostoma whipplei*		
Banded darter	*Etheostoma zonale*		
Yellow perch	*Perca flavescens*		
Logperch	*Percina caprodes*		
Channel darter	*Percina copelandi*		
Blackside darter[a]	*Percina maculata*		
Longnose darter[a]	*Percina nasuta*		
Leopard darter[a]	*Percina pantherina*		
Slenderhead darter	*Percina phoxocephala*		
Dusky darter	*Percina sciera*		
River darter[a]	*Percina shumardi*		
Sauger	*Stizostedion canadense*		
Saugeye	*Stizostedion canadense x vitreum*		
Walleye	*Stizostedion vitreum*		

[a]Fish SGCN have been identified in the state. (ODWC, 2005)
[b]Only the Blue River population of the Least darter (*Etheostoma microperca*) is listed by OSWC as a SGCN.
Sources: (ODWC, 2005) (Oklahoma Biological Survey, 2015b)

Fish communities in Oklahoma follow a roughly defined distribution among two general habitat types: habitats adjacent to and including large rivers or deep lakes and reservoirs, and habitats including smaller streams or shallow lakes and ponds. Large rivers or deeper aquatic habitat fish species include paddlefish (*Polyodon spathula*), alligator gar (*Attractoosteus spatula*), shovelnose sturgeon (*Scaphirhynchus platyrynchus*), largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), and American eel (*Anguilla rostrata*), among others. Small streams or shallow aquatic habitat fish species include chub and minnows, bluegill (*Lepomis macrochirus*), bowfin (*Amia calva*), spotted bass (*Micropterus punctulatus*), smallmouth bass

(*Micropterus dolomieu*), and many others. Some fish species use both habitat types but many tend to occur in one of the two general habitat types.

Freshwater fish and associated freshwater habitats are considered one of the most highly threatened ecosystems based on the decline in species population numbers. Approximately 40 percent of fish species in North America are considered at risk or vulnerable to extinction (USFWS, 2015c) (National Fish Habitat Board, 2010).[88] 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 Oklahoma and the southern Plains states in general, agriculture, urbanization, and irrigation diversion are the primary threats to aquatic habitat. Urbanization around larger cities has increased barriers to fish passages as well as habitat degradation due to sedimentation and pollutant runoff. Irrigation diversion projects on the Arkansas, Red, Neosho, Canadian and other Oklahoma rivers have altered the water flow, influencing aquatic habitat, 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

Oklahoma is home to an unknown number of mollusk and crustacean species, including a multitude of freshwater mussels and crayfish, with at least 29 crayfish species documented in the state (Fetzner, Jr., James W., 2011). Oklahoma has listed 25 species of freshwater mussels and crayfish as SGCN (ODWC, 2005). A number of threatened and endangered aquatic invertebrates are located in Oklahoma. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Many of these species are found along the Arkansas, Red, and North Canadian rivers. River diversions and impoundments are a primary threat to Oklahoma's native mussel species. Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other well-known Oklahoma freshwater invertebrates include a variety of fairy shrimp, amphipods, and pillbug species.

Invasive Aquatic Species

Oklahoma has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase and introduction of select noxious aquatic plant species (29 Oklahoma Statutes § 6-601). In addition to noxious aquatic plant species, ODWC maintains a list of aquatic nuisance species. According to the ODWC, the following species are considered aquatic nuisance species due to the ecological and economic threats they pose to aquatic habitats. (ODWC, 2015c) (ODWC, 2015d)

- Fish **–** Asian carp (which includes three species: silver carp [*Hypophthalmichthys molitrix*], bighead carp [*Hypophthalmichtys nobilis*], and black carp [*Mylopharyngodon piceus*]), white perch (*Morone americana*)

[88] Extinction: "The disappearance of a species from part or all of its range" (USEPA, 2015d).

- Aquatic Invertebrates – Harris mud crab (*Rhithropanopeus harrisii*), zebra mussel (*Dreissena polymorpha*)
- Aquatic Algae – didymo (*Didymosphenia geminata*), golden alga (*Prymnesium parvum*)
- Noxious Aquatic Plants – mosquito fern (*Azolla pinnata*), caulerpa (*Caulerpa taxifolia*), anchored water hyacinth (*Eichhornia azure*), hydrilla (*Hydrilla verticillata*), hygro (*Hygrophila polysperma*), water spinach (*Ipomoea aquatica*), African elodea (*Lagarosiphon major*), ambulila (*Lmnophila* spp.), purple loosestrife (*Lythrum salicaria*), marsilea (*Marsilea quadrifolia*), Australian waterclover (*Marsilea mutica*), waterclover (*Marsilea minuta*), paperbark tree (*Melaleuca quinquenervia*), cat's claw (*Monochoria hastate*), duck lettuce (*Ottellia alismoides*), Japanese arrowhead (*Sagittaria sagittifolia*), all giant and common Salvinia species (*Salvinia spp.*), wetland nightshade (*Solanum tampicense*), exotic bur-reed (*Sparganium erectum*), mud mat (*Glossostigma diandrum*), and alligatorweed (*Alternanthera spp.*)

12.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

The USFWS is responsible for administering the ESA (16 U.S.C. §1531 *et seq*.) in state of Oklahoma. The USFWS has identified 13 federally endangered and 9 federally threatened species known to occur in Oklahoma (USFWS, 2015d). Of these 22 federally listed species, 5 of them have designated critical habitat[89] (USFWS, 2015e). There are two candidate[90] species in Oklahoma: Arkansas darter (*Etheostoma cragini*), and rattlesnake-master borer moth (*Papaipema eryngii*) (USFWS, 2015f). 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). The 22 federally listed species include four mammals, seven birds, four fishes, six invertebrates, and one plant (USFWS, 2015d), and are discussed in detail under the following sections. There are no federally listed reptiles or amphibians in Oklahoma. 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 might be required.

[89] 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)).

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

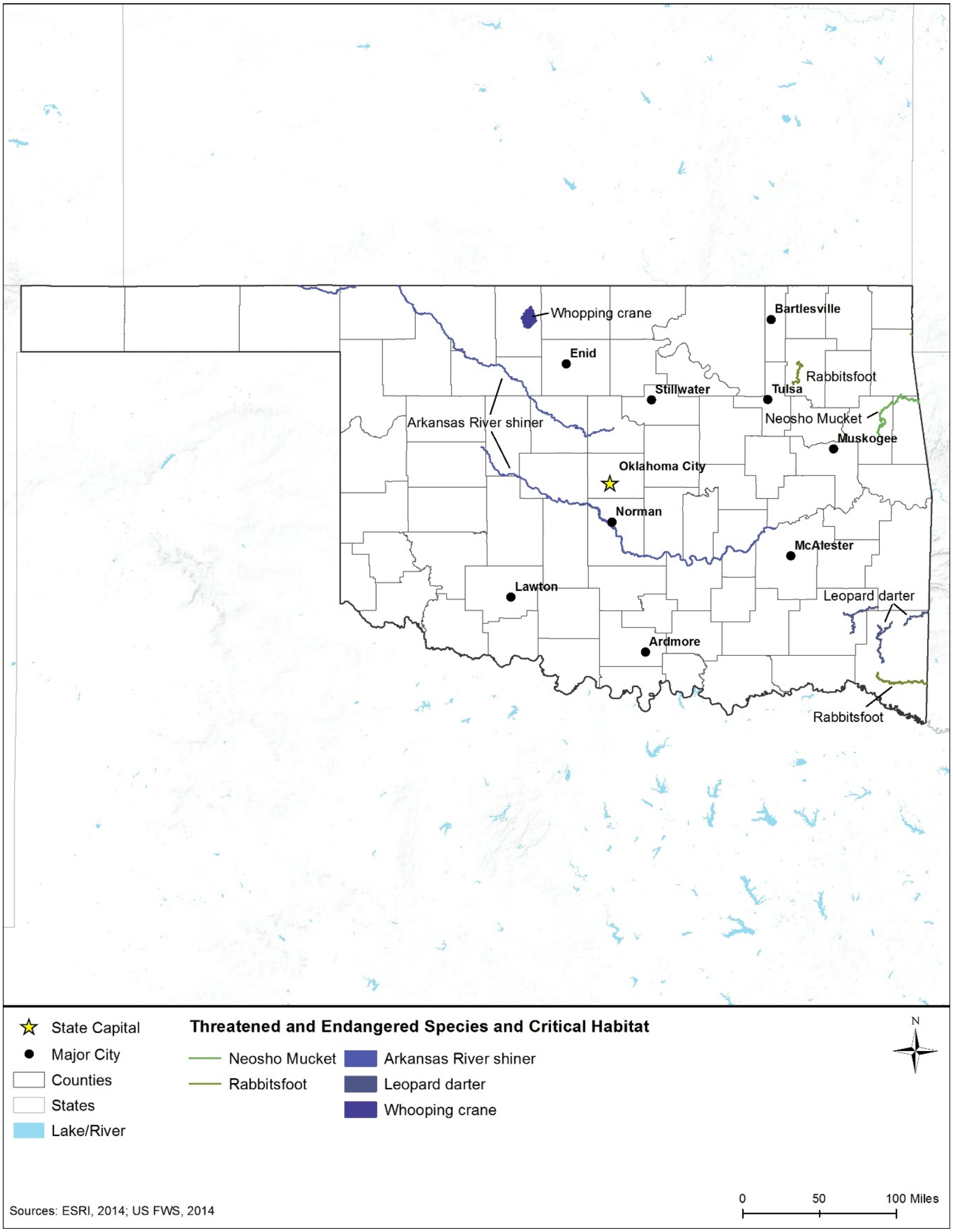

Figure 12.1.6-3: ESA Designated Critical Habitat in Oklahoma

Mammals

Three endangered and one threatened mammals are federally listed for Oklahoma as summarized in Table 12.1.6-4. The gray bat (*Myotis grisescens*) and Ozark big-eared bat (*Corynorhinus townsendii ing*ens) can be found in northeastern Oklahoma. The Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*) can be found in the eastern part of the state. (USFWS, 2015d) Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oklahoma is provided below.

Table 12.1.6-4: Federally Listed Mammal Species of Oklahoma

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Oklahoma	Habitat Description
Gray Bat	*Myotis grisescens*	E	No	Caves in areas with significant limestone karst in northeastern Oklahoma.
Indiana Bat	*Myotis sodalis*	E	No	Forested regions in the Ozark and Ouachita mountains in eastern Oklahoma.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Throughout the eastern part of the state in grassland and woodland habitats.
Ozark Big-eared Bat	*Corynorhinus townsendii ingens*	E	No	Caves in areas with limestone karst in northeastern Oklahoma.

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

Gray Bat. The grey bat is an insectivorous[91] bat that weighs approximately 7 to 16 grams and is longer than any other species in the genus *Myotis*. Gray bats have dark gray fur after molting in July or August and then the fur transitions to a chestnut brown. This species was federally listed as endangered in 1976 (41 FR 17736 17740, April 28, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst within southeastern states from Kansas and Oklahoma east to Virginia and North Carolina (USFWS, 1997a) (USFWS, 2015g). In Oklahoma, the gray bat is known to occur in nine counties in the northeastern region of the state (USFWS, 2015g). The species migrates to Oklahoma only during late spring and summer months. In the summer, gray bats inhabit caves in forested habitats in Ottawa, Delaware, Cherokee, and Adair Counties (ODWC, 2011o).

Gray bat Photo credit: USFWS

Gray bats live in caves all year, hibernating in deep vertical caves in the winter and roosting in caves scattered along rivers the rest of the year. Most caves are in limestone karst regions and

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

near rivers where these bats feed on flying aquatic and terrestrial insects. Current threats to this species include human disturbance, habitat loss and degradation due to flooding, and commercialization of caves (e.g., adding gates that alter the air flow, humidity, and temperature in caves) (USFWS, 2015g) (USFWS, 1997a).

Indiana Bat. The Indiana bat is a small, insectivorous mammal measuring approximately 3.0 to 3.5 inches in length with a wingspan of 9.5 to 10.5 inches. Indiana bats have dull grayish chestnut fur and strongly resembles the more common little brown bat (*Myotis lucifugus*) (USFWS, 2006). The Indiana bat was originally federally listed as "in danger of extinction" under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). In 2009, only 387,000 Indiana bats were known to exist in its range, less than half of the population of 1967 (USFWS, 2015h). Regionally, this species is currently found in the central portion of the eastern United States, from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Oklahoma, the Indiana bat has been known to occur within five counties in forested parts of the Ozark and Ouachita Mountains in the eastern part of the state. (ODWC, 2011a) (USFWS, 2015h)

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

The threats to this species include the disturbance and intentional killing of hibernating and maternity colonies, habitat fragmentation and degradation, use of pesticides or other contaminants, White Nose Syndrome, and commercialization of caves (e.g., adding gates that alter air flow, humidity, and temperature in caves) (USFWS, 2015h) (USFWS, 2004a) (GADNR, 2009). White Nose Syndrome is a rapidly spreading fungal disease that afflicts hibernating bats (USGS-NWHC, 2015).

Northern Long-eared Bat. The northern long-eared bat is a medium-sized, brown furred, insectivorous bat. This bat reaches a total length of 3.0 to 3.7 inches, in length (USFWS, 2015i). The northern long-eared bat was listed as endangered in 2013 (78 FR 72058 72059, December 2, 2013) and was relisted as threatened in 2015 (80 FR 17973 18033, April 2, 2015). In the United States, its range includes most of the eastern and north central states (USFWS, 2015j). In Oklahoma, the northern long-eared bat is known to occur in 23 counties in the eastern portion of the state (USFWS, 2015j).

Northern long-eared bat
Photo credit: USFWS

Northern long-eared bats hibernate during winter in caves and mines that exhibit constant temperatures and high humidity, which do not have 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, 2015i).

White Nose Syndrome is the leading cause for the decline of this species. The numbers of Northern long-eared bats in hibernacula has decreased by 99 percent in the northeast United States (USFWS, 2015j). Other threats include hibernacula impacts (e.g., temperature or air flow restrictions), habitat loss or fragmentation, habitat forest management practices that are incompatible with this species’ habitat needs, and strikes with wind turbines (USFWS, 2015i) (USFWS, 2015j).

Ozark Big-eared Bat. The Ozark big-eared bat is a medium-sized bat, weighing approximately 7 to 12 grams with distinguishing facial glands near the snout and long ears (>2.5 centimeters). The Ozark big-eared bats have light to dark brown fur, the shade varies based on age and subspecies. This species was federally listed as endangered in 1979 (44 FR 69206 69208, November 30, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst in Arkansas, Missouri, and Oklahoma (USFWS, 2015k). In Oklahoma, the Ozark big-eared bat is known to occur in five counties in the northeastern region of the state (USFWS, 2015k). Most of the species population occurs in Adair County and adjacent parts of Cherokee and Delaware Counties (ODWC, 2011b).

The Ozark big-eared bats live in caves all year. This species prefers to inhabit karst caves that are located in mature hardwood forests dominated by hickory (*Carya spp.*), beech (*Fagus spp.*), maple (*Acer spp.*), and hemlock (*Tsuga spp.*) trees. Hibernation caves are generally located in areas where wind exposure is minimal, whereas maternity caves are located close to food sources. Although mating occurs in the fall, fertilization occurs following hibernation, from which pregnant females then move to their maternity caves to give birth and raise their young (USFWS, 2008).

A major threat to this species is the disturbance of hibernating and maternity colonies. Disturbance is caused by cave exploration and commercialization, fragmentation of foraging habitat, and encroaching development (USFWS, 2008). Prior to hibernation, Ozark big-eared bats store just enough fat to sustain them until spring. When the bats are disturbed during hibernation their fat reserves are burned more quickly and can result in the bats starving to death before spring arrives (USFWS, 1997b).

Birds

There are four endangered and three threatened species that are federally listed and known to occur in the state of Oklahoma, as summarized in Table 12.1.6-5. The least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*) are found close to water, while the red-cockaded woodpecker (*Picoides borealis*) is found in mature forests in southeastern Oklahoma. The black-capped vireo (*Vitreo atricapilla*) is found in brushy hardwood thickets in southwestern Oklahoma, and the lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a rare occupant of prairies in the western portion of the state. (USFWS, 2015d) Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oklahoma is provided below.

Table 12.1.6-5: Federally Listed Bird Species of Oklahoma

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Oklahoma	Habitat Description
Black-capped Vireo	*Vireo atricapilla*	E	No	Brushy thickets of deciduous trees in southwestern Oklahoma.
Least Tern	*Sterna antillarum*	E	No	Wide, sandy river banks throughout Oklahoma.
Lesser Prairie-chicken	*Tympanuchus pallidicinctus*	T	No	Mixed grass prairie lands in western Oklahoma.
Piping Plover	*Charadrius melodus*	T	No	Open beaches along lakes and rivers throughout the state.
Red Knot	*Calidris canutus rufa*	T	No	Coastlines of large rivers, and wetlands and marshes throughout the state.
Red-cockaded Woodpecker	*Picoides borealis*	E	No	Mature pine forest in southeastern Oklahoma.
Whooping Crane	*Grus americana*	E	Yes	Marshes, wetlands, and river habitats in the western half of Oklahoma.

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

Black-capped Vireo. The black-capped vireo is one of the smallest of the vireos, weighing 9 to 10 grams and measuring approximately 4.5 inches in length. The species is sexually dichromatic (sexes are different colorations); males have a black head, olive green back, and white below, with tinged yellowish-green flanks, while females generally have a gray head (USFWS, 1991a). This species was federally listed as endangered in 1987 (52 FR 37420 37423, October 6, 1987).

Historic species range extended from south-central Kansas, through central Oklahoma and Texas, and through central Coahuila (Mexico) (USFWS, 1991a). Current migratory range in Oklahoma between mid-April and early September covers in nine counties in the southwestern portion of the state (USFWS, 2015l), with known populations located in the Wichita Mountains of northern Comanche County and the canyon lands of northern Blaine County north of Watonga (ODWC, 2011c).

Black-capped vireo habitat includes low brushy thickets of deciduous trees such as oaks, redbuds, and plums on thin and rocky soils. Threats to this species include habitat loss associated with development and agriculture, as well as cowbird nest parasitism (ODWC, 2011c).

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). Least Terns occur along the Atlantic and Gulf coasts of the U.S., as well as on several wide, sandy rivers in Great Plains such as the Missouri, Platte, and Yellowstone. The tern is a summer resident in Oklahoma and may be found on portions of the Arkansas, Cimarron, Canadian, and Red rivers (ODWC, 2011d). The least tern is known to occur in 46 counties throughout the state of Oklahoma (USFWS, 2015m).

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 (USFWS, 2014c). 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).

Lesser Prairie-chicken. The lesser prairie-chicken is a medium-sized, grayish brown grouse of approximately 16 inches in length. The species is marked with alternating brown and white bands and have tufts of elongated feathers on each side of their neck. The lesser prairie-chicken was federally listed as threatened in 2014 (79 FR 19973 20071, April 10, 2014) although current legislation is challenging this listing (National Audubon Society, 2015b) (USFWS, 2015n). Historically the lesser prairie-chicken was found throughout the southern plains of states of Texas, New Mexico, Oklahoma, Kansas, and Colorado, but today, the species ranges in less than 16 percent of these grasslands (USFWS, 2014d). Locally, the species is known to occur in 10 counties in western Oklahoma (USFWS, 2015n).

Lesser Prairie-chicken
Photo credit: USFWS

Primary threats to the species include habitat loss and fragmentation due to development, infrastructure, and land conversion, impacts from oil/gas and wind farms, transmission lines, and recent droughts which dropped the lesser prairie-chicken populations by more than half. Additional factors include impacts from invasive plants, predation, and that the species becomes less resilient with greater isolation (USDA, 2011).

Piping Plover. The piping plover is a small, pale brown-colored, shorebird with a short beak and black band across its forehead, measuring approximately 7.25 inches in length. The piping plover was listed as endangered in 1985 for the Great Lakes watershed of both the United States and Canada, and as threatened in the remainder of its range in the U.S., which includes the Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, and the Virgin Islands (50 FR 50726 50734, December 11, 1985) (USFWS, 2015o). Critical habitat was designated in 2002 (67 FR 57637, September 11, 2002), but there is no designated critical habitat in Oklahoma. The piping plover may be found in northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. for approximately 3 to 4 months during the summer breeding season. In Oklahoma, the species is typically a spring and fall migrant and has been known to occur throughout the state, most recently in Woodward, Alfalfa, Oklahoma, Cleveland, Tulsa, and Washington Counties. There are two nesting records for the piping plover in the Oklahoma panhandle (ODWC, 2011e).

Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Nesting often occurs in palustrine wetlands[92] in the Northern Great Plains (USFWS, 1988). They feed on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates. Current threats to this species include habitat loss and habitat degradation, human disturbance, pets, predation, flooding from coastal storms, and environmental contaminants (USFWS, 2015p) (USFWS, 2015q).

Red Knot. The red knot is approximately 9 inches in length with a wing span up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2013c).The species was listed as threatened in 2014 (79 FR 73705 73748, December 11, 2014). The knot migrates annually from its breeding grounds above the Arctic Circle to the tip of South America where it winters. During spring and fall migration, the red knot travels in “non-stop segments of 1,500 miles and more, ending at stop sites called staging areas” (USFWS, 2005). In Oklahoma, the red knot is a rare spring and fall transient throughout the state. Only 40 birds have been reported to land in Oklahoma, of which 85 percent have been during the fall migration (ODWC, 2015j).

The preferred habitat for the red knot is intertidal marines, estuaries, and bays. Mussel beds are important food sources for the red knot. Red knots eat mussels and other mollusks almost all year; however, during migration season red knots eat “juvenile clams and mussels and horseshoe crab eggs” (USFWS, 2013c). Current threats to the red knot include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at their migration stopovers; and disturbance by humans, dogs, vehicles, and climate change (USFWS, 2014b) (USFWS, 2016).

Red-cockaded Woodpecker. The red-cockaded woodpecker is a small black and white bird that grows approximately 7 inches with a wingspan of about 15 inches. It is characterized by its black cap and white cheek patches (USFWS, 2015z). Male red-cockaded woodpeckers have a “rarely visible” red marking on the side of their neck (USFWS, 2015s).The red-cockaded woodpecker was listed as endangered in 1970 under early endangered species legislation (35 FR

[92] Palustrine wetlands: “Palustrine wetlands include nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens” (USEPA, 2015d).

16047 16048, October 13, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). Regionally, this species is known to occur in open pine forests from Virginia south to Florida and west to Oklahoma and Texas. In Oklahoma, the red-cockaded woodpecker occurs in two counties in the southeastern region of the state (USFWS, 2015ai) on the McCurtain County Wilderness Area, which is owned by the ODWC and is the largest tract of uncut pine forest in the state (ODWC, 2011f).

The preferred habitat for the red-cockaded woodpecker is mature pine forests, with the preferred pine species being the longleaf pines (*Pinus palustris*). Red-cockaded woodpeckers forage on insects by pecking pine trunks and branches and flaking away bark. Its diet is primarily composed of insects, with occasional wild fruits and pine seeds. Another current threat to the red-cockaded woodpecker includes lack of suitable habitats (USFWS, 2003).

Whooping Crane. The whooping crane is large snowy white plumed bird with a black beak and feet. It is the tallest bird of 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.) (USFWS, 2015aj). The whooping crane nests in Canada and in Florida and Wisconsin in the U.S. It migrates bi-annually between central Canada in summer and the Texas coast in the winter, crossing the Great Plains in the spring and fall. The migratory corridor runs nearly straight from the Canadian Prairie Provinces of Alberta and Saskatchewan through the Great Plains states of eastern Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. The species migrates throughout 59 counties in the western half of Oklahoma (USFWS, 2015aj).

Suitable habitat for the whooping crane consists of marshes, wet meadows and prairies, riverine habitats, and agricultural fields. Historically, threats to the whooping crane included hunting, displacement by humans, and loss of habitat. Current reasons for this species' decline have to with 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, 2007).

Fish

There are four threatened fish species federally listed and known to occur in the state of Oklahoma as summarized in Table 12.1.6-6. The Neosho madtom (*Noturus placidus*) occurs within the Neosho River along the Oklahoma-Kansas state border. The Arkansas River shiner (*Notropis girardi*) is found along the Cimarron and Canadian rivers in Oklahoma, the leopard darter (*Percina pantherina*) occurs throughout the Little River watershed in southeast Oklahoma, and the Ozark cavefish (*Amblyopsis rosae*) occurs in groundwater habitats in the northeastern region of Oklahoma. (USFWS, 2015d) Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oklahoma is provided below.

Table 12.1.6-6: Federally Listed Fish Species of Oklahoma

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Oklahoma	Habitat Description
Arkansas River Shiner	*Notropis girardi*	T	Yes	Cimarron and Canadian rivers in Oklahoma.
Leopard Darter	*Percina pantherina*	T	Yes	Within the Little River watershed in southeast Oklahoma.
Neosho Madtom	*Noturus placidus*	T	No	Within the Neosho River along the Oklahoma-Kansas state border.
Ozark Cavefish	*Amblyopsis rosae*	T	No	Underground streams and wet caves in northeast Oklahoma.

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

Arkansas River Shiner. The Arkansas River shiner is a small minnow, measuring up to 2 inches in length. This species has a light tan back, silvery sides, and a white belly. Distinguishing features include a rounded snout and a dark mark at the base of the tail fin (USFWS, 2001). The Arkansas River shiner was federally listed as threatened in 1998 (63 FR 64772 64799, November 23, 1998). Regionally, this species is known to occur in Arkansas, Kansas, New Mexico, Oklahoma, and Texas. Historically, the Arkansas River Shiner occupied the Arkansas River and all its major river tributaries in the Great Plains, including the Cimarron, North Canadian, and Canadian rivers. Presently in Oklahoma, this species occurs in the Canadian River, and a small population may persist in the Cimarron River (ODWC, 2011g). Critical habitat has been designated for the Arkansas River shiner and it consists of portions of the Cimarron River in Kansas and Oklahoma and a section of the Canadian River in Oklahoma (70 FR 59808 59846, October 13, 2005).

The preferred habitat for the Arkansas River shiner is a shallow, braided channel with a primarily sandy bottom, where pools and riffles are also present. The primary threat to this species is stream modification and reduction caused by impoundments, water diversion, groundwater mining, channelization, and non-native species (USFWS, 2001).

Leopard Darter. The leopard darter is a small fish, with a total body length of up to 8.7 centimeters. This species ranges from tan to olive in color and is distinguishable by the 11 to 14 black spots along each of its sides (USFWS, 2012b). The leopard darter was federally listed as threatened in 1978 (43 FR 3711 3716, January 27, 1978). Regionally, this species is endemic to the Little River basin in Arkansas and Oklahoma. In Oklahoma, this species is known to occur within the Little River watershed (ODWC, 2011h) in three counties in the southeast region of the state (USFWS, 2015r). Critical habitat has been designated for the leopard darter in Oklahoma and Arkansas. In Oklahoma, upper Little River, the Black Fork Creek tributary to the Little River, upper portions of the Glover River, and the main channel of the Mountain Fork have been established as critical habitat (43 FR 3711 3716, January 27, 1978).

From June to early February this species typically inhabits pools with rocky bottoms. During the reproductive season, from February to April, this species inhabits riffles (USFWS, 2012b). The major threats to this species include habitat loss, fragmentation, and degradation. The primary cause of these threats is the creation and operation of dams and reservoirs, which alter hydrology and isolate populations. Agricultural and logging operations contribute to habitat degradation through spills, runoff, and increased erosion (USFWS, 2012b).

Neosho Madtom. The Neosho madtom is a small catfish, averaging less than 3 inches in length. It has a brownish stripe and mottled skin pigment, and a relatively deep body. The Neosho madtom was listed as threatened in 2013 (78 FR 57076 57097, September 17, 2013) (USFWS, 2015ak). The current distribution of the Neosho madtom occurs in the Neosho River drainage, including the Neosho River in Kansas and Oklahoma, the Cottonwood River in Kansas, and the Spring River in Missouri and Kansas (USFWS, 1990). In Oklahoma, the species occurs within a 14-mile reach of the Neosho River near the Oklahoma-Kansas state line (ODWC, 2011i) in Craig and Ottawa Counties (USFWS, 2015ak).

Habitat for mature Neosho madtom includes shallow, gravel-bottom rivers, with swift currents. Threats to this species includes habitat destruction and modification, principally due to impoundments, dredging activities, and increased water demands (USFWS, 1990).

Ozark Cavefish. The Ozark cavefish is a small fish, pinkish-white in appearance, with a total body length of approximately 2.25 inches. This species lacks eyes, pigment, and pelvic fins (USFWS, 2011a) (USFWS, 2015af). The Ozark cavefish was first federally listed as threatened in 1984 (49 FR 43965 43969, November 1, 1984). Regionally, the Ozark cavefish is restricted to the Springfield Plateau in northeast Oklahoma, northwest Arkansas, and southwest Missouri. In Oklahoma, this species is known to occur in streams in wet caves in Delaware, Mayes, and Ottawa Counties in the northeast region of the state (ODWC, 2011j).

Suitable habitat for this species includes cave streams, sinkholes, and underground aquifers where light is always absent (USFWS, 2011a). The major threat to this species is habitat loss or degradation. The primary cause of these threats is agricultural operations and development, which can cause spills, runoff, changes in hydrology, and increased groundwater withdrawals. Human disturbance caused by exploration of caves is also a threat to this species (USFWS, 2011a).

Invertebrates

Five endangered and one threatened invertebrate species are federally listed and known to occur in the state of Oklahoma as summarized in Table 12.1.6-7. The rabbitsfoot (*Quadrula cylindrica cylindrica*) and winged mapleleaf (*Quadrula fragosa*) occur in streams in both the northeast and southeast regions of Oklahoma. The Neosho mucket (*Lampsilis rafinesqueana*) occurs in northeast Oklahoma, although the mucket is an aquatic species and the moth inhabits forested areas. The Ouachita rock pocketbook (*Arkansia wheeleri*) and scaleshell mussel (*Leptodea leptodon*) occur in southeastern Oklahoma, and the American burying beetle is found in the eastern one-third of the state. (USFWS, 2015d) Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oklahoma is provided below.

Table 12.1.6-7: Federally Listed Invertebrate Species of Oklahoma

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Oklahoma	Habitat Description
American Burying Beetle	*Nicrophorus americanus*	E	No	Flat, forested areas in the eastern third of the state.
Neosho Mucket	*Lampsilis rafinesqueana*	E	Yes	Occurs within the Arkansas River system in northeastern Oklahoma.
Ouachita Rock Pocketbook	*Arkansia wheeleri*	E	No	Within Kiamichi and Little rivers in southeastern Oklahoma.
Rabbitsfoot	*Quadrula cylindrical cylindrica*	T	Yes	Streams in northeast and southeast Oklahoma.
Scaleshell Mussel	*Leptodea leptodon*	E	No	In the Kiamichi and Little rivers in southeastern Oklahoma.
Winged Mapleleaf	*Quadrula fragosa*	E	No	In the Little, Kiamichi, and Boggy river systems in the southeast and northeast portions of Oklahoma.

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

American Burying Beetle. The American burying beetle is the largest carrion beetle in North America with a length of between 1 to 2 inches. It has a shiny black shell, smooth shiny black legs, 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, 1991b). Historically the species ranged in more than 150 counties in 35 states of the eastern and central U.S. (USFWS, 1991b) but today is found in 5 distinct populations across 10 states. In Oklahoma, the American burying beetle is found in 31 counties in the eastern third of the state (USFWS, 2015t).

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

Neosho Mucket. The Neosho mucket is a medium-sized mussel, measuring up to 3.7 inches in length. The shell of this species is olive-yellow to brown with green rays that are usually discontinuous. Males have an elliptical shell, while females have an ovate (USFWS, 2015u). This species was listed as endangered in 2013 (78 FR 57076 57097, September 17, 2013). This species is endemic to the Arkansas River system and is known to occur in Arkansas, Kansas, Missouri, and Oklahoma. In Oklahoma, this species is known to occur in 11 counties in the northeastern corner of the state (USFWS, 2015u). Specifically the species occurs in the Illinois River upstream from Tenkiller Reservoir, and potentially in portions of the Illinois River's larger tributaries – the Barren Fork, Caney Creek, and Flint Creek. Small populations may also occur in the upper reaches of the Verdigris River and Neosho River near the state line (ODWC, 2011k). Critical habitat has been designated for the Neosho mucket and consists of seven stream segments throughout its range (80 FR 24691 24774, April 30, 2015). In Oklahoma, critical habitat exists along the Illinois River from the Arkansas-Oklahoma state line to its confluence with Baron Creek through Adair, Cherokee, and Delaware Counties; and along the Elk River from the Missouri-Oklahoma state line to its confluence of Buffalo Creek in Delaware County (USFWS, 2015v).

The Neosho mucket is commonly found in riffles and runs with fast currents and gravel bottoms. Occasionally, this species is found close to shore, out of the main current (USFWS, 2015u). Threats to this species include habitat loss and degradation due to development, agricultural operations, and treated wastewater releases (USFWS, 2015v).

Ouachita Rock Pocketbook. The Ouachita rock pocketbook is a medium-sized mussel, measuring up to 4.4 inches in length (USFWS, 2004b). This species has a shiny shell that is brown to black in color. The Ouachita rock pocketbook was federally listed as endangered in 1991 (56 FR 54950 54957, October 23, 1991). Regionally, this species is known or believed to occur in Arkansas and Oklahoma (USFWS, 2015ag). In Oklahoma, remaining populations exist in the Kiamichi River and the Little River in three counties (La Flore, McCurtain, and Pushmataha) in the southeastern region of the state (USFWS, 2015ag) (ODWC, 2011l).

The Ouachita rock pocketbook inhabits stable substrates within pools, backwaters, and side channels. This species is typically found in mussel beds where several other mussel species are also present (USFWS, 2004b). The major threat to this species is habitat loss and degradation due to water impoundment, channelization, and reduced water quality (USFWS, 2004b).

Rabbitsfoot. The rabbitsfoot can grow up to 6 inches in length. The shell of the rabbitsfoot mussel is generally yellowish, greenish, or olive in color and turns yellowish brown with age (USFWS, 2015w). The rabbitsfoot mussel was federally listed as threatened in 2013 (78 FR 57076 57097, September 17, 2013). Regionally, this species occurs from Kansas to Pennsylvania and from Oklahoma to Alabama. In Oklahoma, this species is known or believed to occur in five counties in the northeast and southeast regions of the state (USFWS, 2015w). Critical habitat was designated in 2015 at 31 stream segments where the mussels are known to occur (80 FR 24691 24774, April 30, 2015). Critical habitat for rabbitsfoot mussel in Oklahoma is located along the Verdigris River from Oologah Lake dam to Oklahoma Highway 266 in Rogers County, and along Little River from its confluence with Glover River to the Oklahoma-Arkansas state line in McCurtain County (USFWS, 2015v).

The rabbitsfoot is a sedentary filter feeder that obtains its oxygen and food from the water column. The rabbitsfoot prefers the shallow area of streams and rivers with sand and gravel along the banks. These mussels seldom burrow and instead use the gravel along the banks as refuge in fast moving rivers and streams. For reproduction this species prefers a stable and undisturbed habitat with a sufficient population of host fish including several genera of shiners (*Cyprinella, Luxilus*, and *Notropis*) (USFWS, 2011b).

The rabbitsfoot prefers shallow areas of streams and rivers with sand and gravel along the banks. These mussels seldom burrow and instead use the gravel along the banks as refuge in fast moving rivers and streams. For reproduction this species prefers stable and undisturbed habitats with a sufficient population of host fish (USFWS, 2015w). The current threats to the rabbitsfoot include the loss of habitat, isolation of populations, range restrictions, sedimentation, and presence of exotic non-native species (USFWS, 2012c).

Scaleshell Mussel. The scaleshell mussel is a smooth, brownish green mussel. This species is approximately 4 inches in length, with paper thin shell and light brown markings (USFWS, 2010). The scaleshell was federally listed as endangered in 2001 (66 FR 54808 54832, October 30, 2001). Historically, the scaleshell mussel occurred in 56 rivers throughout the Mississippi River Basin, but in the last 25 years it has only been documented in 18 streams (USFWS, 2010). In Oklahoma, the species is known to occur in the Kiamichi and Little rivers in the Ouachita Mountains in four counties in the southeastern region of the state (USFWS, 2015x) (ODWC, 2011m).

Though each mussel produces more than 400,000 larvae, 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 (USFWS, 2010). The scaleshell mussel is typically found in a variety of substrates within the stable riffles and runs of medium to large rivers (USFWS, 2010).

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, 2010).

Winged Mapleleaf. The winged mapleleaf is a generally round, reddish-brown, green-accented mussel which grows up to approximately 4 inches in length and may have two rows of bumps which lead from the rear hinge to the shell opening (USFWS, 1997c). The species was federally listed as endangered in 1991 (56 FR 28345 28349, June 20, 1991).

Historically, it was reported that the winged mapleleaf occurred in 34 rivers throughout the Mississippi River drainage (USFWS, 1999). However, there is speculation that all reports of the winged mapleleaf occurring from the Tennessee River below Wilson Dam may have actually been the mapleleaf mussel (*Quadrula quadrula)* (USFWS, 1999) (USFWS, 1997c). In 2001, The Fish and Wildlife Service created non-essential experimental population rule for the winged mapleleaf to be reintroduced to the Wilson Dam tailwater (66 FR 32250 32264, June 14, 2001). However, the Fish and Wildlife Service stated that the winged mapleleaf would not be released into the Wilson Dam tailwater until the speculation of the previously identified populations is resolved. In Oklahoma, the species is known or believed to occur in the Little River and potentially the Kiamichi and Boggy River systems throughout five counties in southeast and northeast portions of the state (ODWC, 2011n) (USFWS, 2015y).

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

Plants

One endangered plant species is federally listed and known to occur in the state of Oklahoma as summarized in Table 12.1.6-8. Harperella (*Ptilimnium nodosum*) occurs in habitats that are seasonally flooded in the southeastern portion of Oklahoma (USFWS, 2015d). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oklahoma is provided below.

Table 12.1.6-8: Federally Listed Plant Species of Oklahoma

Common Name	Scientific Name	Federal Status a	Critical Habitat in Oklahoma	Habitat Description
Harperella	*Ptilimnium nodosum*	E	No	Rocky, seasonally flooded areas in southeast Oklahoma.

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

Harperella. Harperella, or pond harperella, is a perennial herb that grows between half a foot and three feet tall. Its thin stalks have quill-like leaves and end in small white flowers with typically five petals each (USFWS, 2015al). The species was first listed as federally endangered in 1988 (53 FR 37978 37982, September 28, 1988). Harperella's range reaches down the coasat from Maryland to Georgia and extends across to Oklahoma. In Oklahoma, harperella is known or believed to exist in two counties (Le Flore and McCurtain) in the southeast region of the state (USFWS, 2015aa).

Habitat for pond harperella consists of shallow ponds in hilly terrain and along gravelly stream-banks of swift moving water. Threats to harperella consist of water changes in flow, depth, and quality, along with human factors such as damming, hydrologic alterations, and development. Habitat destruction, either through overwhelming water coverage or severe dehydration, can detrimentally impact the species' survival (USFWS, 2015ah).

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 Oklahoma, characterizing existing, baseline conditions for use in evaluating the potential environmental consequences resulting from implementing the Proposed Action or Alternatives.

Land Use and Recreation

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

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

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

Airspace

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

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

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

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

Because the Nation's airspace is governed by federal laws, there are no specific Oklahoma state laws that would alter the existing conditions relating to airspace for this PEIS. Title 3 Aircraft and Airports of the Oklahoma Statutes provide the authority to govern aviation for the state (The Oklahoma State Courts Network, 2015a).

12.1.7.3. Land Use and Ownership

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

Land Use

Table 12.1.7-1 identifies the major land uses by coverage type in Oklahoma. Agricultural land comprises the largest portion of land use, with 31 percent of Oklahoma's total land area occupied by this category. Forests and woodlands represent the second largest area of land use, with 26 percent of the total land area. Developed areas account for approximately six percent of the total land area. The remaining percentage of land includes public land, surface water, and other land covers, shown in Figure 12.1.7-1, that are not associated with specific land uses. (USGS, 2011)

Table 12.1.7-1: Major Land Use in Oklahoma by Coverage Type

Land Use	Square Miles	Percent of Land
Agricultural Land	21,328	31%
Forest and Woodland	18,228	27%
Developed Land	4,294	6%
Public Land, Surface Water, and other Land Cover	24,745	36%

Source: (USGS, 2011)

Agricultural Land

Agricultural land exists throughout the state on 21,328 square miles, or 31 percent of the total land area (Figure 12.1.7-1) (USGS, 2011). Approximately 80,245 farms exist in Oklahoma, with an average size of 0.7 square miles (U.S. Department of Agriculture, Census of Agriculture, 2012a). Oklahoma's top agricultural products are cattle and calves (48 percent of total agricultural receipts); grains, oilseeds, beans, and peas (18 percent of total agricultural receipts); poultry and eggs (14 percent of total agricultural receipts); and hogs and pigs (nine percent of total agricultural receipts) (U.S. Department of Agriculture, Census of Agriculture, 2012b).

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with and adjacent to agricultural areas. The largest concentrations of forested areas are located in the eastern portion of the state where forests, lakes, and the Ouachita Mountains dominate the landscape (Figure 12.1.7-1) (USGS, 2011). Section 12.1.6 presents additional information about terrestrial vegetation.

National Forests

National forestland in Oklahoma comprises approximately three percent of the state's total forestland, and includes a portion of one national forest, the Ouachita National Forest. This national forest occurs along the eastern border of the state, covering 550 square miles in Oklahoma (USGS, 2014f). The forest is managed for multiple uses and values, including recreation activities (e.g., camping, hiking), timber production, and maintenance of fish and wildlife habitat.

State Forests

State forests do not exist in Oklahoma. However, the state of Oklahoma owns small tracts of forestland that are managed as state parks and wildlife areas. State land ownership is discussed in detail below in the Land Ownership section.

Private Forest and Woodland

The large majority of Oklahoma's forests and woodlands (approximately 95 percent) are owned by private individuals and companies (Oklahoma Department of Agriculture, Food, and Forestry, 2015). Private forest lands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, and national forests. For additional information regarding forest and woodland areas, see section 12.1.6, Biological Resources and section 12.1.8, Visual Resources.

Developed Land

Developed land in Oklahoma is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 12.1.7-1). Although only six percent of Oklahoma's land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 12.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates.

Table 12.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Oklahoma City, OK	861,505
Tulsa, OK	655,479
Norman, OK	103,898
Lawton, OK	94,457
Enid, OK	47,609
Total State Population	**3,878,051**

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

12.1.7.4. Land Ownership

Land ownership within Oklahoma has been classified into four main categories: private, federal, state, and tribal (Figure 12.1.7-2).[93]

Private Land

The large majority of land in Oklahoma is privately owned (approximately 62,500 square miles or 91 percent of the total land in the state) (Figure 12.1.7-2), with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 12.1.7-1) (USGS, 2014g). Highly developed, urban, metropolitan areas transition into suburban, agriculture, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.[94] (See footnote below)

Federal Land

The federal government manages 2,328 square miles, or approximately three percent, of land in Oklahoma, including military installations, national forests, national parks, national scenic areas, and NWRs (Figure 12.1.7-2) (USGS, 2014f). Four federal agencies manage the majority of federal lands throughout the state (Figure 12.1.7-2 and Table 12.1.7-3). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.[95] (USGS, 2014g)

[93] 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.

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

[95] Not all Federal agency land is depicted in Figure 12.1.7-3 given the small size of some of the land acreage.

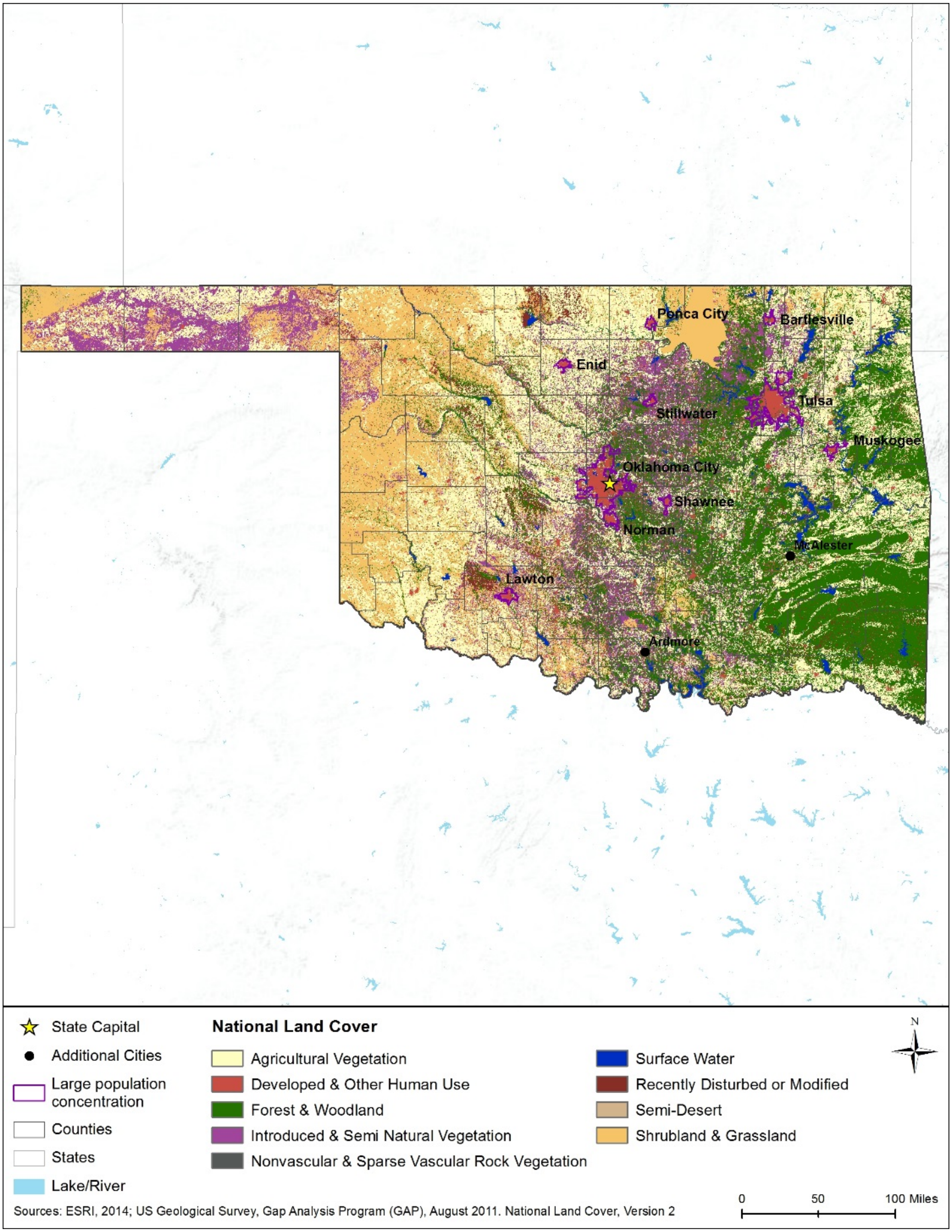

Figure 12.1.7-1: Major Land Use Distribution by Coverage Type

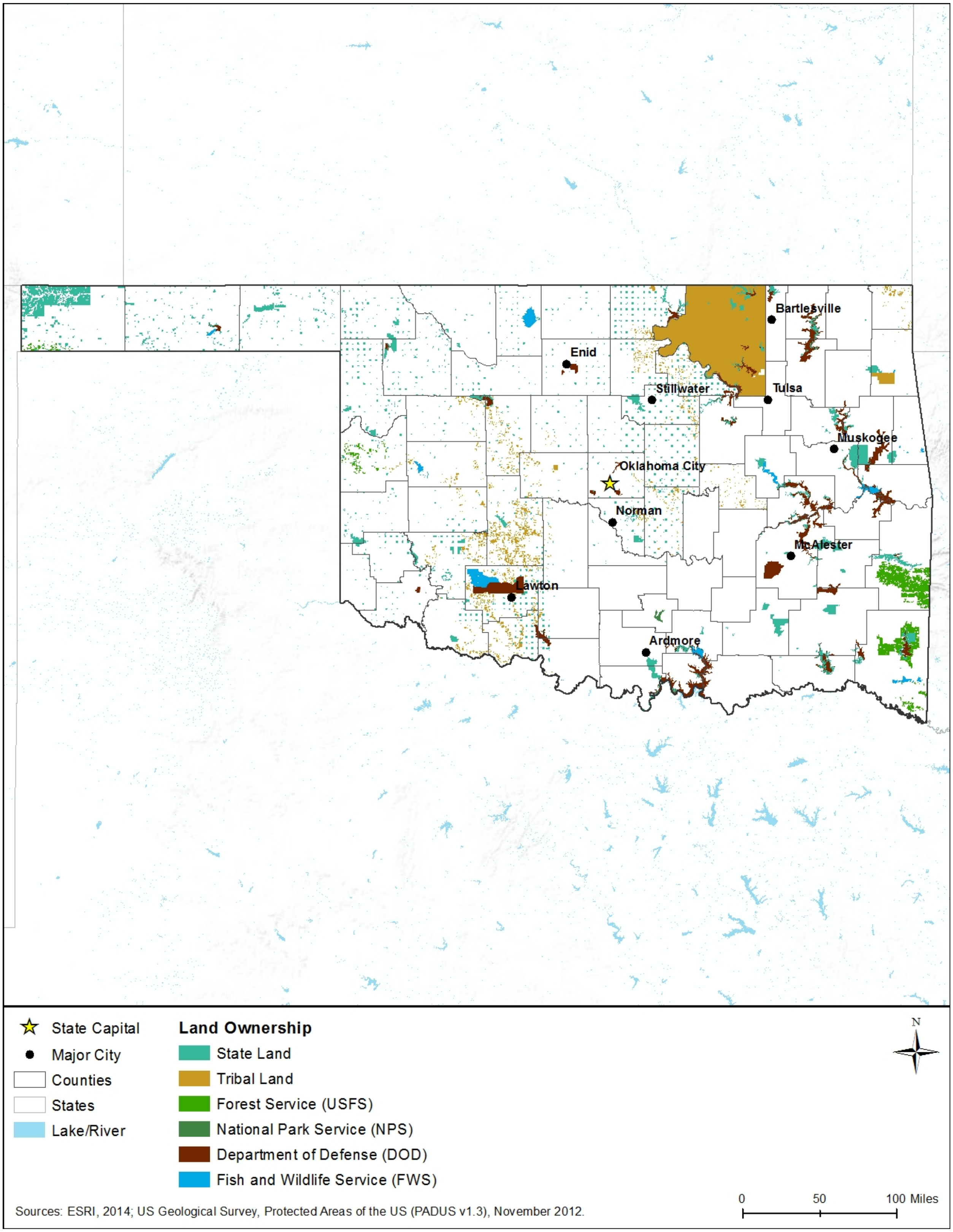

Figure 12.1.7-2: Major Land Ownership Distribution

Table 12.1.7-3: Federal Land in Oklahoma

Agency[a]	Square Miles	Representative Type
Department of Defense (DOD)	1,439	Military Installations and Lakes
U.S. Forest Service (USFS)	603	Forests and Scenic Areas
USFWS	270	Wildlife Refuges
NPS[b]	16	Recreation Area, Historic Sites, and National Memorial
Total	**2,328**	

[a] The BLM also manages small parcels of land; however, the majority of BLM management in Oklahoma involves sub-surface minerals management.
[b] Additional trails and corridors pass through Oklahoma that are part of the National Park System.
Source: (USGS, 2014g)

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

- The DOD (including the USACE) manages 1,439 square miles of land and surface water comprised of the U.S. Army Ammunition Depot, Fort Sill, three air force bases (Altus, Vance, and Tinker Air Force Bases), and 23 lakes (Optima, Fort Supply, Kaw, Waurika, Texoma, Arcadia, Hulah, Birch, Keystone, Heyburn, Hugo, Sardis, Eufaula, Skiatook, Candy, Copan, Oologah, Fort Gibson, Tenkiller Ferry, Robert S. Kerr, Wister, Broken Bow, and Pine Creek Lakes) (USGS, 2014g).
- The USFS manages 603 square miles of land comprised of the Ouachita National Forest, Winding Stair Mountain National Recreation Area, Indian Nations National Scenic and Wildlife Area, Beech Creek National Scenic and Botanical Area, and two national grasslands (Black Kettle and Rita Blanca National Grasslands (USGS, 2014g).
- The USFWS manages 270 square miles of land comprised of nine NWRs: Optima, Washita, Wichita Mountains, Salt Plains, Tishomingo, Deep Fork, Sequoyah, Little River, and Ozark Plateau (USGS, 2014g).
- The NPS manages 16 square miles of land consisting of 4 officially designated NPS units, including Chickasaw National Recreation Area, Fort Smith National Historic Site, Oklahoma City National Memorial, and Washita Battlefield National Historic Site (USGS, 2014g).

State Land[96]

Oklahoma owns, leases or manages approximately 2,241 square miles of land, or approximately three percent of the total land in the state (Figure 12.1.7-2) (USGS, 2014g). These lands are managed primarily by the Oklahoma Commissioners of the Land Office, ODWC, and State Parks and Recreation. The Commissioners of the Land Office manage approximately 1,172 square miles of land scattered throughout the state that was designated for common schools, colleges, universities. These lands were made available to state schools through the Enabling Act of 1906, which granted statehood to the Oklahoma Territory. These lands are leased for agricultural farming and grazing, outdoor sporting events, and other recreational activities, including camping, hunting, and fishing. Revenue generated from such uses are distributed to

[96] 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.

state common schools, colleges, and universities (Oklahoma Commissioners of the Land Office, 2015).

The ODWC manages approximately 824 square miles of land within 74 wildlife management areas that are scattered throughout the state. These wildlife management areas are managed to protect and retain fish and wildlife habitat and provide opportunities for fishing, hunting, and other recreational activities (ODWC, 2015f) (USGS, 2014g).

The Oklahoma Tourism and Recreation Department manages approximately 176 square miles of land across the state within 34 state parks (Oklahoma Tourism and Recreation Department, 2015a) (USGS, 2014g).

Tribal Land

Approximately 3,018 square miles, or four percent, of land in Oklahoma is managed by American Indian tribes across trust lands and reservations held in trust by the Bureau of Indian Affairs (Figure 12.1.7-2) (USGS, 2014g).[97] Table 12.1.7-4 presents the names of the American Indian tribes that manage trust lands and reservations in Oklahoma and the associated square miles those lands cover.

Table 12.1.7-4: American Indian Reservations and Other Land Holdings of Oklahoma

American Indian Tribes	Square Miles
Comanche Nation	0.0038
Apache Tribe	0.0038
Fort Sill Apache	0.0038
Caddo Indian Tribe	0.0038
Delaware Nation	0.0038
Wichita and Affiliated Tribes (Wichita, Keechi, Waco and Tawak)	0.0038
Cheyenne-Arapahoe Tribes	0.0038
Tonkawa Tribe of Indians	0.0038
Otoe-Missouria Tribe of Indians	0.0038
Ponca Tribe Indians	0.0038
Kickapoo Tribe	0.0038
Iowa Tribe	0.0038
Absentee-Shawnee Tribe	0.0038
Kaw Nation	0.0038
Pawnee Indian Tribe	0.0038
Sac & Fox Nation	0.0038
Thlopthlocco Tribal Town	0.0038
Alabama-Quassarte Tribal Town of the Creek Nation	0.0038
Peoria Tribe Indians	0.0038
Ottawa Indian Tribe	0.0038
Shawnee Tribe	0.0038
Seneca-Cayuga Tribe	0.0038
Quapaw Tribe	0.0038
Wyandotte Tribe	0.0038

[97] 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 for sovereign nations.

American Indian Tribes	Square Miles
Wyandotte Nation	0.0038
Delaware Tribe of Indians	0.0041
United Keetoowah Band of Cherokee Indians	0.0046
Kialegee Tribal Town of the Creek Indian Nation	0.0055
Wichita and Affiliated Tribes	0.0059
Kiowa Indian Tribe	0.0076
Chickasaw Nation	0.0076
Seminole Nation	0.0076
Choctaw Nation	0.0076
Muscogee (Creek) Nation	0.0076
Cherokee Nation	0.0076
Modoc Tribe	0.0076
Miami Tribe	0.0076
Peoria Tribe Trust Land	0.0646
Ottawa Tribe Trust Land	0.0697
Eastern Shawnee Tribe Trust Land	1.28
Kaw Nation Trust Land	1.86
Iowa Tribe Trust Land	1.9
Tonkawa Tribe Trust Land	1.97
Fort Sill Apache Trust Land	4.43
Seneca-Cayuga Tribe Trust Land	5.85
Citizen Potawatomi Trust Land	6.26
Kickapoo Tribe Trust Land	9.98
Absentee-Shawnee Tribe Trust Land	18.38
Quapaw Tribe Trust Land	19.73
Ponca Tribe Trust Land	22.31
Thlopthlocco Tribal Town (Creek)	25.3
Sac and Fox Nation Trust Land	25.46
Pawnee Indian Tribe Trust Land	30.75
Otoe-Missouria Tribe Trust Land	32.65
Cheyenne-Arapahoe Trust Land	116.92
Kiowa, Comanche, Apache Trust Land	395.98
Osage Reservation	2,296.73
Total	**3,018.05**

Source: (USGS, 2014g)

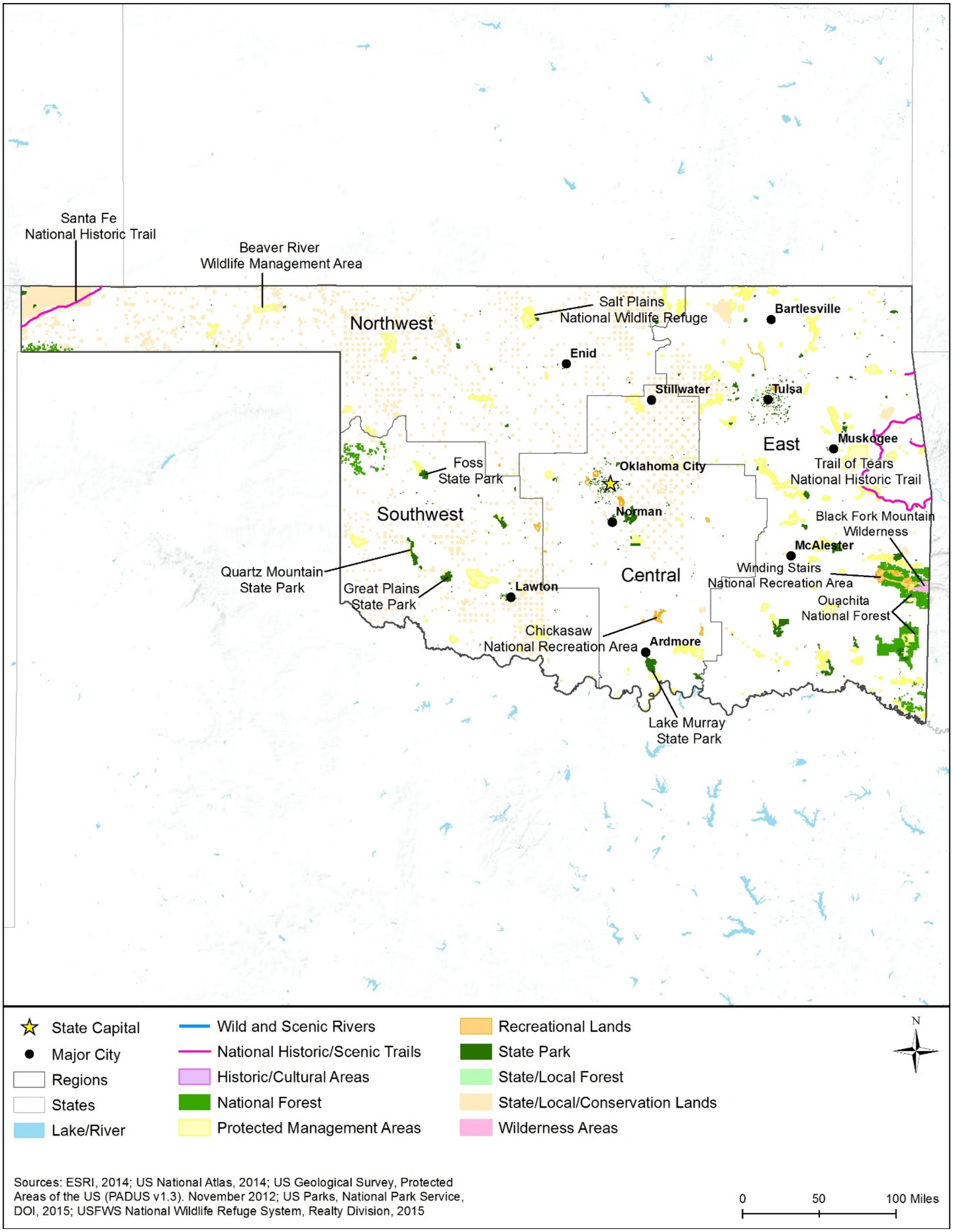

Figure 12.1.7-3: Oklahoma Recreation Resources

12.1.7.5. Recreation

Oklahoma is a geographically diverse state, with four mountain ranges and high plains. Recreation in the state takes advantage of the mountain ranges, forested areas, and manmade reservoirs. Hunting is popular within the state, with public and private wildlife management areas seasonally open for deer, elk, antelope, bear, mountain lion, turkey, and other game species (ODWC, 2015g). The state contains nine NWRs: activities within the refuges include hiking, and other trail use; camping and picnicking; fishing, kayaking, and other water activities; and licensed, seasonal hunting (USFWS, 2015ab). On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, and lake, river, or beach access points. Availability of community-level facilities is typically commensurate to the population's needs.

This section discusses recreational opportunities available at various locations throughout Illinois. For information on visual resources, see Section 12.1.8, Visual Resources, and for information on the historical significance of locations, see Section 12.1.11, Cultural Resources.

Northwest Region

Oklahoma's Northwest Region consists of the panhandle and the northwest section of the state, bordered by Colorado and Kansas to the north and Texas and New Mexico to the west (see Figure 12.1.7-3).[98] Known as the Red Carpet Country, this region is generally High Plains.

The Northwest Region contains nine state parks, which offer a variety of opportunities. The Alabaster Caverns State Park is the largest gypsum cave in the world, with hiking, tours, spelunking, and camping (Oklahoma Tourism and Recreation Department, 2015d). The Great Salt Plains State Park has a unique barren salt landscape surrounding a salt lake: activities include swimming, fishing, hiking, horseback riding, and kayaking (Oklahoma Tourism and Recreation Department, 2015e). Black Mesa State Park and Nature Preserve, in the panhandle, consists of black lava-coated mesas: activities within the park include camping, hiking, and wildlife watching (Oklahoma Tourism and Recreation Department, 2015f).

Southwest Region

The Southwestern Region, also known as Great Plains Country, is bordered to the west and south by Texas and the south by the Gulf of Mexico (see Figure 12.1.7-3). The region consists of short-grass prairie. Four state parks are located in the Southwest Region: the Great Plains State Park is known for mountain biking in the foothills of the Wichita Mountains; Fort Cobb State Park is popular for its golf course and lake activities; the Red Rock Canyon State Park is popular

[98] 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.

for mountain climbing and rappelling; and the Foss State Park has camping facilities and horseback riding trails (Oklahoma Tourism and Recreation Department, 2015g).

The Black Kettle National Grassland contains three recreation areas: Black Kettle Recreation Area, Skipout Lake, and Spring Creek Lake. In addition to grazing land and the Black Kettle Interpretive Trail, the recreation areas are outfitted for hiking and other trail use; camping and picnicking; fishing, boating, and other water activities; and licensed, seasonal hunting (USFS, 2015a).

Central Region

Oklahoma's Central Region consists of Frontier and Chickasaw Countries, bordered to the south by the Red River and Texas (see Figure 12.1.7-3). This region is comprised of hills and rolling prairies, with Oklahoma City the major population center. Oklahoma City is visited for attractions including the Skydance Bridge, and events including horse shows (Oklahoma City Convention & Visitors Bureau, 2015).

The Chickasaw National Recreation Area consists of two areas: the Platt Historic District, formerly the Platt National Park area, and the Lake of the Arbuckles, a reservoir popular for water activities. Other activities in the area include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; fishing, boating, and other water activities; and licensed, seasonal hunting. (NPS, 2015c)

Eastern Region

The Eastern Region, also known as Green or Choctaw Countries, is bordered to the north by Kansas, the east by Missouri and Arkansas, and the south by Texas (see Figure 12.1.7-3). This region has rolling hills and prairie, and Tulsa is the major population center. Tulsa is visited for its casinos and wineries, and for its Art Deco architecture (Visit Tulsa, 2015).

The Eastern Region contains 17 state parks and several golf courses, with a variety of recreation depending on their geography. State Parks including Grand Lake, Lake Wister, Sequoyah Bay, and Okmulgee specialize in water-based recreation, including boating, fishing, and swimming. Other parks, including Arrowhead and Natural Falls State Parks have cultivated extensive multi-use trails for hiking, horseback riding, bicycling, and other use. (Oklahoma Tourism and Recreation Department, 2015h) (Oklahoma Tourism and Recreation Department, 2015i)

12.1.7.6. Airspace

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

Airspace Categories

There are two categories of airspace or airspace areas:

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

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 12.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[99] service is based on the airspace classification (FAA, 2008).

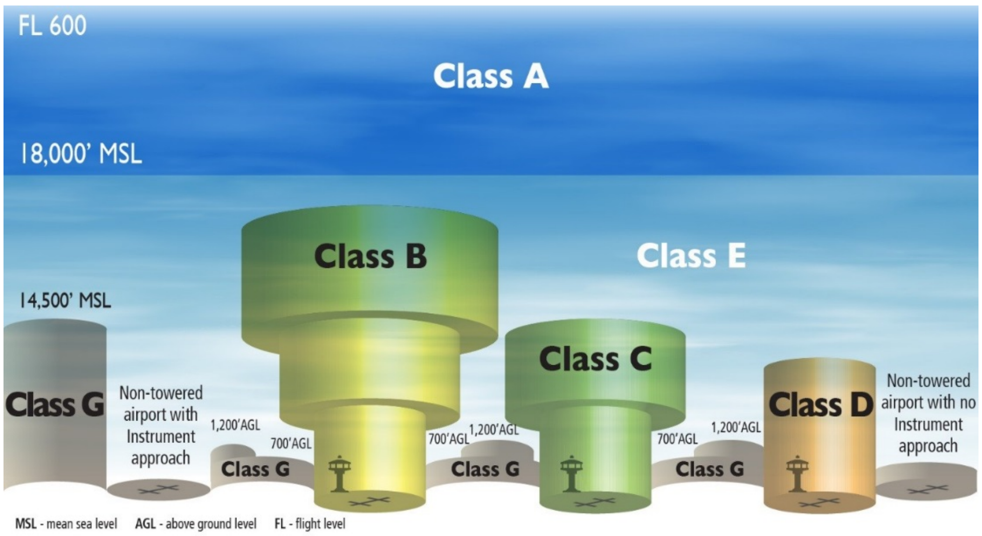

Figure 12.1.7-4: National Air Space Classification Profile

Source: (FAA, 2008)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[100]. 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).[101]

[99] ATC – Approved authority service to provide safe, orderly, and expeditious flow of air traffic operations (FAA, 2015c) .
[100] 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)
[101] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015c).

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

Uncontrolled Airspace

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

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (See Table 12.1.7-5).

Table 12.1.7-5: SUA Designations

SUA Type	Definition
Prohibited Areas	"Airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts."
Restricted Areas	"Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73."
Warning Areas	"Airspace of defined dimensions, extending from three NM from the U.S. coast, which contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn non-participating pilots of the potential danger. A warning area may be located over domestic or international waters or both."
MOAs	"Airspace of defined vertical and lateral limits established for separating certain military activities (e.g., air combat maneuvers, air intercepts, testing, etc.) from IFR traffic. Whenever an MOA is in use, non-participating IFR traffic may be cleared through a MOA if

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

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

Other Airspace Areas

Other airspace areas, explained in Table 12.1.7-6, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 12.1.7-6: Other Airspace Designations

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

Type	Definition
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.

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

12.1.7.7. Aerial System Considerations

Unmanned Aerial Systems

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

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

Balloons

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

12.1.7.8. Obstructions to Airspace Considerations

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

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

12.1.7.9. Oklahoma Airspace

The mission of the Oklahoma Aeronautics Commission is to "…promote aviation, which includes ensuring that the needs of commerce and communities across Oklahoma are met by the state's 110 public airports that comprise the state's air transportation system, and ensuring the growth and vitality of the state's aerospace industry." (Oklahoma Government , 2015) There is one FAA FSDO for Oklahoma located in Oklahoma City (FAA, 2015b).

Oklahoma 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 Oklahoma, while Figure 12.1.7-6 and Figure 12.1.7-7 presents the breakout by public and private airports/facilities. There are approximately 387 airports within Oklahoma as presented in Table 12.1.7-7 and Figure 12.1.7-5 through Figure 12.1.7-7 (USDOT, 2015a).

Table 12.1.7-7: Type and Number of Oklahoma Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	136	157
Heliport	2	87
Seaplane	1	0
Ultralight	0	4
Balloonport	0	0
Gliderport	0	0
Total	**139**	**248**

Source: (USDOT, 2015b)

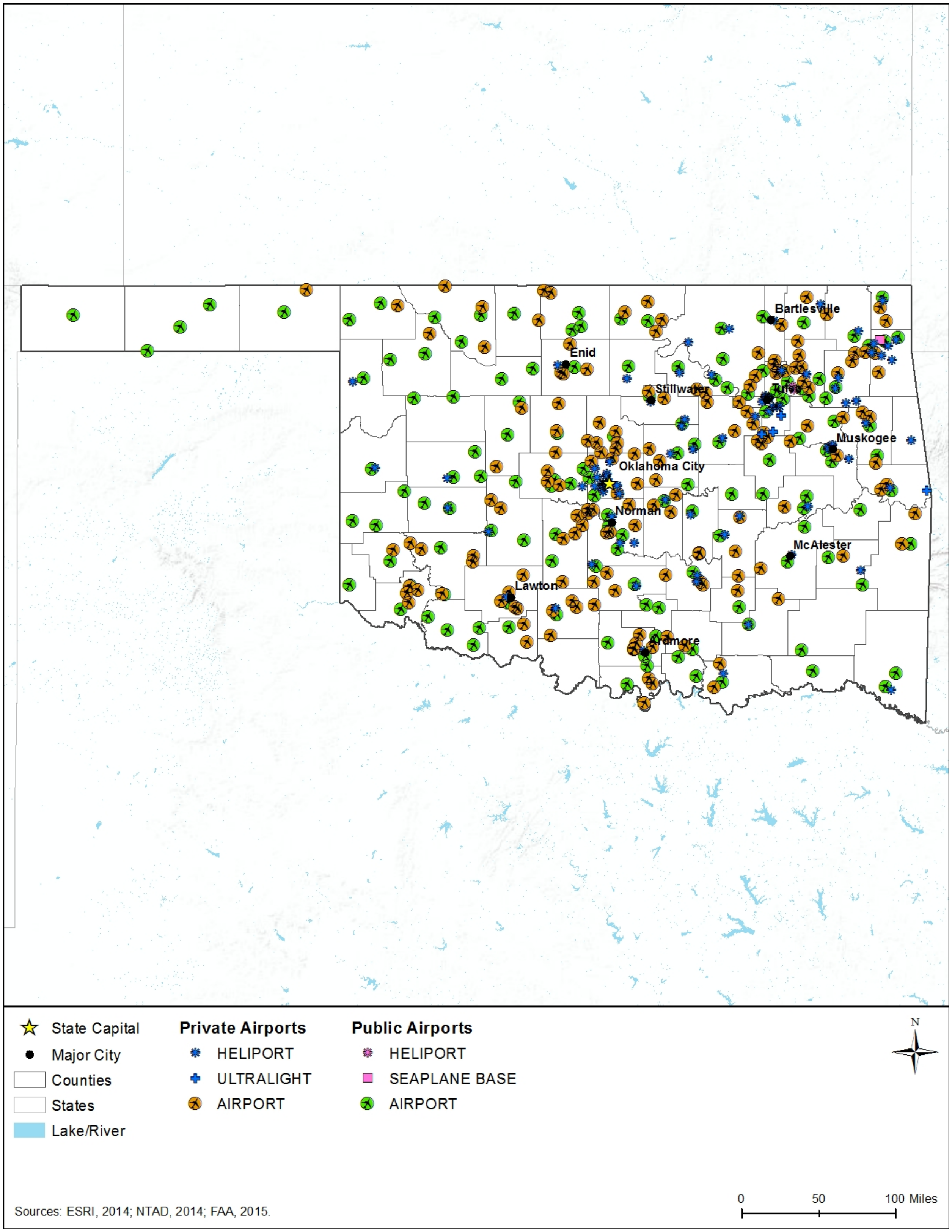

Figure 12.1.7-5: Composite of Oklahoma Airports/Facilities

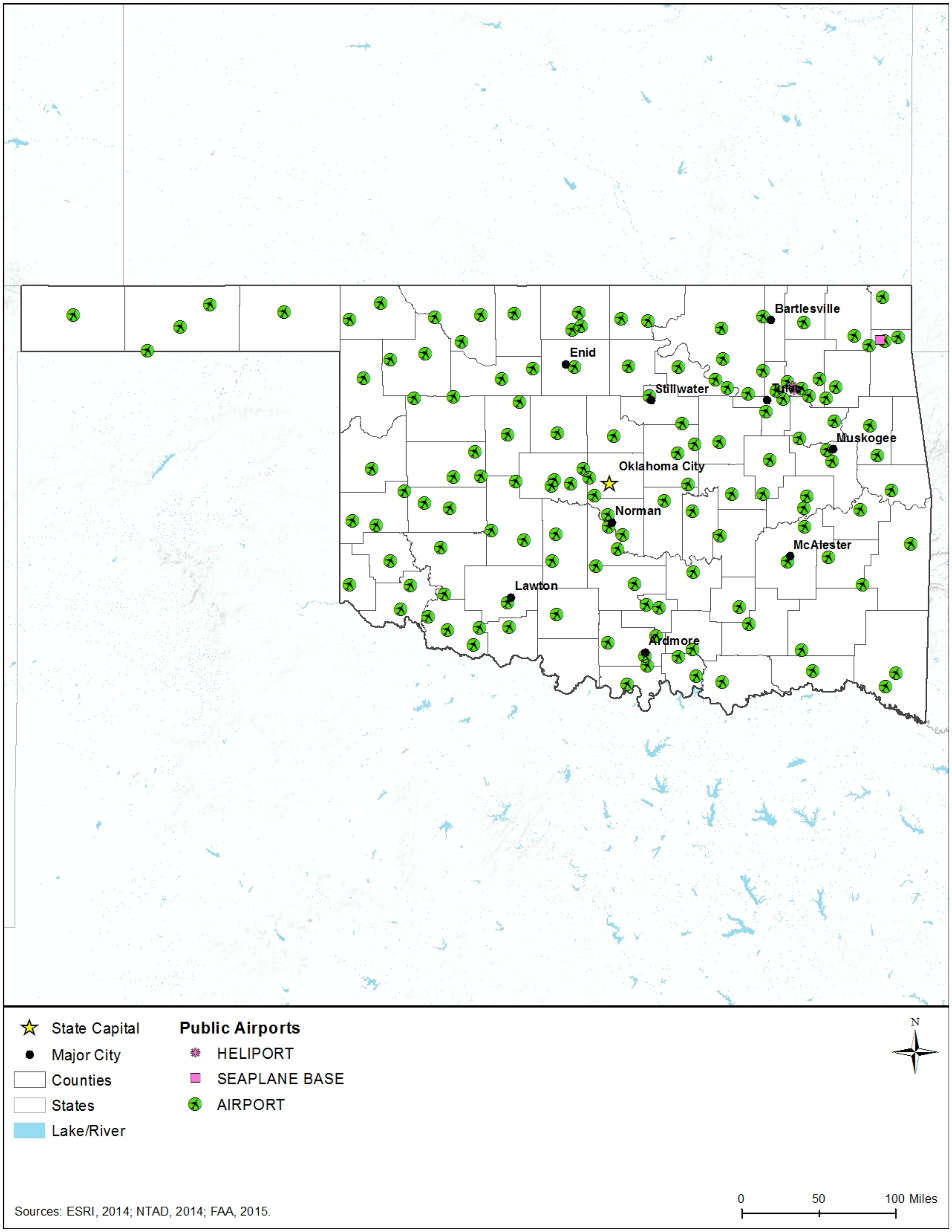

Figure 12.1.7-6: Public Oklahoma Airports/Facilities

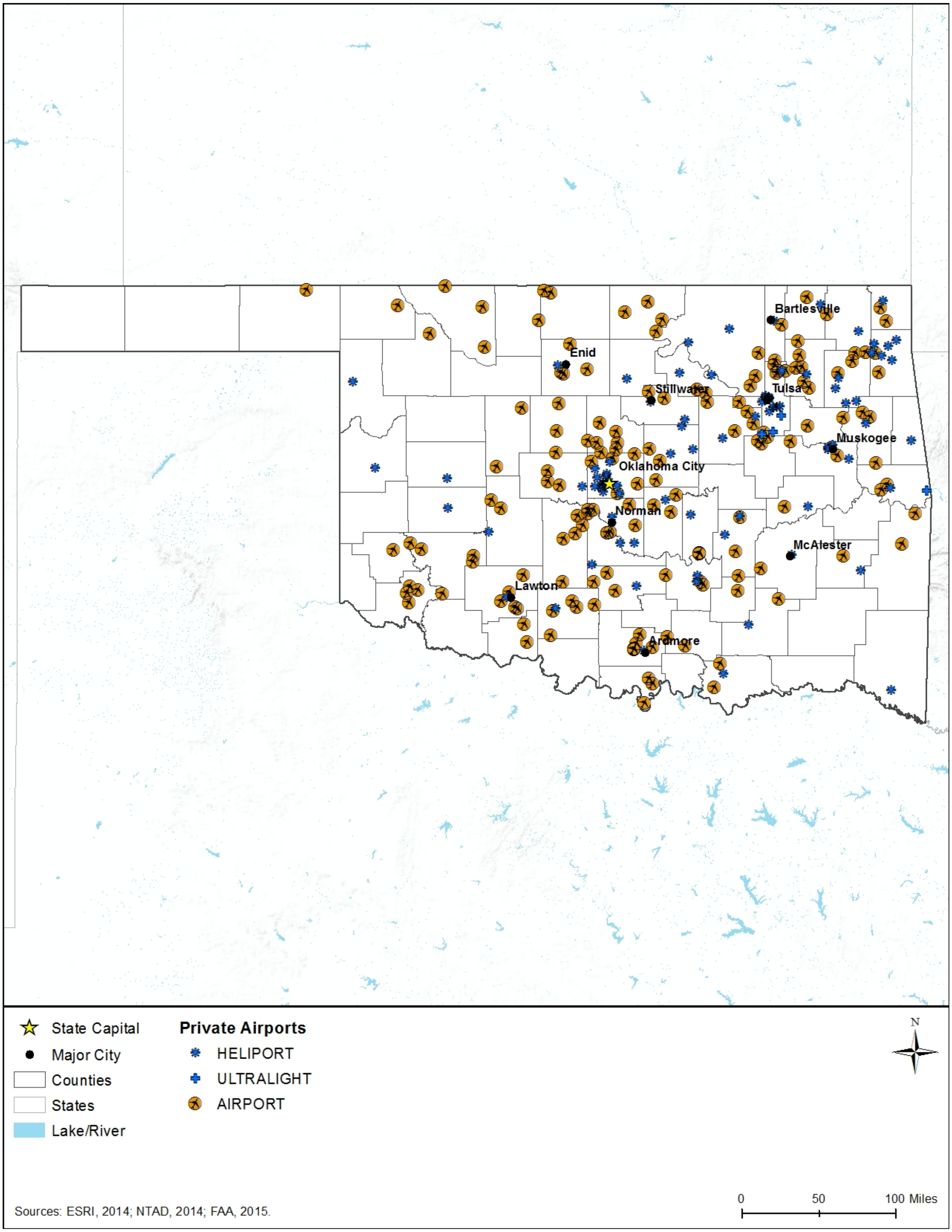

Figure 12.1.7-7: Private Oklahoma Airports/Facilities

There are Class C and D controlled airports as follows:

- Three Class C –
    - Tinker Air Force Base (AFB), Oklahoma City
    - Tulsa International
    - Will Rogers World Airport, Oklahoma City
- Thirteen Class D
    - Altus AFB
    - Ardmore Municipal
    - Clinton-Sherman, Clinton
    - Vance AFB, Enid
    - Enid Woodring Municipal
    - Henry Post Army Air Field, Fort Sill
    - Lawton Municipal
    - University of Oklahoma Westheimer Airpark, Norman
    - Wiley Post Airport, Oklahoma City
    - Stillwater Municipal
    - Tulsa Richard Lloyd Jones Jr. (FAA, 2015e)

SUAs (i.e., six restricted, seven MOAs, and three alert areas) located in Oklahoma are as follows:

- Fort Sill (Restricted) –
    - R-5601A – Surface to 40,000 feet MSL
    - R-5601B – Surface to 40,000 feet MSL
    - R-5601C – Surface to 40,000 feet MSL
    - R-5601D – 500 feet AGL to FL 400
    - R-5601E – 500 feet AGL to 6,000 feet MSL
    - R-5601F – 500 feet AGL to FL 400 (FAA, 2015f)

The seven MOAs for Oklahoma are as follows:

- Hollis –
    - From 11,000 feet MSL up to, but not including, FL 180
- Rivers –
    - 8,000 feet MSL to, but not including, FL 180

- Vance –
    - 1A – 8,000 feet MSL to, but not including, FL 180
    - 1B – 7,000 feet MSL to, but not including, FL 180
    - 1C – 8,000 feet MSL to, but not including, FL 180
    - 1D – 8,000 feet MSL to, but not including, FL 180
- Washita –
    - 8,000 feet MSL to, but not including, FL 180 (FAA, 2015f)

MOAs of Texas (Sheppard 1 and 2) extends into the lower southwest corner of Oklahoma, while the MOA of Arkansas (Hog High South) extends just into the lower southeast portion of the state (FAA, 2015f). The three Alert Areas are as follows:

- Fredrick –
    - A-561 – Surface to 4,000 feet MSL
- Enid –
    - A-562A – Surface to and including 10,000 feet MSL
    - A-562B – 6,000 feet MSL to, but not including, FL 180 (FAA, 2015f)

The Alert Area of Wichita Falls, Texas (A-636) extends into the lower southwest corner of the state. The SUAs for Oklahoma are presented in Figure 12.1.7-8. There are no TFRs (See Figure 12.1.7-8) (FAA, 2015g). Figure 12.1.7-9 presents the MTRs in Oklahoma consisting of 27 Visual Routes, 22 Instrument Routes, and 18 Slow Routes.

UAS Considerations

The National Park Service (NPS) signed a policy memorandum on June 24, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service" (NPS, 2014b). There are three National Parks in Oklahoma that must comply with this agency directive (NPS, 2015d).

Obstructions to Airspace Considerations

Several references in the Oklahoma statutes address airspace hazards. As defined in Section 65.1(c) of Title 3 Aircraft and Airports, an airport hazard is "any structure, object of natural growth, or use of land which obstructs the airspace required for the flight of aircraft in landing or taking off at an airport or is otherwise hazardous to such landing or taking off of aircraft" (The Oklahoma State Courts Network, 2015b). Section 120 Aircraft Pilot and Passenger Protection Act of Title 3 specifically addresses potential hazards to aviation. As addressed in Section 120.3, a permit is required from the Oklahoma Aeronautics Commission when the following are planned for construction or installation near a public-use airport:

- "Any proposed structure for an incompatible purpose in the primary surface or the runway protection zone;

- Any structure, alteration or addition to a structure within three (3) statute miles from the airport reference point of a public-use airport, that would result in a total structure height in excess of one hundred fifty (150) feet above the established airport elevation; and
- Any structure, alteration or addition to a structure that would result in a total structure height greater than the horizontal, conical or approach surfaces, as defined in Section 2 of the Aircraft Pilot and Passenger Protection Act" (The Oklahoma State Courts Network, 2015c).

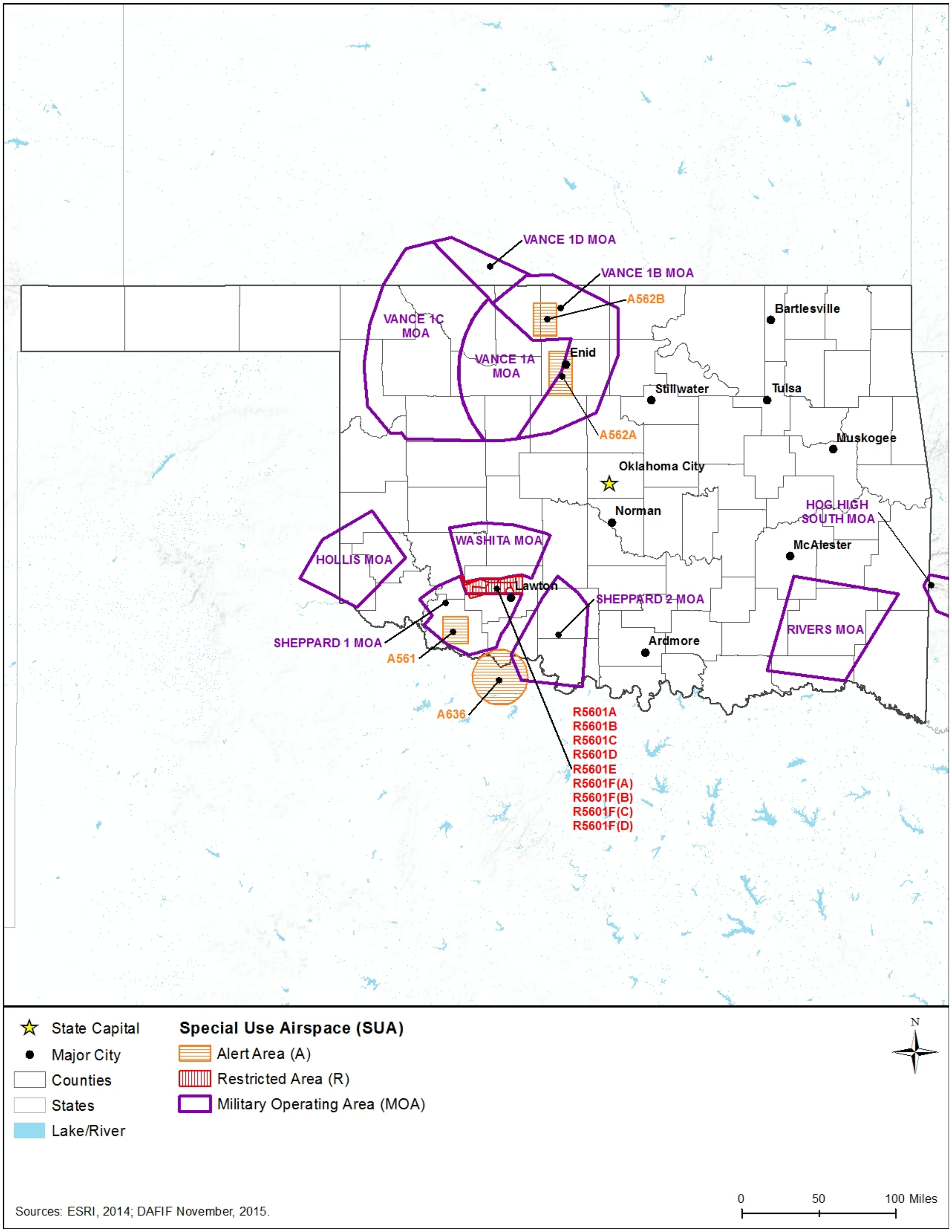

Figure 12.1.7-8: SUAs in Oklahoma

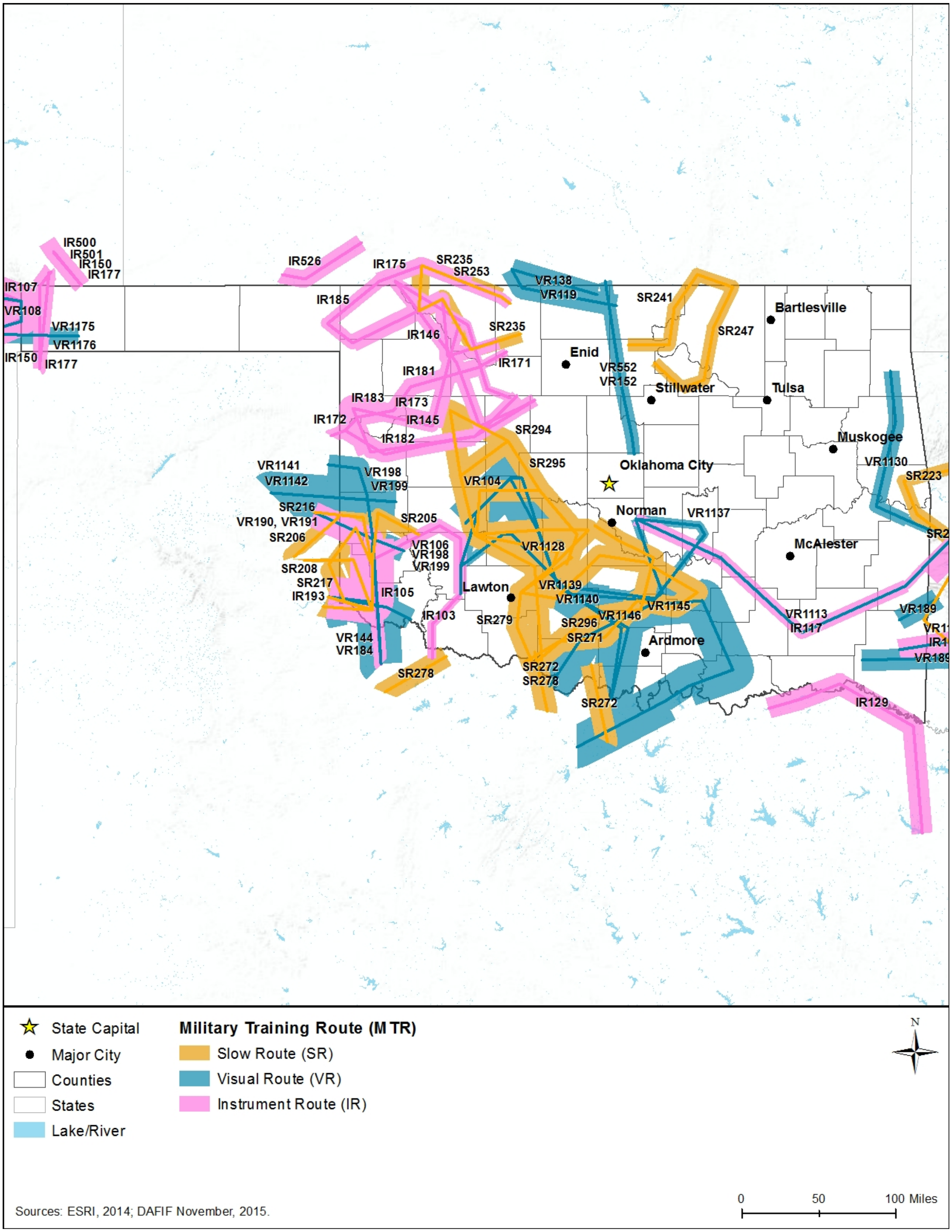

Figure 12.1.7-9: MTRs in Oklahoma

12.1.8. Visual Resources

12.1.8.1. Definition of Resources

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

12.1.8.2. Specific Regulatory Considerations

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

Table 12.1.8-1: Relevant Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Description
Oklahoma Scenic Rivers Act (OSRA)	Oklahoma Scenic Rivers Commission (OSRC)	Establishes the preservation of "free-flowing streams and rivers of Oklahoma...[that]…possess such unique natural scenic beauty, water conservation, fish, wildlife and outdoor recreational values of present and future benefit to the people of the state."
Oklahoma Historical Preservation Act	Oklahoma Historical Society	Creates the state register of historic places and endows the Oklahoma Historical Society with powers to collect, preserve and maintain materials relevant to Oklahoma history including state museums and historic sites.

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

12.1.8.3. Character and Visual Quality of the Existing Landscape

Oklahoma is home to the U.S. most diverse terrain. It houses 10 ecoregions from "Rocky Mountain foothills to cypress swamps, tallgrass prairies, hardwood forests…and pine-covered mountains" (Travel Oklahoma, 2003). The panhandle of Oklahoma is fertile grassland that rises into rocky mesas near the borders of Colorado and New Mexico. The state includes three low mountain ranges: the Arbuckle, Wichita, and Ouachita. Additionally, the eastern part of the state rises into the Ozark Plateau, which is heavily forested with small hills, mountains and crisscrossing waterways. The state includes three significant rivers that drain into the Gulf of Mexico: the Arkansas, Canadian, and Red (World Atlas, 2015).

Most of Oklahoma is characterized by pasture/range lands and croplands (Figure 12.1.7-1 in Section 12.1.7, Land Use, Recreation, and Airspace). Pasture/range lands are the state's most dominant visual resource, comprising 43 percent of total land cover in the state. Their primary vegetation is herbaceous plant and shrubs for foraging livestock. Pasture is different from range in that its vegetation is introduced and propagated to provide preferred forage for grazing livestock (USDA, 2015c). Visual resources within pasture lands are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape. Croplands comprise 29 percent of total land cover in Oklahoma and visual resources within them consist of either row crops, closely sown crops or fallow land awaiting planting. Crops may include hay, silage, fruit trees, berries, tree nuts, vegetables, or melons (USDA, 2014b). 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, Land Use, Recreation, and Airspace, discusses land use and contains further descriptions of land cover within the state.

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

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 Oklahoma, there are 1,246 NRHP listed sites, which include 1 National Recreation Area, 2 National Historic Sites, 1 National Memorial, and 2 National Historic Trails. Some State Historic Sites and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time (NPS, 2014d) (NPS, 2015e) (NPS, 2015f).

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

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015g). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 2016a). Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. In Oklahoma, there are 22 NHLs, including sites such as Boley Historic District, Fort Sill, Murrell Home, Sequoyah's Cabin, and Wheelock Academy (see Figure 12.1.8-1) (NPS, 2015h). By comparison, there are over 2,500 NHLs in the U.S. (NPS, 2015p), with less than 1% of these located in Oklahoma. Figure 12.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Memorial

NPS defines a National Memorial as an area that is "primarily commemorative." Oklahoma is home to one National Memorial, Oklahoma City National Memorial (see Figure 12.1.8-1). Oklahoma City National Memorial honors the victims of the Oklahoma City bombing at the Alfred P. Murrah Federal Building. Visual resources include a small orchard, reflecting pool, chair statues, and a large monument. (NPS, 2015i)

National Historic Trails

The National Trails System Act defines National Historic Trails as "extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historic significance" (NPS, 2012a). Two National Historic Trails pass through Oklahoma and surrounding states: Santa Fe National Historic Trail and Trail of Tears National Historic Trail (see Figure 12.1.8-1) (NPS, 2015n). The Santa Fe National Historic Trail connects Missouri to Santa Fe, New Mexico and was used by Mexican and American traders until after the Mexican-American War when it became a primary artery of trade and travel to the southwestern states and connector to California and Colorado (NPS, 2015o). The Trail of Tears National Historic Trail commemorates the survival of the Cherokee people removed from Georgia, Alabama, and Tennessee to Indian Territory in Oklahoma (NPS, 2015n).

National Historic Sites

Oklahoma has two National Historic Sites which are preserved by the NPS to "commemorate persons, events, and activities important in the nation's history" (NPS, 2003a). The two national historic sites in Oklahoma are Fort Smith National Historic Site and Washita Battlefield National Historic Site (Figure 12.1.8-1). Fort Smith NHS recounts 80 years of life bordering Indian Territory in both Oklahoma and Arkansas (NPS, 2015n).

State Historic Sites and Museums

The Oklahoma Historical Society maintains 31 state historic sites, including museums (14), military sites (6), and historic homes (11). These sites include No Man's Land Museum, Pioneer Woman Museum, Fort Towson, Jim Thorpe Home, and Sequoyah's Cabin (see Table 12.1.8-2 and Figure 12.1.8-1) (Oklahoma Historical Society, 2015a).

Table 12.1.8-2: Oklahoma State Historic Sites

State Historic Site Name	
A.J. Seay Mansion	Museum of the Western Prairie
Atoka Museum & Confederate Cemetery	No Man's Land Museum
Cabin Creek Battlefield	Oklahoma History Center
Cherokee Strip Museum	Oklahoma Route 66 Museum
Cherokee Strip Regional Heritage Center	Oklahoma Territorial Museum
Chisholm Trail Museum	Pawnee Bill Ranch
Fort Gibson	Peter Conser Home
Fort Supply	Pioneer Heritage Townsite Center
Fort Towson	Pioneer Woman Museum
Fort Washita	Sequoyah's Cabin
Frank Phillips Home	Sod House Museum
Fred Drummond Home	Spiro Mounds Museum
George M. Murrell Home	T.B. Ferguson Home
Henry Overholser Mansion	Tom Mix Museum
Honey Springs Battlefield	White Hair Memorial
Jim Thorpe Home	Museum of the Western Prairie

Source: (Oklahoma Historical Society, 2015a)

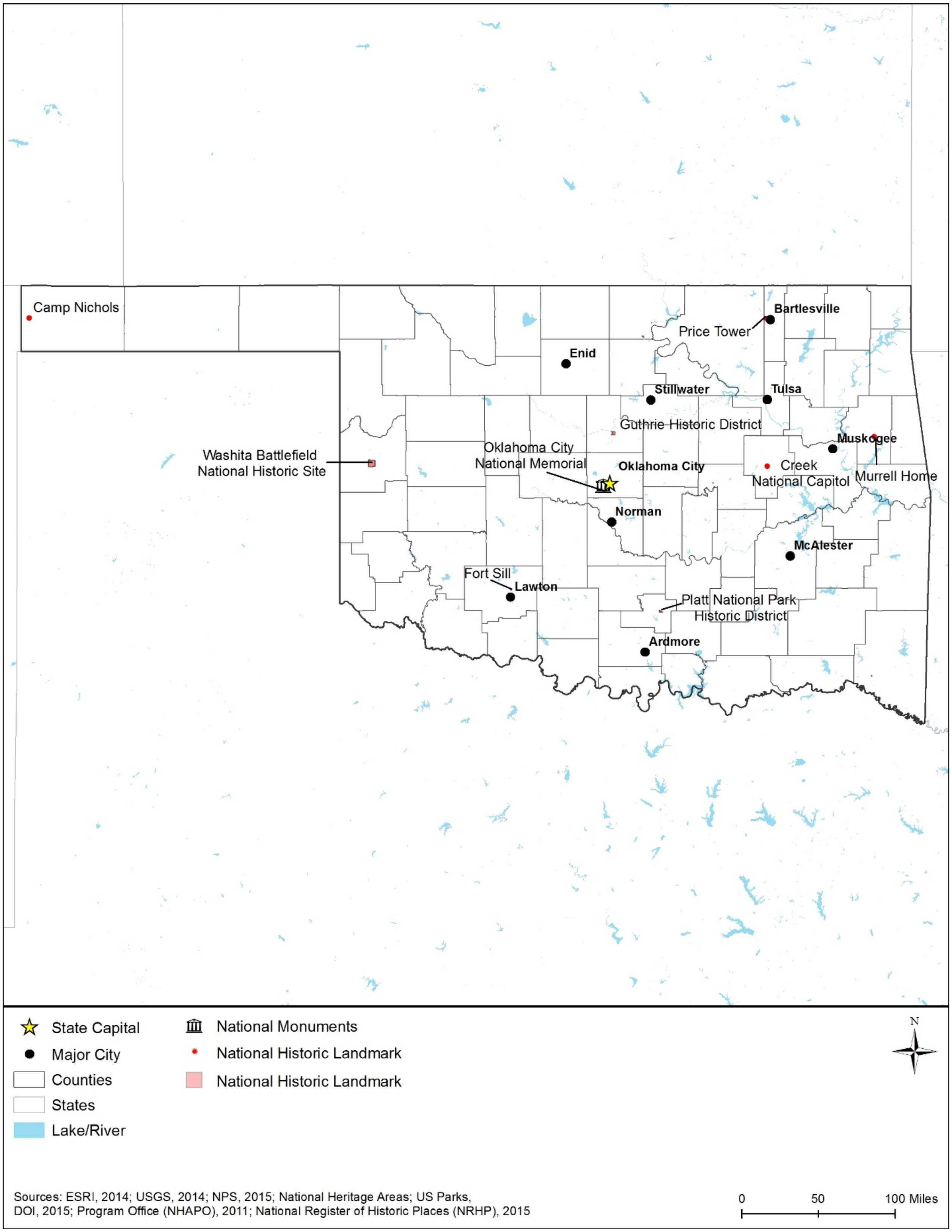

Figure 12.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

12.1.8.5. Parks and Recreation Areas

Parks and recreation areas include state parks, National Recreation Areas, National Forests, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 12.1.7-1 in Section 12.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in Oklahoma. 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 NPS and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. Owned by the U.S. government, these areas are maintained for the public's use. In Oklahoma, there are three[102] officially designated National Parks in addition to three other NPS affiliated areas. There are 1 National Recreation Area, 2 National Historic Sites, 1 National Memorial, and 2 National Historic Trails. Table 12.1.8-3 identifies all the National Parks and affiliated areas located in Oklahoma, including one National Recreation Area (see Figure 12.1.8-1). For additional information regarding parks and recreation areas, see Section 12.1.7, Land Use, Recreation, and Airspace.

Table 12.1.8-3: Oklahoma National Parks and Affiliated Areas

Area Name	
Chickasaw National Recreation Area	Santa Fe National Historic Trail
Fort Smith National Historic Site	Trail of Tears National Historic Trail
Oklahoma City National Memorial	Washita Battlefield National Historic Site

Source: (NPS, 2015n)

Bureau of Land Management

The BLM manages 7.4 million acres across Oklahoma, Kansas, and Texas. The majority of these lands are located in Kansas and Texas, although the BLM does manage three areas in Oklahoma (as noted below), and sub-surface minerals in Oklahoma. BLM lands are managed under a multiple use mandate under the Federal Land Policy and Management Act (FLPMA) meaning that BLM must allow many uses of the lands, 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 that are 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 the visual resources disturbed. 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

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

lower quality visual resources. There are three National Recreation and Scenic Areas managed by BLM in Oklahoma.

National Recreation and Scenic Areas

National Recreation Areas (NRAs) are "lands and waters set aside for recreation use" (NPS, 2003b). In Oklahoma, there are two National Recreation Areas, a National Scenic and Wildlife Area, and one National Scenic and Botanic Area (see Figure 12.1.8-3) (USFS, 2013).[103] The Chickasaw National Recreation Area is managed by NPS (NPS, 2015c). The Winding Stair Mountain National Recreation Area, Indian Nations National Scenic and Wildlife Area, and Beech Creek National Scenic and Botanic Area are managed by the USFS (USFS, 2013). The Chickasaw National Recreation Area is abundant with natural resources including plants, wildlife, and geology (NPS, 2015q). The Winding Stair Mountain National Recreation Area within Ouachita National Forest comprises 26,445 acres and includes the Talimena Scenic Drive (USFS, 2015b).

Figure 12.1.8-2: Chickasaw National Recreation Area

Source: (NPS, 2015c)

National Forests

Several agencies manage forested areas in Oklahoma, including the U.S.D.A. Forest Service. There is one (1) National Forest managed by the U.S. Forest Service (USFS) in Oklahoma: Ouachita National Forest (see Figure 12.1.8-3) (USFS, 2015c). The Ouachita National Forest consists of 1.8M acres in central Arkansas and southeastern Oklahoma (USFS, 2015d). The Ouachita National Forest contains visual resources such as mountains, rugged landscape, flora, streams, lakes, wildlife, and rivers. The USFS conducts inventories of the forest lands and assigns scenic resource categories from which they manage for scenic and visual resources

[103] 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.

(USFS, 1995). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USFS, 1995). For additional information regarding parks and recreation areas, see Section 12.1.7, Land Use, Recreation, and Airspace.

Army Corps of Engineers Recreation Areas

There are 29 U.S. Army Corps of Engineers (USACE) recreation areas within the state, as noted in Table 12.1.8-4 (see Figure 12.1.8-3) (USACE, 2015b). These lakes are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

Table 12.1.8-4: USACE Recreation Areas

Recreation Area Name	
Arcadia Lake	Hugo Lake
Arkansas River – Chouteau Lock and Dam	Hulah Lake
Arkansas River – Newt Graham Pool	John Paul Hammerschmidt Lake
Arkansas River – Robert S. Kerr Pool	Kaw Lake
Arkansas River – W.D. Mayo Pool	Keystone Lake
Arkansas River – Webbers Falls Pool	Lake Texoma
Birch Lake	Oologah Lake
Broken Bow Lake	Optima Lake
Canton Lake	Pine Creek Lake
Copan Lake	Sardis Lake
Eufala Lake	Skiatook Lake
Fort Gibson Lake	Tenkiller Ferry Lake
Fort Supply Lake	Waurika Lake
Great Salt Plains Lake	Wister Lake
Heyburn Lake	

Source: (USACE, 2015c)

Bureau of Reclamation Recreation Areas

The Bureau of Reclamation's "multipurpose approach to water resource development" includes offering recreation areas with important natural and cultural resources (Bureau of Reclamation, 2015a). When planning for recreation, the Bureau must ensure that "potential impacts to natural and cultural resources…are taken into consideration" (Bureau of Reclamation, 2009). Visual resources in these natural areas may revolve around water sources such as lakes, canals, and reservoirs. See Table 12.1.8-5 for the seven Bureau of Reclamation Recreation Areas in Oklahoma (see Figure 12.1.8-3) (Bureau of Reclamation, 2015b).

Table 12.1.8-5: Oklahoma Bureau of Reclamation Recreation Areas

Recreation Area Name	
Altus Reservoir	Lake Thunderbird
Chickasaw National Recreation Area	McGee Creek
Fort Cobb Reservoir	Tom Steed Reservoir
Foss Reservoir	

Source: (Bureau of Reclamation, 2015b)

Federal and State Trails

Oklahoma maintains a network of trails within the state parks systems for recreational purposes, including ATV/ORV driving, hiking, biking, canoeing/kayaking, and horseback riding (Oklahoma Tourism and Recreation Department, 2015b). Due to their locations in the state park system, these trails contain visual resources similar to those in the state park and sites on which they reside. For additional information about Oklahoma's trails, visit the 'Things to Do' portion of the Oklahoma Tourism and Recreation Department's website (Oklahoma Tourism and Recreation Department, 2015c).

In addition to National Scenic and Historic Trails, the National Trails System Act authorized the designation of National Recreational Trails near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2015a). In Oklahoma there are 21 National Recreation Trails administered by the USFWS, the USACE, the USFS, non-profits, and local and state governments (American Trails, 2015b).

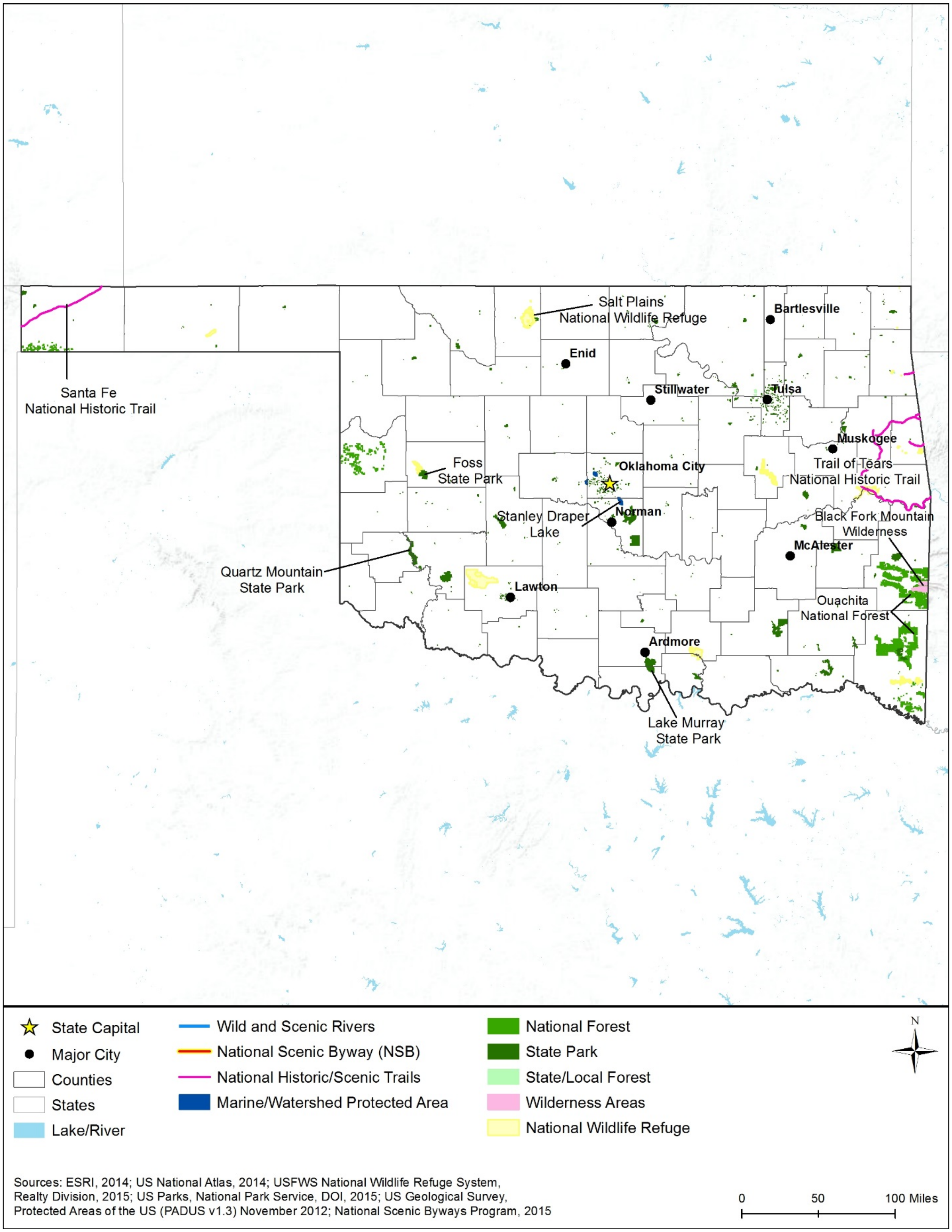

Figure 12.1.8-3: Natural Areas that May be Visually Sensitive

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Oklahoma residents and visitors. There are 52 state parks in Oklahoma (Figure 12.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive. Table 12.1.8-6 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks, visit the state parks portion of Travel Oklahoma's website (Oklahoma Tourism and Recreation Department, 2015j).

Table 12.1.8-6: Examples of Oklahoma State Parks and Associated Visual Attributes

State Park	Visual Attributes
Alabaster Caverns State Park	Alabaster cavern, caves
Gloss Mountain State Park	Gloss Mountains, mesa, valley, prairie, native red dirt, green shrubbery, rocky terrain, wildlife
Lake Wister State Park	Ouachita National Forest, Wister Wildlife Management Area, waterfowl, dogwood, wild cherry, and northern spruce groves
Natural Falls State Park	Waterfall, rock formations, narrow v-shaped valley, dense forests of maple, chinquapin, and white oaks, variety of flora
Red Rock Canyon State Park	Red canyon walls, rocky terrain, fishing pond, native Caddo maple trees

Source: (Oklahoma Tourism and Recreation Department, 2015k)

Figure 12.1.8-4: Gloss Mountain State Park

Source: (Oklahoma Tourism and Recreation Department, 2015l)

State Forests

Ninety-five percent of Oklahoma's forested land is owned by private individuals vice large corporations or government entities (Oklahoma Forestry Services, 2007). The state of Oklahoma does not own or maintain state lands designated as state forests but rather for the purposes of wildlife management and other recreational uses (ODWC, 2015h).

12.1.8.6. Natural Areas

The abundance of natural areas varies by state depending on the amount of public or state lands managed within each. Although many natural areas may not be managed specifically for visual resources, these areas are allowed protection for their natural resources and the resulting management protects these scenic resources. Figure 12.1.8-3 identifies natural areas that may have sensitive visual resources.

Rivers Designated as National or State Wild, Scenic or Recreational

National Wild, Scenic, or Recreational Rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. Oklahoma has no designated wild and scenic rivers (National Wild and Scenic Rivers System, 2015b).

The Oklahoma Scenic Rivers Act was established in 1970 “to protect and preserve scenic rivers in their natural and free-flowing state with attention provided to enhancing scenic beauty, water conservation, fish, wildlife, and outdoor recreational values of present and future benefit to citizens of Oklahoma.” The Oklahoma system of scenic rivers currently includes six (6) designated scenic rivers: Illinois River, Barren Fork Creek, Flint Creek, Lee Creek, Little Lee Creek, and Upper Mountain Fork. (Oklahoma Scenic Rivers Commission, 2015)

National Wildlife Refuges (NWR)

NWRs are a network of lands and waters managed by the USFWS. These lands and waters are “set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats” (USFWS, 2015ac). There are nine NWRs in Oklahoma (USFWS, 2015ad) (see Figure 12.1.8-3) (see Table 12.1.8-7) including the Deep Fork NWR. This refuge is comprised of 9,700 acres of bottomland hardwood forest and 34 miles of the Deep Fork River that drain into the watershed of the Mississippi River (USFWS, 2013d). Visual resources within this NWR include bottomland hardwood forest, songbirds, wildflowers, and wildlife (USFWS, 2013d).

Table 12.1.8-7: Oklahoma National Wildlife Refuges

NWR Name	
Deep Fork NWR	Sequoyah NWR
Little River NWR	Tishomingo NWR
Optima NWR	Washita NWR
Ozark Plateau NWR	Wichita Mountain NWR
Salt Plains NWR	

Source: (USFWS, 2015ad)

State Wildlife Management Areas and Refuges

The ODWC’s Wildlife Division owns, licenses, leases, manages, and maintains thousands of acres of state lands and NWRs on 87 Wildlife Management Areas in cooperation with other agencies or entities for public hunting and recreation (Table 12.1.8-8). For additional information on NWRs and WMAs, see Section 12.1.6, Wildlife.

Table 12.1.8-8: Oklahoma Wildlife Management Areas and Refuges

WMA Name	
Altus Lugert -SW	Lexington -SE
Arcadia CEA - NE	Little River NWR - SE
Atoka -SE	Love Valley- SE
Atoka Public Hunting Area -SE	Lower Illinois River - NE
Beaver River -NW	Major - NW
Black Kettle - NW	McAlester AAP -SE
Blue River -SE	McClellan/Kerr -SE
Broken Bow - SE	McCurtain County WA - SE
Camp Gruber JMTC - NE	McGee Creek - SE
Candy Creek - NE	Mountain Park - SW
Canton - NW	Okmulgee -NE
Cherokee - NE	Oologah -NE
Chickasaw -SE	Optima -NW
Cimarron Bluff - NW	Optima NWR -NW
Cimarron Hills - NW	Osage - NE
Cookson -NE	Ouachita LeFlore Unit - SE
Cooper -NW	Ouachita McCurtain Unit -SE
Copan -NE	Ouachita National Forest - SE
Cross Timbers - SW	Ozark Plateau -NE
Cucumber Creek - SE	Packsaddle - NW
Deep Fork -NE	Pine Creek -SE
Deep Fork NWR - NE	Pushmataha - SE
Dewey County - NW	Red Slough - SE
Drummond Flats -NW	Rita Blanca -NW
Ellis County - NE	Robbers Cave -SE
Eufaula - SE	Salt Plains NWR
Fobb Bottom - SE	Sandy Sanders - SW
Fort Cobb - SW	Schultz - NW
Fort Gibson - NE	Sequoyah NWR
Fort Supply - NW	Skiatook - NE
Gary Sherrer - SE	Sparrow Hawk -NE
Gist -SW	Spavinaw -NE
Grady County -SW	Stringtown -SE
Grassy Slough -SE	Tenkiller - NE
Hackberry Flat -SW	Texoma-Washita Arm -SE
Heyburn -NE	Three Rivers - SE
Hickory Creek -SE	Tishomingo NWR/WMU -SE
Honobia Creek - SE	Washita County - SW
Hugo -SE	Washita NWR - NW
Hulah -NE	Waurika - SW
James Collins -SE	Whitegrass Flats - SE
John Dahl - NE	Wichita Mountains NWR - SW
Kaw - NE	Wister - SE
Keystone- NE	Yourman -SE
Lake Thunderbird SP - SE	Lexington -SE

Source: (ODWC, 2015i)

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 to designate wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value." Over 106 million acres of federal public lands have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and part of the National Park System. Designated wilderness areas are managed by the USFS, BLM, USFWS, and NPS. (NPS, 2015r) Oklahoma is home to three federally managed Wilderness Areas: Black Fork Mountain Wilderness, Upper Kiamichi River Wilderness, and Wichita Mountains Wilderness (see Figure 12.1.8-3) (Wilderness.net, 2015).

National Grasslands

There are two National Grasslands in Oklahoma administered by the USFS, including Black Kettle and Rita Blanca National Grasslands. These National Grasslands are part of the Cibola National Forest spread throughout Oklahoma, Texas, and New Mexico. (USFS, 2015e)

National Natural Landmarks

National Natural Landmarks (NNLs) are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014c). These landmarks may be considered visual resources or visually sensitive. In Oklahoma, there are three NNLs: Devil's Canyon, McCurtain County Wilderness Area, and Salt Plains NWR (Figure 12.1.8-3). Some of the natural features located within these areas include the "largest inland saline basin in the Central lowlands," upland oak-pine forest, and eroded box canyon (NPS, 2012b). Devil's Canyon is an eroded box canyon with many mesic plant species whose natural range ends about 200 miles east of the area (NPS, 2012b).

Figure 12.1.8-5: Devil's Canyon

Source: (NPS, 2012b)

State Preserves

The Oklahoma Tourism and Recreation Department maintains one preservation area, Black Mesa Nature Preserve, in the Black Mesa State Park. This preservation area encompasses 1,600 acres of black lava rock coated mesa and plateau where the Rocky Mountains collide with the shortgrass prairie for unique species at the edges of their natural ranges. Visual resources in the preservation area include 23 rare plant and 8 rare animal species, shortgrass prairie, black mesa, and plateau (Oklahoma Tourism and Recreation Department, 2015m). Additionally, natural and conservation areas also include eight properties owned and managed by The Nature Conservancy. These properties include Boehler Seeps and Sandhills Preserve, Cucumber Creek Preserve, Four Canyon Preserve, J.T. Nickel Family Nature and Wildlife Preserve, Keystone Ancient Forest Preserve, Pontotoc Ridge Preserve, Oka'Yanahli Preserve, and Joseph H. Williams Tallgrass Prairie Preserve. Keystone Ancient Forest Preserve contains stands of post oak and cedar trees as old as 500 years marking the transition from eastern deciduous forests to western prairie (The Nature Conservancy, 2015).

12.1.8.7. Additional Areas

State and National Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. Oklahoma has four designated National Scenic Byways: Cherokee Hills Byway (84 mi), Historic Route 66 (1,408.6 mi), Talimena Scenic Drive (54 mi), and Wichita Mountains Byway (93 mi) (see Figure 12.10.3-1 in Section 12.10, Land Use, Recreation, and Airspace) (FHWA, 2015f).

Similar to National Scenic Byways, the Oklahoma Department of Culture, Recreation and Tourism recognizes five (5) state scenic byways (see Figure 12.1.7-1 in Section 12.1.7 Land Use, Recreation, and Airspace) (see Table 12.1.8-9). Mountain Pass Scenic Byway cuts across the top of the Ouachita Mountains and through the Winding Stair Mountain National Recreation Area and offers mountain views and access to scenic vistas and recreational trails (see Figure 12.1.8-3) (Oklahoma Tourism and Recreation Department, 2015n).

Table 12.1.8-9: Oklahoma State Byways

State Byway Name	Mileage
The Kiamichi Trace	NA
Mountain Gateway Scenic Byway	22
Mountain Pass Scenic Byway	23
Osage National Heritage Trail	70
Tallgrass Prairie Preserve	50

Source: (Oklahoma Tourism and Recreation Department, 2015c)

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, 2005). When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides important context for analysis of FirstNet projects, and in addition, FirstNet projects may affect the socioeconomic conditions of a region.

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet's mission is to provide public safety broadband and interoperable emergency communications coverage throughout the nation. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes. The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. 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.[104] This PEIS addresses environmental justice in a separate section (Section 12.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and recreation (Section 12.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 12.1.1, Infrastructure), and aesthetic considerations (Section 12.1.8, Visual Resources).

[104] See https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and U.S. levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level (U.S. Census Bureau, 2016).[105]

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 PEIS.

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

12.1.9.3. Communities and Populations

This section discusses the population and major communities of Oklahoma (OK) and includes the following topics:

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

Statewide Population and Population Growth

Table presents the 2014 population and population density of Oklahoma in comparison to the South region[106] and the nation. The estimated population of Oklahoma in 2014 was 3,878,051. The population density was 57 persons per square mile (sq. mi.), which was considerably lower than the population density of both the region (114 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Oklahoma was the 28th largest state by population among the 50 states and the District of Columbia, 19th largest by land area, and had the 36th greatest population density (U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015e).

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

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Oklahoma	68,595	3,878,051	57
South region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

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

Population growth is an important subject for this PEIS given FirstNet's mission. Table12.1.9-2 presents the population growth trends of Oklahoma from 2000 to 2014 in comparison to the South region and the nation. The state's annual growth rate in the 2010 to 2014 period (0.83 percent) nearly matched the rate during the 2000 to 2010 period (0.84 percent). The growth rate of Oklahoma in the 2010 to 2014 period was lower than the growth rate of the region, at 1.14 percent, and similar to the growth rate of the nation, at 0.81 percent.

[106] The South region is comprised of the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, Tennessee, and Texas. Throughout the socioeconomics section, figures for the South 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 South 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 Oklahoma

Geography	Population			Numerical Population Change		Rate of Population Change (AARC)[a]	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Oklahoma	3,450,654	3,751,351	3,878,051	300,697	126,700	0.84%	0.83%
South Region	86,516,862	99,487,696	104,109,977	12,970,834	4,622,281	1.41%	1.14%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

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

Demographers prepare future population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use 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 Oklahoma's population will increase by approximately 511,000 people, or 13.2 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.78 percent, which is similar to the historical growth rate from 2010 to 2014 of 0.83 percent. The projected growth rate of the state is less than that of the region (0.97 percent) and similar to the projected growth rate of the nation (0.80 percent).

Table 12.1.9-3: Projected Population Growth of Oklahoma

Geography	Population 2014 (estimated)	Projected 2030 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)[a] 2014 to 2030
Oklahoma	3,878,051	4,205,487	4,573,147	4,389,317	511,266	13.2%	0.78%
South Region	104,109,977	122,323,551	120,794,020	121,558,786	17,448,809	16.8%	0.97%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

[a] AARC = Average Annual Rate of Change (compound growth rate)
Sources: (U.S. Census Bureau, 2015f) (UVA Weldon Cooper Center, 2015) (ProximityOne, 2015)

Population Distribution and Communities

Figure 12.1.9-1 presents the distribution and relative density of the population of Oklahoma. 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, 2015i).

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, 2012b; U.S. Census Bureau, 2015j). 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. In general, the central and northeastern portions of the state are more densely settled than the western and southeastern parts.

Table 12.1.9-4 provides the populations of the 10 largest population concentrations in Oklahoma, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[107] In 2010, the largest population concentration was the Oklahoma City area, which had 861,505 people. The state had one other population concentration over 500,000 (Tulsa area), and one area with a population just over 100,000 (Norman area). The smallest of these 10 population concentrations was the Ponca City area, with a 2010 population of 26,047. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Norman area, with an annual growth rate of 1.85 percent. Three other areas had a growth rate over 1.00 percent (Oklahoma City, Stillwater, and Tulsa areas). The Ponca City area experienced a population decline during this period.

Table 12.1.9-4 also shows that the top 10 population concentrations in Oklahoma accounted for 51.9 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 82.5 percent of the entire state's growth. These figures indicate that the populations within these 10 areas are growing at a faster rate than the population in the remainder of the state.

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

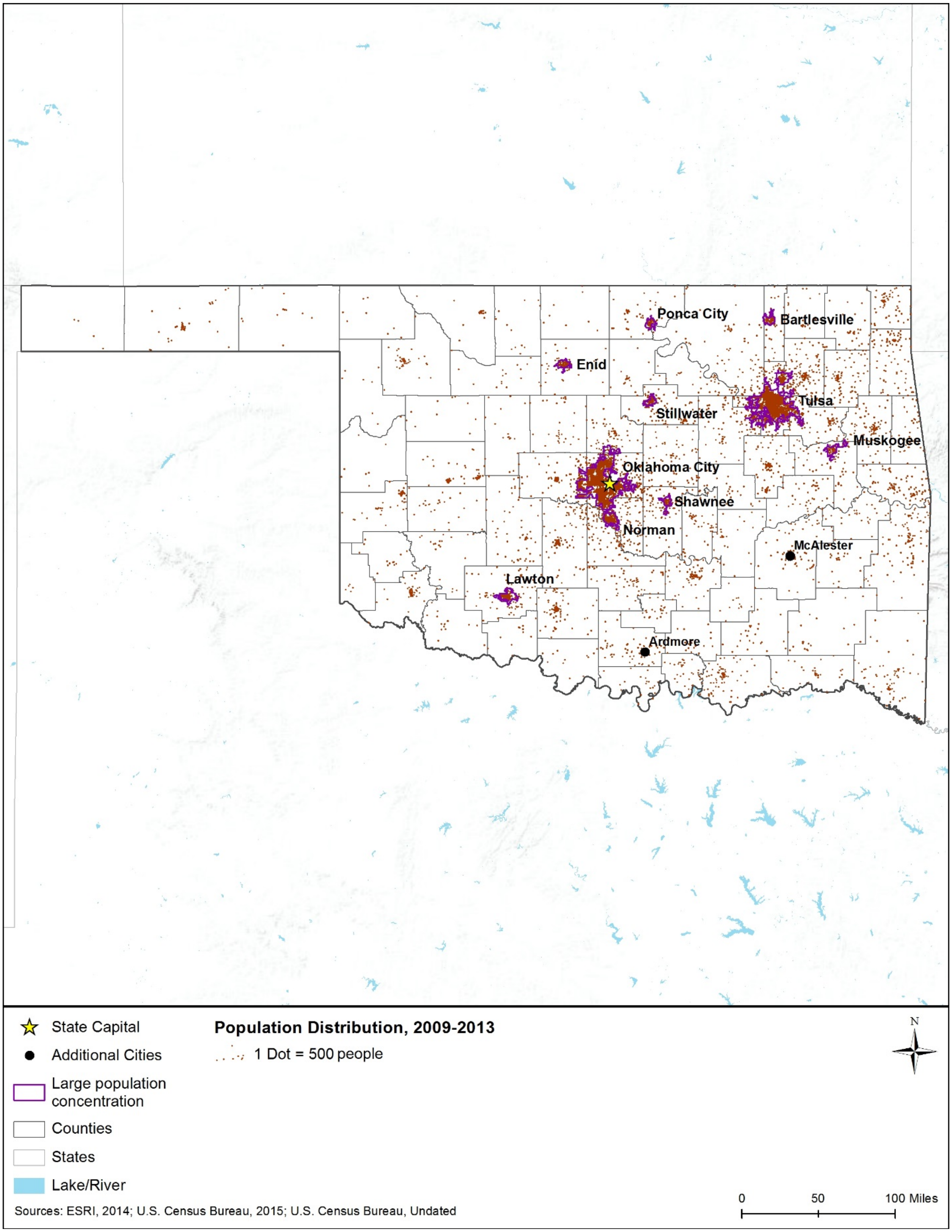

Figure 12.1.9-1: Population Distribution in Oklahoma, 2009–2013

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

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)[a]
Bartlesville	38,541	38,874	38,953	8	333	0.09%
Enid	45,654	47,609	47,944	5	1,955	0.42%
Lawton	89,556	94,457	92,930	4	4,901	0.53%
Muskogee	38,637	42,052	42,270	7	3,415	0.85%
Norman	86,478	103,898	106,491	3	17,420	1.85%
Oklahoma City	747,003	861,505	879,331	1	114,502	1.44%
Ponca City	26,382	26,047	25,882	10	(335)	-0.13%
Shawnee	31,696	34,255	34,430	9	2,559	0.78%
Stillwater	38,288	44,515	44,652	6	6,227	1.52%
Tulsa	558,329	655,479	662,801	2	97,150	1.62%
Total for Top 10 Population Concentrations	**1,700,564**	**1,948,691**	**1,975,684**	**NA**	**248,127**	**1.37%**
Oklahoma (statewide)	**3,450,654**	**3,751,351**	**3,785,742**	**NA**	**300,697**	**0.84%**
Top 10 Total as Percentage of State	**49.3%**	**51.9%**	**52.2%**	**NA**	**82.5%**	**NA**

[a] AARC = Average Annual Rate of Change (compound growth rate)
Sources*:* (U.S. Census Bureau, 2015k; U.S. Census Bureau, 2015l; U.S. Census Bureau, 2015m)

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

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

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

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 12.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 12.1.9-5 compares several economic indicators for Oklahoma to the South region and the nation. The table presents two indicators of income[108] – per capita and median household – as income is a good measure of general economic health of a region.

Per capita income is total income divided by the total population. As a mathematical average, the very high incomes of a relatively small number of people tend to bias per capita income figures upwards. Nonetheless, per capita income is useful as an indicator of the relative income level across two or more areas. As shown in Table 12.1.9-5, the per capita income in Oklahoma in 2013 ($24,284) was $727 lower than that of the region ($25,011), and $3,900 lower than that of the nation ($28,184) (BLS, 2015b; U.S. Census Bureau, 2015n; U.S. Census Bureau, 2015o; U.S. Census Bureau, 2015p).

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 Oklahoma ($45,724) was $838 lower than that of the region ($46,562), and $6,526 lower than that of the nation ($52,250) (BLS, 2015b; U.S. Census Bureau, 2015n; U.S. Census Bureau, 2015o; U.S. Census Bureau, 2015p).

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 Oklahoma to the South region and the nation. In 2014, Oklahoma's statewide unemployment rate of 4.5 percent was considerably lower than the rates for the region (6.1 percent) and the nation (6.2 percent)[109] (BLS, 2015b; U.S. Census Bureau, 2015n; U.S. Census Bureau, 2015o; U.S. Census Bureau, 2015p).

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

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

Table 12.1.9-5: Selected Economic Indicators for Oklahoma

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Oklahoma	$24,284	$45,724	4.5%
South Region	$25,011	$46,562	6.1%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015c; U.S. Census Bureau, 2015q; U.S. Census Bureau, 2015r; U.S. Census Bureau, 2015s)

Figure 12.1.9-2 and Figure 12.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015t) and unemployment in 2014 (BLS, 2015c) 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, 2012b; U.S. Census Bureau, 2015j). 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 Oklahoma.

Figure 12.1.9-2 shows that, at the county level, MHI in 2013 had a variable distribution across the state, with high and low MHI levels occurring throughout the state. Relatively few counties had MHI values above the national average; most of these were near the two largest population concentrations, Oklahoma City and Tulsa. The counties classified as having the lowest MHI levels were generally located in the eastern and southern portions of the state. Table 12.1.9-6 shows that the 2009–2013 MHI was above the state average in the Bartlesville, Norman, Oklahoma City, and Tulsa areas. MHI in all other population concentrations was below the state average. MHI was lowest in the Muskogee, Shawnee, and Stillwater areas, which are three of the five smallest areas shown in the table. The smallest area, Ponca City, also had a relatively low MHI.

Figure 12.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state. However, most counties in the southeast portion of the state had unemployment rates above the national average, as did the county in the northeast corner of the state. Counties with the lowest unemployment rates were located in the more sparsely populated, western half of the state. When comparing unemployment in the population concentrations to the state average (Table 12.1.9-6), five of the 10 areas had 2009–2013 unemployment rates that were higher than the state average. These areas were the Lawton, Muskogee, Ponca City, Shawnee, and Tulsa areas.

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 lower in Oklahoma than in the South region and the nation. The percentage of government workers was higher in the state than in the region and nation. Self-employed workers were a similar percentage in the state as the region and nation.

By industry, Oklahoma has a mixed economic base and some notable figures in the table are as follows. Oklahoma in 2013 had a considerably higher percentage (more than two percentage points difference) of persons working in "agriculture, forestry, fishing and hunting, and mining" than did the region or the nation. It also had a considerably lower percentage of workers in "professional, scientific, management, administrative, and waste management services" than the region or nation. In all other industries, Oklahoma had relatively similar percentages of employment (within two percentage points) to the region and nation.

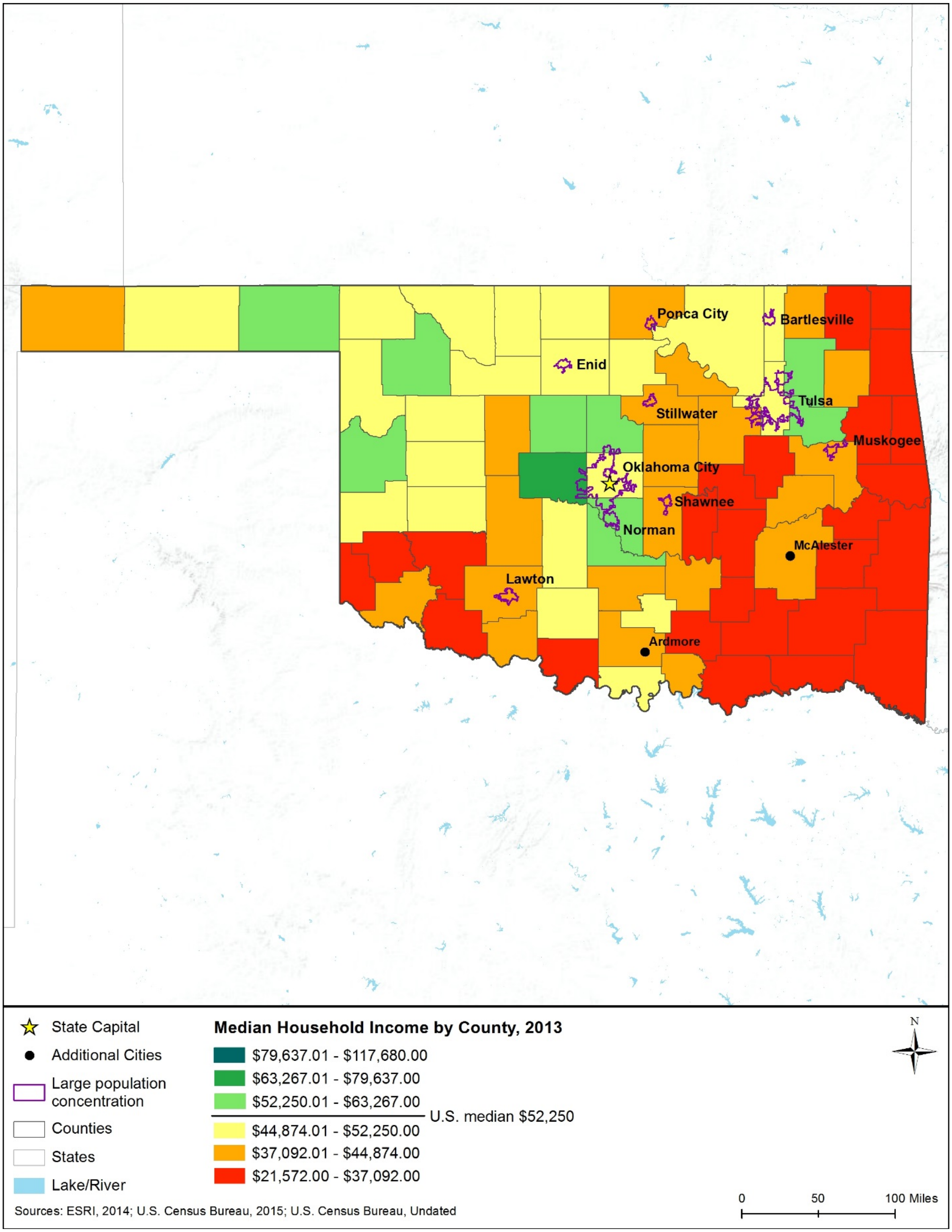

Figure 12.1.9-2: Median Household Income in Oklahoma, by County, 2013

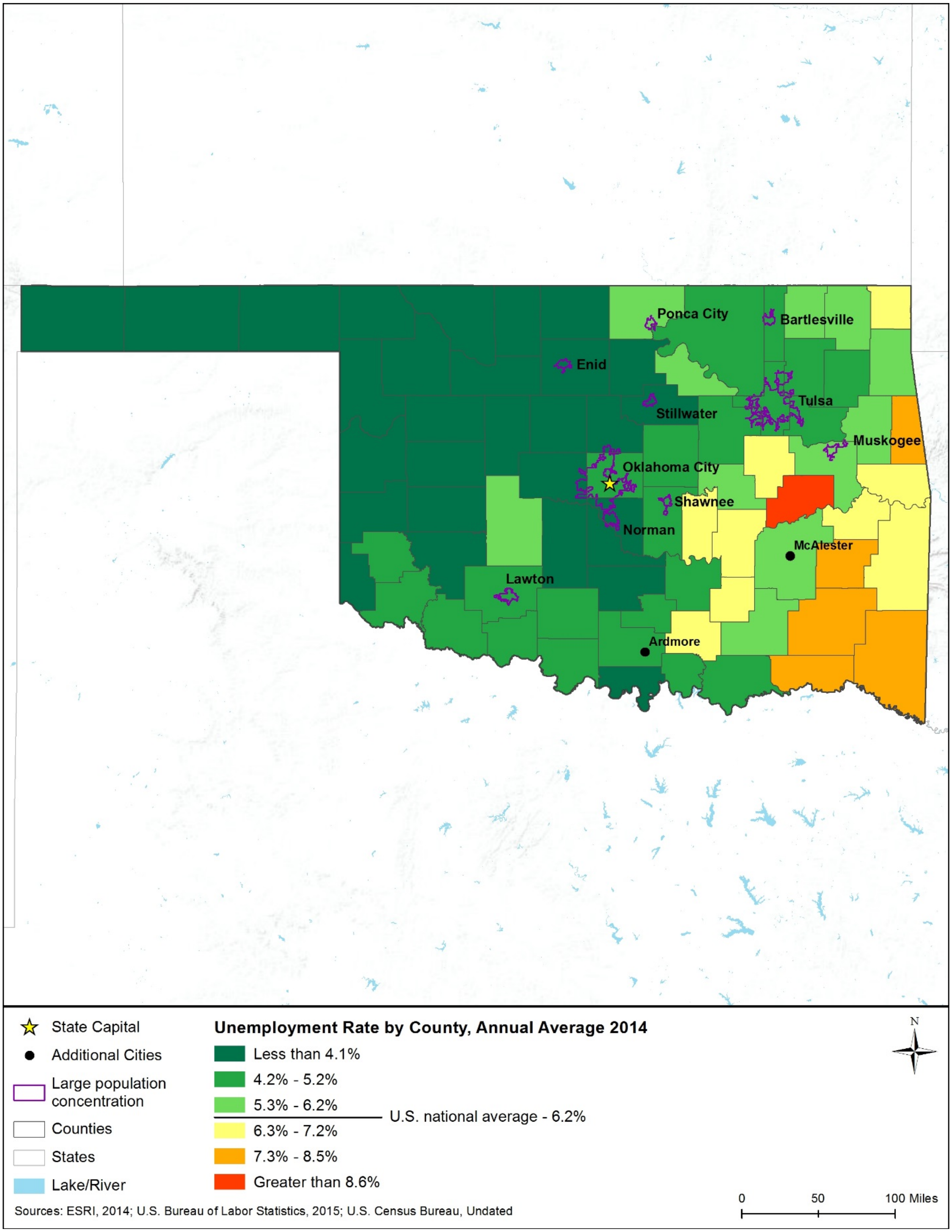

Figure 12.1.9-3: Unemployment Rates in Oklahoma, by County, 2014

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

Area	Median Household Income	Average Annual Unemployment Rate
Bartlesville	$46,793	6.3%
Enid	$42,258	6.7%
Lawton	$43,359	10.0%
Muskogee	$34,602	8.2%
Norman	$47,312	6.2%
Oklahoma City	$48,335	6.4%
Ponca City	$40,037	7.9%
Shawnee	$35,784	8.4%
Stillwater	$31,610	6.0%
Tulsa	$48,591	7.2%
Oklahoma (statewide)	$45,339	7.0%

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

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

Class of Worker and Industry	Oklahoma	South Region	United States
Civilian Employed Population 16 Years and Over	1,716,784	45,145,155	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	76.8%	79.4%	79.7%
Government workers	16.8%	14.5%	14.1%
Self-employed in own not incorporated business workers	6.2%	5.9%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	5.4%	2.4%	2.0%
Construction	6.8%	6.9%	6.2%
Manufacturing	10.1%	9.9%	10.5%
Wholesale trade	2.7%	2.8%	2.7%
Retail trade	11.9%	12.1%	11.6%
Transportation and warehousing, and utilities	5.1%	5.2%	4.9%
Information	1.8%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	5.7%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	8.2%	10.5%	11.1%
Educational services, and health care and social assistance	21.9%	22.0%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.2%	9.9%	9.7%
Other services, except public administration	5.2%	5.2%	5.0%
Public administration	6.2%	4.8%	4.7%

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

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 Oklahoma, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Bartlesville	5.3%	4.6%	2.0%	8.8%
Enid	5.7%	5.6%	1.3%	5.1%
Lawton	6.5%	3.5%	1.7%	7.6%
Muskogee	6.0%	3.9%	1.4%	4.4%
Norman	3.7%	3.2%	2.3%	9.8%
Oklahoma City	7.5%	4.4%	2.1%	10.0%
Ponca City	5.2%	3.8%	1.7%	6.5%
Shawnee	6.5%	3.3%	1.6%	7.6%
Stillwater	4.6%	2.3%	1.4%	6.3%
Tulsa	6.5%	5.6%	2.9%	11.1%
Oklahoma (statewide)	7.2%	5.1%	1.9%	8.1%

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

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 Oklahoma to the South region and nation on several common housing indicators.

As shown in Table 12.1.9-9, in 2013, Oklahoma had a percentage of occupied housing units (86.0 percent) that was slightly higher than the region (85.2 percent) and somewhat lower that the nation (87.6 percent). Of the occupied units, Oklahoma had a somewhat higher percentage of owner-occupied units (65.5 percent) than the region (64.6 percent) or nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Oklahoma in 2013 (72.3 percent) was considerably higher than the region (63.8 percent) and nation (61.5 percent). The homeowner vacancy rate in Oklahoma (2.3 percent) nearly matched the rate for the region (2.2 percent) and was slightly higher than the rate for the nation (1.9 percent). This rate reflects “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2015w). The vacancy rate among rental units in Oklahoma (8.2 percent) was slightly lower than that for the region (8.5 percent) and higher than the rate for the nation (6.5 percent).

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

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Oklahoma	1,682,358	86.0%	65.5%	2.3%	8.2%	72.3%
South Region	44,126,724	85.2%	64.6%	2.2%	8.5%	63.8%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

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

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: Selected Housing Indicators for the 10 Largest Population Concentrations in Oklahoma, 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
Bartlesville	18,052	90.5%	68.4%	3.9%	4.1%	79.5%
Enid	21,134	87.5%	63.2%	3.5%	9.2%	81.1%
Lawton	39,564	86.6%	49.8%	3.0%	10.4%	68.7%
Muskogee	18,935	86.7%	59.4%	1.9%	7.2%	73.5%
Norman	46,228	88.6%	53.9%	1.7%	8.2%	61.9%
Oklahoma City	377,514	89.6%	61.8%	2.2%	7.4%	71.6%
Ponca City	12,174	86.1%	67.6%	3.3%	9.4%	82.4%
Shawnee	15,181	87.0%	59.3%	3.2%	8.5%	78.6%
Stillwater	19,626	89.0%	36.8%	3.6%	5.7%	51.6%
Tulsa	290,151	89.6%	61.9%	2.4%	8.8%	70.5%
Oklahoma	1,669,828	86.5%	67.1%	2.3%	8.2%	73.1%

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

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 Oklahoma and compares these values to values for the South 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, 2015w).

The table shows that the median value of owner-occupied units in Oklahoma in 2013 ($116,500) was lower than the corresponding values for the South region ($137,752) and the nation ($173,900).

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

Geography	Median Value of Owner-Occupied Units
Oklahoma	$116,500
South Region	$137,752
United States	$173,900

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

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. Four of the 10 areas had median property values higher than the state median value ($112,800). These four areas were the Norman, Oklahoma City, Stillwater, and Tulsa areas, which had median property values ranging from $128,300 to $151,800. All other population concentrations had property values below the state value. The lowest values were in the Enid, Muskogee, Ponca City, and Shawnee areas, which also had median household incomes that were below the state average (Table 12.1.9-6).

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

Area	Median Value of Owner-Occupied Units
Bartlesville	$106,000
Enid	$87,600
Lawton	$104,600
Muskogee	$87,800
Norman	$145,000
Oklahoma City	$128,300
Ponca City	$80,500
Shawnee	$86,500
Stillwater	$151,800
Tulsa	$134,700
Oklahoma (statewide)	$112,800

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet projects may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006a). 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.

Table 12.1.9-13 shows that the Oklahoma state government received more total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments in Oklahoma, on the other hand, received less. Additionally, the Oklahoma state government had higher, and Oklahoma local governments had lower, levels per capita of intergovernmental revenues[110] from the federal government. The Oklahoma state government obtained no revenue from property taxes. Local governments in Oklahoma obtained lower levels of property taxes per capita than local governments in the region or nation. General sales taxes were lower on a per capita basis for the Oklahoma state government, and higher for Oklahoma local governments, compared to their counterparts in the region and nation. Selective sales taxes, and public utility taxes specifically, were lower on a per capita basis for Oklahoma state and local governments, compared to counterpart governments in the region and nation. Individual and corporate income tax revenues, on a per capita basis, for the Oklahoma state government were higher than for counterparts in the region, but lower than revenues for counterparts in the nation. Oklahoma local governments obtained no revenues from individual and corporate income taxes.

[110] 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, 2006b).

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

Type of Revenue		Oklahoma		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	**($M)**	$23,263	$13,247	$524,374	$449,683	$1,907,027	$1,615,194
	Per capita	$6,098	$3,473	$5,148	$4,414	$6,075	$5,145
Intergovernmental from Federal	($M)	$7,363	$470	$160,706	$18,171	$514,139	$70,360
	Per capita	$1,930	$123	$1,578	$178	$1,638	$224
Intergovernmental from State	($M)	$0	$3,965	$0	$115,088	$0	$469,147
	Per capita	$0	$1,039	$0	$1,130	$0	$1,495
Intergovernmental from Local	($M)	$137	$0	$2,815	$0	$19,518	$0
	Per capita	$36	$0	$28	$0	$62	$0
Property Taxes	($M)	$0	$2,292	$2,073	$109,687	$13,111	$432,989
	Per capita	$0	$601	$20	$1,077	$42	$1,379
General Sales Taxes	($M)	$2,416	$1,888	$82,651	$25,836	$245,446	$69,350
	Per capita	$633	$495	$811	$254	$782	$221
Selective Sales Taxes	($M)	$1,308	$185	$41,447	$9,394	$133,098	$28,553
	Per capita	$343	$49	$407	$92	$424	$91
Public Utilities Taxes	($M)	$39	$144	$5,101	$4,745	$14,564	$14,105
	Per capita	$10	$38	$50	$47	$46	$45
Individual Income Taxes	($M)	$2,774	$0	$38,637	$1,226	$280,693	$26,642
	Per capita	$727	$0	$379	$12	$894	$85
Corporate Income Taxes	($M)	$446	$0	$8,099	$114	$41,821	$7,210
	Per capita	$117	$0	$80	$1	$133	$23

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

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

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 1.8.12).[111] The fundamental principle of environmental justice is, "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA, 2016c). 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,

[111] See https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

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, 2013a).

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

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

- Minority populations consist of "Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic."
- Low-income populations consist of individuals living in poverty, as defined by the U.S. Census Bureau (Census Bureau).
- Environmental effects include social and economic effects. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or American 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, regulations, or policies that are directly relevant to environmental justices for this PEIS. Federal laws relevant to environmental justice are described in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

12.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 12.1.10-1 presents 2013 data on the composition of Oklahoma's population by race and by Hispanic origin. The state's population has substantially higher percentages of individuals who identify as American Indian/Alaska Native (7.5 percent), or as Two or More Races (7.5 percent), than the populations of the South region and the nation. (Those percentages are, for American Indian/Alaska Native, 0.9 percent for the South region and 0.8 percent for the nation; and for Two or More Races, 2.4 percent and 3.0 percent respectively.) The state's population has lower percentages of persons who identify as Black/African American (7.2 percent), Asian (1.9 percent), or Some Other Race (2.7 percent) than the populations of the South region and the nation. The state's population of persons identifying as White (73.1 percent) is similar to the populations of both the South region (72.3 percent) and the nation (73.7 percent).

The percentage of the population in Oklahoma that identifies as Hispanic (9.6 percent) is considerably smaller than in the South region (18.8 percent) and the nation (17.1 percent).

Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin.

The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Oklahoma's All Minorities population percentage (32.6 percent) is lower than that of the South region (42.3 percent) and the nation (37.6 percent).

Table 12.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Oklahoma (16.8 percent) is lower than that for the South region (18.2 percent) and higher than the figure for the nation (15.8 percent).

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

Geography	Total Population (estimated)	Race							Hispanic	All Minorities[a]
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Oklahoma	3,850,568	73.1%	7.2%	7.5%	1.9%	0.1%	2.7%	7.5%	9.6%	32.6%
South Region	102,853,019	72.3%	18.4%	0.9%	2.6%	0.1%	3.3%	2.4%	18.8%	42.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

[a]"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.

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

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

Geography	Percent Below Poverty Level
Oklahoma	16.8%
South Region	18.2%
United States	15.8%

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

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 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 Oklahoma. The analysis used block group data from the Census Bureau's American

Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015ae; U.S. Census Bureau, 2015ad; U.S. Census Bureau, 2015af) and Census Bureau urban classification data (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015j).

Figure 12.1.10-1 shows that Oklahoma has many areas with high or moderate potential for environmental justice populations. These areas are distributed throughout the state, but are most prevalent in the eastern part of the state. They occur both within and outside of the 10 largest population concentrations. Areas with low potential for environmental justice populations are infrequent in eastern Oklahoma, and are much more prevalent in the central portion of the state.

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 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 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 or 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.

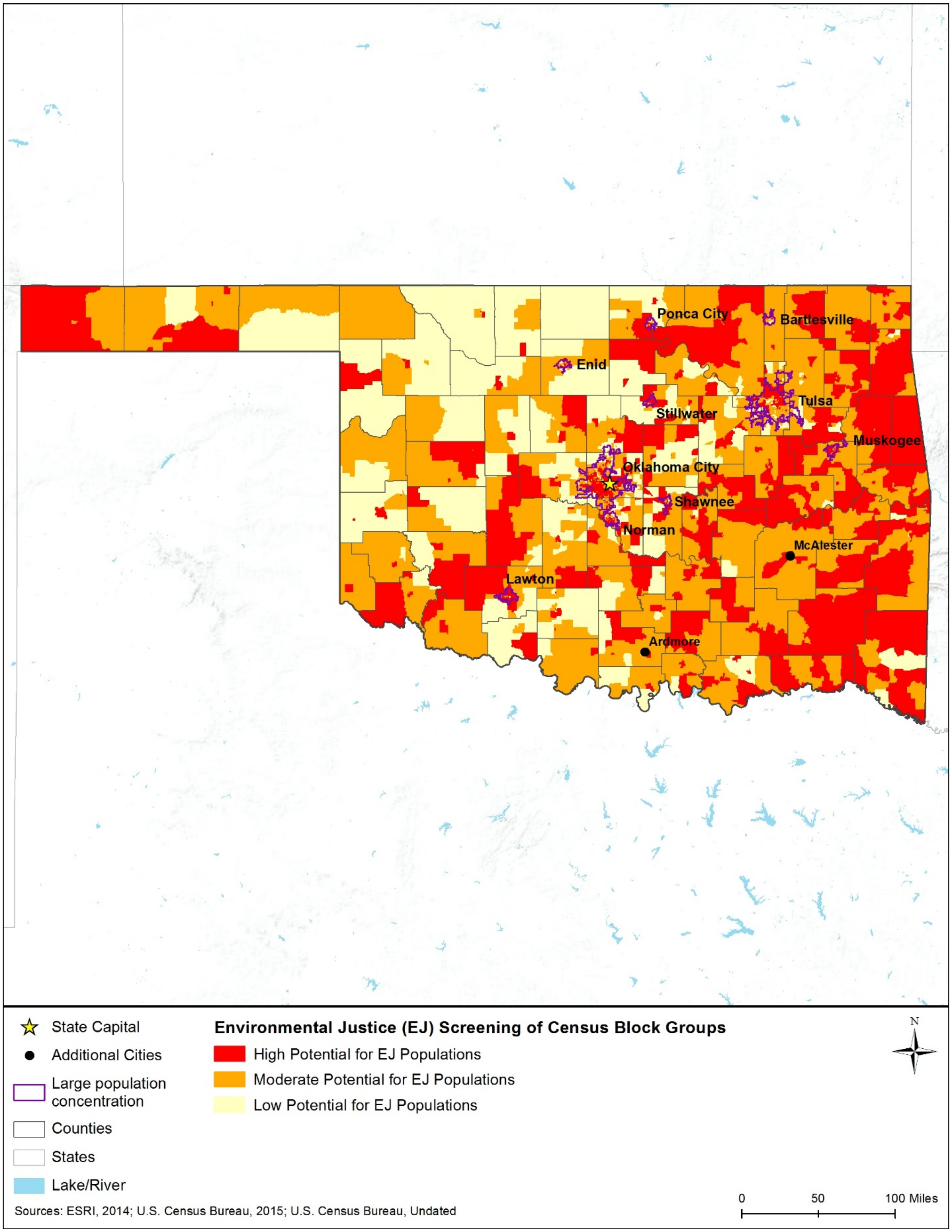

Figure 12.1.10-1: Potential for Environmental Justice Populations in Oklahoma, 2009–2013

12.1.11. Cultural Resources

12.1.11.1. Definition of Resource

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

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

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

- Statutory language and implementing regulations for Section 106 of the NHPA, as amended, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS's program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2016b); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to American Indian tribes or Native Hawaiian organizations (ACHP, 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, such as the NHPA (detailed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Oklahoma has a state law that is similar to the NHPA (Table 12.1.11-1). 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 Oklahoma Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Oklahoma Historical Preservation Act	Oklahoma Historical Preservation Act	Creates the state register of historic places and endows the Oklahoma Historical Society with powers to collect, preserve, and maintain materials relevant to Oklahoma history including state museums and historic sites.

12.1.11.3. Cultural and Natural Setting

Archaeological studies indicate that human beings have inhabited the Oklahoma region more than 12,000 years (SHPO, 2015). It is believed that the first inhabitants of present day Oklahoma were descended from people believed to have crossed the Bering Land Bridge as they followed the migrations of the mammoth, bison, and other large now extinct mammals for the purpose of hunting. The majority of evidence of the region's early human occupation derives from the study of prehistoric and historic archaeological sites. The establishment of various state parks by the Oklahoma Tourism and Recreation Department has furthered the preservation of many important archaeological sites with 82 listed on the National Register of Historic Places (NRHP) (NPS, 2015j). Oklahoma is part of the Atlantic Plain, Interior Highlands, and Interior Plains physiographic regions, and further subdivided into five physiographic provinces (refer to Figure 12.1.3-1). Physiographic regions and provinces are used by archeologists to narrow down large study areas (Fenneman, 1922).

Archaeological material in Oklahoma is primarily found on the ground surface or within one to two feet below the surface. However, Oklahoma contains more than 200 artificial lakes and reservoirs covering more than a million surface acres of water, and archaeologists believe that many prehistoric and historic sites are now submerged (NPS Archaeology Program, 2015).

The following sections examine Oklahoma's prehistory (10000 B.C. to A.D. 1600) and portions of the subsequent historic period after initial contact with Europeans in the 1500s. Section 12.1.11.4 provides an overview of this initial human habitation in Oklahoma and the cultural developments before European contact. Section 12.1.11.5 focuses on the federally recognized American Indian tribes with a cultural affiliation to the state. Section 12.1.11.6 presents a current list of significant archaeological sites in Oklahoma and the resources the state and the federal government use to ensure their protection.

12.1.11.4. Prehistoric Setting

Archaeologists divide Oklahoma's prehistory into four periods: The Paleoindian (10000 B.C. to 6000 B.C.), the Archaic (6000 B.C. to A.D. 1), the Woodland (A.D. 1 to 800), and the Village Farming (A.D. 800 to 1600). The following timeline (Figure 12.1.11-1) provides a guideline to Oklahoma's prehistoric occupation model. Oklahoma is considered part of the Great Plains archaeological culture group of North America (Patton & Marston, 2009). The archaeology of Oklahoma's prehistory has been documented throughout the region with particular periods better represented than others with regional variation. As each period is roughly defined and identified by the technologies of the time, archaeological evidence of these four occupations includes a range of artifacts that are uniquely identifiable to each occupation.

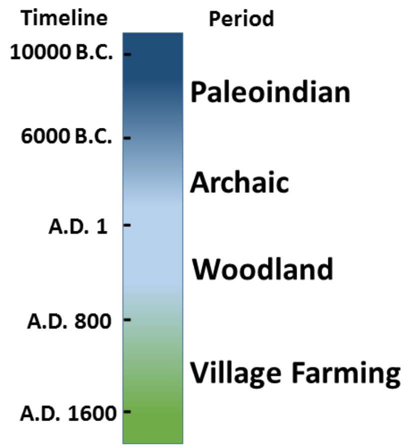

Figure 12.1.11-1: Timeline of Prehistoric Human Occupation

Source: (Institute of Maritime History, 2015)

Paleoindian Period (10000 – 6000 B.C.)

The Paleoindian Period represents the earliest age of human occupation in Oklahoma[112]. The aboriginal people of this time were hunter-gatherer nomads following the migratory patterns of the mammoth, bison, and other large grazing mammals. Cultural remains for this period primarily include large spear points, including Clovis points and Folsom points (Brooks, 2009). Studies show that similar fluted, stone projectile points were widely used across northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier, Inizan, & Feblot-Augustins, 2002).

The Jake Bluff site in Harper County in Northern Oklahoma is illustrative of a typical Paleoindian/bison kill site. Lithic material at the site includes three flakes and Clovis projectile points, as well as a fine-grained quartzite flaked knife associated with butchered animals remains (Stout, 2010). A limited subsurface excavation near the kill site yielded key artifacts including processed bison bone, heat-treated flakes, and a hammerstone. Based on the excavations and radiocarbon dates, the Jake Bluff site is considered a "stratified Paleoindian site" containing evidence of multiple activity areas including a Clovis point/bison kill, a Folsom/bison processing area, and a possible post-Folsom bison processing area (Oklahoma Archaeological Survey, 2005).

[112] New archaeological evidence is mounting that humans inhabited parts of Oklahoma during periods predating the Paleoindian period. DNA analysis of human remains found in Oklahoma in the past decade has raised research questions about the age of archaeological sites discovered in the mid-1980s and 1990s, most notably the 18,000-year old Cooperton mammoth kill site near Fort Supply, Woodward County, and the 30,000-year old Burnham site in Woods County (Puls & Ross, 2009). Both sites indicate the strong possibility of human/megafauna interaction, but neither site provides conclusive data (Stout, 2010). Further archaeological research continues on the topic of pre-Paleoindian habitation in Oklahoma.

Archaic Period (6000 B.C. – A.D. 1)

The Archaic Period in Oklahoma represents about 6,000 years of prehistory. However, despite the lengthy timespan of this period, limited archaeological information has been gathered about the Archaic Period in the Interior Plains (Barlett, Bement, & Brooks, 1993). While there is an exceedingly large number of sites for this period, Archaic groups were predominantly hunter-gatherers who moved seasonally and left only limited traces of their occupation (Brooks, 2005). The people of the Archaic Period were significantly affected by a long drought-prone time during the Middle Holocene known as the Altithermal Period that lasted about 3,000 years (5000 – 2000 B.C.) and may have forced groups of people in the central and western portions of the state to relocate to more favorable settings in the woodlands of eastern Oklahoma (SHPO, 2015).

Research data regarding the lifeways of the Archaic Period aboriginals indicate that their subsistence was dependent on seasonally varied food sources with an increased reliance on local plant and animal resources (Barlett, Bement, & Brooks, 1993). Lithic assemblages indicate greater reliance local chert and quartzite resources to create plant processing and hunting tools. Sites of the Archaic Period have yielded artifacts such as stemmed and notched projectile points, grinding stones, hammerstones, atlatl weights, gravers, scrapers, and choppers (Stout, 2010).

Woodland Period (A.D. 1 – 800)

The Woodland Period is the shortest prehistory period of Oklahoma prehistory, covering only 800 years. The main characteristics for this period are the introduction of ceramics, the use of the bow and arrow, and the first phases of horticulture (Barlett, Bement, & Brooks, 1993). The introduction of pottery indicates the establishment of more stable, sedentary patterns, which allowed for a more permanent and secure form of storage and a new element for preparing and cooking food (Brooks, 2009). The bow and arrow allowed for smaller hunting expeditions because it provided the advantage of longer range, and the newly favorable climate conditions, including cooler temperatures, allowed for farming practices throughout the region (SHPO, 2015).

The Woodland Period is marked by a change in the climate of the region, with cooler temperatures with greater amounts of rainfall. The climate shift resulted in more favorable farming conditions, which led to the development of early horticulture. People of the Woodland Period continued hunting and gathering as they developed horticulture technologies to supplement their diet with plant products (Barlett, Bement, & Brooks, 1993). Horticulture development and adoption was uneven across the Oklahoma region with some cultures of western Oklahoma continuing big game hunting practices with specialized spear points, while other cultures largely sustained themselves with horticulture (Brooks, 2009).

During the Early Woodland Period, trade and exchange patterns with nearby cultures are evident throughout the Oklahoma region (Vehik, 2009). Some archaeologists believe that ceramic decorative patterns may indicate the influence of Hopewellian cultures (Stout, 2010). Most tools were created from local resources. However projectile points, some utilitarian tools, and more often, ornaments have been found to be made from non-local materials originating as far away as the Gulf Coast, Lake Superior, and Yellowstone areas (Vehik, 2009). By the middle of the

Woodland Period (approx. A.D. 400), long-distance trade patterns decreased, and trade centered primarily within local groups.

Patsy's Island in northern Oklahoma has yielded cultural material indicating that it is likely a long-term Woodland Period-era site. The site contains lithic material and fire-affected faunal remains, ceramic fragments, non-fired daub, and plant remnants that indicate maize horticulture (Stout, 2010). The site illustrates the diverse subsistence patterns of some of the inhabitants of the Woodland Period.

Village Farming Period (Plains Village Period) (A.D. 1 – 1600)

The Village Farming Period, also known as the Plains Village Period, is the best understood of the prehistoric periods due to its combination of the temporal proximity to historic events and because Village Farming sites tended to be large, permanent, and made of more durable materials, as described below. Village Farming sites span from the Oklahoma panhandle to southeastern Oklahoma, and number in the tens of thousands (SHPO, 2015). Agriculture became increasingly important throughout this period, with increased reliance on maize production (Barlett, Bement, & Brooks, 1993). As agriculture increased in spatial distribution and populations became larger and more sedentary, political, social and religious systems likewise became more complex and were manifested in physical symbols such as earthen mounds (Brooks, 2009). Artistically advanced forms of ceramics were developed, which was a departure from the utilitarian forms of the previous Woodland Period (Brooks *et al* 2009).

The sedentary populations of the Village Farming Period used different technologies and adapted to their environments in diverse ways throughout the region. With the exception of the aboriginal people of the Oklahoma Panhandle area, Village Farming people generally lived in sturdy, grass-roofed houses with plaster and mud walls. These dwellings were primarily pit-houses with stone-slab walls anchored below the ground surface (Brooks, 2009). Villages throughout the Oklahoma region could accommodate dwellings in numbers of up to several hundred. Remnants of individual dwellings, also called farmsteads, are commonly found near major waterways (Barlett, Bement, & Brooks, 1993).

Similar to the Woodland Period, Village Farming Period cultures practiced different types of agriculture with varying intensity in the Oklahoma region. The intensification of agriculture was more pronounced in the western part of the state, while the eastern part of the state maintained hunting and gathering practices as a cornerstone of their diet (SHPO, 2015). Some archaeologists postulate that the relative paucity of agricultural practices in the east is due the abundance of resources available in the stream and river valleys (Brooks, 2009). By the middle of the Village Farming Period, populations throughout the Oklahoma region emphasized plant domestication with corn, beans, squash, chenopodium, amaranth, and sunflower as major food sources (Stout, 2010).

Aboriginal tool manufacture technology in Oklahoma increased and became more diverse during this period. Tools for processing domesticated plant food proliferated, bones were worked into various tools, as well as ornaments including beads, breastplates, and whistles, and ceramics adopted expressive and stylistic designs (Brooks, 2009). Painted pottery exhibited regional variances and vessels were crafted into a variety of forms including bowls, plates, jars, bottles, and effigies (Brooks, 2009).

The Heerwald site in Custer County, in central-western Oklahoma, is thought to be a Turkey Creek phase (A.D. 1200 –1450) village site of the Village Farming Period. Within the site are multiple bell-shaped, circular, and oval-type storage pits. Artifacts found within the site include chipped stone, diagnostic projectile points, plain and cordmarked ceramics, bone implements, shell, and charcoal deposits (Drass & Baugh, 2011). Faunal remains at the site include remnants of bison, deer, small mammals, fish, birds, and turtle. Evidence of lithic tool production at the site includes projectile points, scrapers, diamond-shaped beveled knives, drills, abraders, flakes, and lithic debitage. Other lithic tools include manos (grinding stones), mortars, pestles, celts (polished stone axes), and stone pipes. Bone and antler tools are widely represented at the site, with scapula hoes, tibia digging stick handles and blades, shaft wrenches, horn core scoops, antler flakers, and related items being common. Agricultural practices at the site are indicated by corn cupules and kernels. Only a portion of the site has been excavated, and the presence of intact storage pits has led archaeologists to believe that more features may be encountered during future excavations (Drass & Baugh, 2011).

During the period immediately prior to European contact in the region, there was a marked reduction in population size, with societies appearing to have “coalesced into communities representing multiple group identities” (SHPO, 2015). Archeologists theorize that the Little Ice Age had profound effects on the previously sprawling agricultural societies (SHPO, 2015). Social complexity declined in some areas with some societies favoring mobile bison hunting groups and others aggregating into less socially complex farming societies (Vehik, 2009). A limited number of agricultural societies continued to develop social complexity and political hierarchies.

Much later, after the creation of the United States and the Louisiana Purchase, American Indians from regions in the Southeast, Northeast, Midwest, Plains, and portions of the Southwest were forcibly moved to “Indian Territory,” now part of Oklahoma, between the 1830s and 1870s.

12.1.11.5. Federally Recognized Tribes of Oklahoma

According to the Bureau of Indian Affairs and National Conference of State Legislators, there are 38 federally recognized tribes in Oklahoma, many of them originating from different regions; Table 12.1.11-2 lists tribes in Oklahoma (National Conference of State Legislators, 2015).

Table 12.1.11-2: List of Federally Recognized Tribes of Oklahoma

Absentee-Shawnee Tribe of Indians	Kaw Nation	Quapaw Tribe of Indians
Alabama-Quassarte Tribal Town	Kialegee Tribal Town	Sac and Fox Nation
Apache Tribe of Oklahoma	Kickapoo Tribe of Oklahoma	Seminole Nation of Oklahoma
Caddo Nation of Oklahoma	Kiowa Indian Tribe of Oklahoma	Seneca-Cayuga Tribe of Oklahoma
Cherokee Nation	Miami Tribe of Oklahoma	Shawnee Tribe
Cheyenne and Arapaho Tribes	Modoc Tribe of Oklahoma	The Chickasaw Nation
Citizens Potawatomi Nation	Muscogee (Creek) Nation	The Choctaw Nation of Oklahoma
Comanche Nation	Osage Tribe	Thlopthlocco Tribal Town
Delaware Nation	Ottawa Tribe of Oklahoma	Tonkawa Tribe of Indians of Oklahoma
Delaware Tribe of Indians	Otoe-Missouria Tribe of Indians	United Keetoowah Band of Cherokee Indians in Oklahoma
Eastern Shawnee Tribe of Oklahoma	Pawnee Nation of Oklahoma	Wichita and Affiliated Tribes (Wichita, Keechi, Waco, Tawakonie)
Fort Sill Apache Tribe of Oklahoma	Peoria Tribe of Indians of Oklahoma	Wyandotte Nation
Iowa Tribe of Oklahoma	Ponca Tribe of Indians of Oklahoma	

Source: (National Conference of State Legislators, 2015)

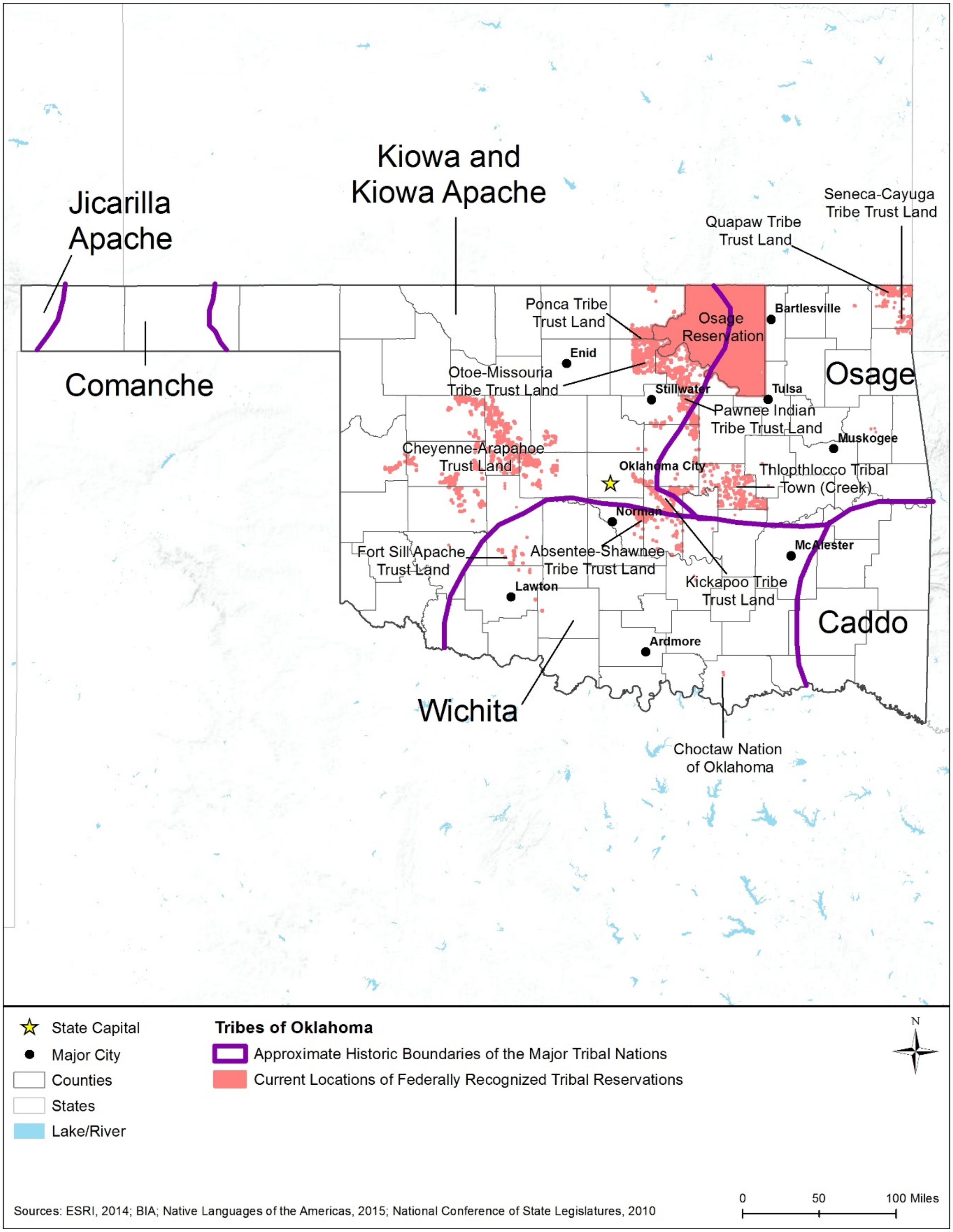

Figure 12.1.11-2: Federally Recognized Tribes in Oklahoma

12.1.11.6. Significant Archaeological Sites of Oklahoma

As previously mentioned in Section 12.1.11.3 there are 82 archaeological sites in Oklahoma listed on the NRHP. Table 12.1.11-3 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are listed on the NPS NRHP website at http://www.nps.gov/nr/ (NPS, 2015j).

Table 12.1.11-3: NRHP Listed Archaeological Sites in Oklahoma

Closest City	Site Name	Type of Site
Arnett	Eggleston Springs	Prehistoric
Belleville	Archeological Site 34JF109	Prehistoric
Berlin	Goodwin-Baker Archeological Site	Prehistoric
Bethel	Pine Creek Mound Group	Prehistoric
Binger	Caddo County Medicine Creek Archeological District	Prehistoric
Bradley	Jewett Site	Prehistoric
Bromide	Wapanucka Academy Site	Historic - Aboriginal
Cache	Arrastra Site	Historic
Carnegie	Cedar Creek District	Historic - Aboriginal
Carter	Edwards Archeological Site	Historic - Aboriginal
Clinton	Heerwald Site	Prehistoric
Colony	McLemore Site	Prehistoric
Eva	Shores Archeological Site	Prehistoric
Felt	Cedar Breaks Archeological District	Historic, Historic - Aboriginal
Fort Cobb	Fort Cobb Site	Military
Fort Sill	Camp Comanche Site	Historic - Aboriginal, Military
Fort Supply	Cooper Bison Kill Site	Prehistoric
Fort Towson	Doaksville Site	Historic - Aboriginal
Gate	Lonker Archeological Site	Prehistoric
Gracemont	Stevens Rock Shelter	Prehistoric
Grove	Bassett Grove Ceremonial Grounds	Historic - Aboriginal
Guymon	Easterwood Archeological Site	Historic - Aboriginal, Prehistoric
Guymon	Nash II-Clawson Archeological Site	Prehistoric
Guymon	Two Sisters Archeological Site	Prehistoric
Hammon	Hodge Site	Historic, Prehistoric
Hammon	Allee Site	Prehistoric
Hammon	Lamb-Miller Site	Prehistoric
Hardesty	Old Hardesty	Historic
Harjo	Rose--Fast Site (34PT28)	Prehistoric
Hugo	Rose Hill Plantation	Historic - Aboriginal
Idabel	Harkey Site	Prehistoric
Kenton	Bat Cave Archeological Site	Prehistoric
Kenton	Red Ghost Cave Archeological District	Prehistoric

Closest City	Site Name	Type of Site
Kenton	Three Entrance Cave Archeological District	Prehistoric
Keota	Otter Creek Archeological Site	Prehistoric
Laverne	Beagley-Stinson Archeological Site	Prehistoric
Lawton	Gore Pit District	Prehistoric
Lebanon	Haley’s Point Site	Prehistoric
Leon	Archeological Site 34LV184	Prehistoric
Lugert	Devil’s Canyon	Historic, Historic - Aboriginal, Military
Luther	Booher Site (OK48)	Prehistoric
Midwest City	Quillin Site	Prehistoric
Mocane	Rose, Billy, Archeological Site	Prehistoric
Mountain Park	Camp Radziminski	Historic
Newkirk	Bryson Archeological Site	Historic, Historic - Aboriginal
Newkirk	Deer Creek Site	Historic, Historic - Aboriginal
Newkirk	Jenkins, Gov. William W., Homestead Site	Historic
Nicut	Fears Site (34SQ76)	Prehistoric
Oklahoma City	Point 8 Site	Prehistoric
Oklahoma City	Spencer No. 2 Site	Prehistoric
Optima	Stamper Site	Prehistoric
Red Oak	McLaughlin Site	Prehistoric
Redland	Spiro Mound Group	Prehistoric
Ringling	San Bernardo	Historic - Aboriginal
Rubottom	Archeological Site 34LV181	Prehistoric
Sasakwa	Roulston-Rogers Site	Prehistoric
Short	Baker “A” Archeological Site (34SQ269)	Prehistoric
Short	Ellison No. 2 Site (34SQ85)	Prehistoric
Short	Kirby--Steely Archeological Site	Prehistoric
Short	Lee’s Creek Ceremonial Center Site (Boundary Increase)	Prehistoric
Short	Lee’s Creek Ceremonial Site	Prehistoric
Short	Starr Pasture Archeological Site (34SQ224)	Prehistoric
Short	Tall Cane Archeological Site (34SQ294)	Prehistoric
Spencer	Nagle Site	Prehistoric
Stigler	Mule Creek Site	Prehistoric
Sulphur	Lowrance Springs Site	Prehistoric
Texanna	Slippery Moss Shelter	Prehistoric
Texhoma	Johnson-Cline Archeological Site	Prehistoric
Tonkawa	Nez Perce Reservation	Historic - Aboriginal
Tullahassee	Tullahassee Mission Site	Historic
Turpin	Sharps Creek Crossing Site	Prehistoric
Wapanucka	McAlister, Bo, Site	Prehistoric
Warner	Johnson Lake Shelters	Prehistoric
Warner	Sheltered Shelter District	Prehistoric

Closest City	Site Name	Type of Site
Weatherford	Little Deer Site	Historic - Aboriginal, Prehistoric
Westville	Ballard Creek Roadbed	Historic
Westville	Breadtown	Historic
Wister	Lake Wister Locality	Prehistoric
Woodward	Patsy's Island Site	Prehistoric
Woodward	Smith No. 2 Site	Prehistoric
Wright City	Davis, Grobin, Mound Group	Prehistoric
Yukon	McGranahan Portion of the Chisholm Trail Roadbed	Historic

Source: (NPS, 2015j)

12.1.11.7. Historic Context

European exploration of present day Oklahoma began in 1541, when separate expeditions led by Francisco Vasquez de Coronado and the remnant members of the Hernando de Soto expedition from Florida explored western and southeastern Oklahoma, respectively, in search of gold. In 1542-1544, a missionary expedition to Kansas led by Andres do Campo, a soldier, and Franciscan Friar Juan de Padilla—both members of the former Coronado expedition—passed back and forth through Oklahoma. In the 17th century, in 1650, Don Diego del Castillo spent time in the mountains of Oklahoma prospecting for silver and gold. While these conquistadors claimed the land for Spain, no permanent settlements were established. In 1682, the Canadian explorer Rene-Robert Cavelier, Sieur de La Salle claimed present day Oklahoma for France (Tulsa City-County Library, 2015). In 1803, Oklahoma was acquired by the U.S. as a part of the Louisiana Purchase, although the western portion temporarily transitioned to the control of the Republic of Texas during the late 1840s (U.S. Department of State: Office of the Historian, 2015a).

During the first half of the 19th century, the region of present day Oklahoma was chosen in the Indian Removal Act of 1830 as a relocation site for eastern American Indian tribes being pushed out of their native lands. Tribes that moved to Oklahoma, either by treaty or forcibly, include the Seminole, Choctaw, and Cherokee. These forced relocations are now referred to as the Trail of Tears (Tulsa City-County Library, 2015) (U.S. Department of State: Office of the Historian, 2015b). Consequently, most of what is now called Oklahoma was known simply as "Indian Territory" (U.S. Department of State: Office of the Historian, 2015b). In 1850, Texas ceded the portion of the land it had claimed, resulting in the addition of the Oklahoma Panhandle and the establishment of the state's southern border in that area (Tulsa City-County Library, 2015).

During the Civil War, many Indian tribes in Oklahoma allied themselves with the Confederacy, and mounted a resistance in the territory. The most notable battle during the conflict was fought at Honey Springs. Ultimately, the decision of the Indians to side with the Confederacy proved detrimental and it was used as justification for seizing additional land following the war. In 1870, work was started on the Missouri-Kansas-Texas Railroad, which was the first railroad to enter Oklahoma. A cycle of conflict with the Indian nations occupying Oklahoma continued for much of the 19th century, with different systems of land management being employed as views regarding the most appropriate way to handle the Indians changed; land deemed "surplus" was opened to non-Indian settlement during this time (Tulsa City-County Library, 2015).

Oklahoma State Cultural Resources Database and Tools

Oklahoma State Historic Preservation Office (SHPO)

The State Historic Preservation Office, which is part of the Oklahoma Historical Society, works to preserve the cultural resources of Oklahoma. The office is responsible for overseeing preservation programs and maintaining historical resources. A list of all National Register of Historic Places nominations is available on the SHPO website at www.okhistory.org/shpo/nationalregister.htm, as well as nomination forms and documents (Oklahoma Historical Society, 2015d).

Oklahoma Historical Society (OHS)

The Oklahoma Historical Society works to collect, preserve, and share the history and culture of Oklahoma. The Historical Society maintains museums, historic homes, historic military sites throughout the state, and articles on historic topics on their website at http://gateway.okhistory.org.

Oklahoma Anthropological Society (OAS)

The Oklahoma Anthropological Society is a statewide nonprofit that encourages the study and preservation of Oklahoma's diverse heritage. Their goal is to spread awareness to the public of the prehistoric and historic sites through the distribution of information via publications. Journal articles and photographs of archaeological sites are available at http://www.ou.edu/cas/archsur/oas/ (Oklahoma Tourism and Recreation Department, 2015c).

Oklahoma Archeological Survey (OAS)

The Oklahoma Archaeological Survey is based at the University of Oklahoma in Norman and serves as the central repository for records on known archaeological sites throughout the state. This OAS maintains articles on Oklahoma prehistory, information about cultural resource management, and an interactive timeline of Oklahoma's prehistory at http://www.ou.edu/archsur/ (Oklahoma Tourism and Recreation Department, 2015n).

Oklahoma Department of Transportation Cultural Resources Program (ODOT CRP)

The Oklahoma DOT Cultural Resources Program helps in maintaining Oklahoma's archaeological and historic past before and during transportation-related construction projects. The ODOT CRP conducts research to identify and evaluate historic properties and archaeological sites and conducts archaeological investigations to evaluate the significance of archaeological sites and assess their eligibility for listing in the National Register of Historic Places. Archaeological reports from 1975 through 2015, information about Programmatic Agreements with Tribes, and geocoded maps may be accessed on ODOT's website at http://www.ou.edu/archsur.

The first oil producing well was opened in Oklahoma in 1889, signifying a major economic development for the area. In 1890, the Oklahoma Territory was established, and in 1892, the University of Oklahoma was opened in Norman, Oklahoma. On November 16, 1907, Oklahoma was admitted to the Union as the 46th state, and in 1910, the capital was moved to Oklahoma City. Oil continued to grow in economic importance during the early 20th century, with the discoveries of the Cushing Oil Pool and the Healdton Oil Field being made in 1912 and 1913, respectively (Tulsa City-County Library, 2015).

Additional highly productive oil fields were discovered during the early 20th century, increasing Oklahoma's economic prowess as the country began to rely more heavily on petroleum products. Following the Great Depression, oil fields were intentionally closed in order to normalize prices that resulted from overproduction (Tulsa City-County Library, 2015).

During World War II (WWII), many Oklahomans served in the military, but the state also served as a training ground for troops from around the nation and was the home to several large military installations, including prisoner of war (POW) camps that housed thousands of captured German soldiers (Oklahoma Historical Society, 2015b).

Oklahoma has 1,246 NRHP listed sites, as well as 22 NHLs (NPS, 2014d). Oklahoma does not contain any National Heritage Areas (NHA) (NPS, 2015k). Figure shows the location of NRHP sites within Oklahoma.[113]

12.1.11.8. Architectural Context

Historic resources in Oklahoma include both those associated with the settlement of non-indigenous Americans and the forced relocation of much of the Indian population from east of the Mississippi River. Resources associated with the Indian population take many forms and include transportation corridors, such as the Ballard Creek Roadbed in Adair County; private dwellings, such as the Walker Farmhouse in Craig County; and institutional buildings, such as the Choctaw's Wheelock Academy, in McCurtain County, which has been designated as a NHL (Oklahoma Historical Society, 2015c).

Oklahoma has a collection of historic military resources relating to the relocation of the Indian population to the area, as well as the Civil War, WWI, and WWII. "Honey Springs Battlefield (NHL, McIntosh and Muskogee Counties) was the site of the largest American Civil War engagement in Indian Territory" (Oklahoma Historical Society, 2015c). The Battle of Honey Springs was significant insomuch as it included "divided Native Americans who fought and died there for both the North and South. The Battle of Honey Springs illustrates how the most destructive conflict in American history moved into what was then Indian Territory and into the lives of its residents who fought to preserve their way of life" (NPS, 2001). Davis Air Field, in Muskogee, OK, is an example of an airfield associated with WWII (Warde & Everett, 1993).

Commercial historic resources in Oklahoma date from the late 19th century, when the territory was opened to widespread non-indigenous settlement. These properties are representative of the

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

growth that occurred during the late 19th and early 20th centuries, sparked by transportation improvements and the expanding oil industry (Oklahoma Historical Society, 2015c).

Ranching activities were common in Oklahoma, and associated resources associated remain today. Examples of ranching resources include the Perryman Ranch Headquarters, in Jackson County; the J. P. Tipton Farmstead, in Kay County; and engineering resources, such as the Old Settler's Irrigation Ditch in Harper County. Structures were built of stone, wood, brick, and earth (Oklahoma Historical Society, 2015c). Dr. Irvin D. Leoser's Log Cabin in Tahlequah, provides, "one of the earliest examples of frontier log construction remaining in the state of Oklahoma" (Library of Congress, 2016). This log cabin, which was built in the late 1840s, is constructed of 12-inch square oak logs (Library of Congress, 2016). "Territorial architecture (1890's-1907) is abundant but best seen in Guthrie, home to the nation's largest contiguous urban historic district on the National Register, extending 1,400 acres and 400 city blocks" (Oklahoma Film & Music, 2016a); 19th century Victorian architecture is common throughout the city (Oklahoma Film & Music, 2016b). The Oklahoma Panhandle also contains a collection of wooden grain elevators dating to the first quarter of the 20th century (National Register of Historic Places, 1984).

Oklahoma retains several historic districts representing a variety of 20th century styles (Oklahoma Historical Society, 2015c). Revivalism was popular during the late 19th and early 20th century and includes style such as Colonial Revival, Classical Revival, and Tudor Revival. Prairie and Craftsman architecture were favored from around 1910 up until the start of WWII, overlapping with the continuing revival movement, which continued to exert its influence on design (McAlester, 2013). During and after WWII, minimal traditional houses were built to house returning veterans, followed by ranch houses starting in the 1950s. Additional Modern styles that were popular include but are not limited to International, Art Deco,[114] A-frame, and Split-Level (Ozan, 2014). Oklahoma also contains resources associated with the New Deal programs, such as the Civilian Conservation Corps CCC) and Works Progress Administration (WPA), education related resources, transportation resources, industrial resources, and health and medical facilities (Oklahoma Historical Society, 2015c).

[114] The City of Tulsa has the "nation's third largest collection of art deco buildings, after Miami Beach and New York." (Preserve America, 2009)

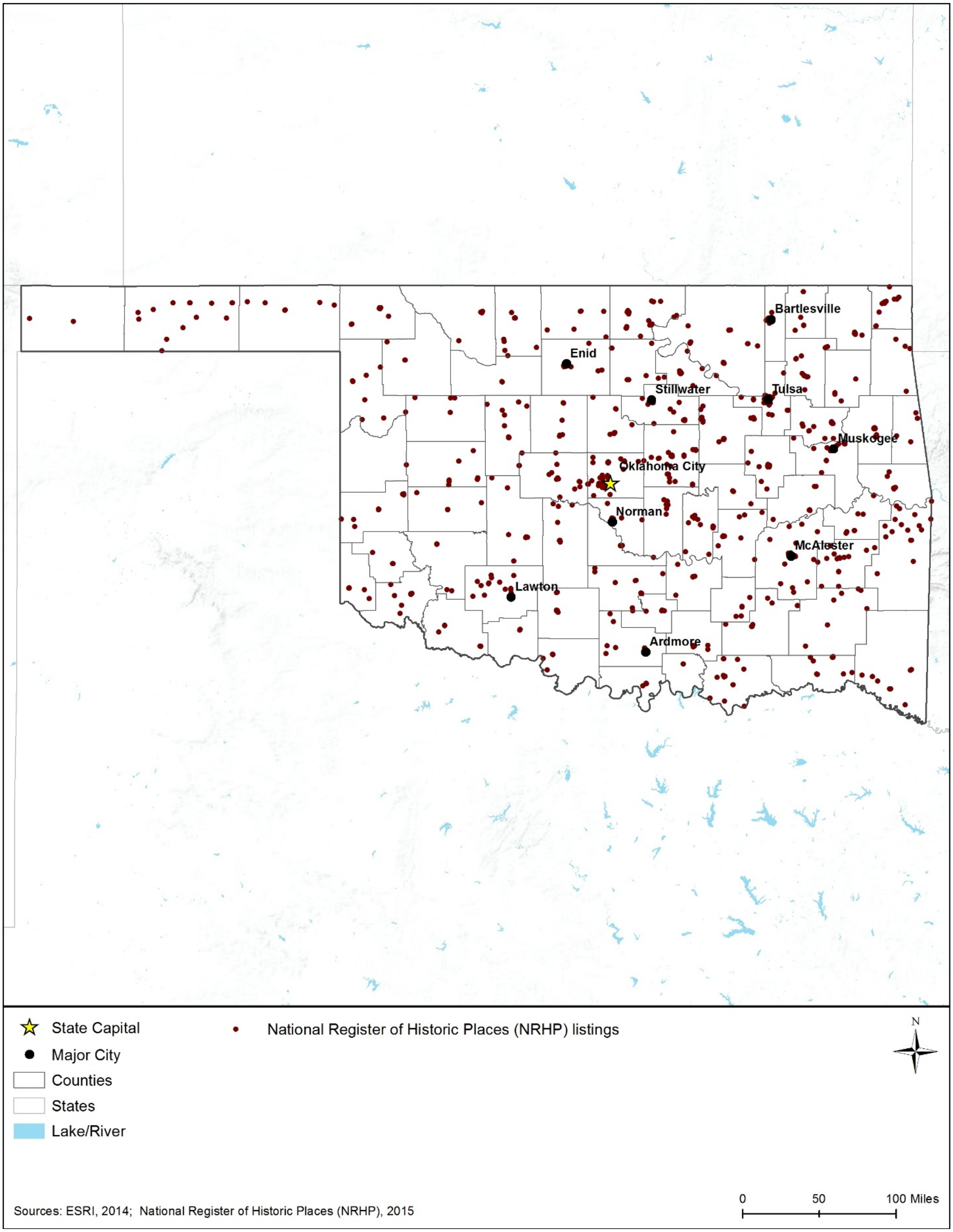

Figure 12.1.11-3: National Register of Historic Places (NRHP) Sites in Oklahoma

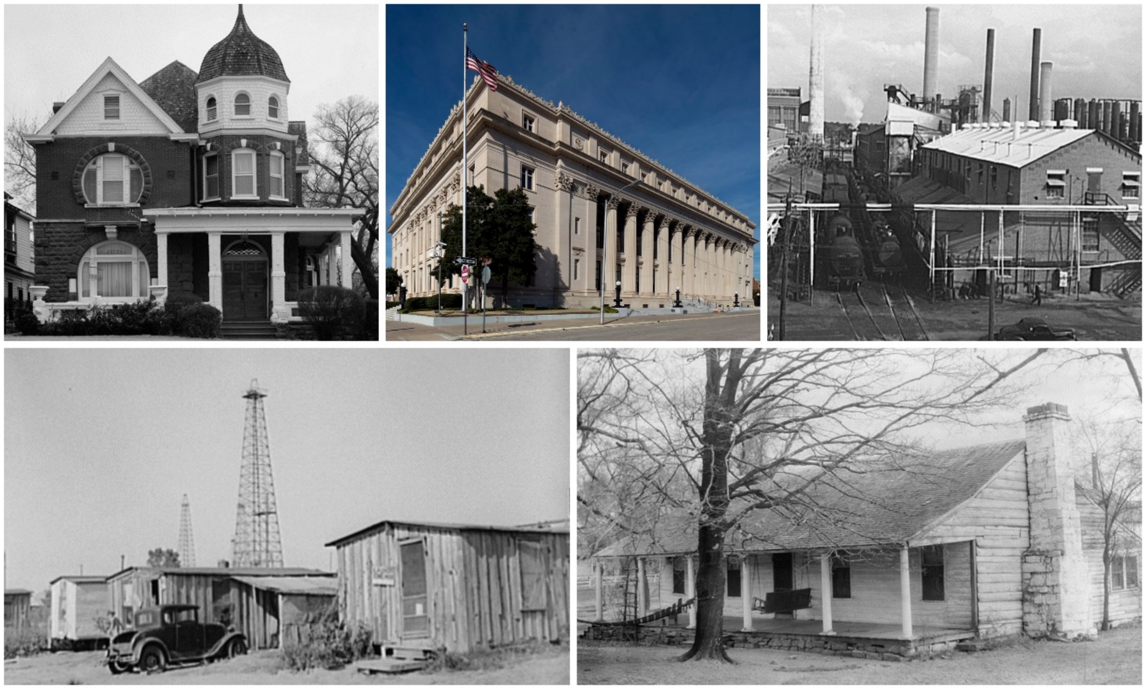

Figure 12.1.11-4: Representative Architectural Styles of Oklahoma

- Top Left – P.J. Heilman House (Guthrie, OK) – (Historic American Buildings Survey, 1933)
- Top Middle – Ed Edmondson Courthouse (Muskogee, OK) – (Highsmith, 2013)
- Top Right – Oil Refinery (Tulsa, OK) – (Vachon, 1942)
- Bottom Left – Homes of Oil Field Workers (Oklahoma City, OK) – (Lee, 1939)
- Bottom Right – Howard House (Fort Gibson, OK) – (Historic American Buildings Survey, 1934)

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 topography[115] 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)[116] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[117] This section discusses the existing air quality in Oklahoma. The USEPA designates areas within the United States as attainment,[118] nonattainment,[119] maintenance,[120] or unclassifiable[121] 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 PM_{10}), ozone (O_3), and oxides of sulfur (SO_x). The NAAQS establish various standards, either primary[122] or secondary,[123] 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, 2016d). HAPs can have severe adverse impacts on human health and the

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

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

[117] Averaging Time: "The period over which data are averaged and used to verify proper operation of the pollution control approach or compliance with the emissions limitation or standard." (USEPA, 2015p)

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

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

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

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

[122] 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, 2015q)

[123] 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, 2015q)

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, Oklahoma maintains its own air quality standards, the Oklahoma Ambient Air Quality Standards (OKAAQS). Table 12.1.12-1 presents an overview of the OKAAQS as defined by the ODEQ.

Table 12.1.12-1: Oklahoma Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m^3	ppm	µg/m^3	ppm	
CO	8-hour	10,000	9	-	-	The standard is attained when the 8-hour average concentration does not exceed 9 ppm.
	1-hour	40,000	35	-	-	The standard is attained when the 1-hour average concentration does not exceed 35 ppm.
Lead	3-month	0.15	-	0.15	-	Not to be exceeded more than once during a 3-year period.
NO_2	1-hour	-	0.1	-	-	The standard is attained when the 3-year average of the 98th percentile of the daily maximum 1-hour average concentration at each monitor within an area does not exceed 100 ppb.
	Annual	-	0.053	100	0.053	Not to be exceeded more than once during a 3-year period.
PM_{10}	24-hour	150	-	-	-	The standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m^3.
$PM_{2.5}$	Annual	12	-	15.0	-	The standard is attained when the annual arithmetic mean is equal to or less than the numerical standard.
	24-hour	35	-	-	-	The standard is attained when the 98th percentile concentration is equal to or less than the numerical standard.
O_3	8-hour	-	0.075	-	0.075	The standard is attained when the computed 3-year average of the annual 4th-highest daily maximum 8-hour average does not exceed 0.075 ppm.
SO_2	1-hour	-	0.075	-	-	The standard is attained when the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area does not exceed 75 ppb.
	3-hour	-	-	1,300	0.5	Not to be exceeded more than once per year.

Source: (DEQ, 2015n)

Title V Operating Permits/State Operating Permits

Oklahoma 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, 2015o). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015o). The ODEQ Rule 252:100-8-3(a) describes the applicability of Title V operating permits (DEQ, 2015n). Oklahoma requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 12.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014).

Table 12.1.12-2: Major Air Pollutant Source Thresholds

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

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

Oklahoma DEQ issues three types of operating permits for minor sources: (1) permit by rule, (2) general permits, and (3) individual permits.

- There are no permit by rule categories applicable to FirstNet;
- General permits are applicable to facilities meeting the following criteria:
    - Actual emissions less than 100 TPY of each regulated air pollutant, except HAPs;
    - Emits or has the potential to emit less than 10 TPY of any single HAP, or less than 25 TPY of any combination of HAPs; and
- Individual permits are applicable to all minor facilities. A facility that does not qualify for either permit by rule or general permit, must apply for an individual permit. (DEQ, 2015n)

Exempt Activities

The ODEQ does not explicitly exempt any source from obtaining a permit. However, facilities that emit less than 40 TPY and do not have the potential to emit above major source thresholds (see Table 12.1.12-3), may apply for a permit exemption with the ODEQ (Kienlen, 2015). In addition, all activities should review applicable stationary source requirements, or contact the ODEQ for additional assistance (DEQ, 2015n).

Temporary Emissions Sources Permits

The ODEQ may issue temporary permits for major sources under Rule 252:100-8-6.2 (Temporary Sources) for emissions from similar operations by the same source owner or operator at multiple temporary locations. The temporary emission source must have a change of location at least once during the term of the permit (DEQ, 2015n).

State Preconstruction Permits

The ODEQ requires construction permits under Rule 252:100-7-15 for the construction of a new facility or modification of an existing facility. Three different types of permits are issued for minor sources: (1) permit by rule, (2) general permit, and (3) individual permit. The qualifications for each type are outlined above under Title V Operating Permits/State Operating Permits. For major sources, under rule 252:100-8-4 (Requirements for Construction and Operating Permits), ODEQ requires construction permits for the construction or reconstruction of any source that will require a Title V operating permit. (DEQ, 2015n)

General Conformity

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

The estimated pollutant emissions are compared to *de minimis*[124] levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 12.1.12-3). As a result, lower *de minimis* thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

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.

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

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

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

To demonstrate conformity,[125] 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 Requirements

Oklahoma is in attainment for all the six criteria pollutants; none of its counties exceed the NAAQS. Oklahoma does have a SIP for regional haze. A copy of the regional haze SIP can be found on the Oklahoma DEQ website:
http://www.deq.state.ok.us/aqdnew/RulesAndPlanning/Regional_Haze/index.htm.

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

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, while unclassifiable areas are combined with attainment areas. Currently all of Oklahoma is in attainment. Figure 12.1.12-1 shows that no maintenance, or unclassifiable areas exist in Oklahoma.

Air Quality Monitoring and Reporting

The Oklahoma measures air pollutants at 22 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (DEQ, 2015o). Annual Oklahoma State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region (DEQ, 2015o). The ODEQ reports real-time pollution levels of NO_2, O_3, SO_2, PM_{10}, $PM_{2.5}$, H_2S and CO on their website: http://www.deq.state.ok.us/aqdnew/monitoring/cpdata.htm.

Throughout 2014, O_3 measurements exceeded the federal standard of 0.075 ppm at 19 locations in Oklahoma with the following maximum values listed in Table 12.1.12-4. Oklahoma did not exceed Federal standards for eight-hour CO, one-hour O_3, or one-hour SO_2. However, the ODEQ website (http://www.deq.state.ok.us/AQDNew/monitoring/archcharts/archchart.htm) did not contain data for any of the other criteria pollutants.

Air Quality Control Regions

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

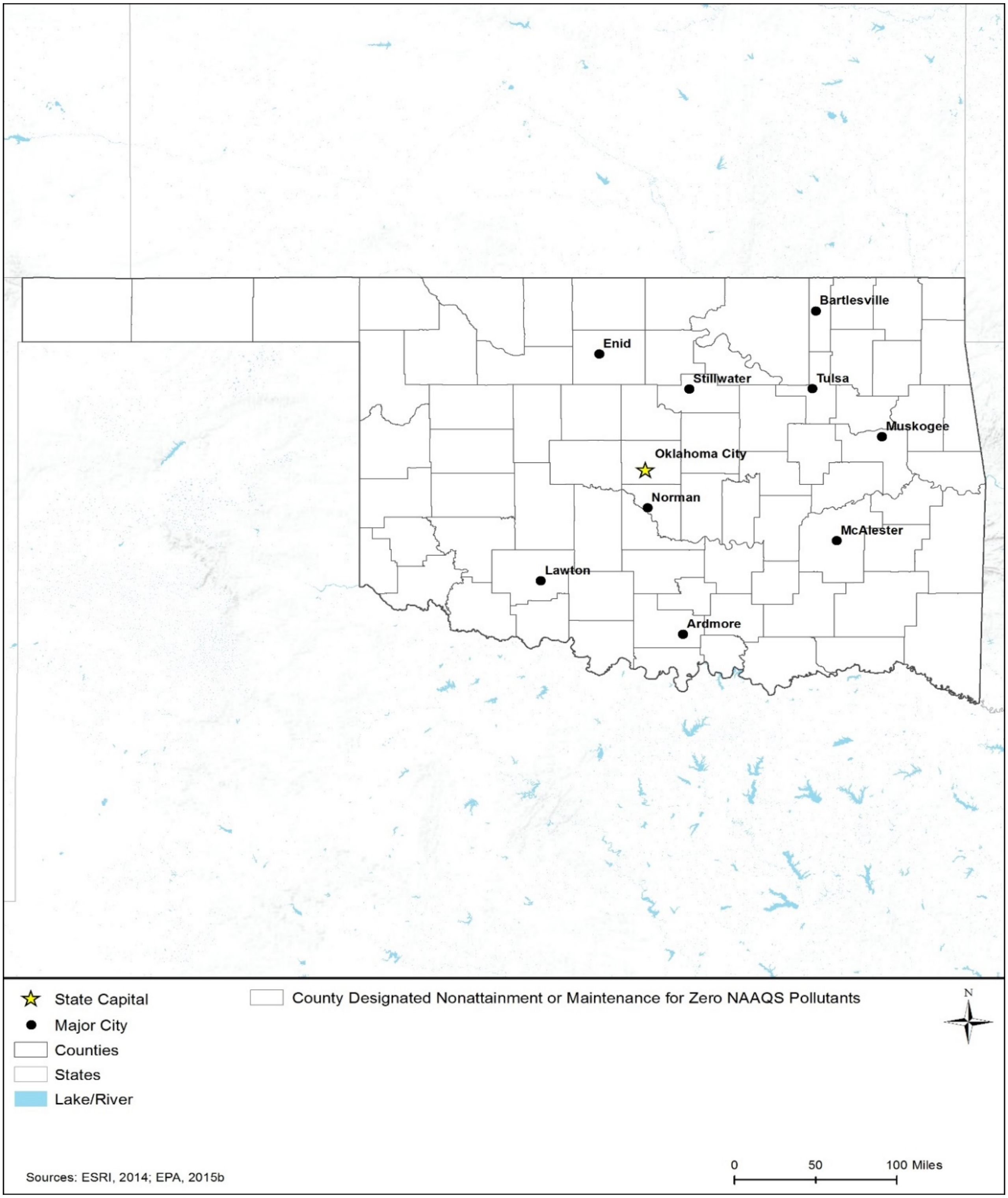

Figure 12.1.12-1: Nonattainment and Maintenance Counties in Oklahoma

Table 12.1.12-4: Oklahoma 2014 Exceedances

Site	Max Exceedances (ppm)
Walters	0.083
Burneyville	0.081
Healdton	0.085
Tulsa West	0.083
Tulsa East	0.082
Tulsa Central	0.085
Tulsa North	0.085
Tulsa South	0.080
OKC North	0.084
OKC Central	0.082
OKC Moore	0.081
OKC Goldsby	0.080
OKC Choctaw	0.081
OKC Yukon	0.083
Lawton North	0.080
McAlester	0.078
Seiling	0.078
Waurika	0.084
Durant	0.078

Source: (DEQ, 2015p)

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers126 of a Class I area. “The USEPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. “Historically, the USEPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source (USEPA, 1992).

[126] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

Oklahoma contains one Class I area, the Wichita Mountain area. Arkansas has one Class I area, Caney Creek Wilderness, where the 100-kilometer buffer intersects Oklahoma 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 Oklahoma highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 12.1.12-2 correspond to the numbers and Class I areas listed in Table 12.1.12-5.

Table 12.1.12-5: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Wichita Mountains Wilderness Area	8,900	OK
2	Caney Creek Wilderness Area	4,344	AR

[a] The numbers correspond to the shaded regions in Figure 12-1-12-2.
Source: (USEPA, 2013b)

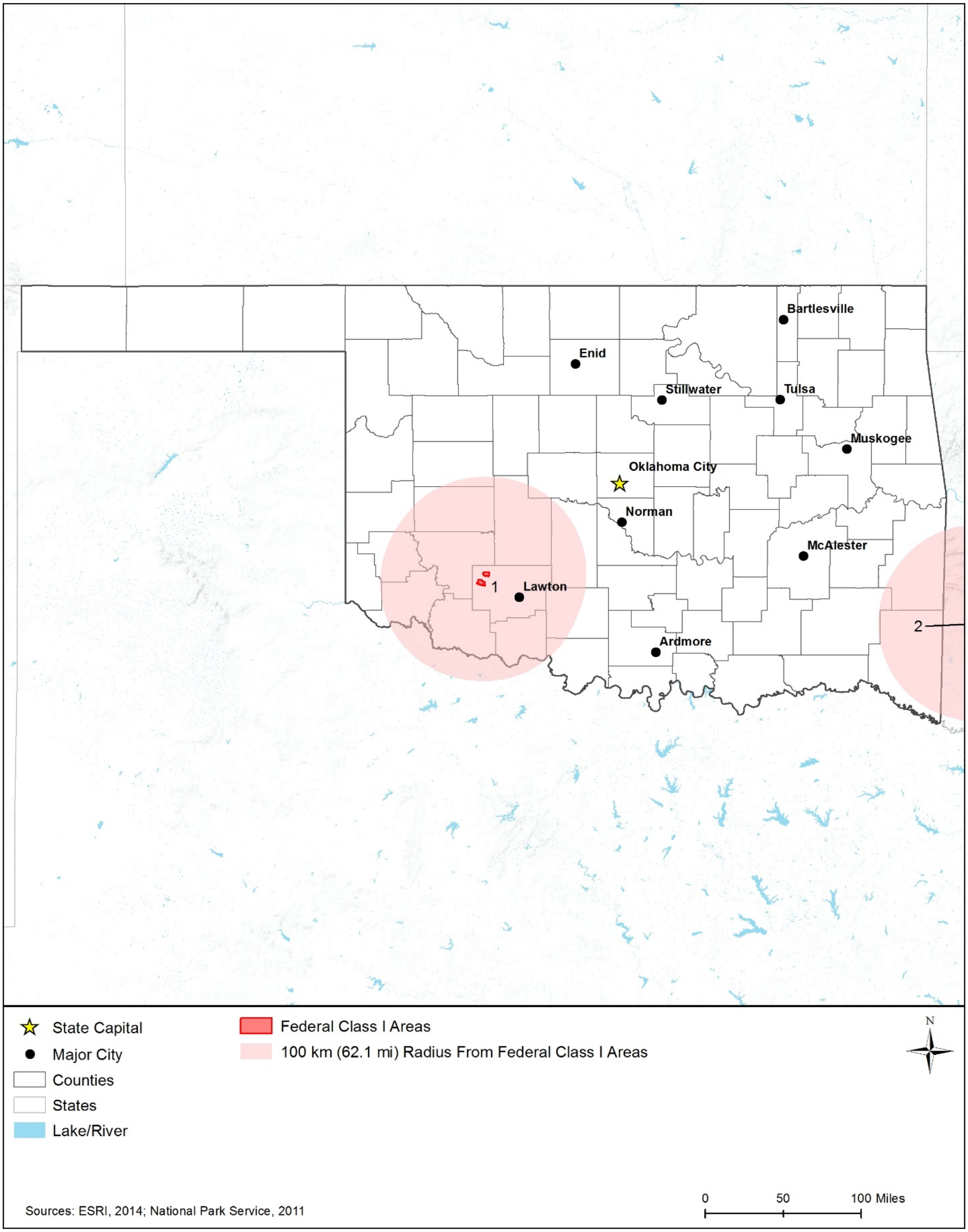

Figure 12.1.12-2: Federal Class I Areas with Implications for Oklahoma

12.1.13. Noise

This section presents a discussion of a basic understanding of environmental noise, 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, 2012a). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

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

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB ("threshold of hearing") to about 140 dB ("threshold of pain") (OSHA, 2016a). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (Federal Transit Authority, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015h). 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.

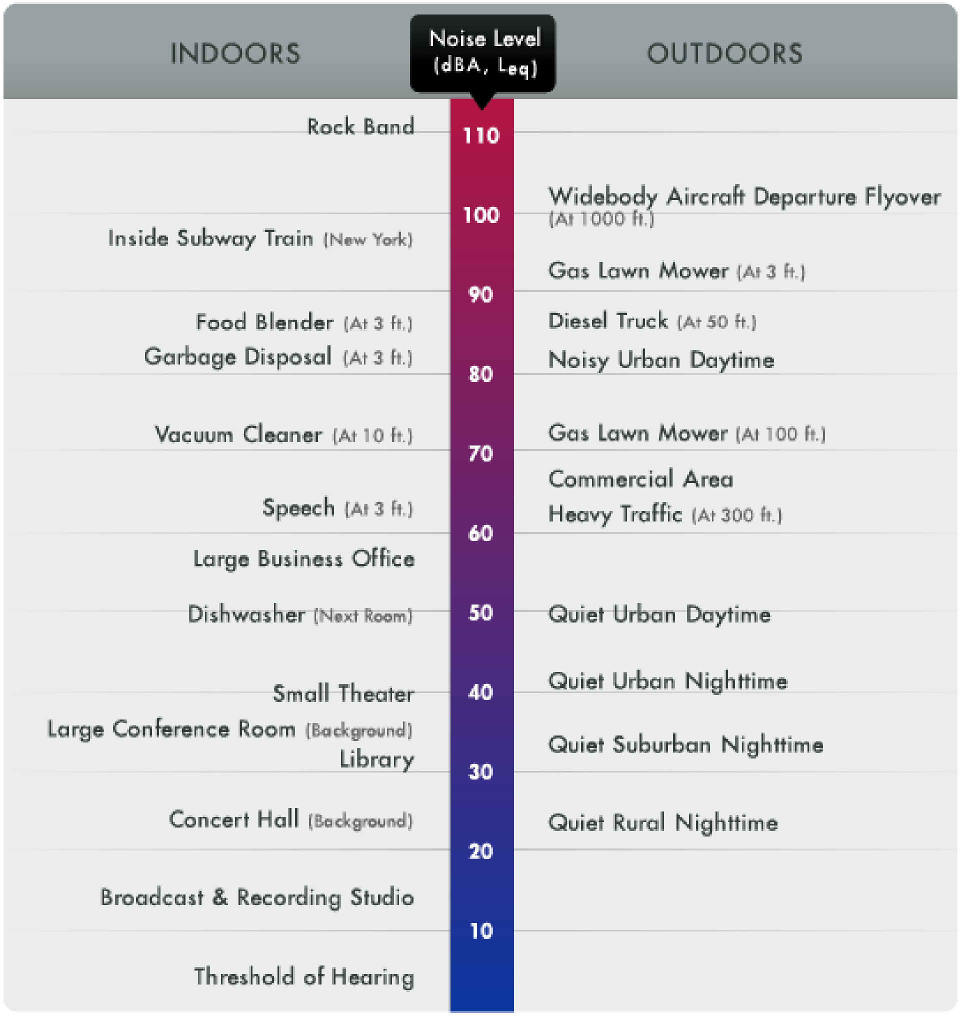

Figure 12.1.13-1: Sound Levels of Typical Sounds

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

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

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

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

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

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.

Oklahoma does not have any state-wide noise regulations that would apply to the Proposed Action. However, many cities and towns may have local noise ordinances to 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 Oklahoma City and Tulsa, are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (FHWA, 2011).

12.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Oklahoma varies widely based on the area and environment of the area. The population of Oklahoma can choose to live and interact in areas that are large cities, rural communities and National and State parks. Figure 12.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Oklahoma may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Oklahoma. As such, this section describes the areas where the population of Oklahoma can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Oklahoma City (and its neighboring boroughs and cities) and Tulsa.
- **Airports:** Areas surrounding airports tend to be more sensitive to noise due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012a). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports are in the proximity of urban communities;

therefore, aircraft operations (arrivals/departures) can result in noise exposure in the surrounding areas to be at higher levels 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 Oklahoma, Will Rogers World Airport (OKC) and Tulsa International Airport (TUL) have more than 394,000 annual operations combined (FAA, 2015i). These operations result in increased ambient noise levels in the surrounding communities. See Section 12.1.1, Public Safety Infrastructure, and Figure 12.1.7-7 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 in those areas. 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, Public Safety 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 (Federal Railroad Administration, 2015). Oklahoma has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend mainly from Oklahoma City and Tulsa to other cities in Oklahoma, Texas, and Arkansas, such as the BNSF Railway and the Stillwater Central Railroad. There are also a number of other rail corridors that join these major rail lines and connect with other cities (ODOT, 2014). See Section 12.1.1, Public Safety 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. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014e). Oklahoma has three officially designated National Parks in addition to three other NPS affiliated areas (NPS, 2015l). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 12.1.8, Visual Resources, for more information about national and state parks for Oklahoma.

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, 2014). Most cities and towns in Oklahoma 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 in Oklahoma.

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, 2012b). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e[127]), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in million metric tons (MMT) CO_2. Where the PEIS 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" (IPCC, 2007). "Atmospheric concentrations of CO_2 increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005" (IPCC, 2007). The atmospheric concentration of CH_4 and N_2O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see Section 12.2.14). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation; and 3) severe weather events (including severe thunderstorms, flooding, and tornadoes).

[127] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents ($MMTCO_2e$). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_{2e}$ = (million metric tons of a gas) * (GWP of the gas)" (USEPA 2015).

12.1.14.2. Applicable Statutes and Regulations

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

12.1.14.3. Greenhouse Gas Emissions

Estimates of Oklahoma's total GHG emissions vary. The Department of Energy's (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as methane (CH_4) and nitrous oxide (NO_x), but not at the state level (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015k). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

According to the EIA, Oklahoma emitted a total of 103.1 MMT CO_2 in 2013. Electric power is the largest-emitting sector at 43 percent of the total, and transportation is next at 29 percent. Emissions are almost evenly split between coal, natural gas, and petroleum products (Table 12.1.14-1) (EIA, 2015c). Annual emissions between 1980 and 2013 are presented in Figure 12.1.14-1 (EIA, 2015c). Between 1980 and 2009, Oklahoma's CO_2 emissions increased from 77.4 to 111.4 MMT (44 percent). The increase was characterized by rapid growth in emissions from coal in the electric power sector. Meanwhile emissions from natural gas first declined, held steady for several years, and then increased beginning in 2006, almost reaching their 1980 levels. Since 2008, total emissions have declined slightly as emissions from coal decreased. Oklahoma was the 17th highest CO_2 emitter among the 50 states and the District of Columbia in 2013, and was ranked 10th for per-capita emissions (EIA, 2014b).

Table 12.1.14-1: Oklahoma CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2012

Fuel Type (MMT)		Source (MMT)	
Coal	31.7	Residential	4.1
Petroleum Products	35.1	Commercial	2.8
Natural Gas	36.2	Industrial	22.2
		Transportation	29.8
		Electric Power	44.2
TOTAL	**103.1**	**TOTAL**	**103.1**

Source: (EIA, 2015d)

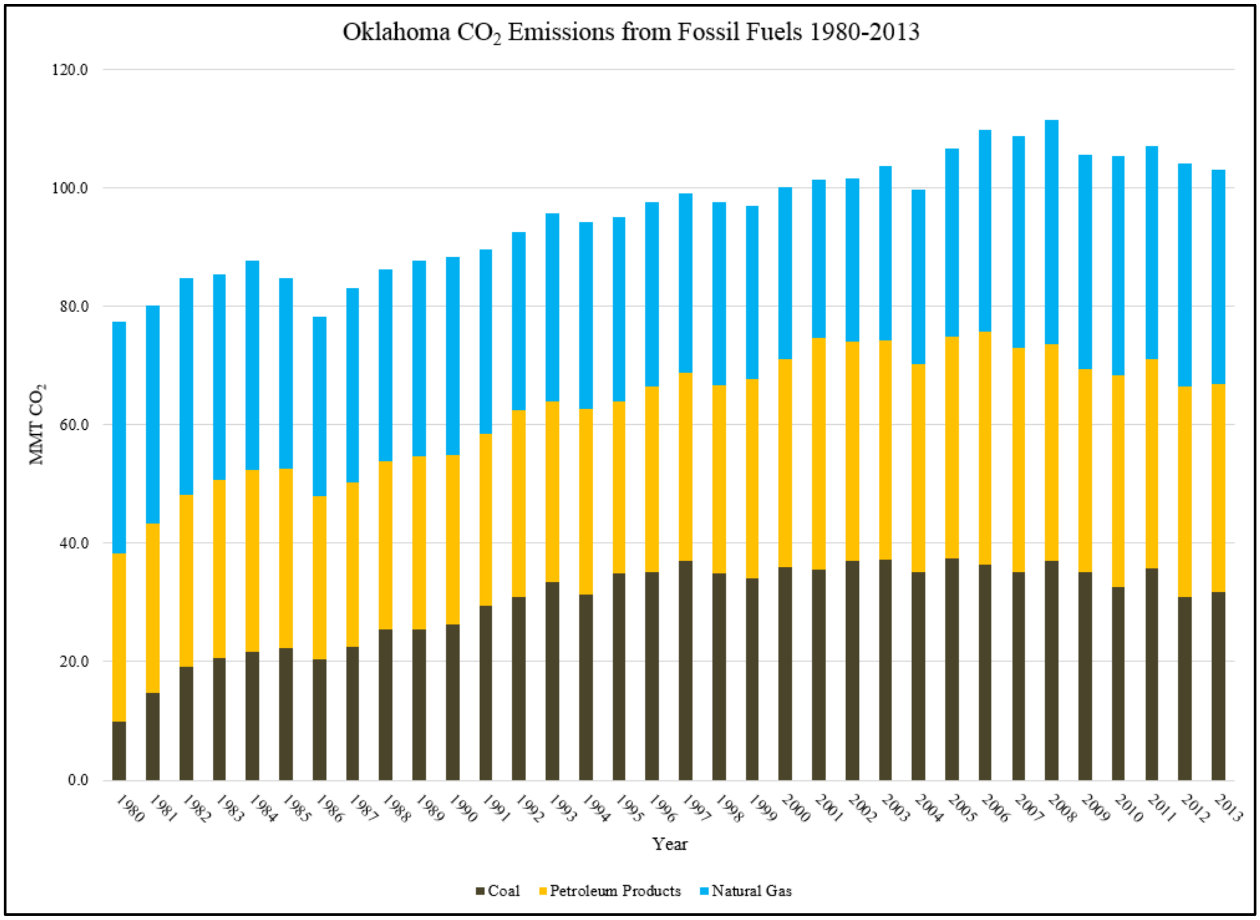

Figure 12.1.14-1: Oklahoma CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015d)

In 2002, the Oklahoma Department of Environmental Quality prepared a Greenhouse Gas Emission and Sinks inventory spanning the years 1990-1999 (DEQ, 2002). Oklahoma's net GHG emissions (including sequestration) increased by 22 percent during this period. However, gross GHG emissions (exclusive of sequestration) increased by 15 percent: from 34 MMT CO_2e in 1990 to 39 MMT CO_2e in 1999. For comparison, total U.S. GHG emissions estimated for 1990 was 6,397 MMT CO_2e and in 1999 was 7,090 CO_2e. It was not possible by reviewing the data to account for the significant discrepancy between the emissions levels calculated in the Oklahoma GHG inventory and those reported by EIA.

The majority of Oklahoma's GHG emissions is CO_2, with a significant minority share contributed by CH_4 and N_2O. Other GHGs emitted in Oklahoma are hydrofluorocarbons (HFCs), sulfur hexafluoride (SF_6) and perfluorocarbons (PFCs) (DEQ, 2002). Carbon dioxide emissions are the result of fossil fuel combustion for the purpose of producing electricity, transportation, agriculture, and industrial processes (DEQ, 2002). The proportions of CO_2, CH_4, and N_2O remained relatively constant between 1990 and 1999. In 1990, CO_2 was 59 percent of total GHG emissions, with CH_4 at 28 percent and N_2O at 13 percent. In 1999, CO_2 was 58 percent, CH_4 was 29 percent, and N_2O was 12 percent. Over the entire period, emissions of other GHGs such as SF_6 and perfluorocarbons were less than 1 percent of total emissions (DEQ, 2002). Note that the CO_2 emissions estimated by Oklahoma subtracted the effects of sequestration: if sequestration was not included, CO_2 emissions would almost double and the proportion of GHGs allocated to CO_2 would be approximately 70 percent. (DEQ, 2002)

Ninety-nine percent of Oklahoma's CO_2 emissions comes from the burning of fossil fuels, with coal a major contributor in the electric power sector. Although there are several bituminous coal reserves, Oklahoma's coal deposits do not meet state demands and a majority of coal enters the state from Wyoming by rail. Over the past 10 years, natural gas output has increased significantly. Currently, six out of ten electricity generating facilities are powered by natural gas. Oklahoma is a top natural gas and shale gas producer and supplies one-twelfth of natural gas in the nation. Oklahoma does not have nuclear power plants and only a small amount of electricity is generated from hydroelectric power facilities (EIA, 2016b).

12.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "reoccurring average weather found in any particular place" (NWS, 2011a). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system (Figure 12.1.14-2). Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2011a). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2011b).

Across the U.S., the five most common climate groups are (A), (B), (C), (D), and (E). The majority of Oklahoma falls into climate group (C) (see Figure 12.1.14-2). Climates classified as

(C) are warm, with humid summers and mild winters. During winter months, "the main weather feature is the mid-latitude cyclone" (NWS, 2011a). During summer months, thunderstorms are frequent. Although the majority of Oklahoma is classified as climate group (C), far western areas of the state are classified as climate group (B). Climates classified as (B) are dry climates, "in large continental regions of the mid-latitudes often surrounded by mountains" (NWS, 2011a). "The most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation" (NWS, 2011a). Oklahoma has two sub-climate categories, which are described in the paragraphs below.

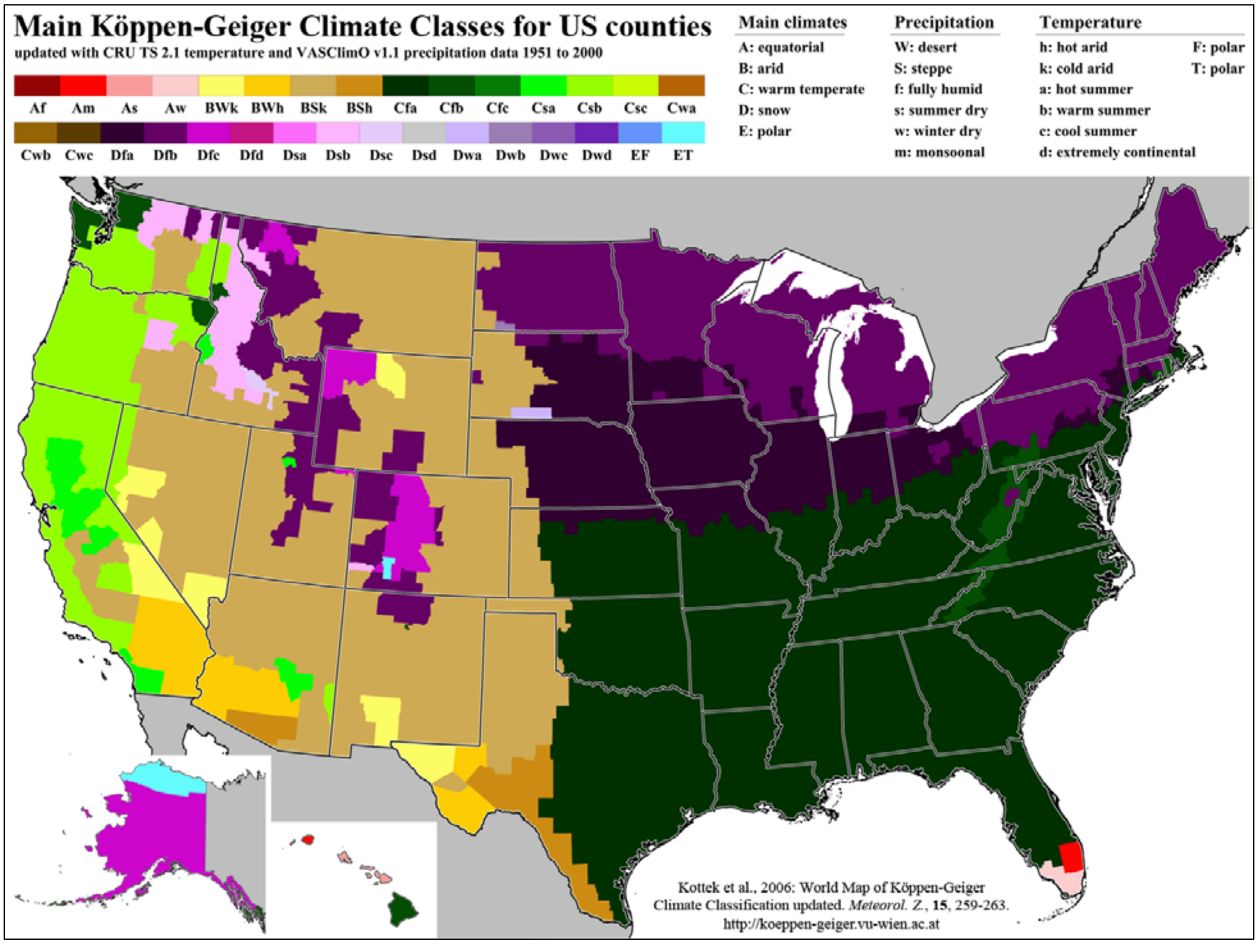

Figure 12.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Bsk – The Köppen-Geiger climate classification system classifies a small region of western Oklahoma as Bsk. Climates classified as Bsk, are mid-latitude and dry. "Evaporation exceed precipitation on average but is less than potential evaporation" (NWS, 2011b). Average temperatures in Bsk climate zones are less than 64 ^{o}F. (NWS, 2011a) (NWS, 2011b)

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

This section discusses the current state of Oklahoma's climate with regard to air temperature, precipitation, and extreme weather events (e.g., flooding, drought, and tornadoes) in the state's two climate regions, Cfa and Bsk.

Air Temperature

Oklahoma is "ideally situated in the middle latitudes between the Rocky Mountains and the Gulf of Mexico." Average temperatures across the state generally decrease from the south to the northwest, with mean annual temperatures ranging from approximately 62 °F along the state's southern border, to approximately 56 °F in the far western panhandle. Statewide, temperatures near 110 °F are common approximately two out of ten years. Temperatures that are slightly below zero are also common approximately two out of ten years. Average maximum and minimum temperatures in Oklahoma range from approximately 120 °F (recorded six times in the state) to approximately negative 27 °F (recorded twice in the state). The highest temperature to occur in Oklahoma was on July 18 and 19, 1936 with a record high of 120 °F (SCEC, 2015). The lowest temperature to occur in Oklahoma was on February 10, 2011 with a record low of negative 31 °F (SCEC, 2015) (McPherson, 2015).

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

Cfa – Oklahoma City, the capital of Oklahoma, is located in central Oklahoma and within the climate classification zone Cfa. The average annual temperature in Oklahoma City is approximately 61.5 °F; 41.1 °F during winter months; 81.2 °F during summer months; 61.0 °F during spring months; and 62.4 °F during autumn months (NOAA, 2015c).

Bsk – Guymon, located in Oklahoma's western panhandle, is within the climate classification zone Bsk. The average annual temperature in Guymon is approximately 56.8 °F; 36.4 °F during winter months; 77.3 °F during summer months; 55.5 °F during spring months; and 57.8 °F during autumn months (NOAA, 2015c).

Precipitation

Eastern regions of the state average approximately 56 inches of precipitation annually, while western areas of the state, such as along the panhandle, average less than 17 inches annually. Precipitation in the state peaks during spring months in Oklahoma, except along the western panhandle, which experiences a peak in precipitation during summer months. A secondary peak occurs during autumn months, particularly within eastern regions of the state. "The annual number of days when measurable precipitation is recorded range from about 45 days in western Oklahoma to above 115 days near our eastern border" (McPherson, 2015). The greatest annual rainfall accumulation was recorded in southeast Oklahoma in 1957 with a total of 84.7 inches. The lowest total annual rainfall was recorded in Oklahoma's panhandle in 1956 with a total of

6.53 inches. Oklahoma's highest single day of rainfall total was approximately 15.68 inches, although other unofficial records of over 20 inches have been recorded (McPherson, 2015).

Snowfall in Oklahoma is frequent across northwestern regions of the state, with an average of approximately 30 inches each year. By comparison, southeastern Oklahoma rarely experiences snowfall. The greatest annual snowfall recorded in Oklahoma was during the winter of 1911 through 1912, in Beaver, with a total of 87.3 inches. The greatest 24-hour snowfall to occur was on February 9, 2011 with a total of 27 inches in Spavinaw (SCEC, 2015). The greatest single-storm snowfall recorded in Oklahoma occurred during February 1971, with a total of 36 inches. More common and destructive than heavy snowfall to the state are ice storms, which occur frequently throughout the state. Between 2000 and 2010, eight severe ice storms have occurred (McPherson, 2015).

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

Cfa – Oklahoma City, the capital of Oklahoma, is located in central Oklahoma and within the climate classification zone Cfa. The average annual precipitation accumulation in Oklahoma City is approximately 36.52 inches; 4.85 inches during winter months; 11.14 inches during summer months; 10.78 inches during spring months; and 9.75 inches during autumn months. (NOAA, 2015c)

Bsk – Guymon, located in Oklahoma's western panhandle, is within the climate classification zone Bsk. The average annual precipitation accumulation in Guymon is approximately 19.30 inches; 1.51 inches during winter months; 8.52 inches during summer months; 5.38 inches during spring months; and 3.89 inches during autumn months. (NOAA, 2015c)

Severe Weather Events

In addition to severe ice storms, the severe weather most common to Oklahoma are floods, droughts, and tornadoes. Flooding in Oklahoma is generally triggered by intense, but short-lived thunderstorms that cause excessive runoff and flash-flooding, particularly in "urban and suburban areas" (McPherson, 2015). Other forms of flooding that are common to Oklahoma are riverine flooding, debris flows, and dam breaks and/or levee failures. One of the state's most severe floods occurred in May, 1984. The area most affected was Tulsa, in which 6 to 15 inches of rain fell during an 8-hour period. In total, there were 14 deaths and 288 injuries. In terms of damage, more than 5,500 buildings were either damaged or destroyed, approximately 7,000 vehicles were destroyed or severely damaged, and dozens of roads and bridges were destroyed or rendered impassable. In total, this flooding event caused approximately $406 million in damages. President Ronald Regan also issued a major-disaster declaration for this flooding event (NWS, 2015).

Droughts in Oklahoma are rarely life threatening, but can significantly damage agricultural production. Droughts in Oklahoma can last anywhere from several months, to several years. Major droughts to have occurred in Oklahoma were between 1909 through 1918, 1930 through 1940, 1952 through 1958, and 1962 through 1972. (McPherson, 2015)

Although less common, tornadoes can also occur in almost any region of Oklahoma. On average, Oklahoma experiences 54 tornadoes per year, with at least 15 rating F2 in strength or higher. The majority of Oklahoma's tornadoes occur between late March and mid-June, "although tornado outbreaks are sometimes associated with the secondary precipitation maximum in autumn" (McPherson, 2015). The majority of tornadoes occur in northern Oklahoma, with an average of 1.5 tornado days per year (1990 through 2009) (Oklahoma Climatological Survey, 2015). Statewide, between the period of 1991 and 2010, 62 tornadoes occurred in Oklahoma (McPherson, 2015) (NOAA, 2015d).

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

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and manmade or natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency (RF) radiation or vehicle traffic. Vehicle traffic is evaluated in Section 12.1.1, Infrastructure.

12.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), the USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Oklahoma, this resource area is regulated by the Oklahoma Department of Labor (OKDOL) and ODEQ. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Oklahoma does not have an OSHA-approved "State Plan"; therefore, private and public sector occupational safety and health programs in the Oklahoma are enforced by OSHA. Public health is regulated by the Oklahoma State Department of Health (OKSDH).

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 12.1.15-1 summarizes the major Oklahoma laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

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

State Law and Regulation	Regulatory Agency	Applicability
OAC: Chapter 252:221	ODEQ	Establishes the state brownfield program to provide for the safe reuse of brownfield properties and allows landowners to resolve their environmental liability.
OAC: Chapter 252:606	ODEQ	Describes the Oklahoma Pollutant Discharge Elimination System Act that outlines permitting standards for discharges to the waters of Oklahoma.
OAC: Chapter 380:40	Oklahoma Department of Labor (OKDOL)	Establishes the Oklahoma Occupational Health and Safety Standards Act, which adopts regulations and national standards, and establishes policies for the enforcement and inspection of labor standard.

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, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 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, 2015). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (International Finance Corporation, 2007).

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes[128] are examples of when confined space work is necessary. Installation of telecommunications activities involves laying conduit and in small trenches (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016c)

[128] 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.

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, 2016d)

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

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

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 6.1.13, 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, 2016d).

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require use of potentially hazardous products (e.g., herbicides). Secondary hazardous materials (e.g., exhaust fumes) may be a greater health risk than the primary hazardous material (e.g., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet activities would involve the generation or storage of hazardous waste, older existing telecommunication structures and sites could have hazardous materials present, such as lead-based (exterior and interior) paint at outdoor structures or asbestos tiles and insulation in equipment sheds. The general public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work. (OSHA, 2016d)

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, 2016d)

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, 2016d)

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, Bureau of Labor Statistics (BLS) uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as either 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 1,960 telecommunication equipment installers and repairers, and 1,270 telecommunication line installers and repairers (Figure 12.1.15-1) working in Oklahoma (BLS, 2015d). In 2012, the most recent year data are available, Oklahoma had 1.5 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013b).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; 7 due to slips, trips, or falls; and 3 due to unknown causes), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Oklahoma had four occupational fatalities in 2008 within the telecommunication line installers and repairers occupations (SOC code 49-9052). By comparison, within the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 71 fatalities in Oklahoma between 2003 and 2014, with the highest fatality years being 2008 and 2013, with 10 fatalities each (BLS, 2015e).

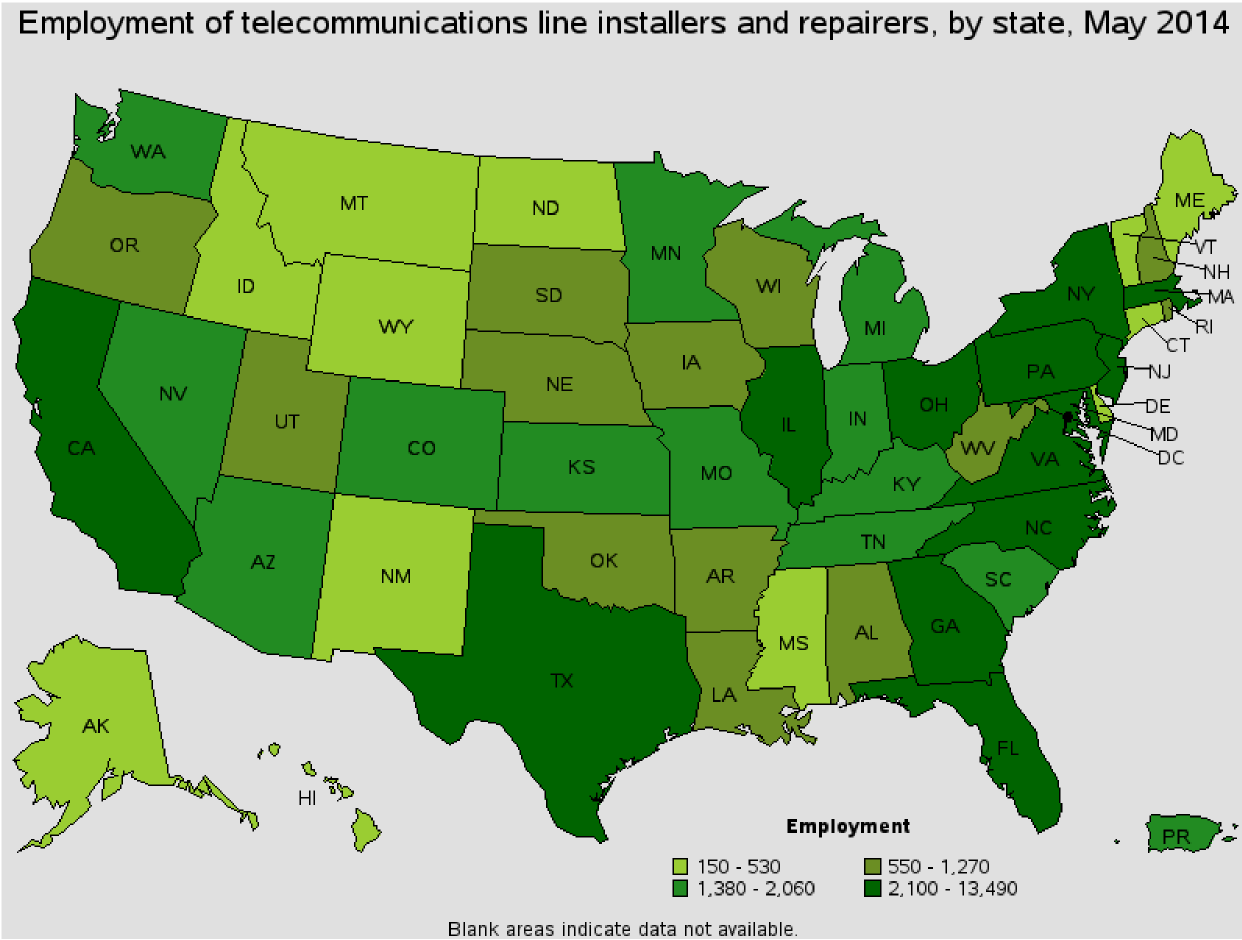

Figure 12.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source*:* (BLS, 2015g)

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. Oklahoma has not recorded incidents of injuries from the public to these sites (Oklahoma State Department of Health, 2015a). At the federal level, injury surveillance and fatality data among the general public is collected through the Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, in Oklahoma, between 1999 and 2013, there were 84 fatalities due to a fall from, out of, or through a building or structure; 31 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 28 fatalities due to exposure to electric transmission lines

(CDC, 2015). 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. Environmental Setting: Contaminated Properties at or near Telecommunication Sites

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

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[129] or listed on the National Priorities List (NPL), as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and Brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

The ODEQ's Superfund Site Remediation Section is responsible for identifying and characterizing abandoned sites in Oklahoma, and determining if they qualify for cleanup under state or federal funds (DEQ, 2015q). As of December 2015, Oklahoma had 47 RCRA Corrective Action sites,[130] 566 brownfield sites, and 11 proposed or final Superfund/NPL sites (USEPA, 2015r). Based on a December 2015 search of USEPA's Cleanups in My Community (CIMC) database, there is one Superfund site (Tar Creek near Commerce, OK) (USEPA, 2015s) and no RCRA Corrective Action sites (USEPA, 2015t) in Oklahoma where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

Brownfield sites in Oklahoma may be enrolled in the ODEQ, Land Protection Division's Brownfields Program (DEQ, 2015e). One example of a brownfield site is the Guthrie Green Park in Tulsa, OK, previously used as a truck terminal. While redeveloping the site in 2008, 12 underground storage tanks (UST) were discovered and removed (10 more than initially thought to exist onsite). Cleanup activities were funded with a grant from ODEQ's Brownfields Program. The site was redeveloped into an urban greenspace, installing geothermal wells to provide heating and cooling to nearby businesses (DEQ, 2015f).

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

[130] Data gathered using USEPA's CIMC search on December 11, 2015, for all sites in Oklahoma, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013c) .

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of December 2015, Oklahoma had 379 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, Oklahoma released 30.8 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from hazardous waste/solvent recovery, paper, chemicals, and food/beverages/tobacco industries. This accounted for 0.75 percent of nationwide TRI releases, ranking Oklahoma 34 of 56 U.S. states, and territories based on total releases per square mile. (USEPA, 2015e)

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 December 13, 2015, Oklahoma had 107 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015f).

The National Institutes of Health (NIH), U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to "visually explore data from the USEPA's TRI and Superfund Program" (NIH, 2015). Figure 12.1.15-2 provides an overview of potentially hazardous sites in Oklahoma.

In addition to hazardous waste contamination, another health and safety hazard includes surface and subterranean mines. Health and safety hazards known to be present at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015a). Gradual settling or sudden sinking of the Earth's surface, also known as subsidence, presents additional risks and is further discussed in Section 12.1.3, Geology. As of May 2015, there were no high priority AMLs (sites posing health and safety hazards) in Oklahoma (U.S. Department of the Interior, 2015a).

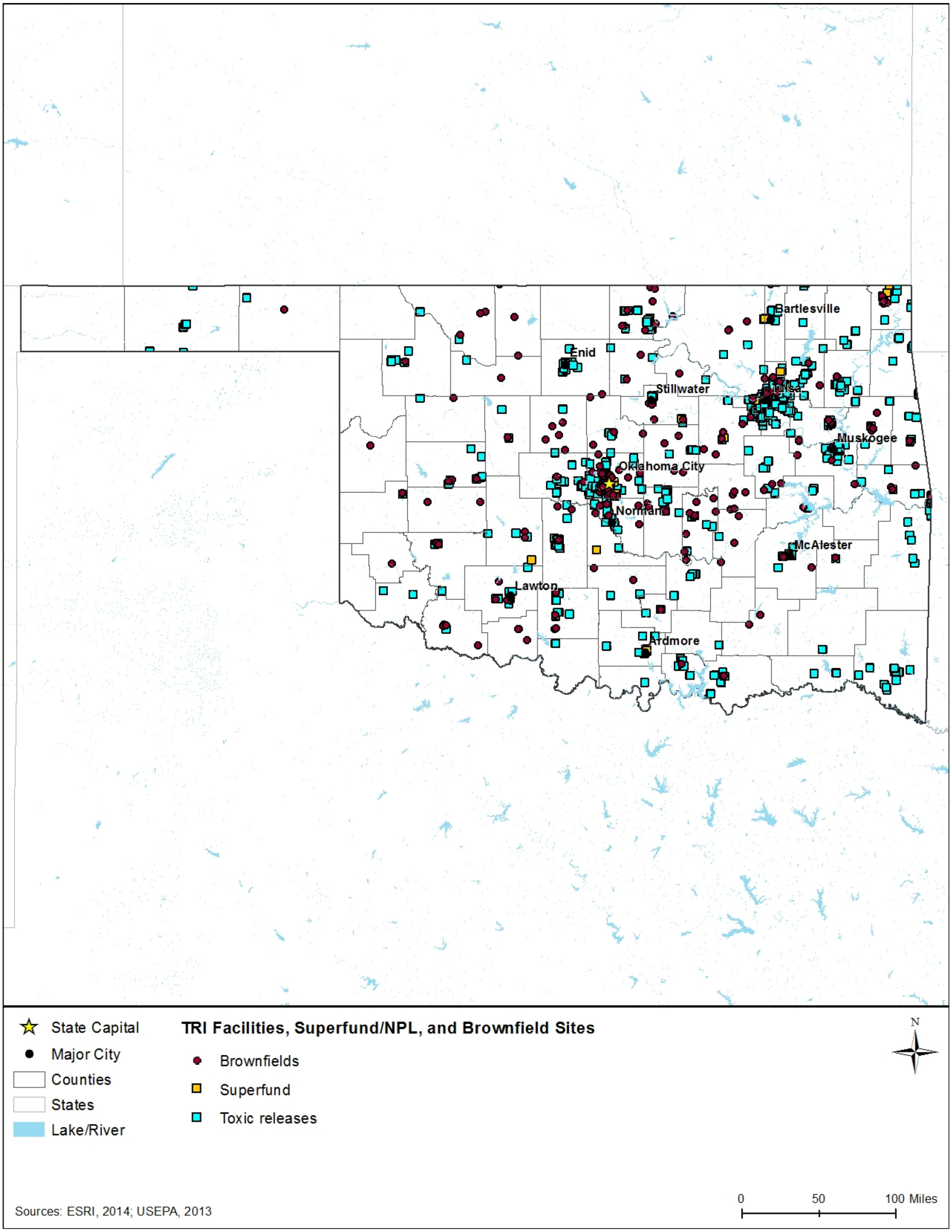

Figure 12.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Oklahoma (2013)

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of December 2015, there are 492 USEPA-regulated telecommunications sites in Oklahoma (USEPA, 2015g). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

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

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors. OKSDH collects environmental and public health data through the Oklahoma Public Health Environmental Tracking System (OKPHETS) (Oklahoma State Department of Health, 2015b).

Spotlight on Oklahoma Superfund Sites: Tar Creek Site

The Tar Creek site is a former 12,600-acre mining area in Ottawa County, OK, which also encompasses portions of Kansas and Missouri. Lead and zinc mining was conducted at the area from the early 1900s until about 1970 by many small operations that eventually consolidated into a few larger mills. These mills produced a mine waste known as “chat” which was dumped into waste piles (Figure 12.1.15-3) that eventually covered more than 1,444 acres, and caused lead contamination of onsite soils, sediments, surface water, and groundwater (USEPA, 2015h).

USEPA added Tar Creek to the NPL in 1983, continues to remediate contaminated surface and groundwater, and is working with potential buyers to sell and remove the chat piles for proper disposal. Additionally, as of April 2015, USEPA has remediated 2,887 residential yards and public areas (all sampled properties testing positive for lead contamination) to decrease the risk of ingesting, touching, or inhaling contaminants in soil (USEPA, 2015h). In 2008, an Agency for Toxic Substances and Disease Registry study concluded that there is not a significant difference in cancer rates between the Tar Creek area and elsewhere in Oklahoma (Agency for Toxic Substances and Disease Registry, 2008).

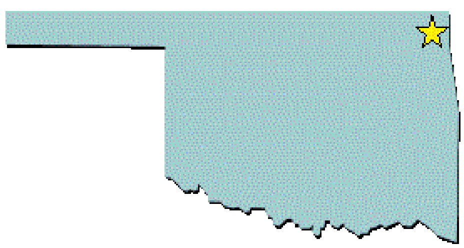

Figure 12.1.15-3 Weathered Chat Pile at Tar Creek Superfund Site, Ottawa County, OK

Source: (DEQ, 2016)

12.1.15.5. Environmental Setting: Abandoned Mine Lands at or near Telecommunications Sites

Another health and safety hazard in Oklahoma includes surface and subterranean mines. In 2015, the Oklahoma mining industry ranked 32nd for non-fuel minerals (primarily crushed stone, Portland cement, and helium), generating a value of $744M (USGS, 2014h). In 2013, the most recent data available, Oklahoma had nine coalmining operations (two underground and seven surface) (EIA, 2013). Health and safety hazards at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (BLM, 2015b).

According to the BLM, there are approximately 26,000 acres of AMLs in Oklahoma (BLM, 2015c). The Oklahoma Conservation Commission, Abandoned Mine Land Reclamation Division promotes the AML Reclamation Program, which is responsible for managing AML health and safety hazards in Oklahoma (Oklahoma Conservation Commission, 2012). Figure 12.1.15-3 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Oklahoma, where Priority 1 and 2 sites pose a significant risk to human health and safety, and Priority 3 sites pose a risk to the environment. As of December 2015, Oklahoma had 234 Priority 1 and 2 AMLs, with 597 unfunded problem areas (U.S. Department of the Interior, 2015b).

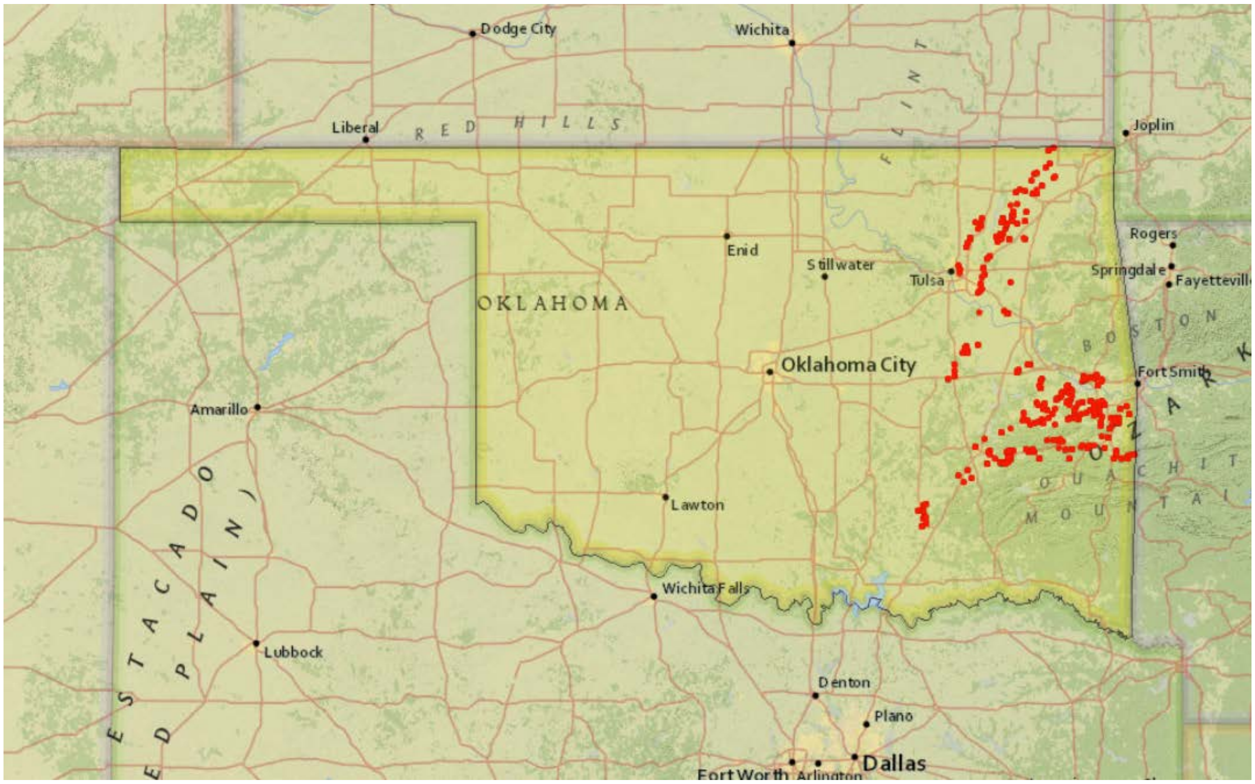

Figure 12.1.15-3: Abandoned Mine Lands in Oklahoma (2015)

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

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs or mine fires, presenting occupational exposure risks from fire, toxic gases, and subsidence during FirstNet deployment, operation, and maintenance activities. Because the locations of many abandoned mines are unknown or hidden, these mines pose a risk to telecommunications workers because they may be encountered during deployment and maintenance operations.

Public Health and Safety

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

12.1.15.6. Environmental Setting: Natural & Manmade Disaster Sites

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

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

Telecommunication Worker Occupational Health and Safety

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

Currently, OKSDH 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 487 NRC-reported incidents for Oklahoma in 2015 with known causes, only 55 were attributed to natural disaster (natural phenomenon or flood), while 432 were attributed to manmade disasters (such as equipment failure and operator error). For example, on June 22, 2015, flooding of an oil production facility near Dickson (Carter County), caused spillage of 419 barrels of oil and 144 barrels of oily water into the nearby Washita River before the spill was contained. (U.S. Coast Guard, 2015) Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters.

Public Health and Safety

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support. In 2014, Oklahoma had 2 weather-related fatalities (1 due to a tornado and 1 due to unknown causes) and 41 non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (National Weather Service, 2015b)

Spotlight on Oklahoma Natural Disaster Sites: 2013 Moore Tornado

On May 20, 2013, multiple tornadoes hit central Oklahoma. During this event, an EF-5 tornado (wind gusts exceeding 200 miles per hour) struck Moore, OK, causing billions of dollars in damage and 24 fatalities. The tornado formed near Newcastle, OK, and tracked 14 miles in length and 1.1 miles wide through Moore, OK, before dissipating near Oklahoma City, OK (Figure 12.1.15-5). Shortly after formation, the tornado crossed Interstate 44 and struck the Orr Family Farm, a local tourist attraction including a petting zoo and horse training facility, where it killed livestock and threw two 10-ton storage tanks a half mile to the east. The tornado also destroyed Briarwood Elementary School and damaged multiple neighborhoods. (NOAA, 2014)

Damage to critical infrastructure included the Moore Medical Center, which was rendered nonfunctional and eventually demolished, leaving Moore, OK, without a hospital. The McClain Power Plant in Newcastle, OK, was also knocked offline. Power outages from the tornadoes peaked at 61,500 customers (U.S. Department of Commerce, 2013b). Tornadoes also destroyed 2 of 36 outdoor warning devices and damaged 2 others. One fire station was able to relocate rescue equipment and personnel before the tornado hit, allowing for rapid deployment. However, fallen trees and debris made many roadways impassable, hindering first responders (City of Moore, Oklahoma, 2014).

Figure 12.1.15-5 Photo of May 20, 2013 EF-5 Tornado

Source: (National Weather Service, 2015a)

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 specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews.

At the programmatic level, the categories of impacts have been defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, include the No Action Alternative. The No Action provides a comparison to describe the effects of environmental resources of the existing conditions to the proposed Alternatives.

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance. 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 Oklahoma associated with construction, deployment, and operation of the Proposed Action and Alternatives. Chapter 16, 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 as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.1-1: Impact Significance Rating Criteria for Infrastructure

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

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

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

NA = Not Applicable

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 development. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport or harbor operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., departments of transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 12.2.1-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

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

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

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

Commercial assets would be using a different spectrum for communications; as such, commercial telecommunication systems, communications, or level of service would experience no impacts. 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.[131] Anticipated impacts would be less than significant due to the limited extent and temporary nature of deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The activities proposed by FirstNet would have less than significant impacts on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the 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 U.S.

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.

[131] 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.

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would have no impacts to infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN), however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have no impact on infrastructure resources.

Activities with the Potential to Have Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs)[132], huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase, however, it is anticipated that this tie-in would cause less than significant impacts as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new, or replacement of existing, telecommunications poles.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant include installation of new or replacement towers requiring ground disturbance.
  - 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 a result of the construction of lands and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads, could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be

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

independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site specific plans.
- Deployable Technologies: Deployable technologies such as COWs, COLTs, and SOWs are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however, this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. Also, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be launched or recovered 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), would be regionally based around the on-going phase of deployment, and minor. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

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

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would also likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and also minimize disruptions and misinformation resulting from limited or disrupted service. Chapter 16, 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.

12.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure 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 less than significant impacts to infrastructure at the programmatic level even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Chapter 16, 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.

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 infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 16, 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.

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 deployment and operation of the Proposed Action. 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 Oklahoma associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.2.2. 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 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

12.2.2.3. Description of Environmental Concerns

Soil Erosion

Soil erosion is an environmental concern for 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 Oklahoma 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 Oklahoma that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Aqualfs, Aquepts, Aquerts, Aquolls, Calcids, Fluvents, Orthents, Udalfs, Udepts, Uderts, Udolls, Udults, Ustalfs, Ustepts, Usterts, and Ustolls (see Section 12.1.2.4, Soil Suborders and Figure 12.1.2-2).

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. For the majority of projects, impacts to soils would be expected to be less than significant 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 where practicable and feasible, to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 16).

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, as well as the implementation of BMPs and mitigation measures (Chapter 16), minimal topsoil mixing is anticipated.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Heavy equipment could cause perceptible compaction and rutting of susceptible soils. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

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 Oklahoma are hydric soils with poor drainage conditions, which include Aqualfs, Aquerts, and Aquolls. These suborders constitute approximately 1.7 percent of Oklahoma's land area,[133] and are found mostly in the southwestern and northeastern portions of the state (see Figure 12.1.2-2). The potential for compaction or rutting impact would be generally low at FirstNet network deployment sites where other soil types predominate.

Based on impact significance criteria presented in Table 12.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant due to the extent of susceptible soils in the state (see Chapter 16).

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

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and POP structures, and would not impact soil resources because it would not produce perceptible changes to soil resources.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, with no impacts to soil resources. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite

[133] 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.

phones, and video cameras would not impact soil resources because those activities would not require ground disturbance.

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

Activities with the Potential to Have Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
  - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
  - New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.

  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas. 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 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 16, 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.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts at the programmatic level to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be less than significant at the programmatic level due to the temporary nature and small-scale of operations activities with the potential to create impacts. Chapter 16, 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.

12.2.2.5. 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 at the programmatic level, regardless of whether the 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 16, 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.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to soil resources at the programmatic level associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off 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 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to soil resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.2, Soils.

12.2.3. Geology

12.2.3.1. Introduction

This section describes potential impacts to Oklahoma geology resources associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.3.2. 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 are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.3-1: Impact Significance Rating Criteria for Geology

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

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMP and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological Resources Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.

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

NA = Not Applicable

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, and effects on 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, parts of Oklahoma are at risk to moderate earthquake events. As shown in Figure 12.1.3-5, central Oklahoma is more susceptible to earthquakes than the remainder of the state, though no earthquake over magnitude 5.6 on the Richter scale has ever occurred in the state. Based on the impact significance criteria presented in Table 12.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have no impacts 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 or near Oklahoma, some amount of infrastructure could be subject to earthquake hazards. Chapter 16, 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.

Volcanic Activity

Volcanoes were considered but not analyzed for Oklahoma, as they do not occur in Oklahoma; therefore, volcanoes do not present a hazard to the state.

Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 12.1.3.8, portions of eastern Oklahoma are at moderate to high risk of experiencing landslide events. Based on the impact significance criteria presented in Table 12.2.3-1, potential impacts to landslide potential from deployment or operation of the Proposed Action would have less than significant impacts; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas in which landslides are highly prevalent. The highest potential for landslides in Oklahoma is in Le Flore, Haskell, Latimer, Pittsburg, Coal, Atoka, McIntosh, and Muskogee Counties. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Oklahoma's major cities, including Tulsa and Muskogee, are in or near areas that experience landslides with moderate to high frequency, some amount of infrastructure could be subject to landslide hazards. Chapter 16, 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.

Land Subsidence

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.

As discussed in Section 12.1.3.8 and shown in Figure 12.1.3-7, portions of Oklahoma are vulnerable to land subsidence due to mine collapse and karst topography. Based on the significance criteria presented in Table 12.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have less than significant impacts; however, subsidence impacts to the Proposed Action could be potentially significant to the Proposed Action if FirstNet's deployment locations were within areas at high risk to karst topography or mining areas. To the extent practicable, FirstNet would avoid deployment in known areas of abandoned mines or karst topography. Chapter 16, 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 Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources is not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 12.2.3-1, impacts to mineral and fossil fuel resources is 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. Chapter 16, 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 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, fossils are abundant throughout parts of Oklahoma. Potential impacts to paleontological resources should be considered on a site-by-site basis, and BMPs and mitigation measures (see Chapter 16) may be required help avoid or minimize the potential impacts. Chapter 16, 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.

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 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 less than significant, because they are not likely to require removal of significant volumes of terrain. When ground disturbance is required, BMPs and mitigation measures could be implemented to help avoid or minimize the potential impacts. Chapter 16, 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 Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. In most cases, there would be no impacts to geologic resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to geologic resources because there would be no ground disturbance.

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

Activities with the Potential to Have Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POP), huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance that could cause impacts to water quality from increased suspended solids.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water is not expected to impact geologic resources, including marine paleontological resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require

ground disturbance in locations that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.

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

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geology associated with deployment could result in incidental 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, thus these impacts are expected to be less than significant at the programmatic level. For the same reason, impacts to deployment from geologic hazards are likely to be less than significant at the programmatic level as well. Chapter 16, 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.

Operation Impacts

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

The operation of the Preferred Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant 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, landslides, or land subsidence. Chapter 16, 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.

12.2.3.4. Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the

Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be less than significant at the programmatic level due to the small-scale and short term nature of the deployment. Chapter 16, 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.

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 geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative because there would be no ground disturbance.

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 were subject to increased seismic activity, landslides, and land subsidence. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to geologic resources (or from geologic hazards) as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.3, Geology.

12.2.4. Water Resources

12.2.4.1. Introduction

This section describes potential impacts to water resources in Oklahoma associated with deployment and operation of the Proposed Action and alternatives, and discusses BMPs and mitigation measures that would avoid or minimize those potential impacts. Chapter 16, 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.

12.2.4.2. 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. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity. Violation of various regulations including: CWA, SDWA.	Effect that is potentially significant, but with mitigation is less than significant.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA
Floodplain degradation[a]	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with mitigation is less than significant.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is potentially significant, but with mitigation is less than significant.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

[a] Since public safety infrastructure is considered a critical facility, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690). (See http://www.archives.gov/federal-register/codification/executive-order/11988.html and https://www.federalregister.gov/articles/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and).
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 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

In Oklahoma, almost all of the state's surface waterbodies are impaired. Designated uses of the impaired rivers, streams, and lakes include agriculture, fish and wildlife propagation, and primary contact recreation. Major pollutants affecting these impaired waters include pathogens,[134] turbidity,[135] dissolved oxygen, and mercury. Main sources for these pollutants include agriculture, livestock/animal grazing, mine runoff, and septic systems. (USEPA, 2015j)

Deployment activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal onsite 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. Water quality could also be impaired by actions that introduce or cause bacteria such as coliform or *e.coli*, or change other water chemistry.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids

[134] Pathogens are bacterium, virus, or other microorganism that can cause disease (USEPA, 2015n).
[135] Turbidity is a measure of water clarity; the more particles (soils, organic matter), the cloudier, or higher turbidity (USGS, 2015l).

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 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 trenching[136] or tower construction were to occur near or below the existing water table (depth to water), then dewatering would be anticipated at the location. Residual contaminated groundwater could be encountered during dewatering activities. Construction activities would need to comply with Oklahoma dewatering requirements. Any groundwater, any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness and permeability (ease of water or liquid contaminants to pass through aquifers to groundwater) of most Oklahoma aquifers, there is potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 12.2.4-1, there would likely be less than significant impacts on groundwater quality within most of the state. In areas where groundwater is close to the surface, then site-specific analysis, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on human beings, 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 since the majority of FirstNet's likely

[136] Telecommunications activities involve laying conduit, with minimal trenching. Trenching activities would likely be at a minimal depth (less than 36 inches) and width (6 to 12 inches).

deployment, on the watershed or subwatershed level 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. Additionally, any effects would be temporary, lasting no more than one season or water year,[137] or occur only during an emergency.

Examples of activities that would have less than significant include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that include pervious surfaces such as gravel parking lots.
- Land uses that do not change the flow of water or drainage patterns.
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures could reduce the risk of additional impacts to floodplain degradation (see Chapter 16).

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.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Where stormwater is contained onsite 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 result 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,

[137] A water year is defined as "the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months." (USGS, 2016c)

impacts to drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 12.2.4-1. Projects that include minor consumptive use of surface water with less than significant impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have less than significant impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns offsite or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 12.1.4.7, approximately 300 towns and cities draw drinking water from Oklahoma’s groundwater resources, and it accounts for 43 percent of the total water usage of the state (OWRB, 2014). In general, Oklahoma’s groundwater is acceptable for crop irrigation, and for drinking water. However, some aquifers do not produce water that is acceptable for drinking due to high levels of dissolved solids, high salinity or naturally occurring contaminants. Statewide, nitrate contamination from human activities (e.g., animal wastes, sewage, and fertilizers) has impaired groundwater uses (OWRB, 2013). Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would be unlikely to cause significant impacts to water quality due to the expected small volume of these materials. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Storage of petroleum or chemical products.

Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities should be less than significant since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. It is likely that areas that utilize groundwater for potable water purposes would be avoided. According to Table 12.2.4-1, potentially significant impacts to groundwater or aquifer characteristics would only occur if actions resulted in 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 on a watershed or within multiple watersheds that is ongoing and permanent. Chapter 16, 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.

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 Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to water resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used and the water resource’s current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts

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

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

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality, floodplain degradation, drainage pattern and flow alteration, and changes to aquifer characteristics. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water would impact water resources. Site-specific impact assessment would be required to

shoreline environments prior to installation to fully assess potential impacts to coastal environments.

- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids, groundwater impacts from trenching activities are not expected. If a new roadway were built, additional impervious surfaces would not be expected to impact water resources or by increasing the overall amount of runoff and nonpoint pollution.
- Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause impacts to water quality from increased suspended solids that could occur during the replacement of poles and structural hardening.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Deployable Technologies: Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites or deployment in unpaved areas. The amount of impact depends on the land area affected, installation technique, and location. If trenching were to occur near or below the existing water table (depth to water), then

dewatering activities could impact water quality. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be no impacts to water resources because there would be no ground disturbance.

- Deployment of drones, balloons, blimps, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters. In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure could include water quality impacts, but are expected to be less than significant due to the small-scale of individual activities. Chapter 16, 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.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of tower 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 16, 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.

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 existing roads and utility ROW. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected at the programmatic level. Chapter 16, 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.

12.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.[138]

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to water resources if those activities occurred on paved surfaces if there is any runoff into the surface water. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving; however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites 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, and therefore would have less than significant impacts at the programmatic level. Chapter 16, 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.

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

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

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 no impacts at the programmatic level to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off 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, may result in less than significant effects to water quality at the programmatic level, 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 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to water resources because of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.4, Water Resources.

12.2.5. Wetlands

12.2.5.1. Introduction

This section describes potential impacts to wetlands in Oklahoma associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.5.2. 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 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

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[a] or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation measures Incorporated	Impact Level: Less than Significant	Impact Level: 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 potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[a] "Magnitude" is defined based on the type of wetland impacted, 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.

NA = Not Applicable

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, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partner(s) would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 16).

There are approximately 948,000 acres of wetlands throughout Oklahoma (USFWS, 2014a). In Oklahoma, the main type of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the state, as shown in Figure 12.1.6-1.

Based on the impact significance criteria presented in Table 12.2.5 1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and local regulations.

In Oklahoma, as discussed in Wetlands, Section 12.1.5.4, regulated high quality wetlands include pitcher plant bogs, cypress-tupelo swamps, and wetlands associated with critical resource waters. ’’If any of the proposed deployment activities were to occur in these high quality wetlands, potentially significant impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would be required, in addition to BMPs and mitigation measures to avoid potentially significant impacts to wetlands. 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 16, 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 Other Direct Effects

Other direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 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) may cause potentially significant impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds are potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. 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 16, 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 Oklahoma include:

- Vegetation Clearing: removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- Ground Disturbance: Increased amounts of stormwater runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- Direct Hydrologic Changes (flooding or draining): Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- Direct Soil Changes: Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameter, such as the acidic conditions of pitcher plant bogs (which are high quality wetlands in Oklahoma).

- 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 Efects:[139] Changes in Function(s)[140] or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures, as practicable and feasible (see Chapter 16).

Examples of functions related to wetlands in Oklahoma 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

[139] 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.

[140] 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.

oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.

- *Wildlife Habitat*: Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- *Recreational Value*: Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- *Groundwater Recharge*: Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to the significance criteria defined in Table 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. Deployment activities would have less than significant indirect impacts on wetlands in the state because forested wetlands, peatlands, vernal pools, playas, kettles, and other high quality wetlands are regionally scarce, proposed deployment activities would be evaluated for impact at the site level. 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 16, 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.

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

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launches for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity

to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal environments.
- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
- Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the

implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, or blimps piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant at the programmatic level due to the small-scale and short term nature of the deployment. 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 16, 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 further avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there could be ongoing potential other direct impacts to wetlands if heavy equipment is used for routine operations and maintenance application of herbicides occurs to control vegetation along all ROWs and near structures, depending on the proximity of wetlands. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are expected to be less than significant 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 ROWs. Chapter 16, 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.

12.2.5.5. 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 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 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland’s quality and function.

It is anticipated that there would be less than significant impacts to wetlands at the programmatic level associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility ROWs would be utilized for maintenance and inspection activities. Site maintenance, including mowing or herbicides, is anticipated to result in less than significant effects to wetlands at the programmatic level due to the limited nature of site maintenance activities, including mowing and application of herbicides. 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 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 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 Oklahoma associated with deployment and operation of the Proposed Action and its alternatives. Chapter 16, 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.

12.2.6.2. 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. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 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 criterial associated with threatened and endangered species in Oklahoma.

Table 12.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury /mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: MBTA and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Oklahoma for at least one species. Anthropogenic[a] disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

<table>
<tr><th rowspan="2">Type of Effect</th><th rowspan="2">Effect Characteristics</th><th colspan="4">Impact Level</th></tr>
<tr><th>Potentially Significant</th><th>Less than Significant with BMPs and Mitigation Measures Incorporated</th><th>Less than Significant</th><th>No Impact</th></tr>
<tr><td rowspan="3">Vegetation and Habitat Loss, Alteration, or Fragmentation</td><td>Magnitude or Intensity</td><td>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.</td><td rowspan="3">Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.</td><td>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.</td><td>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.</td></tr>
<tr><td>Geographic Extent</td><td>Regional effects observed within Oklahoma 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.</td><td>Effects realized at one location.</td><td>NA</td></tr>
<tr><td>Duration or Frequency</td><td>Chronic and long-term effects not likely to be reversed over several years for at least one species.</td><td>Temporary, isolated, or short-term effects that are reversed within one to three years.</td><td>NA</td></tr>
</table>

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Oklahoma for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress, or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Oklahoma for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Oklahoma for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Oklahoma.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

[a] Anthropogenic: “Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities” (USEPA, 2016e)
NA = Not Applicable

12.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Oklahoma 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, however, FirstNet deployment events are expected to be relatively small in scale and therefore would have less than significant impacts at the programmatic level. The implementation of standard BMPs, mitigation measures, and avoidance measures could help to minimize or altogether avoid potential impacts to plant population survival. Chapter 16, 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.

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 potential 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. In Oklahoma, about 31 percent of the total land cover is rangeland and about 17 percent of the land cover is unfragmented forest. However, about 39 percent of Oklahoma has experienced extensive land use change due to cropland and pastureland creation (NRCS, 2010).

Construction of new infrastructure and long-term facility maintenance could 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, could be undertaken to minimize or avoid potential impacts. Chapter 16, 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.

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. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment. 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. Chapter 16, 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.

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.

As described in Section 12.1.6.4, when non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. A total of three noxious weeds are state-listed in Oklahoma as set forth under the provisions of the Oklahoma Noxious Weed Law and Rules. The rule states that every landowner is responsible for treating, controlling, or eradicating these species, otherwise they may be fined (ODA, 2000). 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 impacts are expected to be less than significant at the programmatic level due to the small-scale and localized nature of likely FirstNet activities. BMPs could help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action. Chapter 16, 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 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, and as explained in this section, the same type of Proposed Action infrastructure could result in a range impacts, from no impacts to less than significant impacts at the programmatic level, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology[141], and the nature as well as the extent of the habitats affected. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to terrestrial vegetation because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.

[141] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

- 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 biological resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in in limited nearshore and inland bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, vegetation loss, and invasive species effects.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. Despite the variability, these impacts are expected to be less than significant at the programmatic level due to the small-scale and limited geographic scope of expected deployment activities. Chapter 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would not be 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 because there would be no ground disturbance. Site maintenance, including mowing or herbicides, may result in less than significant effects at the programmatic level 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 16, 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.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

<u>Deployment Impacts</u>

As described above, implementation of deployable technologies could result in less than significant impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. Nonetheless, 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 16, 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.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant at the programmatic level. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to terrestrial vegetation at the programmatic level associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.6.3, Terrestrial Vegetation.

12.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Oklahoma are discussed in this section. Chapter 16, 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.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 12.2.6-1, less than significant impacts would be anticipated at the programmatic level given that the majority of proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet Proposed Actions, impacts to individual behavior of animals would be short term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed; therefore, impacts are generally expected to be less than significant, as discussed further below. Chapter 16, 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

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Oklahoma. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, preferred vegetation along roadways, areas of insect relief, and ease of travel along road corridors (FHWA, 2015e). Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur.

Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

For example, if tree-roosting bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small-scale and would be dependent on the location and type of deployment activity, and tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species. 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 soarers, typically having large wing spans (FAA, 2012b).

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation, and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

Direct mortality and injury to birds of Oklahoma are not likely to be widespread or affect populations of species as a whole; individual impacts may be realized depending on the location and type of the deployment activity. Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small scale of likely FirstNet actions. If siting considerations and BMPs and mitigation measures are implemented (Chapter 16), potential impacts could be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures, as defined through consultation with USFWS.

Reptiles and Amphibians

In Oklahoma, reptiles and amphibians 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 effects are expected to be temporary and isolated, affecting only individual animals.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Oklahoma 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

As described in Section 12.2.6.3, 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 because of the small-scale nature and limited geographic scope of expected deployment activities. These potential impacts are described for Oklahoma's wildlife species below. Chapter 16, 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

Mammals occupy a wide range of habitats throughout Oklahoma and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bear) by decreasing the availability of forest for cover from predators or foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals (e.g., bats, foxes) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by BMPs and mitigation measures (see Chapter 16).

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the ODWC could 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 habitats.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[142] species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stop overs (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, could help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Oklahoma’s amphibians and reptiles typically consist of wetlands and the surrounding upland forest. Impacts are expected to be less than significant given the short-term nature and limited geographic scope of individual activities. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 16) would be implemented 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 to Oklahoma’s amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[143]

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

[142]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.
[143] See Section 12.2.5, Wetlands, for a discussion of BMPs for wetlands.

are expected. Impacts to sensitive invertebrate species are discussed below in Section 12.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, impacts are expected to remain less than significant due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 16, 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 to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur.

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, et al., 1997). The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur.

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, and repeated disturbances would not occur.

Terrestrial Invertebrates

Terrestrial invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be less than significant.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are anticipated to be less than significant due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Potential effects to migration patterns of Oklahoma's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below. Chapter 16, 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

Some large mammals (e.g., black bears) will perform short seasonal migrations between foraging/breeding habitats and denning habitats. Some small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[144]

Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, as a group, shorebirds migrating through Oklahoma undertake some of the longest-distance migrations of all animals. According to the National Audubon Society, Oklahoma is new to the IBA program and a total of four IBAs have been identified in Oklahoma, including breeding,[145] migratory stop-over, and feeding areas (NAS, 2008). 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. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. For example, wood frogs use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, 2010). Mortality and barriers to movement could occur as result of the Proposed Action (Berven, 1990) (Calhoun, 2007).

[144] A location chosen by an animal for hibernation

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

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be less than significant. BMPs could help to further avoid or minimize the potential impacts.

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Oklahoma'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 due to the short-term and limited nature of expected activities. Chapter 16, 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

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Oklahoma.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small-scale and impacts are expected to be less than significant. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). The majority of FirstNet deployment or operation activities are likely to be small-scale. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, 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 spiny softshell turtle will lay its eggs in exposed soil in late spring or summer (USGS, 2015g).

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, or alter water quality through sediment infiltration or obstruction of natural water flow to pools, though BMPs could help to avoid or minimize the potential impacts

Terrestrial Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; therefore, 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. Oklahoma has adopted regulations to reduce the impacts of nuisance wildlife species on native wildlife species. The ODWC maintains a list of species to be regulated (ODWC, 2015e).

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.

Potential invasive species effects to Oklahoma's wildlife are described below.

Terrestrial Mammals

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites, as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations.

Birds

FirstNet deployment activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities from machinery or construction workers.

Reptiles and Amphibians

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.

<u>Terrestrial Invertebrates</u>

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects could pose a threat to Oklahoma's forest and agricultural resources. Species such as the gypsy moth and the emerald ash borer are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs and mitigation measures could help to avoid or minimize the potential for introducing invasive terrestrial invertebrate species during implementation of the Proposed Action. Invasive species effects related to terrestrial invertebrates could be minimized with the implementation of BMPs and mitigation measures (Chapter 16).

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. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wildlife resources because there would be no ground disturbance.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have no impact on wildlife resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species

effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individuals as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
- New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water and construction of landings and/or facilities on the shore 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.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to wildlife on roadways from vehicular movement. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, blimps, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant at the programmatic level given the small scale of likely individual FirstNet projects; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and would be unlikely to cause population-level impacts, and are therefore expected to remain less than significant at the programmatic level. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to wildlife resources at the programmatic level associated with routine inspections of the Preferred Alternative. Site maintenance activities that may result in accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to have less than significant effects to fisheries and aquatic habitats at the programmatic level. Potential spills of these materials would be expected to be in small quantities.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individuals and unlikely to cause population-level impacts, and therefore would likely be less than significant at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, 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.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant at the programmatic level because deployment activities are expected to be temporary and localized, likely affecting only a small number of wildlife. Chapter 16, 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.

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. Proposed FirstNet actions at specific individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wildlife resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.6.4, Terrestrial Wildlife.

12.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Oklahoma are discussed in this section. Chapter 16, 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.

Description of Environmental Concerns

Direct Injury/Mortality

The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012c). Additionally, Oklahoma has designated several sites in its Comprehensive Wildlife

Conservation Strategy (CWCS) for protection and conservation of fish and other aquatic life. Target fish species include the Red River pupfish, Arkansas darter, Arkansas River shiner, Plains killifish, Plains minnow, flathead chub, and Red River shiner (ODWC, 2005).

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 that the majority of proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, direct injury or mortality impacts at the population-level or sub-population-level 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

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. The Oklahoma CWCS identifies habitat fragmentation, including hydrologic modification, as among state's most serious threats to biodiversity and ecological function (ODWC, 2005).

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. Therefore, potential impacts are expected to be less than significant. Additionally, deployment activities with the potential for impacts to sensitive aquatic habitats could be addressed through BMPs and mitigation measures as defined through consultation with the appropriate resource agency.

Indirect Injury/Mortality

Erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could have potential impacts on water quality. Exposure to contaminants from accidental spills from vehicles and equipment could also potentially affect water quality. These potential effects 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. Nonetheless, these impacts are expected to be less than significant due to the small-scale and short term nature of the deployment activities. BMPs and mitigation measures to protect water resources (see Section 12.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and small-scale, and therefore are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are 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 not anticipated, and therefore impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize any potential impacts.

Invasive Species Effects

The potential to introduce invasive plants within construction zones could occur from vessels and equipment being transported from one region to another. 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, impacts are anticipated to be less than significant. BMPs and mitigation measures could help to avoid or minimize the potential for introducing invasive aquatic plant and animal species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to fisheries and aquatic habitats would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to fisheries and aquatic habitats because there would be no disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have no impact on the aquatic environment.

Activities with the Potential to Have Impacts

Potential /deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other

associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g., mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites (some fish). Disturbance, including noise, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, structural hardening, or physical security measures required ground disturbance, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less than significant at the programmatic level due to the small scale and localized nature of deployment activities that have the potential to impact aquatic habitats. Chapter 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Site Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated, at the programmatic level, that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance activities that may result in accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to have less than significant effects to fisheries and aquatic habitats. Potential spills of these materials would be expected to be in small quantities.

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 16, 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.

Alternatives Impact Assessment

The following section assesses potential impacts to fisheries and aquatic habitats associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts 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 16, 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.

Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, the impacts could vary greatly among species and geographic region. Nonetheless, it is anticipated that there would be less than significant impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to fisheries and aquatic habitats as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 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 Oklahoma 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 16, 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. 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

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in **Error! Reference source not found.**, any direct injury or mortality of a listed species at the individual-level, as well as any impact that has the potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency, may affect and likely adversely affect a listed species. There are no federally listed reptiles or amphibians known to occur in Oklahoma. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, fish, invertebrates, and plants with known occurrence in Oklahoma are described below. 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 16, may be implemented as appropriate to further minimize potential impacts.

<u>Terrestrial Mammals</u>

There are three endangered and one threatened mammal species federally listed and known to occur in the state of Oklahoma; they are the gray bat, Indiana bat, northern long-eared bat, and Ozark big-eared bat. Direct mortality or injury to the federally listed Indiana bat or northern long-eared bat could occur if tree clearing activities occurred at roosting sites while bats were present (USFWS, 2012d) (USFWS, 2015ae). Direct mortality or injury to the federally listed gray bat or Ozark big-eared bat could occur if caves were flooded or blocked off while bats were present (USFWS, 1997a) (USFWS, 2008). While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could affect these species; when disturbed by noise or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 1997a). 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 16, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

Four endangered and three threatened bird species are federally listed and known to occur in the state of Oklahoma; they are the black-capped vireo, least tern, lesser prairie-chicken, piping plover, red knot, red-cockaded woodpecker, and whooping crane. 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 they are known to nest. If proposed project sites were 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 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Four threatened fish species are federally listed and known to occur in the state of Oklahoma; they are the Arkansas River shiner, leopard darter, Neosho madtom, and Ozark cavefish. Direct injury or mortality to these species could occur from entanglements resulting from the Proposed Action, but 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 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Five endangered and one threatened invertebrate species are federally listed and known to occur in the state of Oklahoma; they are the American burying beetle, Neosho mucket, Ouachita rock pocketbook, rabbitsfoot, scaleshell mussel, and winged mapleleaf. Direct mortality or injury could occur to the American burying beetle if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by the species. FirstNet would attempt to avoid, as practicable and feasible, areas where the species may occur.

The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to the Neosho mucket, Ouachita rock pocketbook, rabbitsfoot, scaleshell mussel, or winged mapleleaf are unlikely but could occur from changes in water quality from ground disturbing activities, causing stress and lower productivity, resulting from the Proposed Action. Potential impacts may affect, but are not likely to adversely affect, the 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 16, may be implemented as appropriate to further minimize potential impacts.

Plants

One endangered plant species is federally listed and known to occur in the state of Oklahoma; it is harperella. Direct mortality to harperella could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by the species. FirstNet would attempt to avoid, as practicable and feasible, areas where the species may occur; therefore, potential impacts may affect, but are not likely to adversely affect, the 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 16, 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, fish, invertebrates, and plants with known occurrence in Oklahoma are described below.

<u>Terrestrial Mammals</u>

Noise, light, and other human disturbances associated with the Proposed Action could affect federally listed terrestrial mammals, including the gray bat, Indiana bat, northern long-eared bat, and Ozark big-eared bat, 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. 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 16, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

Noise, light, or human disturbance within nesting areas could cause federally listed birds, including the black-capped vireo, least tern, lesser prairie-chicken, piping plover, red knot, red-cockaded woodpecker, and whooping crane, to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. FirstNet would attempt to avoid these areas. 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 16, may be implemented as appropriate to further minimize potential impacts.

<u>Fish</u>

Deployment activities resulting in increased disturbance (e.g., humans, noise), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 12.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction of the federally listed fish species in Oklahoma, including the Arkansas River shiner, leopard darter, Neosho madtom, and Ozark cavefish, are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. 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 16, 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 federally listed invertebrates known to occur in Oklahoma, including the Neosho mucket Ouachita rock pocketbook, rabbitsfoot, scaleshell mussel, and winged mapleleaf. In addition, introduction of invasive aquatic species could indirectly affect mussels as a result of fish populations that they rely on for their reproductive cycle being altered (USFWS, 1997c). Impacts to food sources utilized by the federally listed American burying beetle could affect this species (USFWS, 2014f). 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. 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 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Potential impacts could occur from ground-disturbing activities to harperella as a result of the Proposed Action. However, FirstNet would attempt to avoid these 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 16, 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 Oklahoma 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, including the gray bat, Indiana bat, northern long-eared bat, and Ozark big-eared bat, 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 in Oklahoma. Further, increased human disturbance, noise, and vessel traffic could cause stress to these 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, as practicable and feasible, 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 16, 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 distances often involving many different countries. For example, the piping plover use sites throughout Oklahoma as stopover habitat during their migration from the Northern Great Plains and Great Lakes Area to the coastal habitats in the south. Stopover sites consist of shorelines that occur throughout the state along reservoirs, lakes, ponds, rivers, and wetlands (USFWS, 2014g). Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result in effects to federally listed birds, including the black-capped vireo, least tern, lesser prairie-chicken, piping plover, red knot, red-cockaded woodpecker, and whooping crane. FirstNet would attempt to avoid, as practicable and feasible, 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 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Changes in water quality as a result of ground disturbing activities could impact food sources for the federally listed fish species in Oklahoma, including the Arkansas River shiner, leopard darter, Neosho madtom, and Ozark cavefish. Further, increased human disturbance, noise, and vessel traffic could cause stress to these species causing them to abandon spawning locations or altering migration patterns. Behavioral changes to these listed species are unlikely as the majority of FirstNet deployment projects would not occur in 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 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed invertebrates in Oklahoma, including the Neosho mucket, Ouachita rock pocketbook, rabbitsfoot, scaleshell mussel, and winged mapleleaf, resulting in lower productivity. Disturbances to food sources utilized by the federally listed American burying beetle, especially during the breeding season, could impact foraging behavior. FirstNet would attempt to avoid, as practicable and feasible, 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 16, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to the federally listed harperella are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to potentially significant adverse effects, such as impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed birds, reptiles and amphibians, fish, invertebrates, and plants with designated critical habitat in Oklahoma are described below.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Oklahoma. 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

One of the federally listed bird species in Oklahoma has federally designated critical habitat. Critical habitat for the whooping crane was designated in the Salt Plains NWR. Land clearing, excavation activities, and other ground disturbing activities in this region of Oklahoma could lead to habitat loss or degradation, which could affect the whooping crane depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, areas where the 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 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed bird species in Oklahoma.

Fish

Two of the federally listed fish in Oklahoma have federally designated critical habitat. Critical habitat for the Arkansas River shiner consists of portions of the Cimarron River and Canadian River in Oklahoma. Critical habitat for the leopard darter was designated in the upper Little River, the Black Fork Creek tributary to the Little River, upper portions of the Glover River, and the main channel of the Mountain Fork. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water and therefore would not likely disturb critical habitat. FirstNet would attempt to avoid, as practicable and feasible, 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 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed fish species in Oklahoma.

Invertebrates

Two of the federally listed invertebrate species in Oklahoma have federally designated critical habitat. Critical habitat for the Neosho mucket was designated along the Illinois River from the Arkansas-Oklahoma state line to its confluence with Baron Creek through Adair, Cherokee, and Delaware Counties; and along the Elk River from the Missouri-Oklahoma state line to its confluence of Buffalo Creek in Delaware County. Critical habitat for the rabbitsfoot was designated along Little River from its confluence with Glover River to the Oklahoma-Arkansas state line in McCurtain County. Changes in water quality resulting from ground disturbing activities in these regions of Oklahoma could lead to habitat loss or degradation, which could affect these invertebrates depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, 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 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in Oklahoma.

Plants

No designated critical habitat occurs for harperella in Oklahoma. Therefore, no effect to this species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. Chapter 16, 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.

Activities Likely to Have No Effect

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no effect on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would have no effect on threatened and endangered 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

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – 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., small mammals and young), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 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.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no impacts to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts may affect, but are not likely adversely affect protected species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts.

It is anticipated that operational impacts may affect, but are not likely to adversely affect threatened and endangered species at the programmatic level 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 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 16, may be implemented as appropriate to further minimize potential impacts.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur. Therefore, listed species may be affected, but are not likely to be adversely affected at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, 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 at the programmatic level 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. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to 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 16, 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.

<u>Deployment Impacts</u>

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 at the programmatic level. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to 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 16, may be implemented as appropriate to further minimize potential impacts.

<u>Operational Impacts</u>

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 at the programmatic level as a result of routine operations, management, and monitoring. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to 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 16, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effect on threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.6.6, Threatened and Endangered Species and Species of 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 Oklahoma associated with deployment and operation of the Proposed Action and Alternatives Chapter 16, 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.

12.2.7.2. 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 as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with BMPs and Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is potentially significant, but with mitigation is less than significant.	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with BMPs and Mitigation Measures Incorporated	Less Than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is potentially significant, but with mitigation is less than significant.	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is potentially significant, but with mitigation is less than significant.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with BMPs and Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is potentially significant, but with mitigation is less than significant.	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

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, as required. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 12.2.7-1 less than significant impacts would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 12.2.7-1 less than significant impacts would be anticipated as any new land use would be small-scale and short-term during the construction phase.

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 as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Enjoyment of recreation land could be temporarily impacted by crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 12.2.7-1 less than significant impacts would be anticipated as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

Use of Airspace

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. Potential 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 of time, FirstNet would be unlikely to have a significant impact on 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 Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure, and the specific deployment requirements, some activities would result in potential impacts to land use, recreation, and airspace resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - <u>Land Use:</u> See *Activities with the Potential to Have Impacts* below.
    - <u>Recreation:</u> See *Activities with the Potential to Have Impacts* below.
    - <u>Airspace:</u> 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.
    - <u>Land Use:</u> 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.
    - <u>Recreation:</u> See *Activities with the Potential to Have Impacts* below.
    - <u>Airspace:</u> 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 with the Potential to Have Impacts* below.
  - Recreation: See *Activities with the Potential to Have Impacts* below.
  - Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
  - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
  - Recreation: No impacts to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
  - Airspace: No impacts are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
  - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
  - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
  - Airspace: Lighting of dark fiber would have no impacts to airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
  - Land Use: See *Activities with the Potential to Have Impacts* below.
  - Recreation: See *Activities with the Potential to Have Impacts* below.
  - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below

addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.

- Land Use: See *Activities with the Potential to Have Impacts* below.
- Recreation: See *Activities with the Potential 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 with the Potential to Have Impacts* below.
    - Airspace: See *Activities with the Potential to Have Impacts* below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.

    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact to land use, recreation, or airspace, it is anticipated that this activity would have no impact on land use, recreation, or airspace.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - Airspace: No impacts are anticipated - see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific

location and the compatibility of the new structures with existing and surrounding land uses.

- Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
- Airspace: No impacts are anticipated – see previous section.

- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
  - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
  - Recreation: Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
  - Airspace: No impacts are anticipated – see previous section.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
  - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
  - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
  - Airspace: No impacts are anticipated – see previous section.

- Wireless Projects
  - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The

magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.

        - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
        - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets other criteria. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of Oklahoma's airports.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
        - Land Use: No impacts are anticipated – see previous section.
        - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
        - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.
- Deployable Technologies
    - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
        - Land Use: No impacts are anticipated – see previous section.
        - Recreation: No impacts are anticipated – see previous section.
        - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Oklahoma airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the

required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
        - Land Use: No impacts are anticipated – see previous section.
        - Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
        - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities. Potential impacts to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstructions. These potential impacts are expected to be less than significant at the programmatic level due to the temporary and small-scale nature of deployment activities. Additionally, FirstNet (or its network partner(s)), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. Chapter 16, 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.

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 at the programmatic level 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. Operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. It is anticipated that there would be no impacts at the programmatic level to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for inspections.

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. Once deployment locations are known, the location would be subject to an environmental review to help ensure environmental concerns are identified. 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. FirstNet would coordinate with the FAA to review required certifications. Chapter 16, 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.

12.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected; however, impacts would be less than significant 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 partner(s)) would consult with the FAA to determine how to proceed. Chapter 16, 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.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall these potential impacts would be less than significant at the programmatic level due to the temporary nature of deployment activities. Chapter 16, 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 impact.

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 Oklahoma associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.8.2. 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 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is potentially significant, but with mitigation is less than significant.	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is potentially significant, but with mitigation is less than significant.	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

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 Oklahoma, residents and visitors travel to many national monuments, historic sites, and state parks, such as Natural Falls State Park and the Black Mesa area. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. Based on the impact significance criteria presented in Table 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. Given the small-scale of likely FirstNet activities, impacts are expected to be less than significant.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects could be considered potentially significant.

Based on the impact significance criteria presented in Table 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, as defined in Chapter 16, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

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 depending on the deployment scenario or site-specific conditions. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve minimal new nighttime lighting and pole replacement would be limited.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a national park unit or other sensitive area.

If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal, or areas of surface disturbance, or additional nighttime lightning.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant at the programmatic level due to the small-scale and short term nature of the deployment activities. As discussed above, potential impacts to night skies from lighting are expected to be less than significant at the programmatic level with BMPs and mitigation measures incorporated. Chapter 16, 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.

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 at the programmatic level 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 at the programmatic level 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 16, 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.

12.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.[146]

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 16, 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.

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 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 given the limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides

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

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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to visual resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.8, Visual Resources.

12.2.9. Socioeconomics

12.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Oklahoma associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.9.2. 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 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible economic change.	No change to spending, income, industries, and public revenues.
	Geographic Extent	Regional impacts observed throughout the state/ territory.		Effects realized at one or multiple isolated cities/towns.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Incorporated	Less than Significant	No Impact
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is potentially significant, but with mitigation is less than significant.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

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 below typical market 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 Oklahoma. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $150,000 in the Stillwater area, to approximately $80,000 in the Ponca City area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the U.S., Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006a). 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 could be a minor, direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage-earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and less than significant. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary across Oklahoma. The average unemployment rate in 2014 was 4.5 percent, considerably lower than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state, with the lowest rates occurring in the western half of Oklahoma. Counties with unemployment rates above the national average occurred predominantly in the southeast portion of the state.

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 could 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 12.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because they represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 12.2.9-1. Chapter 16, 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.

Activities Likely to Have No Impacts

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

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below summarizes how the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:

    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be less than significant.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers

sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.

- Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:
  - Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be less than significant.
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be

small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

In general, the abovementioned activities would have less than significant beneficial socioeconomic impacts at the programmatic level. 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. 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 16, 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.

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. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. All operational activities would be conducted by public or private sector employees, and therefore support employment and involve payment of wages. Even if these economic effects are a very small for each operational activity, and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be less than significant.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a less than significant number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be less than significant 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 Oklahoma. Chapter 16, 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.

12.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and therefore less than significant 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. These potential impacts are anticipated to be less than significant at the programmatic level as described above. Chapter 16, 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.

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 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 region and state. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to socioeconomics from deployment and operation of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 12.1.9, Socioeconomics.

12.2.10. Environmental Justice

12.2.10.1. Introduction

This section describes potential impacts to environmental justice in Oklahoma associated with construction/deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.10.2. 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 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is potentially significant, but with mitigation is less than significant.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

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, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013) (see Socioeconomics Environmental Consequences for additional discussion). The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. American Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 12.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 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, Environmental Setting:

Minority and Low-Income Populations, the American Indian/Alaska Native percentage of the population in Oklahoma, and the percentage for Two or More Races, are substantially higher than those of the region and nation. The state's percentage of All Minorities is lower than the percentage for the region or nation. The poverty rate of Oklahoma is below the rate for the region and above the rate for the nation. Oklahoma has many areas with high or moderate potential for environmental justice populations. These areas are distributed throughout the state, but are most prevalent in the eastern part of the state. They occur both within and outside of the 10 largest population concentrations. 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, 2015b; USEPA, 2016f).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

12.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 12.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, 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.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 12.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to environmental justice under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes,

huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, they would not affect environmental justice communities.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have no impacts to environmental justice. If physical access is required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice, it is anticipated that this activity would have no impact on environmental justice.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
    - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise and dust could be temporarily generated, and traffic could be temporarily disrupted. If these effects occur

disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be less than significant at the programmatic level due to the small-scale and short term nature of the deployment, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. Chapter 16, 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.

Operation Impacts

As described in Section 12.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons.

Impacts are expected to be less than significant at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, 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.

12.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant at the programmatic level because they would be temporary in nature. Chapter 16, 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.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant at the programmatic level as operations are expected to be temporary in nature. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to environmental justice as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 12.1.10, Environmental Justice.

12.2.11. Cultural Resources

12.2.11.1. Introduction

This section describes potential impacts to cultural resources in Oklahoma associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, 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.

12.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 12.2.11-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact 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.	Adverse effect that has been procedurally mitigated through Section 126 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 126 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 126 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse effect	**Mitigated adverse effect[a]**	**Effect, but not adverse**	**No effect**
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 126 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[a] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 126 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 American 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 American 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 12.2.11-1, direct deployment impacts could be potentially significant if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would avoid areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout Oklahoma, some deployment activities may be in these areas, in which case BMPs (see below) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would avoid areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs.

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of significant impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to American Indians. It is anticipated that FirstNet would identify potential impacts to such areas through the NHPA consultation process, and would avoid deployment activities that would cause such loss of access.

12.2.11.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts at the programmatic level depending on the deployment scenario or site-specific conditions. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources. The section below addresses potential impacts to cultural resources if deployment of new huts or other equipment is required.
    - Collocation on Existing Aerial Fiber Optic Plant: Installing new fiber on existing utility poles would not have the potential to cause effects to historic properties.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to cultural resources. The section below addresses potential impacts to cultural resources if deployment of new boxes, huts, or other equipment is required.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create new visual effects.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN. Therefore, unless this decision changes, there would be no impacts to cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP[147], huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to cultural resources as mentioned above, installation of new associated huts or equipment, if required, could the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water could impact cultural resources, in areas where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Impacts to cultural resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable, which

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

could result in the disturbance of archaeological sites (archaeological deposits are frequently associated with bodies of water), and the associated structures could have visual effects on historic properties.

- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.

- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas such as Oklahoma City that have larger numbers of historic public buildings.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could affect, but not adversely affect, cultural resources at the programmatic level as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no effect at the programmatic level to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties; however, due to the small scale of expected activities, these actions could affect but not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, 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.

12.2.11.5. Alternatives Impact Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.[148]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect,

[148] As mentioned above and in Section 2.1.3, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

cultural resources at the programmatic level due to the limited amount of expected ground disturbing activities and the short-term of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, 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.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no adverse effects, to cultural resources at the programmatic level associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur; however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to cultural resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.11, Cultural Resources.

12.2.12. Air Quality

12.2.12.1. Introduction

This section describes potential impacts to Oklahoma's air quality from deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Oklahoma'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 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 Oklahoma's air quality addressed in this section are presented as a range of possible impacts.

Table 12.2.12-1: Impact Significance Rating Criteria for Air Quality

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Incorporated**	**Less than Significant**	**No Impact**
Increased air emissions	Magnitude or Intensity	Pollutant concentrations would exceed one or more NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would cause an area to be out of attainment for any NAAQS. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are *de minimis* or conform to the SIP covering nonattainment and maintenance areas.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = Not Applicable

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 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. Currently all of Oklahoma is in attainment (see Section 12.1.12, Air Quality). Figure 12.1.12-1 shows that no maintenance, or unclassifiable areas exist in Oklahoma.

Based on the significance criteria presented in Table 12.2.12-1, air emission impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities.

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 depending on the deployment scenario or site-specific conditions. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points, however this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create minimal new sources of emissions.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to no impact on ambient air quality concentrations.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have no impact on those resources.

Activities with Potential Impacts to Air Quality

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air hazardous air pollutant emissions. It is expected that such impacts would be less than significant due to the shorter duration and localized nature of the activities. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from

the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.

- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
- Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.

- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. However, if additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
  - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant at the programmatic level due to the limited nature of the deployment. Chapter 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be less than significant impacts to air quality at the programmatic level associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be less than significant at the programmatic level as they would still be limited in nature. Chapter 16, 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.

12.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant 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 products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations, would dictate the concentrations and associated impacts. 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 16, 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.

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

12.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and alternatives in Oklahoma. Chapter 16, 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.

12.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise 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 as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 12.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local		County or local	County or local
	Duration or Frequency	Permanent or long-term		Short term	Temporary

12.2.13.3. Description of Environmental Concerns

Increased Noise Levels

The Proposed Action has the potential to generate noise during construction and operation of various equipment used for deployment. These noise levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise could cause impacts on residential areas, or other facilities that are sensitive to noise, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 12.1.13, Noise).

Based on the significance criteria presented in Table 12.2.13-1, noise impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise sources be deployed/operated long-term in the same area. Noise levels from deployment activities are not expected to exceed typical noise levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise-sensitive receptors. However, given that much of the concentration and setup of equipment would often occur in populated areas, FirstNet operations would not be able to completely avoid noise impacts due to construction and operations at various receptors.

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 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. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.

- New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise levels from the use of heavy equipment and machinery.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in in short-term and temporarily increased noise levels to local residents and other noise sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
- Installation of Optical Transmission or Centralized Transmission Equipment: Noise associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the noise emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise over baseline levels temporarily.

- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise levels.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact the local noise environment temporarily.
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, mobile equipment deployed via heavy trucks could generate noise from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise during all phases of flight, including

takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. These impacts are expected to be less than significant at the programmatic level due to the small-scale and short term nature of the deployment. Additionally, pre-existing noise levels achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 16, 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.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant at the programmatic level and similar to several of the deployment activities related to routine maintenance and inspection of the facilities because of the temporary nature of the activities which would not create new permanent sources of noise. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise impacts could result as explained above. Chapter 16, 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.

12.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise levels. Several vehicles traveling together could also create short-term noise impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 16, 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.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate less than significant, short-term impacts at the programmatic level on any residential areas or other noise-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise levels would quickly return to baseline levels. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

12.2.14. Climate Change

12.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Oklahoma associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, 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.

12.2.14.2. 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. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 MMT CO_2e in 2013 (USEPA, 2015l), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO_2 and other GHGs from other projects and human activities, could be significant.

CEQ guidance for the consideration of effects of climate change on the environmental consequences of the proposed action is more general. In addition to the consideration of climate change's effects on environmental consequences, it also includes the impact that climate change may have on the projects themselves (CEQ, 2014). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

Table 12.2.14-1: Impact Significance Rating Criteria for Climate Change

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	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent	Global impacts observed.		Global impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

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. By mid-century, the total number of days above 90 ºF is projected to increase in the majority of the Northeastern states especially the southern portion of the region. Under both low and high GHG emissions scenarios, the frequency, intensity, and duration of heat waves (sequential days with temperatures over 90 ºF) is also expected to increase, with the most intense heat waves occurring under higher emissions scenarios. Increases in temperature will also impact precipitation events, sea level rise, and ocean water acidity (USGCRP, 2014a).

Air Temperature

Figures 12.2.14.3-1 and 12.2.14.3-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Oklahoma from a 1969 to 1971 baseline.

Bsk **–** Figure 12.2.14.3-1 shows that by mid-century (2040 to 2059), temperatures in the Bsk region of Oklahoma 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 region would increase by approximately 6 °F. (USGCRP, 2009)

Figure 12.2.14.3-2 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 Bsk region of Oklahoma, temperatures would increase by approximately 9 and 10 °F. (USGCRP, 2009)

Cfa **–** Temperatures in this region are expected to increase by mid-century (2040 to 2059) by 4 °F under a low emissions scenario. By the end of the century (2080 to 2099) under a low emissions scenario temperatures are expected to increase 5 or 6 °F depending on the portion of the region. (USGCRP, 2009)

Under a high emissions scenario in the Cfa region temperatures are anticipated to increase 5 °F by mid-century, and by the end of the century temperatures are expected to increase 9 °F. (USGCRP, 2009)

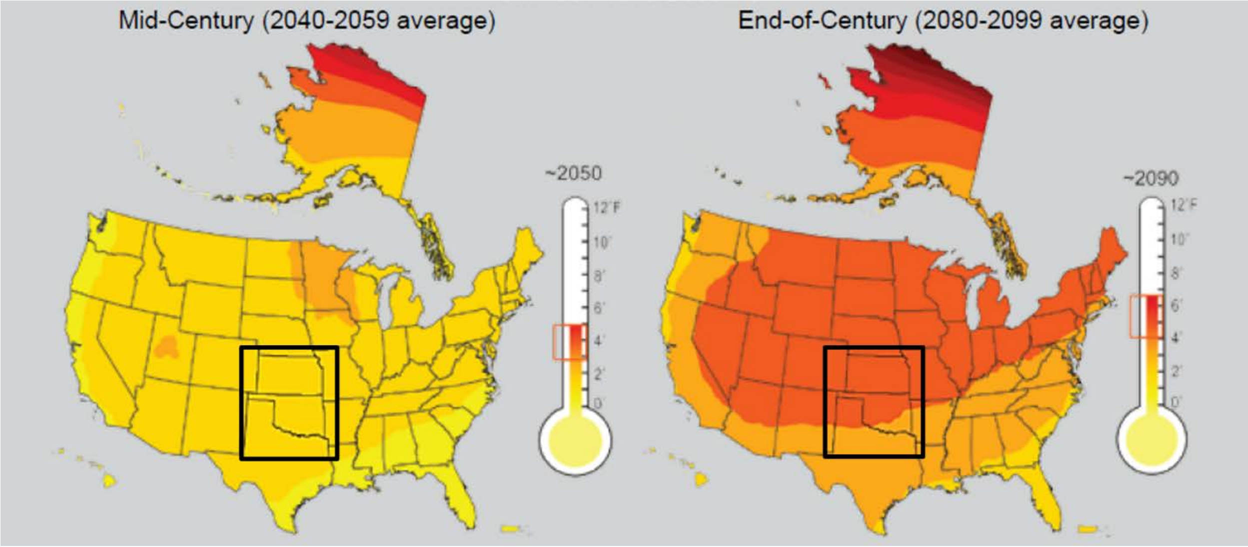

Figure 12.2.14-1: Oklahoma Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

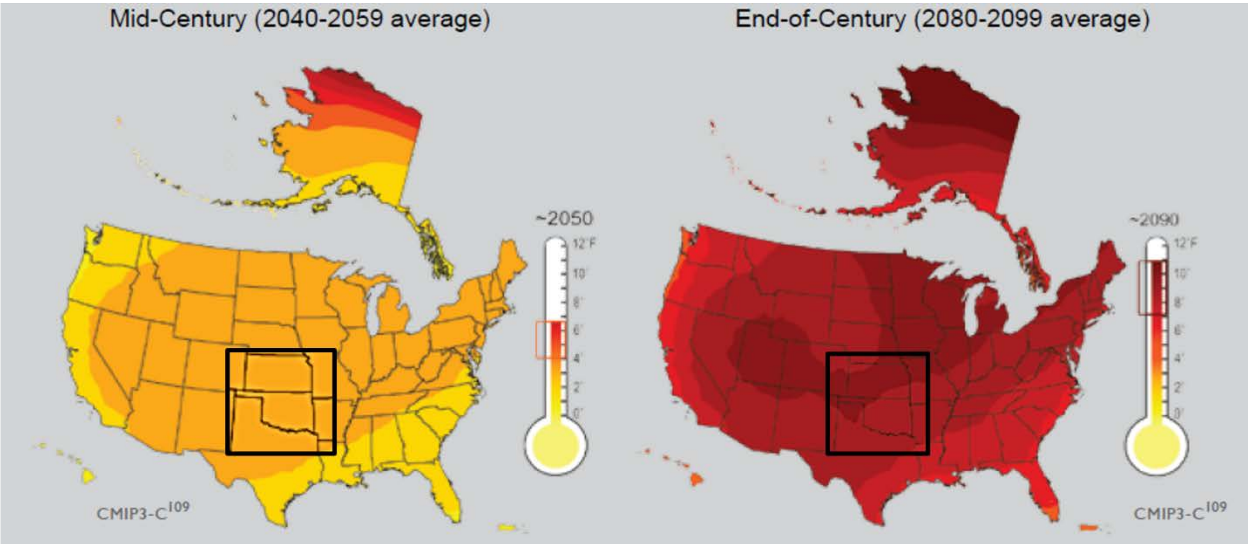

Figure 12.2.14-2: Oklahoma High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

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, 2014b)

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, 2014c)

In Oklahoma there is an expected increase in the number of consecutive dry days while the rest of the state will have an increase in these numbers under a low emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario, the majority of the state is also projected to have an increase in the number of consecutive dry days. An increase in consecutive dry days could lead to drought. (USGCRP, 2014b)

Figures 12.2.14.3-3 and 12.2.14.3-4 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 12.2.14.3-3 show seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions means more than 70 percent cuts from current levels by 2050. (USGCRP, 2014d)

Figure 12.2.14.3-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014d)

Bsk – Figure 12.2.14.3-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation would remain constant or increase by 10 percent in winter and spring for the Bsk region of Oklahoma. However, there are no expected changes in precipitation in summer or fall other than fluctuations due to natural variability. (USGCRP, 2014d)

Figure 12.2.14.3-4 shows that if emissions continue to increase, winter and spring precipitation could increase 10 percent or remain constant over the period 2071 to 2099 depending on the portion of the region. In summer, precipitation in this scenario could decrease as much as 10 or 20 percent depending on the portion of the region. Fall precipitation is anticipated to remain constant or decrease 10 percent over the same period. (USGCRP, 2014d)

Cfa – Under a low emissions scenario, winter, summer, and fall precipitation is expected to remain constant in the Cfa region. Spring precipitation may increase 10 percent or remain constant depending on the portion of the region. (USGCRP, 2014d)

Under a high emissions scenario precipitation in winter and spring will increase 10 percent or remain constant depending on the portion of the region. Summer precipitation is expected to decrease 10 or 20 percent depending on the area of the Cfa region. In fall precipitation will decrease 10 percent or remain constant depending on the portion of the region. (USGCRP, 2014d)

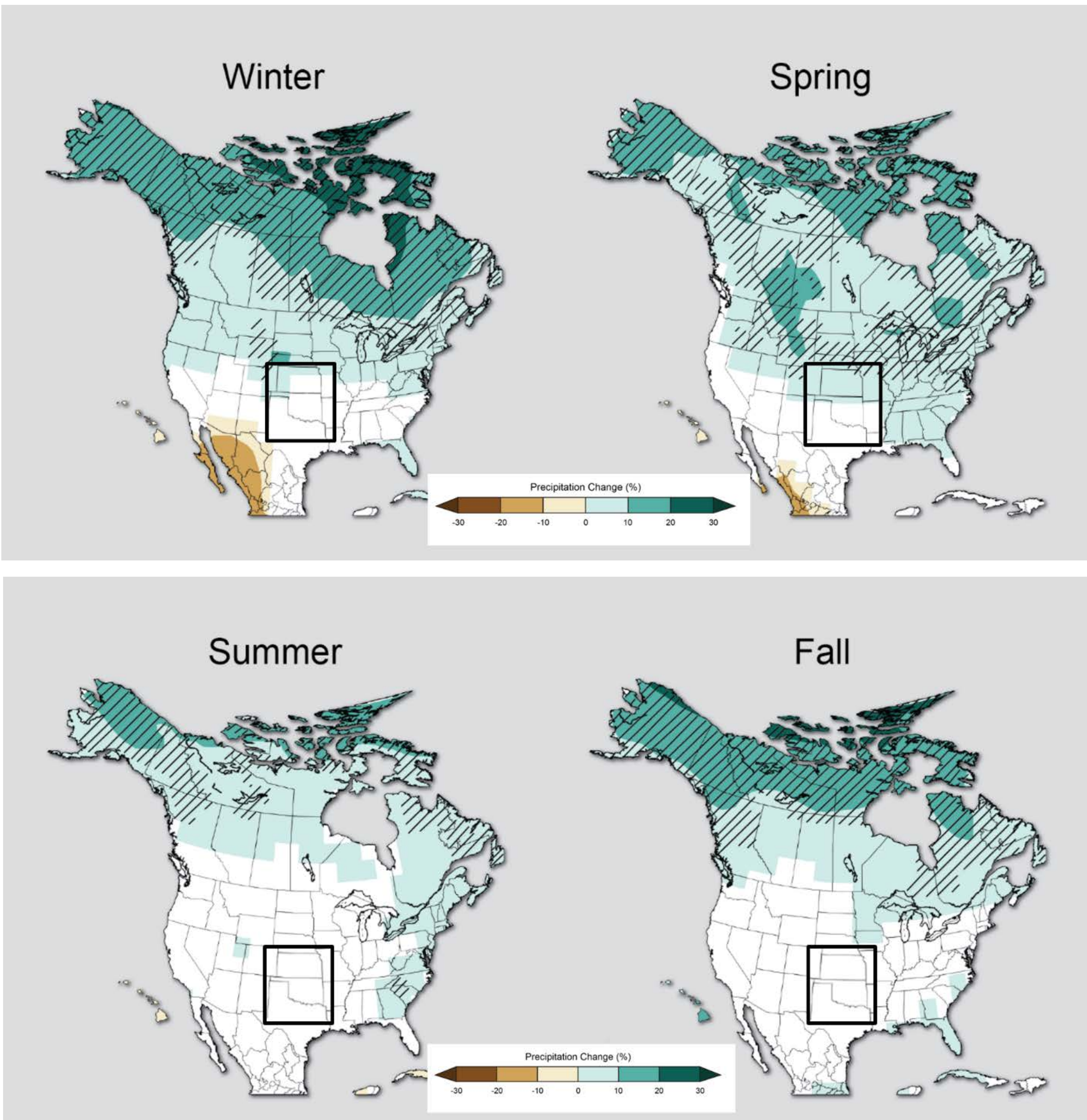

Figure 12.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014d)

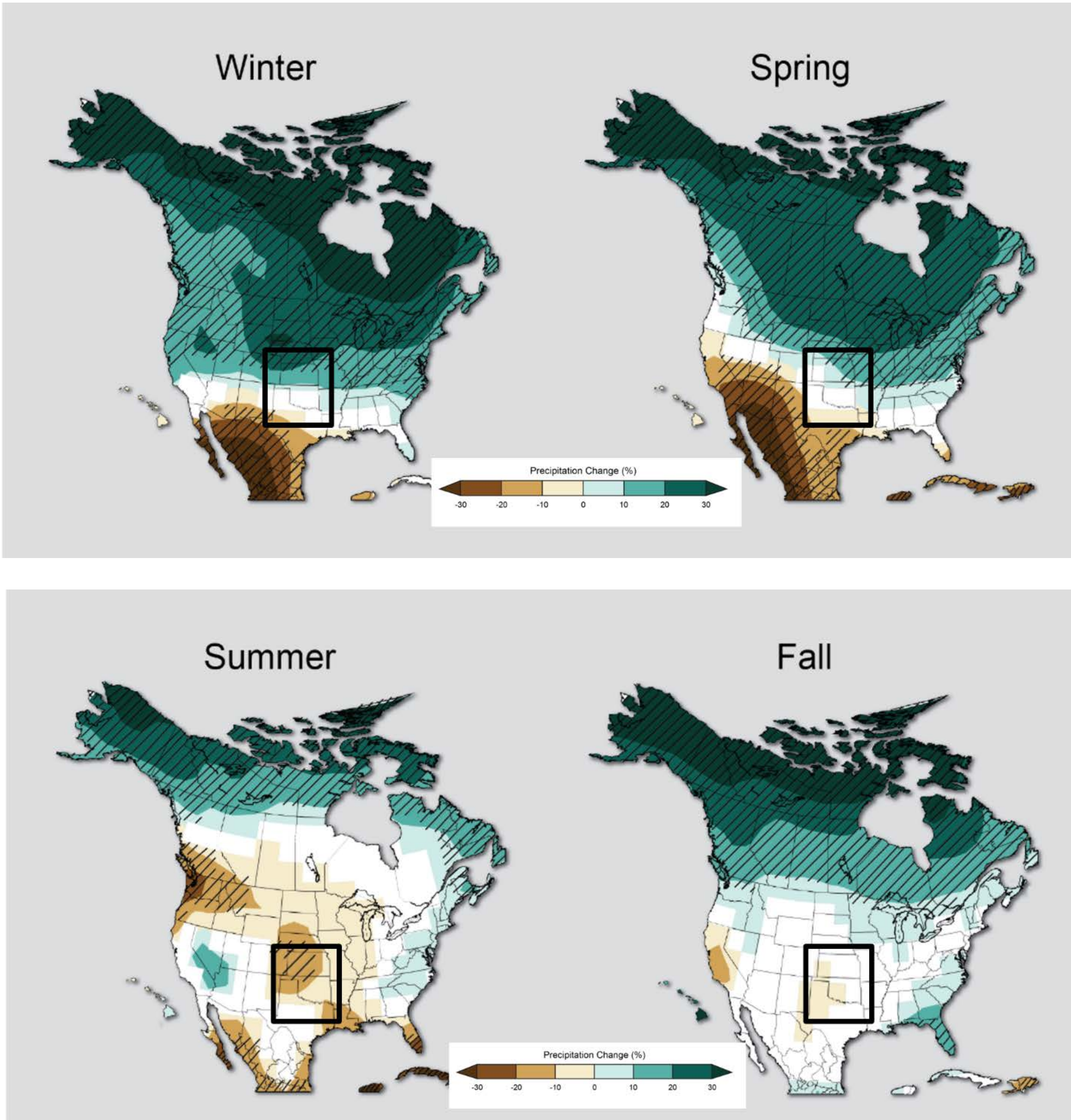

Figure12.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Source: (USGCRP, 2014d)

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, 2014f)

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 CO_2 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 of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015b). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO_2/day. Running continuously, the tower would cause the emission of 446 MT of CO_2 per year. However, grid-provided electricity would result in less CO_2 emissions than on-site provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs/MWh (USEPA, 2015m), the same transmitter would be responsible for approximately 271 MT of CO_2 per year running continuously. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated.

Effects of Climate Change on Project-Related Impacts

Climate change may increase project-related impacts by magnifying or otherwise altering impacts in other resources areas. Some may even run on low/no-emissions renewable energy. Therefore, this scenario is a "worst-case" for GHG emissions. If the system deployment resulted in the operation of more than 50 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters (Vereecken, et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Impact of Climate Change on Project-Related Resource Effects

Climate change may impact project-related effects by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. Climate change may expose areas of Oklahoma to increased intensity and duration of heat waves and extended periods of drought which together would negatively impact natural and cultivated ecosystems (USGCRP, 2014e). Extended heat waves would also increase human morbidity and mortality due to extreme heat as well as potential increases in air pollution (USGCRP, 2014g).

These effects would vary from state to state depending on the resources in question and their relationship to climate change. These impacts will be considered fully in Chapter 18, Cumulative Impacts. No BMPs will be described for this aspect of the resource.

Impact of Climate Change on FirstNet Installations and Infrastructure

Climate change impacts on FirstNet installations and infrastructure will vary from state to state, depending on the placement and vulnerability of the installations and infrastructure, and the impacts that climate change is anticipated to have in that particular location.

For areas of Oklahoma 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, 2014g). The projected increased frequency and duration of extreme heat waves would increase general demand on the electric grid, reduce electricity transmission capacity (DOE, 2015), and potentially overwhelm the capacity onsite equipment needed to keep microwave and other transmitters cool. Based on the impact significance criteria presented in Table 12.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

12.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

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

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
    - Distribution of Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities

Activities with Potential to Have Impacts

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wired Projects
  - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
  - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
  - Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
  - New Build - Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small engine sources would contribute to GHGs.
  - Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction as construction, as it would not occur. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.

- Deployable Technologies
  - COWs, COLTs, SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts in excess of 25,000 MT if operated in large numbers over the long-term. However, this would be highly dependent on their size, number, and the frequency and duration of their use.
  - Deployable Aerial Communications Architecture: Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of 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 16, 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.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant at the programmatic level 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.

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 16, 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.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant due to the temporary nature of the operation of deployables. 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 operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be less than significant at the programmatic level due the limited duration of deployment activities. Chapter 16, 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.

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.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

Climate change effects have the most noticeable impacts over a long period of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology at the programmatic level due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.14, Climate Change.

12.2.15. Human Health and Safety

12.2.15.1. Introduction

This section describes potential impacts to human health and safety in Oklahoma associated with deployment of the Proposed Action and alternatives. Chapter 16, 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.

12.2.15.2. 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 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural and Manmade Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

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 could sometimes be hazardous. 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 of chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

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, 2016e).

- Engineering controls;
- Work practice controls;
- Administrative controls; and then
- Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes,[149] 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 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

[149] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016f)

employer specific workplace rules and operational practices (OSHA, 2016e). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet project sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2016e). 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.

<u>No State Plan</u> - The Oklahoma Department of Labor (ODOL) is not authorized by OSHA to administer a state program for public or private sector employers. Therefore, ODOL 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 because 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 mine lands. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior’s Abandoned

Mine Lands inventory, through the Oklahoma State Department of Environmental Protection, 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 Oklahoma state laws in order to protect workers and the general public from direct exposure or fugitive contamination.

Exposure assessments identify relevant site characteristics, temporal exposure parameters, and toxicity data to determine the likelihood of adverse health effects. More formally known as a human health risk assessment (HHRA), these studies provide mathematical justification for implementing controls at the site to protect human health. If the HHRA determines the potential for adverse health effects is too great NYSDEP may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRAs help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRAs take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

Natural and Manmade Disasters

The impacts of natural and manmade disasters are likely to present unique health and safety hazards, as well as exacerbate pre-existing hazards, such as degrading occupational work conditions and disturbing existing environmental contamination. The unique hazards presented by natural and manmade disasters may include, fire, weather incidents (e.g., floods, tornadoes, hurricanes, etc.), earthquakes, vandalism, large- or small-scale chemical releases, utility disruption, community evacuations, or any other event that abruptly and drastically denudes the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure. Additionally, such natural and manmade disasters could directly impact public safety communication infrastructure assets through damage or destruction.

Based on the impact significance criteria presented in Table 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, 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. Chapter 16, 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.

12.2.15.4. 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. Chapter 16, 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.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be no impacts to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential

for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in limited nearshore and inland bodies of water requires workers to operate over aquatic environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shore to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in

the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator

would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, and environmental contamination), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure and release of hazardous chemicals and hazardous waste, and release of historic contamination to the surrounding environment. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant at the programmatic level due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be less than significant impacts to human health and safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant at the programmatic level due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, 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.

12.2.15.5. 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 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 16, 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.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety at the programmatic level associated with routine inspections. Use of 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 would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 16, 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to human health and safety as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.2.15, Human Health and Safety.

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AFB	Air Force Base
AGL	Above Ground Level
AML	Abandoned Mine Lands
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CCR	Consumer Confidence Report
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFA	Controlled Firing Areas
CFOI	Census for Fatal Occupational Injuries
CGP	Construction General Permit
CIMC	Cleanups in My Community
CNP	Cellular Network Partnership’s
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Truck
COT	Commonwealth Office of Technology
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
DAQ	Division of Air Quality
DEP	Department for Environmental Protection
DEQ	Department of Environmental Quality
DMRE	Division of Mine Reclamation and Enforcement
DNR	Department of Natural Resources
DOE	Department of Energy
DOH	Department of Health
DOJ	Department of Justice
DOT	Department of Transportation
DPS	Department of Public Safety
EDACS	Enhanced Digital Access System
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EIS	Environmental Impact Statement
EJSCREEN	Environmental Justice Screening and Mapping Tool
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right to Know Act
ESA	Endangered Species Act
FAA	Federal Aviation Administration

Acronym	Definition
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
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAO	Government Accountability Office
GAP	Gap Analysis Program
GC	General Condition
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GNIS	Geographic Names Information System
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IBA	Important Bird Areas
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LERN	Law Enforcement Radio Network
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
MOA	Military Operation Areas
MSFCA	Magnuson-Stevens Fisheries Conservation Act
MSFCMA	Magnuson Stevens Fishery Conservation And Management Act
MSL	Mean Sea Level
MWh	megawatthour
MYA	Million Years Ago
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NASAO	National Association of State Aviation Officials
NAWQA	National Water Quality Assessment Program
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles

Acronym	Definition
NMSZ	New Madrid Seismic Zone
NNL	National Natural Landmarks
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notices To Airmen
NO_X	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCA	National Resources Conservation Authority
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NTFI	National Task Force On Interoperability
NTNC	Non-Transient Non-Community
NWCO	Nuisance Wildlife Control Operator
NWI	National Wetlands Inventory
NWP	Nationwide Permit
NWR	National Wildlife Refuges
NWS	National Weather Service
OAC	Oklahoma Administrative Code
OCC	Oklahoma Corporation Commission
OCIO	Office of the CIO
ODAFF	Department of Agriculture, Food, and Forestry
ODEM	Oklahoma Department of Emergency Management
ODOL	Oklahoma Department of Labor
ODOT	Oklahoma Department of Transportation
ODWC	Oklahoma Department of Wildlife Conservation
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OK	Oklahoma
OKAAQS	Oklahoma Ambient Air Quality Standards
OKC	Rogers World Airport
OKDOL	Oklahoma Department of Labor
OKPHETS	Oklahoma Public Health Environment Tracking System
OKSDH	Oklahoma State Department of Health
OKWIN	Oklahoma Wireless Integrated Network
ONHI	Oklahoma Natural Heritage Inventory
OPDES	Oklahoma Pollutant Discharge Elimination System Act
OSHA	Occupational Safety and Health Administration
OSRA	Oklahoma Scenic Rivers Act
OSRC	Oklahoma Scenic Rivers Commission
OTR	Ozone Transport Region
PAB	Palustrine aquatic bed
PACE	Purchase of Agricultural Conservation Easements
PADUS	Protected Area Database of the United States
PCN	Preconstruction Notification
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested
PGA	Peak Ground Acceleration
PHS	Priority Habitats and Species

Acronym	Definition
POP	Points of Presence
POW	Prisoner of War
PPE	Personal Protective Equipment
PRNA	Proposed Research Natural Area
PSAP	Public Safety Answering Points
PSC	Public Service Commission
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSRS	Public Safety Radio System
PSS	Palustrine scrub-shrub
PTE	Potential to Emit
PSW	Public Water Supplies
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SCEC	State Climate Extremes Committee
SCIP	Statewide Communication Interoperability Plan
SDF	International-Sandiford Field
SDS	Safety Data Sheets
SF_6	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Needed
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act
SNA	State Natural Areas
SNP	State Nature Preserves
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SO_X	Oxides of Sulfur
SPL	Sound Pressure Level
SRS	Statewide Radio System
SUA	Special Use Airspace
SWAP	Source Water Assessment Program
SWPPP	Storm Water Pollution Prevention Plan
TFR	Temporary Flight Restrictions
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TNC	Transient Non-Community Systems
TPY	Pollutant Threshold Level
TRI	Toxics Release Inventory
TS	Terminology Services
TSCA	Toxic Substances Control Act
TUL	Tulsa International Airport
TVA	Tennessee Valley Authority
TWA	Time Weighted Average
UA	Unmanned Aircraft

Acronym	Definition
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
UPS	United Parcel Service
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USDOJ	United States Department of Justice
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
UST	Underground Storage Tanks
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
WPA	Works Progress Administration
WQC	Water Quality Certification
WWI	World War I
WWII	World War II

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