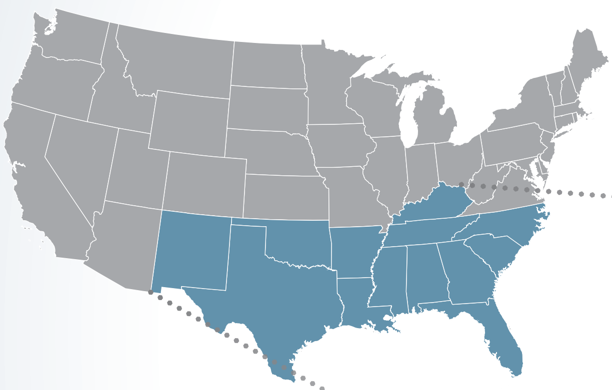
FirstNet®

Nationwide Public Safety Broadband Network

Final Programmatic Environmental Impact Statement for the Southern United States

VOLUME 5 - CHAPTER 7



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First Responder Network Authority

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Nationwide Public Safety Broadband Network

Final Programmatic Environmental Impact Statement for the Southern United States

VOLUME 5 - CHAPTER 7

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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 Commerce—National Telecommunications and Information Administration
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
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August 2017

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7. KENTUCKY

Kentucky was populated for centuries by American Indian tribes with a rich cultural history. Kentucky joined the Union in 1792 as the 15th state (Kentucky Legislative Research Council, 2015). Kentucky is bordered by Missouri and Arkansas to the west, Indiana and Ohio to the north, West Virginia and Virginia to the east, and Tennessee to the south. This chapter provides details about Kentucky as it relates to the Proposed Action.

General facts about Kentucky are provided below:

- **State Nickname:** The Bluegrass State
- **Land Area:** 39,486.34 square miles; **U.S. Rank:** 37 (U.S. Census Bureau, 2015a)
- **Capital:** Frankfort
- **Counties:** 120 (U.S. Census Bureau, 2015b)
- **2014 Estimated Population:** 4,413,457; **U.S. Rank:** 26 (U.S. Census Bureau, 2015c)
- **Most Populated Cites:** Louisville/Jefferson County metro, Lexington-Fayette urban county, Bowling Green, and Owensboro (U.S. Census Bureau, 2015b)
- **Main Rivers:** Ohio River, Kentucky River, Cumberland River, and Green River
- **Bordering Waterbodies:** Ohio River
- **Mountain Ranges:** A portion of the Appalachian Mountains
- **Highest Point:** Black Mountain (4,145 ft) (USGS, 2015a)

7.1. AFFECTED ENVIRONMENT

7.1.1. Infrastructure

7.1.1.1. Introduction

This section provides information on key Kentucky 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 includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures and other man-made facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Section 7.1.1.3 provides an overview of Kentucky's traffic and transportation infrastructure, including road and rail networks and waterway facilities. Kentucky'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 Kentucky are presented in more detail in Section 7.1.1.4. Section 7.1.1.5 describes Kentucky's public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Kentucky's utilities, such as power, water, and sewer, is presented in Section 7.1.1.6.

7.1.1.2. Specific Regulatory Considerations

Multiple Kentucky laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 7.1.1-1 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, 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 7.1.1-1: Relevant Kentucky Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Revised Statutes: Title V Military Affairs: Kentucky Administrative Rules: Title 106 Department of Military Affairs	Kentucky Emergency Response Commission	Establishes, develops, and supports a statewide comprehensive emergency management program for mutual aid; disaster and emergency response; assists in the development, implementation, and maintenance of emergency management. programs and public safety telecommunications systems; develops policies related to the response of government to the release of hazardous substances.
Kentucky Revised Statutes: Title XXIV Public Utilities: Kentucky Administrative Regulations: Title 807 Energy and Environment Cabinet – Public Service Commission	Public Service Commission	Defines "utility"; creates geographic areas for retail electric service; requires a certificate to begin construction of a public utility; requires public utilities to furnish adequate, efficient, safe, and reasonable service; regulates public utilities; ; oversees telecommunications company operations, right-of-way construction, tower construction, and siting of ; electric generation and transmission facilities.
Kentucky Revised Statutes: Title XV Roads, Waterways, and Aviation; Title XVI Motor Vehicles: Kentucky Administrative Rules: Title 600 Transportation Cabinet; Title 602 Transportation Cabinet – Office of Aeronautics; Title 603 Transportation Cabinet – Department of Highways	Kentucky Transportation Cabinet	Regulates all railroads within the state; coordinates efforts to promote traffic safety and traffic safety education coordinates hazardous material transport; governs construction and maintenance of roads and utility rights-of-way;; regulates the operation of aircraft and airports; issues rules and regulations pertaining to the use of land within and around airports; regulates and registers motor vehicles and their operation.

Source: (Kentucky Legislature, 2017a) (Kentucky Legislature, 2017b) (Kentucky Legislature, 2017c) (Kentucky Legislature, 2017d)

7.1.1.3. Transportation

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

The Kentucky Transportation Cabinet (KYTC) has jurisdiction over freeways and major roads, airports, railroads, and mass transit in the state; local counties have jurisdiction for smaller streets and roads. The mission of the KYTC is to "provide a safe, efficient, environmentally sound, and fiscally responsible transportation system that delivers economic opportunity and enhances the quality of life in Kentucky" (KYTC, 2014a).

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

- 79,598 miles of public roads (FHWA, 2014a) and 14,194 bridges (FHWA, 2015a);
- Approximately 3,200 miles of track that includes passenger rail and freight (KYTC, 2015a);
- 276 aviation facilities, including airstrips and heliports (FAA, 2015a); and
- Seven small to medium-size commercial ports along state waterways (Kentucky Association of River Ports, 2008) (World Port Source 2016).

Road Networks

As identified in Figure 7.1.1-1, the major urban centers of the state from north to south are Louisville/Jefferson County-Elizabethtown-Madison, Charleston-Huntington-Ashland, Paducah-Mayfield, Martin-Union City, and Bowling Green-Glasgow (U.S. DoC, 2013a). Kentucky has six 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 7.1.1-2 lists the interstates and their start/end points in Kentucky. 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 7.1.1-2: Kentucky Interstates

Interstate	Southern or western terminus in KY	Northern or eastern terminus in KY
I-24	IL line near Paducah	TN line near Oak Grove
I-64	IN line in Louisville	WV line in Catlettsburg
I-65	TN line near Franklin	IN line in Louisville
I-69	I-24 in Eddyville	Pennyrile Parkway in Nortonville
I-71	I-64 in Louisville	OH line in Covington
I-75	TN line near Saxton	OH line in Covington

Source: (FHWA, 2015b)

In addition to the Interstate System, Kentucky 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). Some State Scenic Byways may be designated on portions of National Scenic Byways. Figure 7.1.1-1 illustrates the major transportation networks, including roadways, in Kentucky. Section 7.1.8, Visual Resources, describes the National and State Scenic Byways found in Kentucky from an aesthetic perspective.

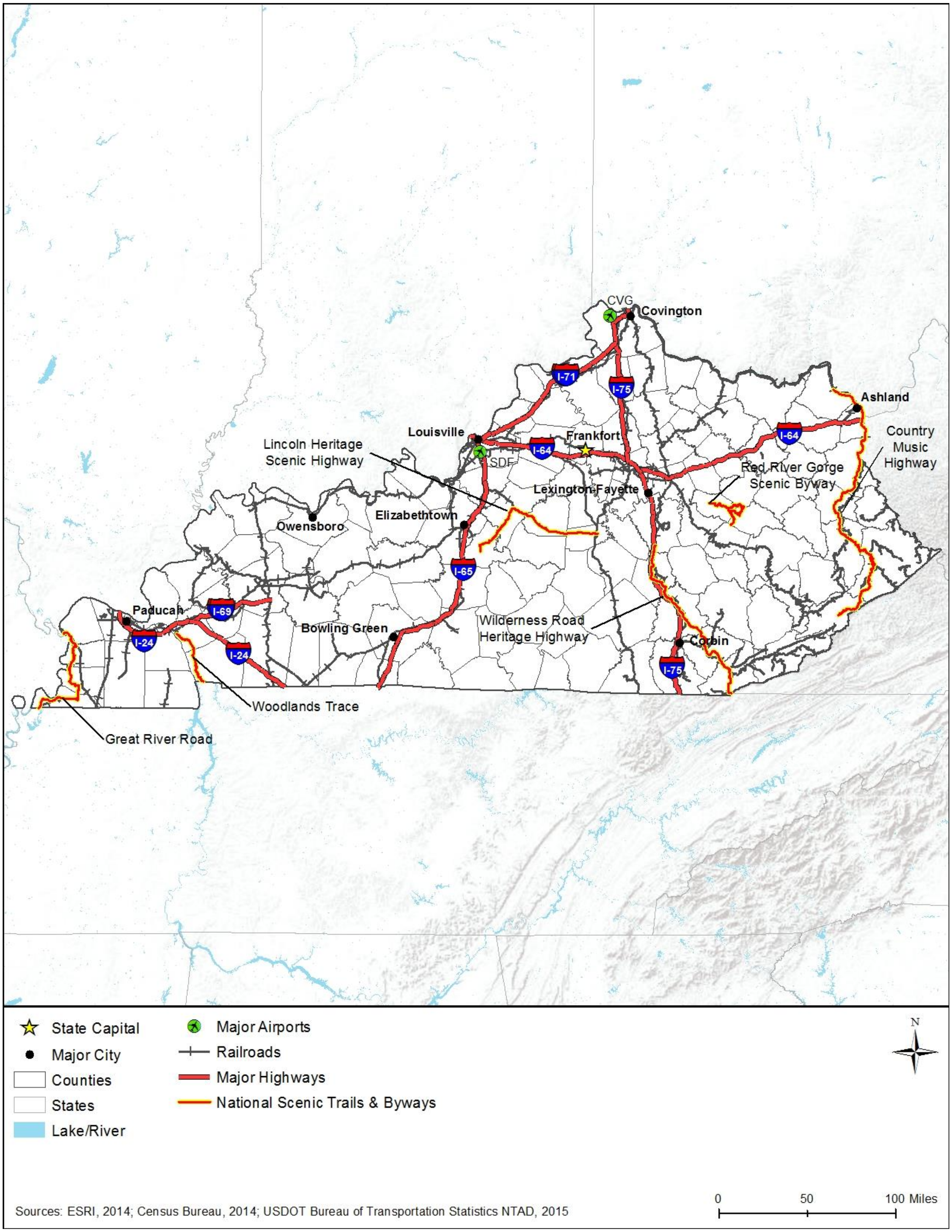


Figure 7.1.1-1: Kentucky Transportation Networks

Airports

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

- Cincinnati/Northern Kentucky International Airport (CVG) is located in Hebron, Kentucky, just across the Ohio River from Cincinnati. In 2014, CVG served 5,908,711 passengers, facilitated 133,518 aircraft operations, and handled 5,273 tons for freight (CVG, 2015).
- Louisville International-Standiford Field (SDF) is located within the city limits of Louisville. In 2014, SDF served 1,634,983 passengers (FAA, 2015b). Also in 2014, the airport handled 11,568,369,154 pounds of cargo, making it the third busiest airport in the nation in terms of cargo moved (FAA, 2015c). SDF is one of the busiest cargo airports in the nation because the United Parcel Service (UPS) operates its hub for its overnight-delivery business at the airport (SDF, 2015).

Figure 7.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 7.1.7 Airspace, provides greater detail on airports and airspace in Kentucky.

Rail Networks

Kentucky is connected to a rail network of passenger rail (Amtrak) and freight rail. Figure 7.1.1-1 illustrates the major transportation networks, including rail lines, in Kentucky. Amtrak runs two lines through Kentucky: Cardinal and City of New Orleans. The Cardinal runs three days per week between Chicago and New York City, whereas the City of New Orleans runs once per day between Chicago and New Orleans. In total, Amtrak stops at four stations in Kentucky. Table 7.1.1-3 provides a complete list of Amtrak lines that run through Kentucky.

Table 7.1.1-3: Amtrak Train Routes Serving Kentucky

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Kentucky
Cardinal	New York, NY	Chicago, IL	26 hours 30 minutes	Ashland, South Shore, Maysville
City of New Orleans	Chicago, IL	New Orleans, LA	19 hours	Fulton

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

Five Class I railroad companies operate in Kentucky: BNSF Railway, Canadian National, CSX Transportation, Norfolk Southern, and Union Pacific (KYTC, 2015a). In addition, Kentucky has one Class II railroad and 13 Class III railroads (KYTC, 2015a). In 2011, Kentucky was sixth in the nation for the tons of freight rail that originated in the state, 11th in terms of the total tons of freight carried via rail, and the third largest freight rail shipper of coal (KYTC, 2015a). In 2011, Kentucky moved 267.5 million tons of freight by rail (KYTC, 2015a).

Harbors and Ports

Kentucky has about 1,100 miles of navigable waterways, including the Mississippi, Ohio, Big Sandy, Tug Fork, Tennessee Cumberland, Green, and Licking Rivers. The state has “12 river ports, seven of which are operating ports and five of which are developing ports” (World Port Source 2016).

- The Hickman-Fulton County Riverport Authority in Hickman facilitates waterway transportation of movement of raw materials and finished products, including agricultural commodities. "The port is adjacent to a natural slack water harbor at mile marker 922 on the Mississippi River, and is the only operating Kentucky public riverport located on the Mississippi River."
- The Paducah-McCracken County Riverport Authority in Paducah operates port facilities "between River Mile 1.3 and 2.0 on the left descending bank of the Tennessee River, near its confluence with the Ohio River." The port has three dock facilities that handle up to four barges carrying bulk and general cargoes. "A 2.3 thousand square meter (25 thousand square foot) dockside staging area can accommodate goods of any size. The liquid cargo tank facility supports both barge-to-rail and barge-to-truck transfers… Among the major cargoes passing through Paducah-McCracken Riverport are aggregates, building materials, dry bulk and liquid fertilizers, steel rolls and beams, containers, veneer logs, finished lumber, wood products, pulpwood, agricultural feeds and grains, fuels and other petroleum products, coal and ores, zircon sand, aluminum, and palletized cargo."
- Henderson County Riverport Authority in Henderson operate a small port facility at River Mile 808 on the left descending bank of the Ohio River, west of the City of Henderson.
- The Owensboro Riverport Authority in Owensboro has facilities at River Mile 759 on the left descending bank of the Ohio River. The port handles about 860,000 tons of cargo annually, including steel, aluminum, copper, zinc, lead, magnesium, grain, paper, fertilizer, and bulk commodities.
- The Louisville-Jefferson County Riverport Authority in Pleasure Ridge Park operates facilities at River Mile 618 on the left descending bank of the Ohio River, as well as an adjoining industrial park. Facilities include a "bulk commodity transfer terminal, a general cargo dock, barge fleeting, ground storage, and almost 21 kilometers (13 miles) of off- and on-site rail tracks." The port's bulk terminal handles grain, coal, potash, fertilizer, steel, scrap, sand, lumber, cement, and petroleum coke.
- The Greenup-Boyd County Riverport Authority in Catlettsburg operates a small port facility on River Mile 332 on the left descending bank of the Ohio River.
- The Eddyville Riverport and Industrial Development Authority in Eddyville operates a combined the industrial development authority and the port operation in a natural harbor at River Mile 43 on the Cumberland River. (Kentucky Association of River Ports, 2008) (World Port Source 2016)

The Seamen's Church Institute (SCI) operates the Center for Maritime Education in Paducah, which focuses on professional education for the inland river towing industry (SCI, 2016). Additionally, several barge lines have headquarters or operation centers in the state (Kentucky Association of River Ports, 2008).

7.1.1.4. Public Safety Services

Kentucky public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 7.1.1-4 presents Kentucky's key demographics including population; households; land area; population density;

and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 7.1.9, Socioeconomics.

Table 7.1.1-4: Key Kentucky Indicators

Kentucky Indicators	
Estimated Population (2014)	4,413,457
Households (2009-2013)	1,694,996
Land Area (square miles) (2010)	39,486.34
Population Density (persons per sq. mile) (2010)	109.9
Municipal Governments (2013)	419

Source: (U.S. Census Bureau, 2015p) (U.S. Census Bureau, 2013)

Table 7.1.1-5 presents Kentucky's public safety infrastructure, including fire and police stations. Table 7.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 7.1.1-5: Public Safety Infrastructure in Kentucky by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,042
Law Enforcement Agencies [b]	389
Fire Departments [c]	680

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

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

Table 7.1.1-6: First Responder Personnel in Kentucky by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	2,320
Fire and Rescue Personnel [b]	20,589
Law Enforcement Personnel [c]	33,712
Emergency Medical Technicians and Paramedics [d e]	3,610

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

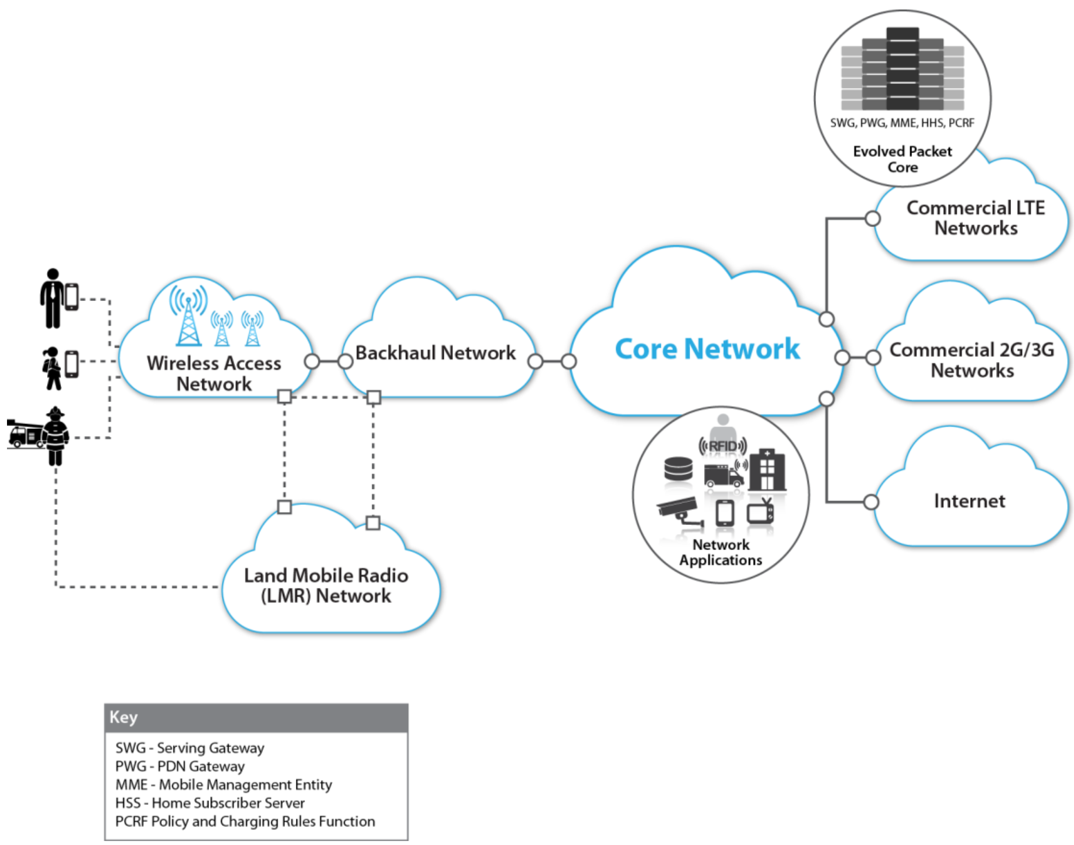
[a] BLS Occupation Code: 43-5031.
[b] BLS Occupation Codes: 33-2011 (Firefighters), 33-2021 (Fire Inspectors and Investigators), 33-1021 (First-Line Supervisors of Fire Fighting and Prevention Workers), and 53-3011 (Ambulance Drivers and Attendants, Except Emergency Medical Technicians). Volunteer firefighters 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.

7.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Kentucky; 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 7.1.1-2 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).



Prepared by: Booz Allen Hamilton

Figure 7.1.1-2: Wireless Network Configuration

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 7.2.1), 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 scale, which is national (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information, including jurisdictional challenges, funding challenges, the pace of technology evolution, and communication interoperability. Communication interoperability has been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and at the state level, including in Kentucky.

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).

Public safety LMR networks are in a state of transition as Kentucky recently upgraded its statewide microwave tower network in 2013 to IP-digital in support of emergency communications. Public safety county networks have begun selective transition to more modern digital Project 25 (P25) systems as is the case in the Louisville P25 multi-county system. However, the majority of the state's LMR systems remain on legacy analog Very High Frequency (VHF),[2] Ultra High Frequency (UHF),[3] and 800 MHz systems (State of Kentucky, 2014).

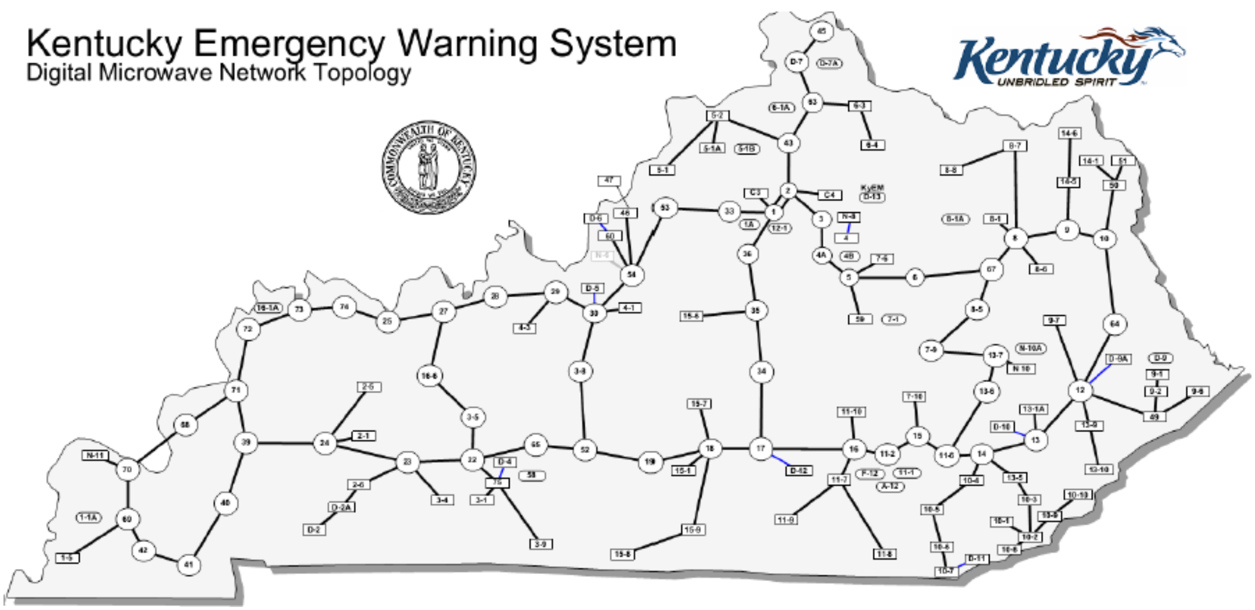
[2] VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA, 2005).
[3] UHF band covers frequencies ranging from 300 MHz to 3000 MHz (NTIA, 2005).

The Kentucky Wireless Interoperability Executive Committee (KWIEC) is responsible for LMR interoperability, spectrum management oversight, and network modernization planning. The Kentucky Commonwealth Office of Technology (COT) has oversight and operational responsibility for the statewide digital microwave network, which supports its emergency communication system delivering voice, data, and video; known as the Kentucky Emergency Warning System (KEWS) (State of Kentucky, 2014).

Statewide Public Safety Networks

There is no statewide LMR system in Kentucky serving public safety across common frequencies, as public safety systems in the state operate across a diverse collection of VHF, UHF, and 800 MHz frequencies and channels. According to Kentucky's 2014 Statewide Communication Interoperability Plan (SCIP) report, "Currently, there is no statewide communications system in Kentucky; public safety agencies primarily operate in the VHF, UHF, and 800 MHz frequency bands. Since most radios do not have the capability to operate on different frequency bands, the KWIEC [Kentucky Wireless Interoperability Executive Committee] implemented mutual aid standards that formalize wireless voice communication protocols necessary to achieve interoperability. Several mutual aid channels are set aside to operate in the VHF, UHF, and 800 MHz bands during emergency response events, and public safety voice communications equipment is automatically programmed with the corresponding frequencies to establish on-scene voice communications interoperability" (State of Kentucky, 2014).

The KEWS is a digital microwave system providing statewide emergency communications capability with voice, data, and video capability for public safety and state agency users via the KEWS IP-based digital backbone capacity. Figure 7.1.1-3 depicts the topology and tower locations of the KEWS system (Commonwealth Office of Technology, 2012).



Source: (Commonwealth Office of Technology, 2012)

Figure 7.1.1-3: Kentucky Emergency Warning System Digital Microwave Network

Kentucky continues to operate a statewide low-speed mobile data network, IP MobileNet operating on 800 MHz. The state's 2012 Annual Report on public safety summarized this system and highlighted its speed limitations as follows, "the statewide IP MobileNet system serves as Kentucky's low speed mobile data network. It was designed for first responders whose primary requirement was short text based transfers to and from base or other mobile users. With a maximum throughput of 19.2 kbps per channel, it is of little use to first responders needing high speed data transfers, but it is performing as designed and continues to be useful for its intended purpose" (Commonwealth Office of Technology, 2012).

The Louisville P25 system is a multi-county public safety LMR network serving four Kentucky counties: Jefferson (where Louisville is located), Bullitt, Oldham, and Shelby Counties (RadioReference.com, 2015a). The Lexington P25 system also serves multiple Kentucky counties, providing public safety LMR communications to three counties: Fayette (where the city of Lexington is located), Jessamine, and Madison Counties (RadioReference.com, 2015b).

City and County Public Safety Networks

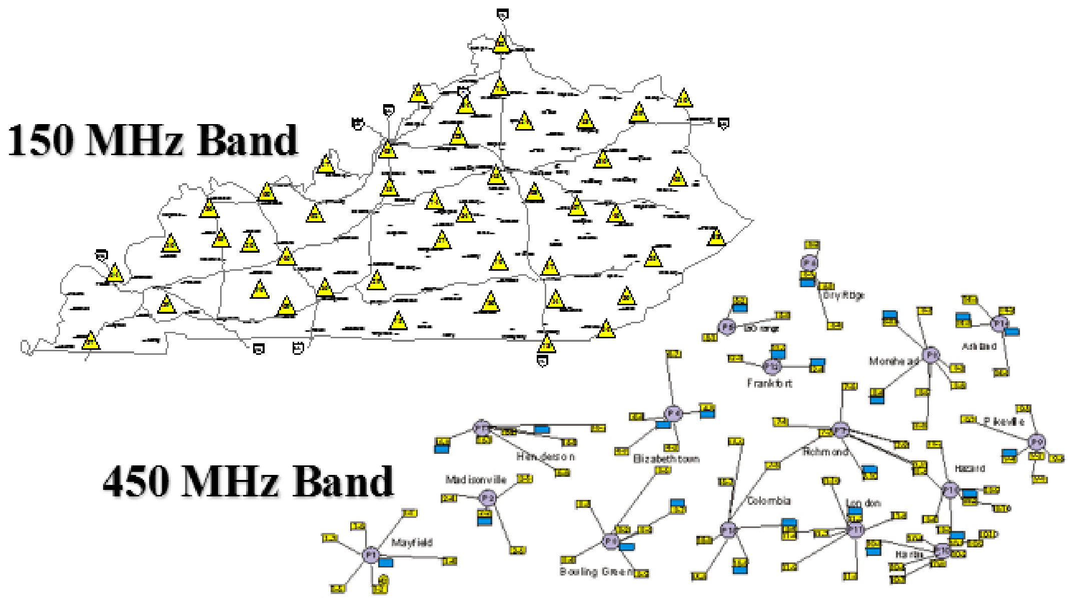
At the local and county public safety level, legacy analog VHF and UHF systems in Kentucky represent over 90 percent of the systems in the state, with 800 MHz systems making up the remainder (State of Kentucky, 2005). The adoption of digital P25 systems in Kentucky has been selective with only a minority of the 120 counties adopting the digital P25 technology, as Table 7.1.1-7 below indicates (Project25.org, 2015). Legacy analog public safety LMR systems for police/sheriff, fire, and Emergency Medical Services (EMS) users provide voice communications, including dispatch and tactical communications over VHF and UHF systems (RadioReference.com, 2015c).

Table 7.1.1-7: Kentucky P25 Pubic Safety Systems

Kentucky P25 Public Safety Systems	Frequency Band
Hamilton County-Cincinnati Public Safety	800 MHz
Hopkins County P25	UHF Lo
Indiana Project Safety Hoosier SAFE-T (P-25)	800 MHz
Lexington-Fayette County Government (P25)	800 MHz
Louisville Emergency Communications Network	800 MHz
Madison County Public Safety (P25) System	800 MHz
Owensboro Public Safety & Services (P25)	800 MHz

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

Figure 7.1.1-4 below depicts the locations of the VHF and UHF towers and, the overall system footprint for these Kentucky public LMR frequencies (KWIEC, 2005). As of mid-2015, there were 7 public safety P25 systems operational in Ohio. One of these systems, Indiana's Project Hoosier SAFE-T, originates in Ohio, but serves Henderson County in Kentucky (RadioReference.com, 2015d). All of the Kentucky P25 public safety LMR systems currently operate on 800 MHz with the exception of Hopkins County which operates on UHF. Table 7.1.1-7 lists the P25 Public Safety systems serving Kentucky and provides the individual operational frequencies being used (Project25.org, 2015).



Source: (KWIEC, 2005)

Figure 7.1.1-4: Kentucky Locations of VHF and UHF Towers, and Overall System Footprint

Public Safety Answering Points (PSAPs)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 192 PSAPs serving Kentucky's 120 counties (FCC, 2016d).

Commercial Telecommunications Infrastructure

Kentucky'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 Kentucky'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

Kentucky'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 7.1.1-8 presents the number of providers of switched access[4] lines, Internet access,[5] and mobile wireless services including coverage.

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

Table 7.1.1-8: Telecommunications Access Providers and Coverage in Kentucky as of December, 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines[a]	153	97.2% of households[b]
Internet access[c]	82	49% of households
Mobile Wireless[d]	9	92% of population

Source: (FCC, 2014a) (FCC, 2014b) (NTIA, 2014) (FCC, 2013)

[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 by technology provided; the 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.

Table 7.1.1-9 shows the wireless providers in Kentucky along with their geographic coverage. The following five maps, Figure 7.1.1-5 through Figure 7.1.1-9, show AT&T's and Verizon's coverage, TOAST.net's and Bluegrass Cellular's coverage, Sprint's and T-Mobile's coverage, and Appalachian Wireless', Cricket Wireless', and ConnectGRADD's coverage, and the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 7.1.1-9: Wireless Telecommunications Coverage by Providers in Kentucky

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	98.51%
TOAST.net	57.26%
Verizon Wireless	54.22%
Sprint	39.70%
Bluegrass Cellular	31.81%
Appalachian Wireless	13.32%
T-Mobile	11.98%
Cricket Wireless	6.17%
ConnectGRADD	5.90%
Other[a]	19.25%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: Avolutia, LLC; FastNet; Kentucky WiMAX; ALTIUS Broadband; City of Williamstown, Cable & Internet Service; EPBNET; Ken-Tenn Wireless, LLC; Broadlinc Wireless; CBW of Kentucky; ClearLinc Broadband; KYWIFI; NTELOS; QKY Wireless; Kudu Systems; MEWS; Blue Zoom Wifi; OOLWireless; WiMAX Express; BluegrassNet; Vortex Wireless; QX.net; megaWi; Kentucky Wireless; MST Wireless; Liberty Communications, Inc.; Chapel Communications Inc.; Community Connect; Community Telecom Services; Hopkinsville Electric System; PowerNet Global Communications; ConnectLink, Inc.; WWGapTel; Integrated Networks, Inc.; Heavenwire.net; Egan Technology Services.

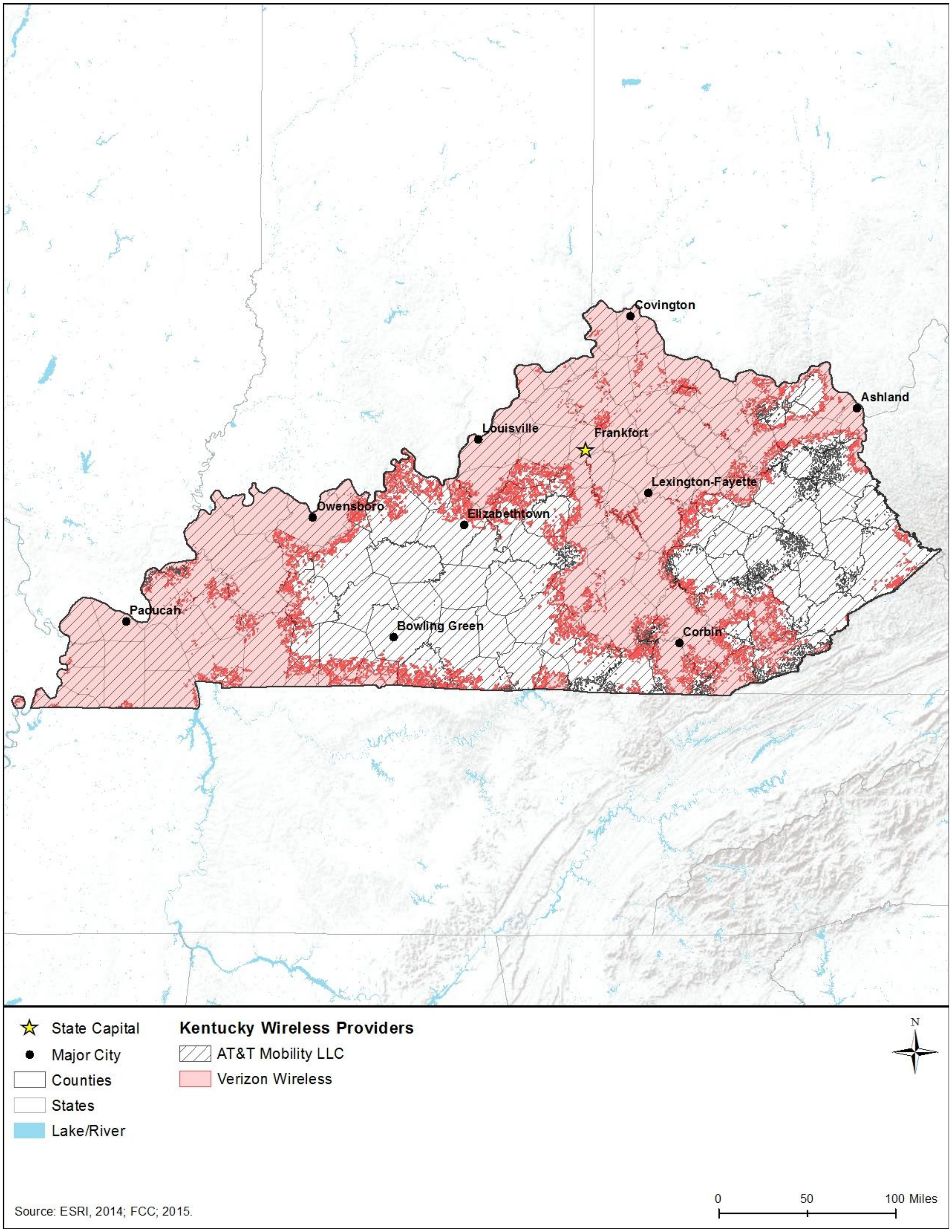


Figure 7.1.1-5: Top Wireless Providers Availability in Kentucky

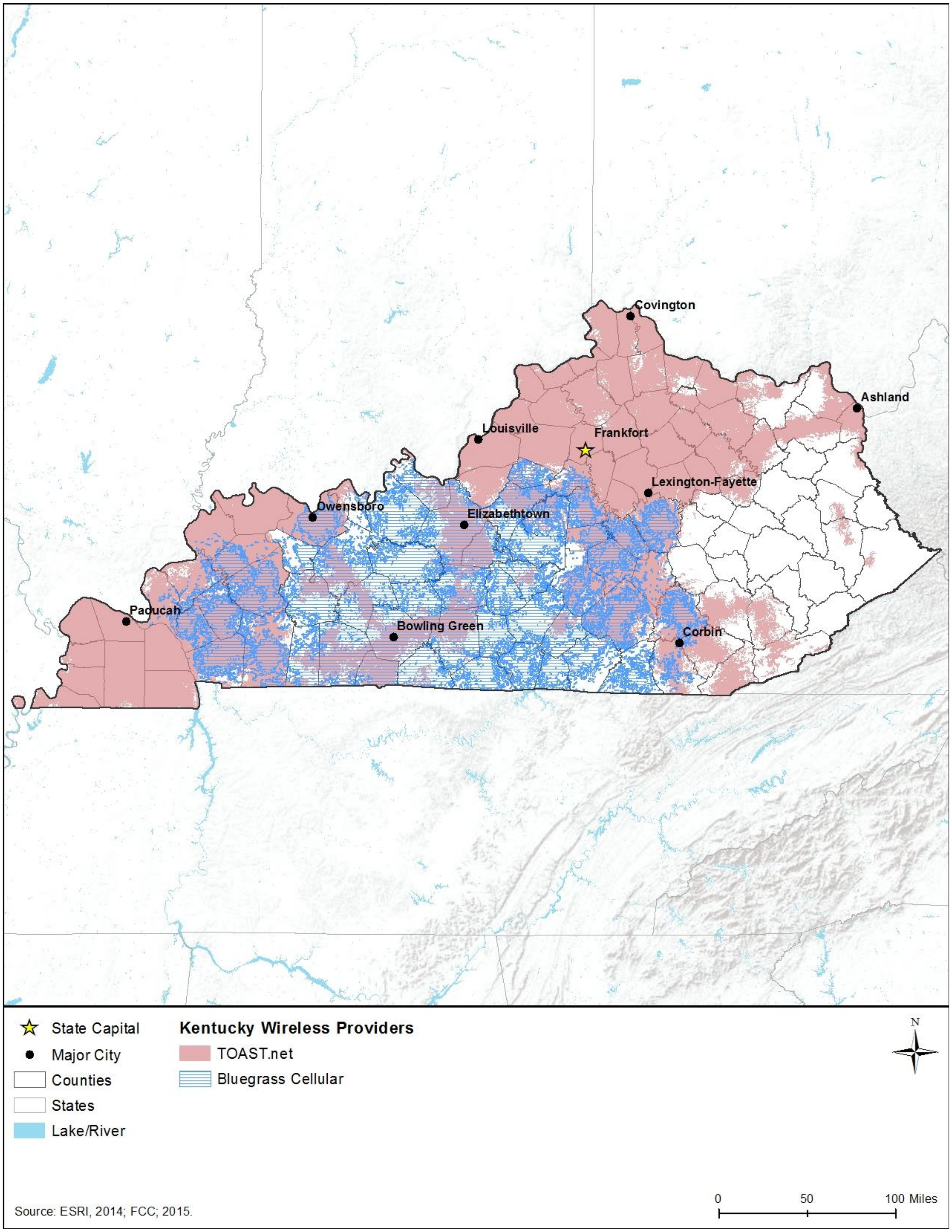


Figure 7.1.1-6: TOATS.net and Bluegrass Cellular Wireless Availability in Kentucky

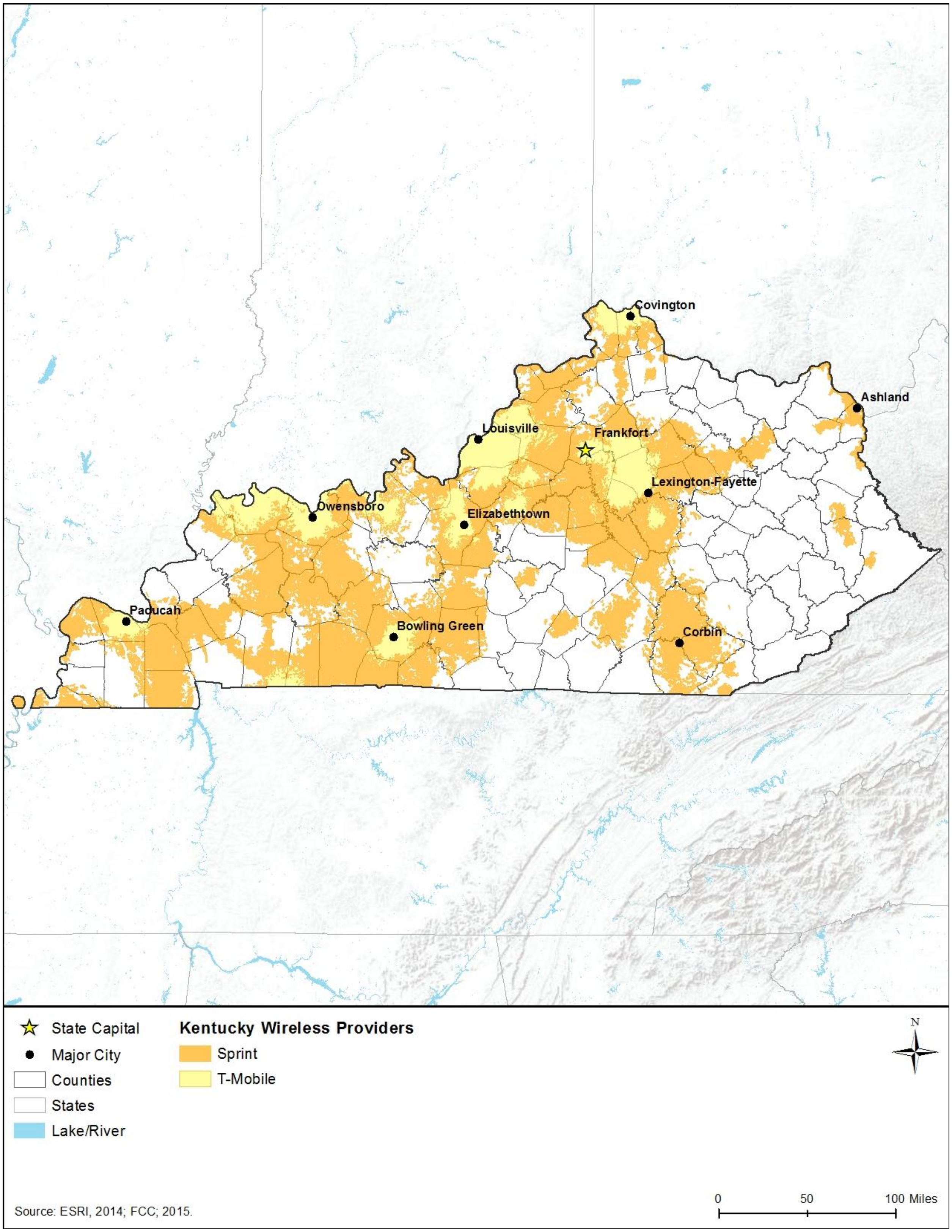


Figure 7.1.1-7: Sprint and T-Mobile Wireless Availability in Kentucky

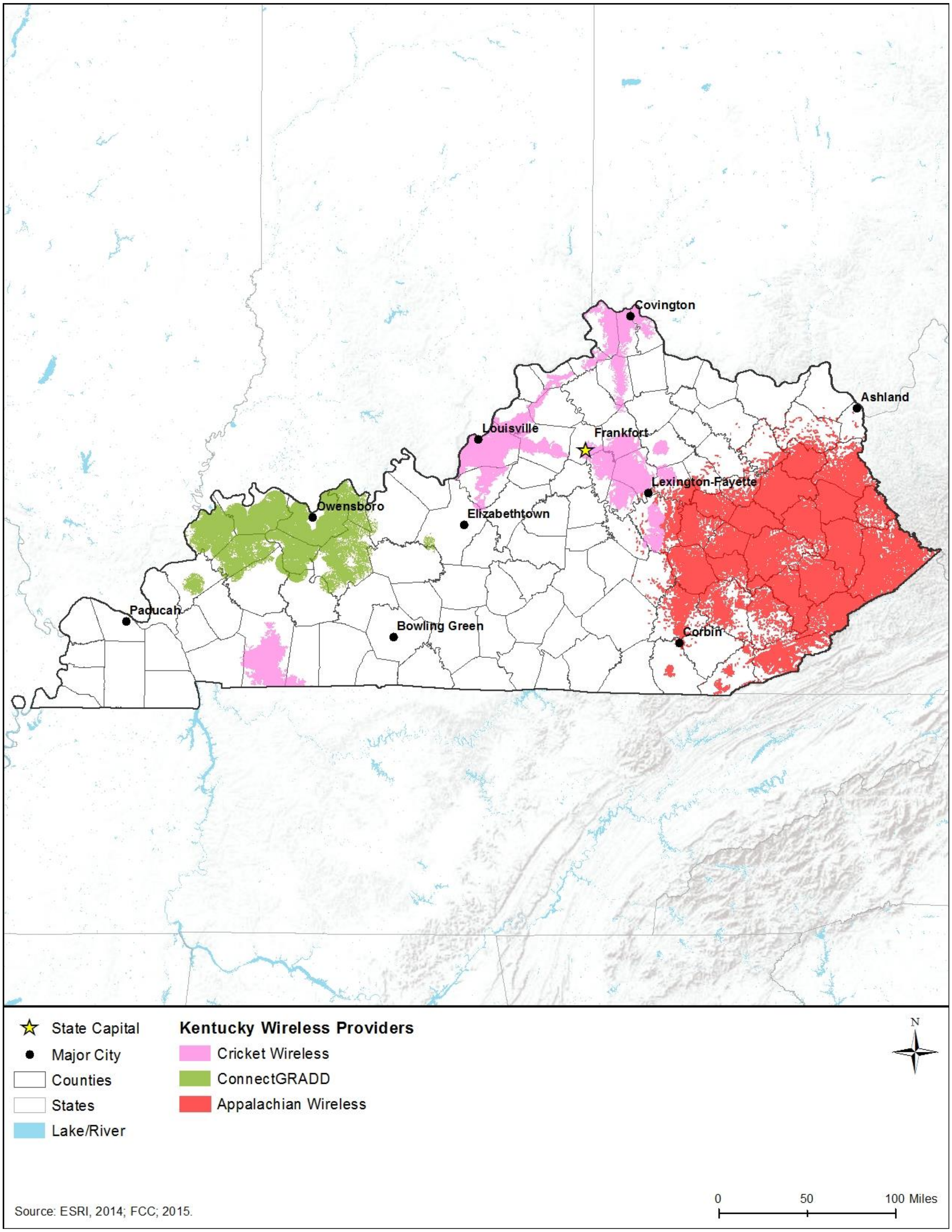


Figure 7.1.1-8: Appalachian Wireless, Cricket Wireless, and ConnectGRADD Wireless Availability in Kentucky

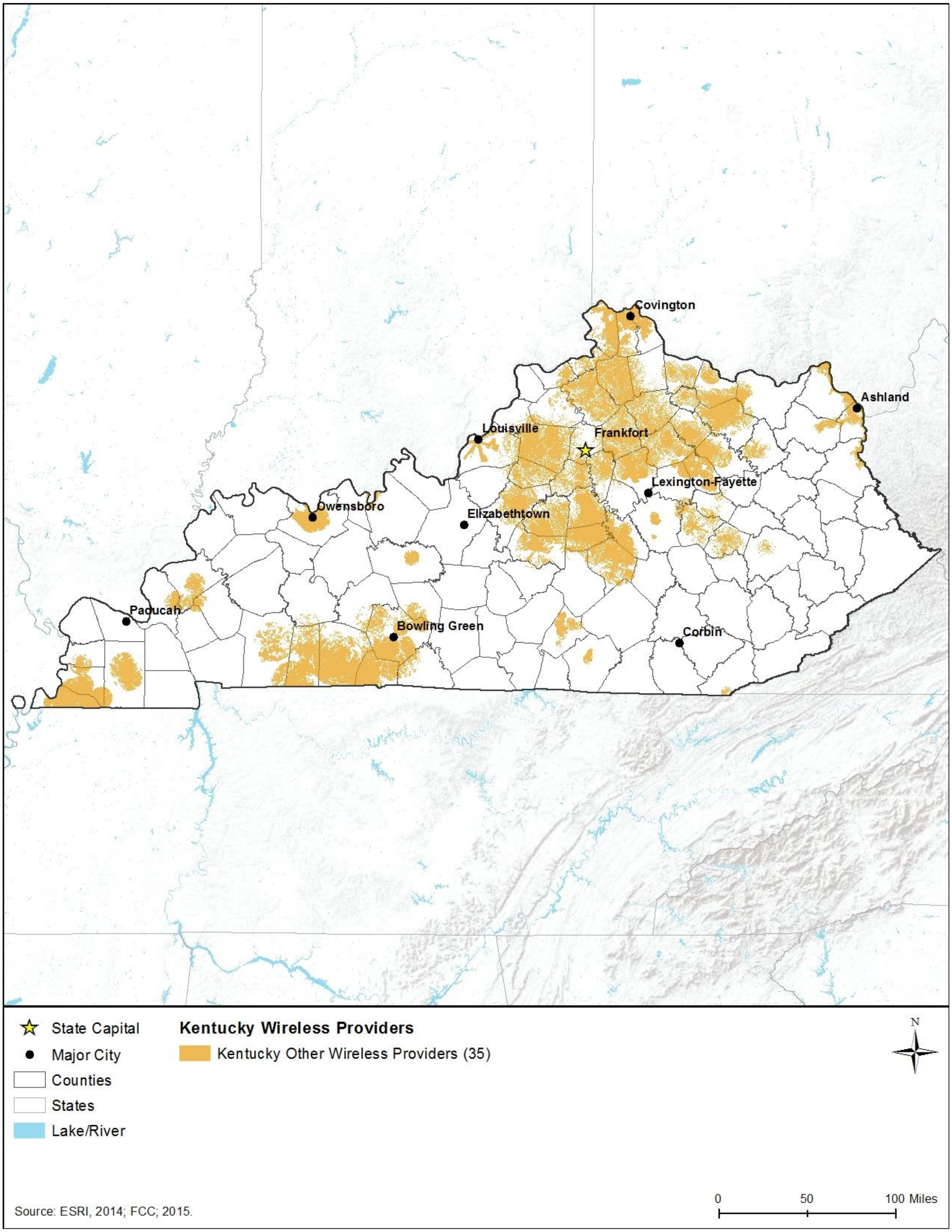


Figure 7.1.1-9: Other Providers Wireless Availability in Kentucky

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, 2009b). Figure 7.1.1-10 presents representative examples of each of these categories or types of towers.

Monopole
100 – 200 feet
Source: http://laps.noaa.gov/birk/laps_intranet/site_photos/Monarch/tower.jpg

Lattice
200 – 400 feet
Source: Personal Picture

Guyed
200 – 2,000 feet
Source: http://www.esrl.noaa.gov/gmd/ccgg/insitu/

Figure 7.1.1-10: Types of Towers

Telecommunications tower infrastructure proliferates throughout Kentucky, although tower infrastructure is concentrated in the higher and more densely populated areas of Kentucky. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).[6] Table 7.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Kentucky, by tower type, and Figure 7.1.1-11 presents the location of those 1,946 structures, as of June 2016.

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

Table 7.1.1-10: Number of Commercial Towers in Kentucky by Type

Constructed[a] Towers[b]		**Constructed Monopole Towers**	
100 ft. and over	332	100 ft. and over	0
75 ft. – 100 ft.	890	75 ft. – 100 ft.	1
50 ft. – 75 ft.	375	50 ft. – 75 ft.	21
25 ft. – 50 ft.	157	25 ft. – 50 ft.	26
25 ft. and below	28	25 ft. and below	6
Subtotal	**1,625**	**Subtotal**	**54**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100 ft. and over	23	100 ft. and over	1
75 ft. – 100 ft.	39	75 ft. – 100 ft.	4
50 ft. – 75 ft.	9	50 ft. – 75 ft.	0
25 ft. – 50 ft.	4	25 ft. – 50 ft.	0
25 ft. and below	1	25 ft. and below	0
Subtotal	**76**	**Subtotal**	**5**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100 ft. and over	13	100 ft. and over	0
75 ft. – 100 ft.	114	75 ft. – 100 ft.	0
50 ft. – 75 ft.	30	50 ft. – 75 ft.	0
25 ft. – 50 ft.	17	25 ft. – 50 ft.	0
25 ft. and below	2	25 ft. and below	0
Subtotal	**176**	**Subtotal**	**0**
Constructed Tanks[d]			
Tanks	10		
Subtotal	**10**		
Total All Tower Structures		**1,946**	

Source: (FCC, 2015)

[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, 2015).
[b] Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).
[c] Multiple constructed structures per antenna registration (FCC, 2016c).
[d] Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016c).

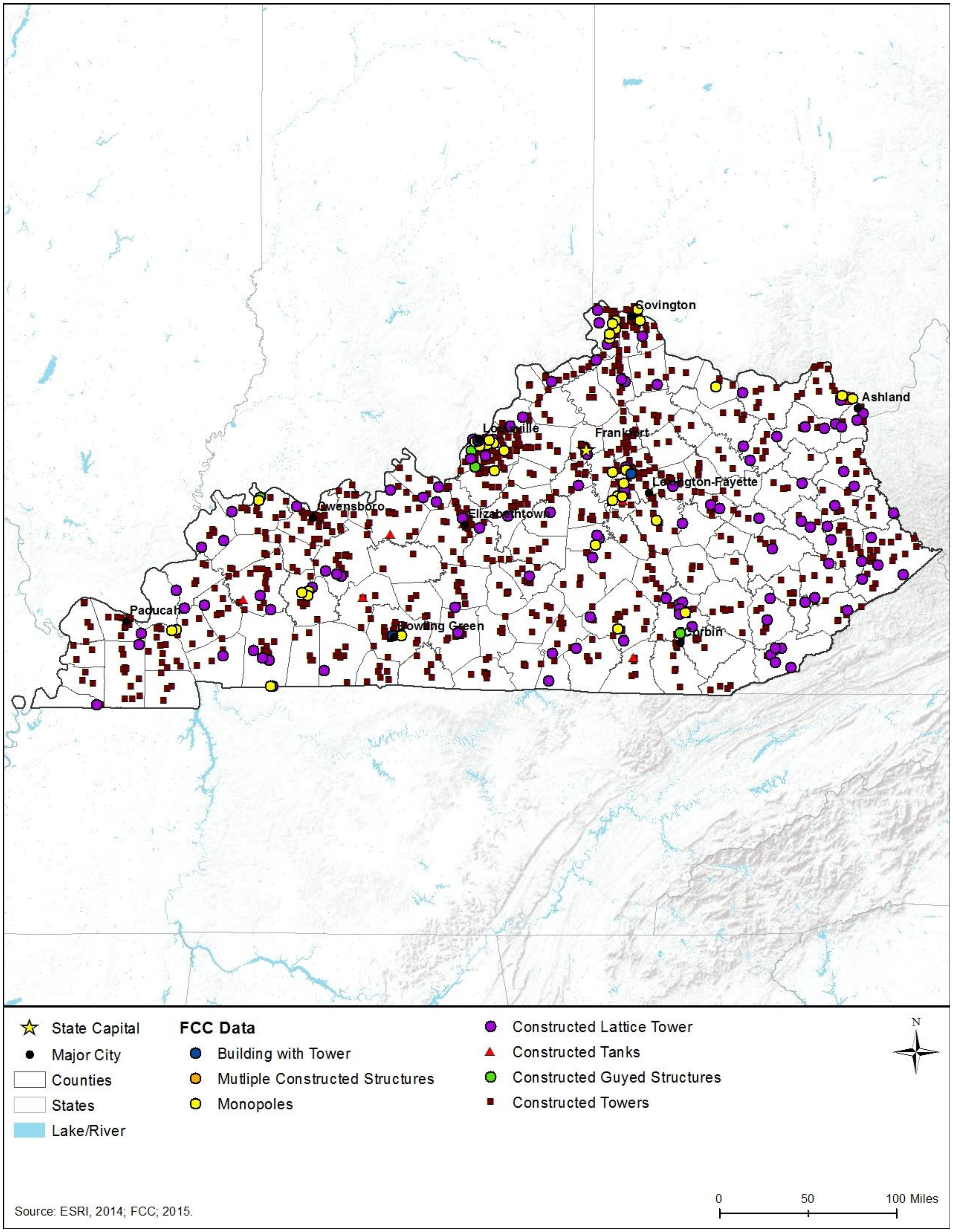
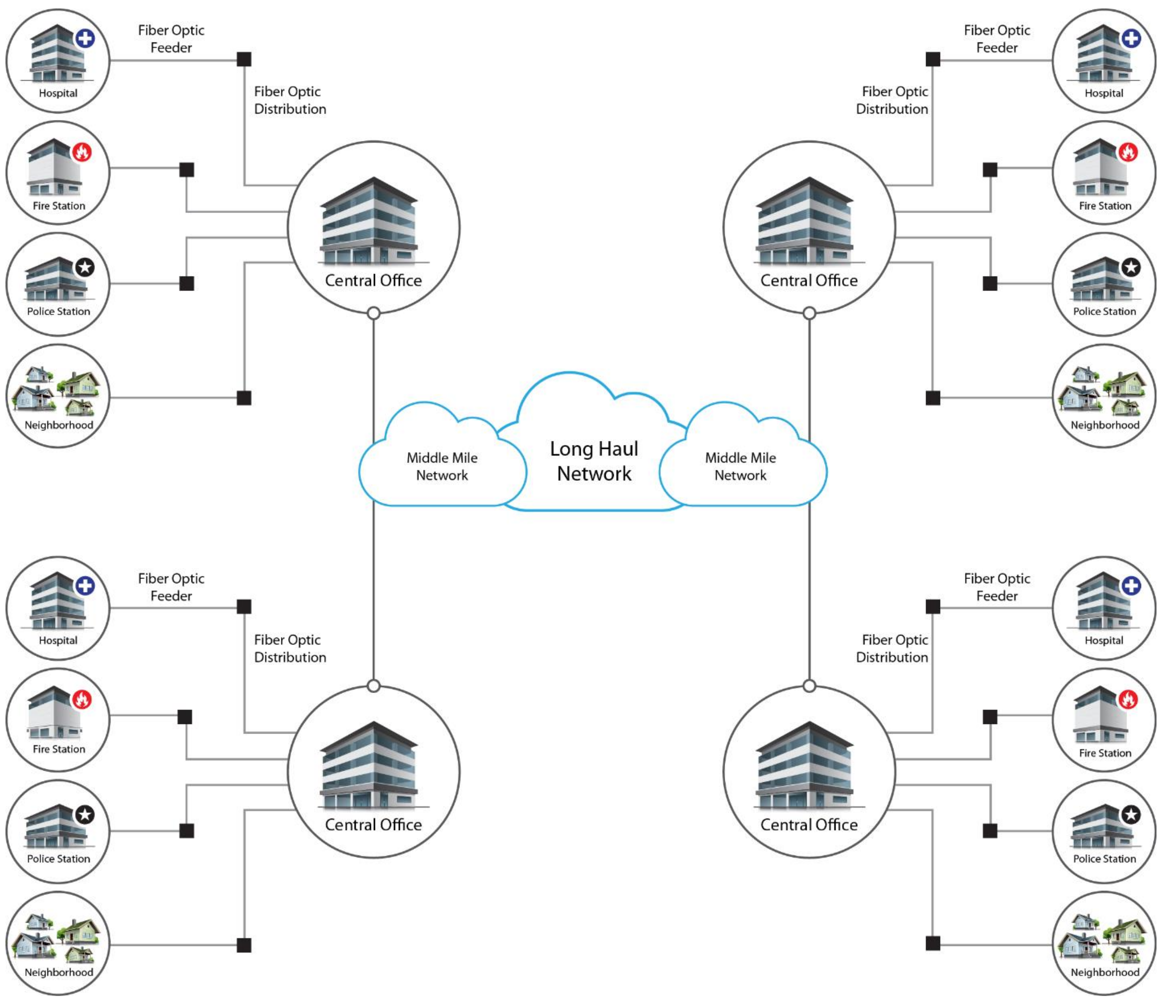


Figure 7.1.1-11: FCC Tower Structure Locations in Kentucky

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 7.1.1-12. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions). (FCC 2000)



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

Figure 7.1.1-12: Typical Fiber Optic Network in Kentucky

Last Mile Fiber Assets

In Kentucky, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Kentucky there are 60 fiber providers that offer service in the state, as listed in Table 7.1.1-11. Figure 7.1.1-13 shows coverage for AT&T Kentucky, Figure 7.1.1-14 shows coverage for TOAST.net, Time Warner Cable, Windstream Kentucky East LLC, and Blue One Communications Inc., and Figure 7.1.1-15 shows coverage for other providers with less than 5 percent coverage area, respectively.[7]

Table 7.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
AT&T Kentucky	14.73%
TOAST.net	14.40%
Time Warner Cable	12.50%
Windstream Kentucky East, LLC	11.88%
Blue One Communications, Inc.	8.42%
Other[a]	22.66%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5% coverage area. Providers include: South Central Rural Telephone; WK&T Telecommunications Cooperative; Cincinnati Bell Telephone; Comcast; Mediacom; Mountain Telephone; Duo County Telephone Cooperative, Inc.; Foothills Broadband; Brandenburg Telecom LLC; Inter Mountain Cable, Inc.; MegaPath Corporation; T.V. Service; PRTC; Logan Telephone Cooperative, Inc.; Suddenlink Communications; Ballard Telephone Cooperative; TDS Telecom; North Central Communications; Thacker-Grigsby Telephone; Access Cable Television, Inc.; VCI Internet; Highland Telephone Cooperative; Lycom Communications, Inc.; Zito Media; Inside Connect Cable; Frankfort Plant Board; Armstrong Utilities; SOUTH CENTRAL TELCOM; Coalfields Telephone Company, Inc.; Big Sandy Broadband, Inc.; Limestone Cablevision; Glasgow Electric Plant Board; Mikrotec CATV, LLC; Crystal Broadband Network; City of Williamstown, Cable & internet Service; Irvine Community Television, Inc.; BGMU; Hopkinsville Electric System; Bardstown Cable TV; Franklin Municipal FiberNET; Level 3 Communications, LLC; Barbourville Online; Harlan Community Television, Inc.; Bracken Cablevision; EPBNET; OMU; Eastern Cable Corp; TW Telecom of Kentucky LLC; Murray Electric Systems; Lumos Networks; Blazing Speeds LLC; Your Telecommunications Co.; Frank Howard TV Cable; Avolutia, LLC; Cogent Communications.

[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 "Kentucky Other Fiber Providers". All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "Kentucky Other Wireless Providers". Providers under 5% were denoted in their respective tables.

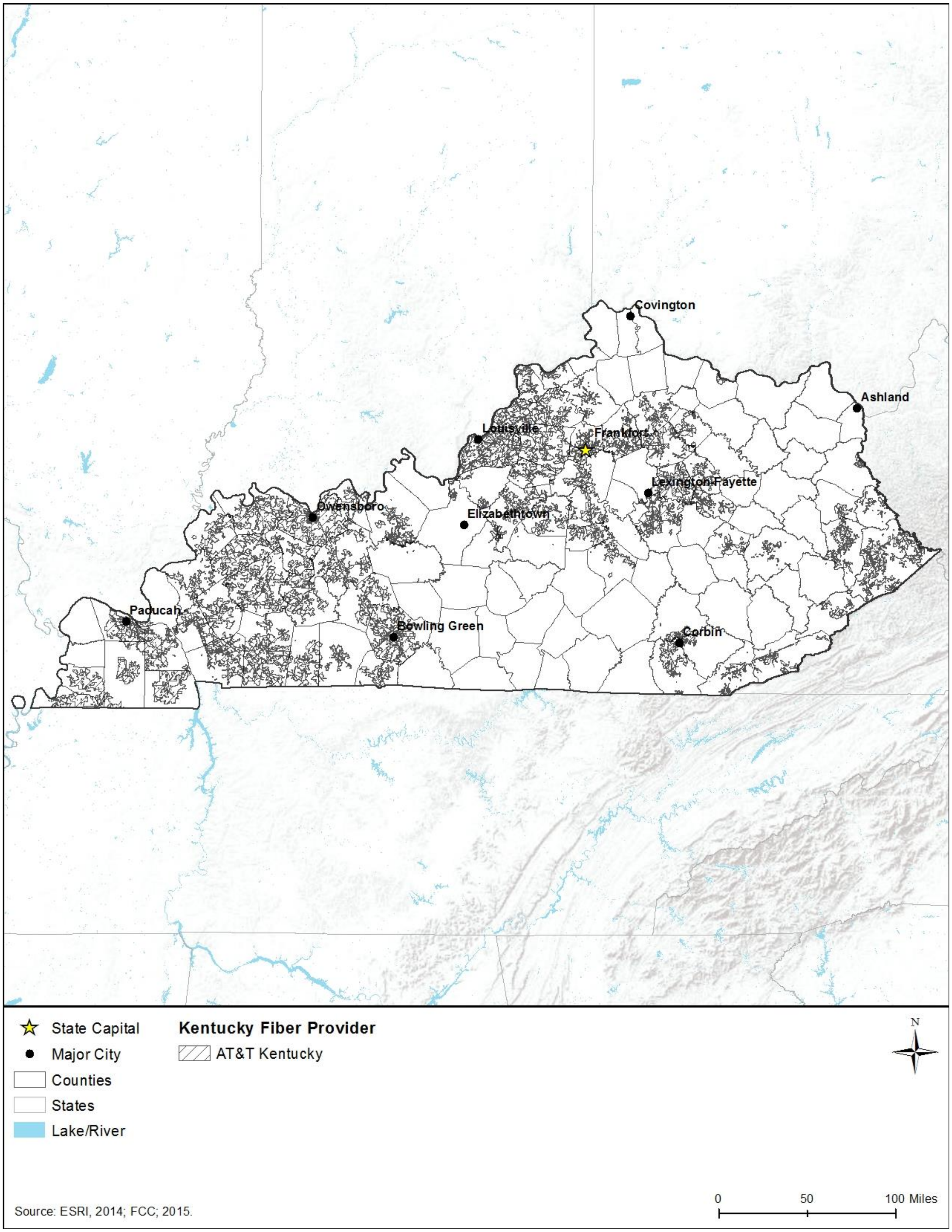


Figure 7.1.1-13: Fiber Availability in Kentucky for AT&T

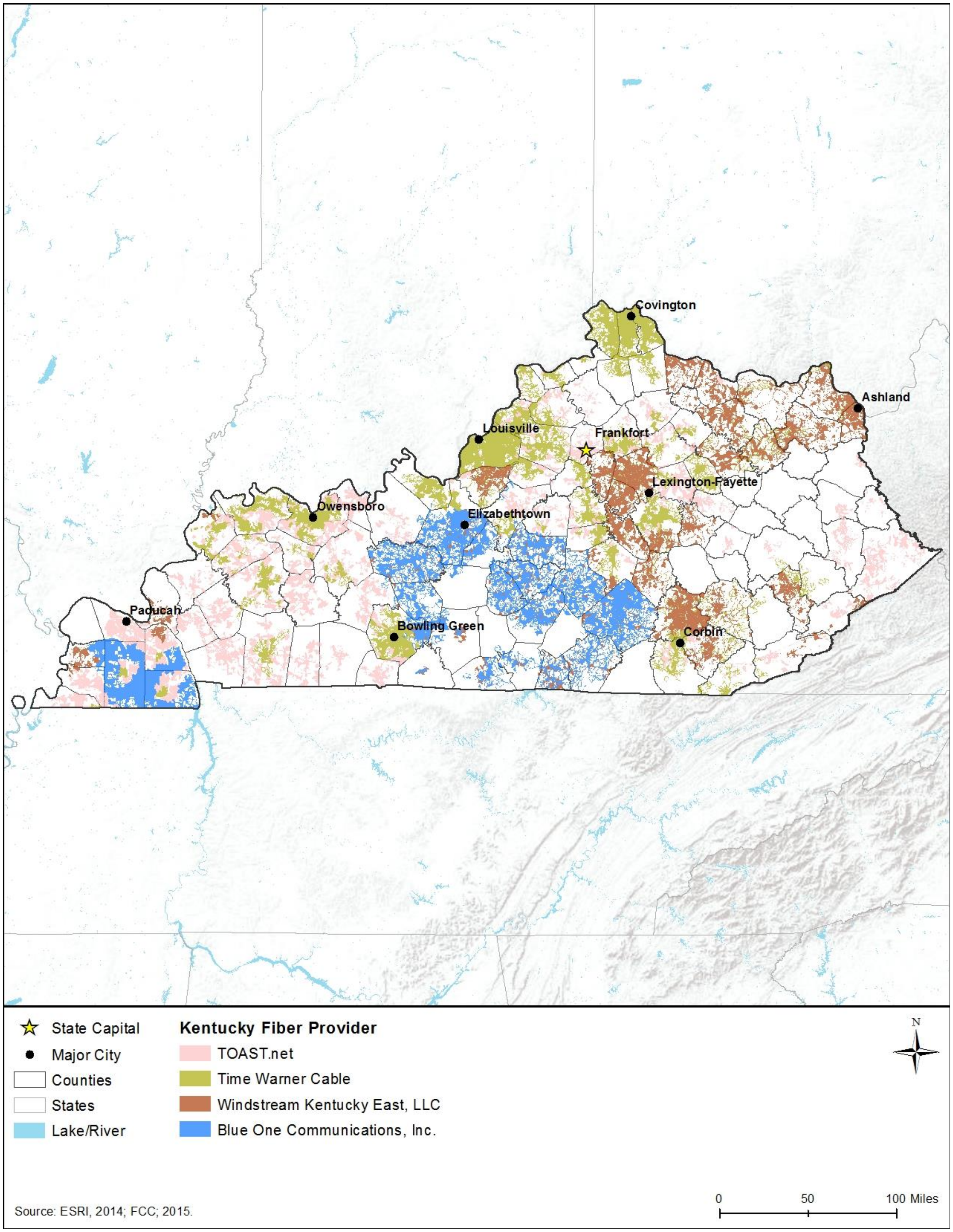


Figure 7.1.1-14: TOAST.net, Time Warner Cable, Windstream Kentucky East LLC, and Blue One Communications Inc.'s Fiber Availability in Kentucky

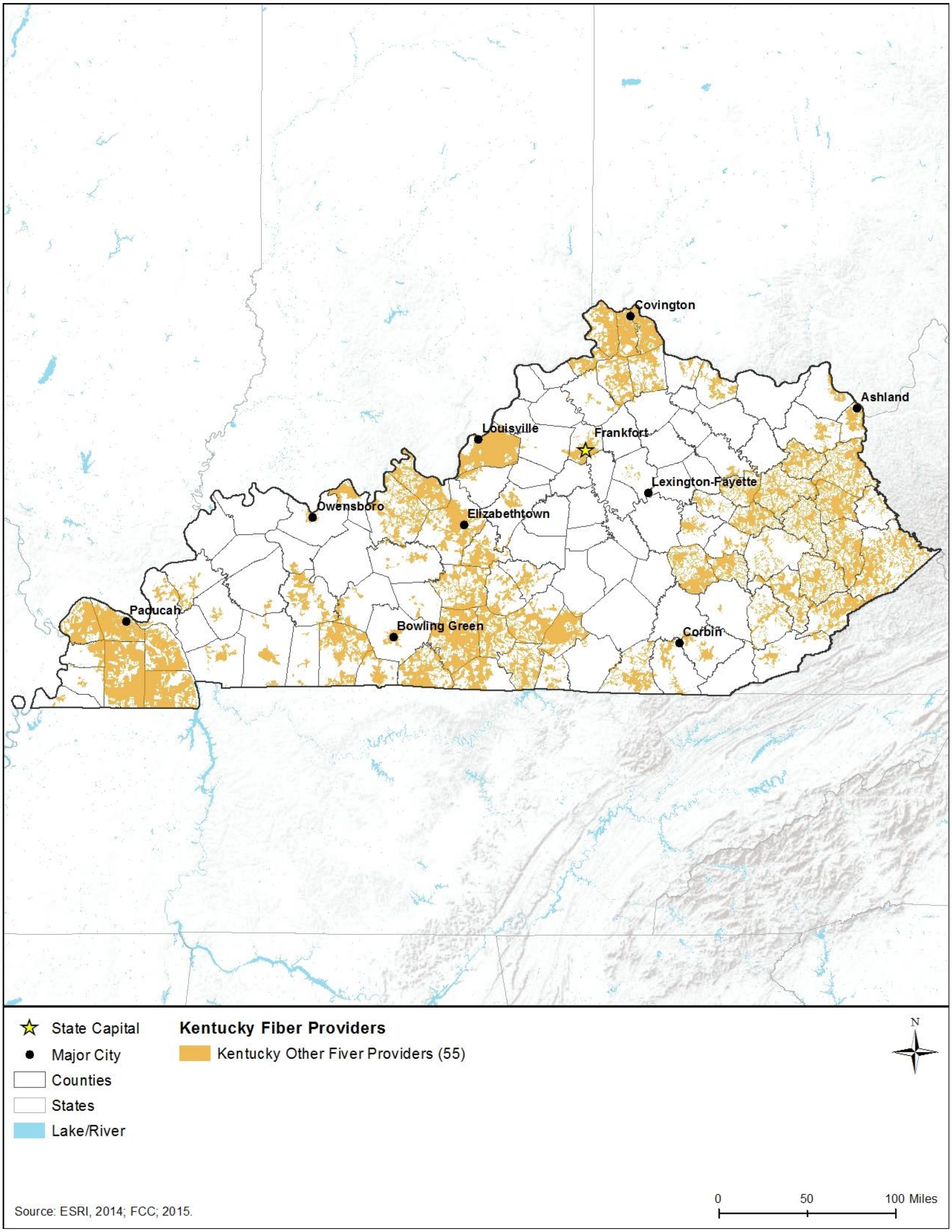


Figure 7.1.1-15: Other Provider's Fiber Availability in Kentucky

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 (CIO Council, 2015; GAO, 2013). These facilities also provide racks and cages for equipment, power and cooling, cabling, physical security, and 24x7 monitoring. 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.

7.1.1.6. 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 7.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Much of Kentucky's electric utility industry is regulated by the Kentucky Public Service Commission (PSC). The PSC's jurisdiction extends to electric utility companies owned by investors and electric cooperatives owned by customers. As a part of its duties, the PSC regulates changes in utility rates, changes in service boundaries, and the construction of new facilities, in addition to helping resolve customer complaints and ensure compliance with service regulations (PSC, 2015a). There are four investor-owned utility companies that operate under the jurisdiction of the PSC: Duke Energy Kentucky, Inc., Kentucky Power Company, Kentucky Utilities Company, and Louisville Gas and Electric Company. There are also 21 rural electric cooperatives that fall within the PSC's oversight. The PSC also lists 5 investor-owned utilities as having pending requests to operate in Kentucky (PSC, 2015b).

The majority of the electricity produced in Kentucky comes from generation facilities using coal as a fuel source (EIA, 2015a). In 2016, approximately 83 percent of generated electricity came from coal-burning generation plants, amounting to 66,889 thousand megawatthours[8] of the 80,345 thousand megawatthours produced in the state (EIA, 2017a). Kentucky, the third-largest coal-mining state, produced more than 61 million short tons of bituminous coal in 2015.(EIA, 2015b). Aside from coal, hydroelectric power, natural gas, and petroleum coke provide significant amounts of power (EIA, 2017a). Hydroelectric facilities provided 3,450 thousand megawatthours of electricity in 2016, while natural gas produced 8,255 thousand megawatthours, and petroleum coke produced 1,139 thousand megawatthours (EIA, 2017a). The state's industrial sector used 37.5 percent of its electricity in 2014, compared to the

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

24.4 percent used by the transportation sector, 22.2 percent used by residential sources, and 14.9 percent used by Kentucky's commercial sector (EIA, 2015b).

Water

Kentucky's PSC regulates many aspects of the business of water utilities. This regulation includes changes in rates or service boundaries, construction of facilities, resolving complaints, and enforcing service regulations, among other things (PSC, 2015a). The PSC's regulatory authority extends to investor owned water utilities, water districts, water associations, and municipal utilities. The state is home to 6 investor owned water companies, 113 water districts, 21 water associations and 99 municipal water utilities, all of which operate under the PSC oversight (PSC, 2015b).[9]

The quality of Kentucky's water is overseen by the state Department for Environmental Protection's (DEP) Division of Water. The Division of Water enacts regulations outlined in the federal Safe Drinking Water Act (SDWA) under authority granted by the United States Environmental Protection Agency (USEPA). The Division has authority over the state's public water systems, defined as a system that "serves at least 25 people or has 15 service connections for at least 60 days per year. Public water systems are further classified into community water systems or non-community water systems" (KDEP, 2015a). The Division does not regulate quality of private drinking water wells or cisterns, as they are not covered under the SDWA (KDEP, 2015a). The SWDA also mandates that communities protect the sources of their water. State Source Water Protection Programs achieve this through six steps: defining the source water areas to be protected, identifying potential contamination sources for these waters, determining how vulnerable the waters are to contamination, notifying the public of identified threats, taking steps to reduce threats, and creating contingency plans to deal with contamination. In Kentucky, this is done on a county-by-county basis, though many counties join together to function as a larger entity called a planning district (KDEP, 2015b). In addition to protecting the source of drinking water, each public water system is required to complete a Consumer Confidence Report, which details the water's source, any contaminants found in the water, and other regulatory compliance information regarding the quality of the systems water. These reports are completed annually and must be made available to the public (KDEP, 2015c).

Wastewater

The treatment and discharge of Kentucky's wastewater is regulated by the DEP. Their primary methods of regulation include the use of Kentucky Pollutant Discharge Elimination System (KPDES) permits for wastewater facility operation and certifications allowing wastewater facility employees to operate (KDEP, 2015d) (KDEP, 2015e). KPDES permits allow for

[9] The Kentucky Public Service Commission (PSC) has "jurisdiction over water districts, water associations, investor-owned water utilities, and some sewer utilities. [PSC] also has jurisdiction to review the wholesale rates of municipal utilities that provide service to jurisdictional utilities . . . referred to as municipal wholesale water providers." To identify Kentucky water providers, go to the PSC Home Page: http://psc.ky.gov/ (hover over Utility Information and then move down to Master Utility Search) or go to http://psc.ky.gov/utility_master/mastersearch.aspx. On the Master Utility Search page, select desired Utility Type (e.g., Water Districts) and click "Search." The Master Utility Search page can also identify water providers by Utility Identification Number or Utility Name.

discharge, but detail limits on the types and amounts of pollutants that may be released. These limitations are based on data specific to the quality of the receiving body of water. The DEP offers both general and individual KPDES permits. General permits are used to cover operations with similar characteristics and needs, such as the general permits for "On-Site Wastewater Treatment Systems Serving Individual Family Residences" or "Coal Mining Operations" (KDEP, 2015d). Individual permits are more specific, being tailored to the needs of the facility in question. These permits are organized into broader categories such as Industrial, Mining, or Municipal. Information provided by the facility during the application process helps to define more specific information for each permit (KDEP, 2015d).

The operators of wastewater treatment facilities must also be certified to ensure their competency. The proper treatment of Kentucky's wastewater prior to its discharge helps to keep the state's residents safe and healthy (KDEP, 2015e). Operator certifications are broken into five classes, based on educational and experience relate requirements (KDEP, 2015f). Operator certification requires each individual to pass an examination (KDEP, 2015e).

Solid Waste Management

Kentucky's solid waste is managed and regulated by the Division of Waste Management, part of the DEP. Every five years the DEP publishes a report on the status of state solid waste management, including a plethora of detail on the composition and disposal of waste. The 2013 Annual Report shows that in 2012, the state of Kentucky interred a total of 5,117,599 tons of waste in its 266 landfills. Of this, 3,935,559 tons was produced by the state of Kentucky, while 1,182,040 tons came from out-of-state sources (KDEP, 2013). A further 1,970,490 tons of material (32 percent of the total) was recycled that year- indicating that a total of 6,127,721 tons of waste material was generated by Kentucky in 2012. This recycling rate was an increase from the 29 percent seen the previous year, and was the highest rate noted since 2008. Kentucky also maintains more than fifty electronic waste recycling programs, which collected 3,947 tons of e-waste in 2012 (KDEP, 2013).

Increases in the generation of solid waste have been noted over the past several years. The 6,127,721 tons of waste produced in Kentucky in 2012 can be compared to the 5,278,337 tons generated in 2002. These increases mirror an increase in Kentucky's population over the same time frame. In 2002, some 4,075,000 people lived in the State, which blossomed to about 4,400,000 by 2012 (KDEP, 2013). As such, household collection of waste is imperative. In 2012, the state had a municipal collection rate of 85.5 percent, indicating "approximately 14.5 percent of households (254,943 households) disposed of their MSW illegally or were not accounted for by current tracking methods" (KDEP, 2013).

7.1.2. Soils

7.1.2.1. 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.

7.1.2.2. 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 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 7.1.2-1 below.

Table 7.1.2-1: Relevant Kentucky Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Pollutant Discharge Elimination System (KPDES) General Permit KYR10	Kentucky Department of Environmental Protection (KDEP)	Erosion and sediment controls are required as part of the KPDES General Permit KYR10 for construction activities disturbing one acre or more.

Source: (KDEP, 2016a)

7.1.2.3. Environmental Setting

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

- East and Central Farming and Forest Region;
- Mississippi Delta Cotton and Feed Grains Region; and
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

Within and among Kentucky's three LRRs are eight 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 Kentucky's MLRAs are presented in Figure 7.1.2-1 and Table 7.1.2-2.

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, 2009a).

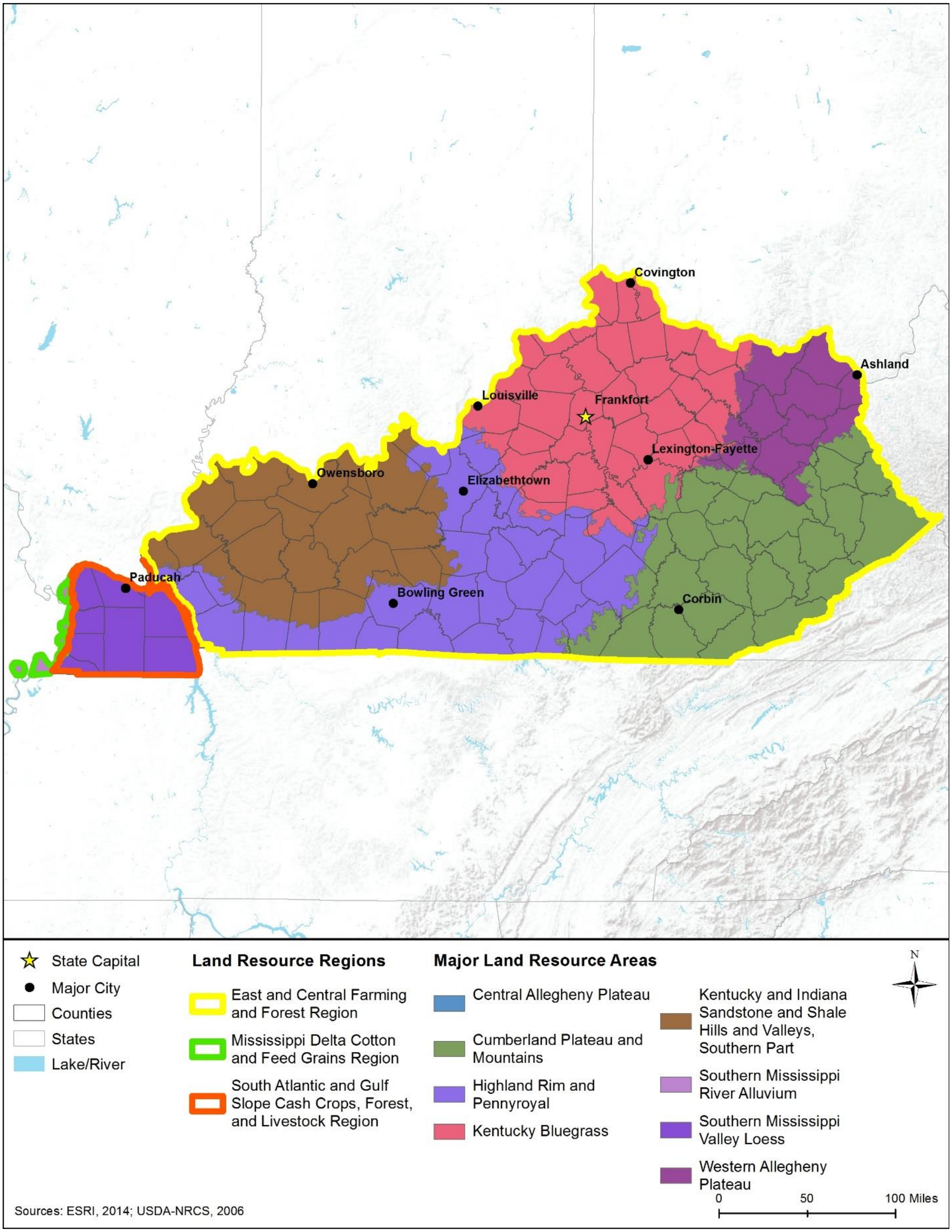


Figure 7.1.2-1: Locations of Major Land Resource Areas in Kentucky

Table 7.1.2-2: Characteristics of Major Land Resource Areas in Kentucky

MLRA Name	Region of State	Soil Characteristics
Central Allegheny Plateau	Northeastern Kentucky	Alfisols,[a] Inceptisols,[b] and Ultisols[c] are the dominant soil orders. These clayey to skeletal soils range from somewhat poorly drained to excessively drained, and range from shallow to very deep.
Cumberland Plateau and Mountains	Eastern Kentucky	Most of the soils are Ultisols. These soils range from shallow to very deep, and from moderately well drained to somewhat excessively drained. They are clayey or loamy.
Highland Rim and Pennyroyal	Western Kentucky	Alfisols, Inceptisols, and Ultisols are the dominant soil orders. These clayey or loamy soils[d] are typically moderately well drained or well drained, and are moderately deep to very deep.
Kentucky Bluegrass	Northern Kentucky	Alfisols, Inceptisols, and Mollisols[e] are the dominant soil orders. These clayey or loamy well drained soils range from shallow to very deep.
Kentucky and Indiana Sandstone and Shale Hills and Valleys, Southern Part	Western Kentucky	These soils are generally Alfisols, and are loamy or clayey.
Southern Mississippi River Alluvium	Southeastern Kentucky	Alfisols, Entisols,[f] Inceptisols, and Vertisols[g] are the dominant soil orders. These generally clayey or loamy soils range from poorly drained to somewhat poorly drained, and are very deep.
Southern Mississippi Valley Loess	Southwestern Kentucky	Alfisols, Entisols, Inceptisols, and Ultisols are the dominant soil orders. These deep or very deep soils range from well drained to poorly drained and are loamy or silty.
Western Allegheny Plateau	Northeastern Kentucky	Inceptisols and Ultisols are the dominant soil orders. These loamy soils range from somewhat poorly drained to excessively drained, and are moderately deep to very deep.

[a] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10 percent of the world's ice-free land surface" (NRCS, 2015d).
[b] Inceptisols: "Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17 percent of the world's ice-free land surface" (NRCS, 2015d).
[c] 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 percent of the world's ice-free land surface" (NRCS, 2015d).
[d] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts" (Purdue University Consumer Horticulture, 2006).
[e] 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).
[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 percent 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 percent of the world's ice-free land surface" (NRCS, 2015d).

7.1.2.4. 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 twelve 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). FirstNet used the STATSGO2 database to obtain soils information at the programmatic level to ensure consistency across all the states and territories. This regional information provides a sufficient level of detail for a programmatic analysis. The best available soils data and information, including the use of the more detailed SSURGO database, will be used, as appropriate, during subsequent site-specific assessments. The STATSGO2[17] soil database identifies 13 different soil suborders in Kentucky (NRCS, 2015a). Figure 7.1.2-2 depicts the distribution of the soil suborders, and Table 7.1.2-3 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; the U.S. General Soil Map is comprised of general soil association units and is maintained and distributed as a spatial and tabular dataset.

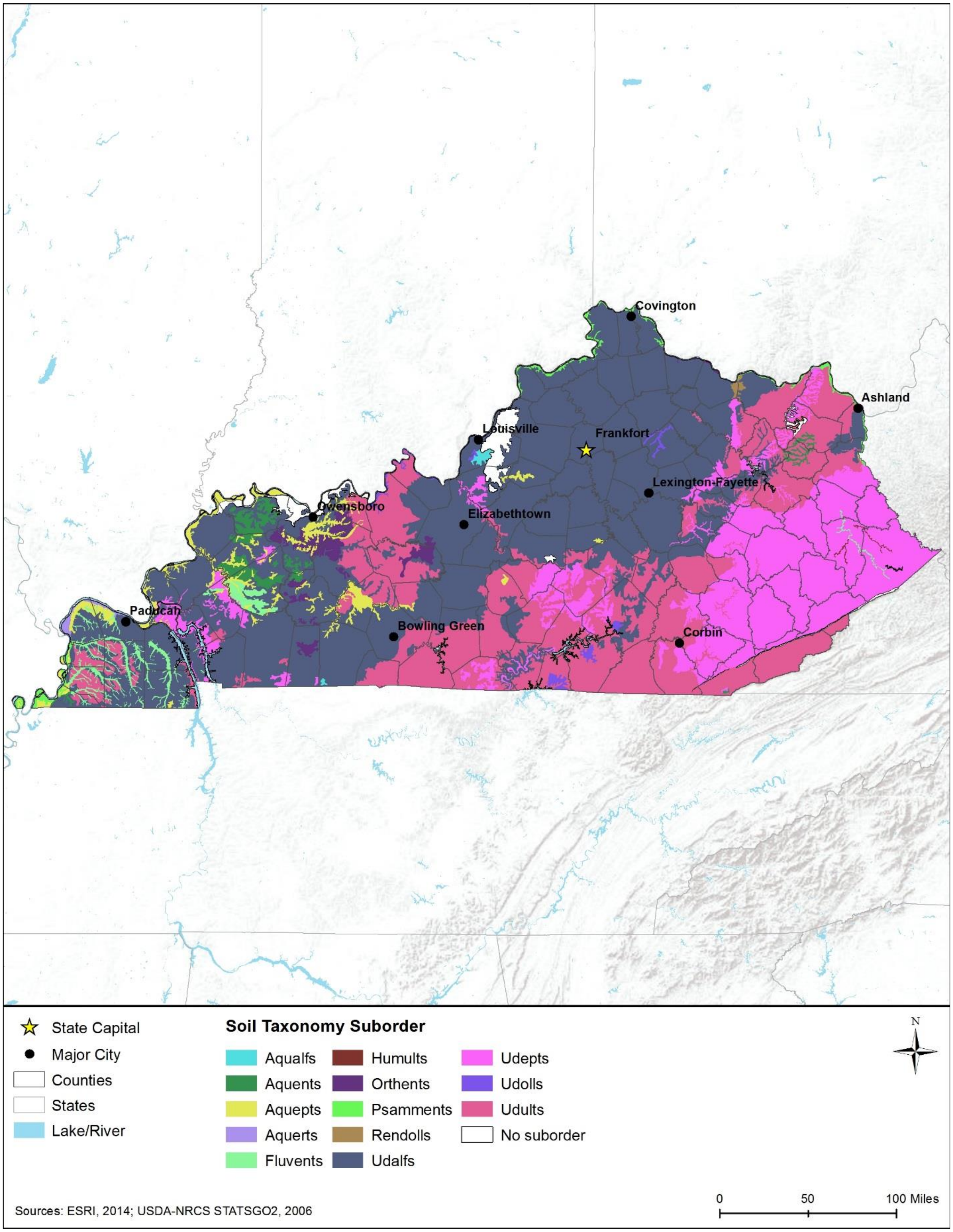


Figure 7.1.2-2: Kentucky Soil Taxonomy Suborders

Table 7.1.2-3: Major Characteristics of Soil Suborders[a] Found in Kentucky, as depicted in Figure 7.1.2-2

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.	Silt loam	0-3	Poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Fine sandy loam, Loamy sand, Silt loam	0-2	Poorly drained to somewhat poorly drained	No, Yes	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Fine sandy loam, Silt loam, Silty clay, Silty clay loam	0-2	Poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Silty clay	0-2	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Loam, Silt loam	0-25	Moderately well drained to well drained	No, Yes	B, C	Medium	Moderate, Low	Medium	High, due to hydric soil and poor drainage conditions
Ultisols	Humults	Humults are mostly freely drained soils found in places with generally high rainfall, and predominantly utilized as forest, pasture, or cropland.	Loam	0-2	Well drained	No	B	Medium	Moderate	Medium	Low
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Channery silt loam, Flaggy silt loam, Gravelly silt loam, Variable	0-20	Well drained	No	C	Medium	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.	Fine sand, Gravelly sand, Loamy fine sand	0-12	Excessively drained	No	A	Low	High	Low	Low
Mollisols	Rendolls	Rendolls are found in more humid areas. They are formed under grass and shrubs or forest vegetation in highly calcareous parent materials. Most of these soils are used for pasture or cropland, although some are used for forest or rangeland.	Silty clay loam	12-30	Well drained	No	D	High	Very Low	High	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, Flaggy silty clay, Flaggy silty clay loam, Gravelly clay, Gravelly silt loam, Gravelly silty clay, Loam, Sandy clay loam, Silt loam, Silty clay, Silty clay loam, Stratified very gravelly sand to very fine sand, Unweathered bedrock, Very channery loam, Very fine sandy loam, Weathered bedrock	0-50	Somewhat poorly drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium 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.	Channery clay, Channery sandy loam, Channery silt loam, Fine sandy loam, Flaggy sandy loam, Gravelly loam, Gravelly sandy loam, Gravelly silt loam, Loam, Silt loam, Silty clay loam, Stratified gravelly sandy loam to silty clay loam, Unweathered bedrock	0-80	Moderately well drained to well drained	No, Yes	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Flaggy silty clay loam, Loam, Silt loam, Stratified fine sand to silty clay loam	0-50	Well drained	No	B, D	Medium, High	Moderate, 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).	Channery loam, Channery silt loam, Clay, Clay loam, Fine sandy loam, Gravelly loam, Gravelly silt loam, Gravelly silty clay loam, Loam, Sandy clay, Sandy loam, Silt loam, Silty clay, Silty clay loam, Very gravelly fine sandy loam, Very gravelly sandy loam, Weathered bedrock	0-70	Somewhat poorly drained to somewhat excessively 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 soil suborder, some specific soil types are hydric while others are not.
[c] Based on Runoff Potential, described in Section 7.1.2.5.

7.1.2.5. 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 7.1.2-3 provides a summary of the runoff potential for each soil suborder in Kentucky.

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). Psamments and Udepts fall into this category in Kentucky.

Group B. Silt loam or loam soils. This group of soils has a "moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures" (Purdue University, 2015). This group has medium runoff potential. Aquents, Fluvents, Humults, Udalfs, Udepts, Udolls, and Udults fall into this category in Kentucky.

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, Aquents, Aquepts, Fluvents, Orthents, Udalfs, Udepts, and Udults fall into this category in Kentucky.

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

7.1.2.6. Soil Erosion

"Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity" (NRCS, 2015f). Water-induced erosion can transport soil into streams, rivers, and lakes, degrading water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil particles displaced by wind can cause human health problems and reduced visibility, creating a public safety hazard (NRCS, 1996a). Table 7.1.2-3 provides a summary of the erosion potential

[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).

for each soil suborder in Kentucky. Soils with medium to high erosion potential in Kentucky include those in the Aqualfs, Aquents, Aquepts, Aquerts, Fluvents, Humults, Orthents, Rendolls, Udalfs, Udepts, Udolls, and Udults suborders, which are found throughout most of the state (Figure 7.1.2-2).

7.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (USFWS, 2009). Other characteristics that factor into compaction and rutting risk include soil composition (i.e., low organic soil is at increased risk of compaction), amount of pressure exerted on the soil, and repeatability (i.e., the number of times the pressure is exerted on the soil). Machinery and vehicles that have axle loads greater than ten 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 7.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Kentucky. Soils with the highest potential for compaction and rutting in Kentucky include those in the Aqualfs, Aquents, Aquepts, Aquerts, Fluvents, and Udepts suborders, which are found across the state, but primarily in the western and eastern areas of Kentucky (Figure 7.1.2-2).

7.1.3. Geology

7.1.3.1. 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 7.1.4), Human Health and Safety (Section 7.1.15), and Climate Change (Section 7.1.14).

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

- Section 7.1.3.3, Environmental Setting: Physiographic Regions[20] and Provinces;[21]
- Section 7.1.3.4, Surface Geology;
- Section 7.1.3.5, Bedrock Geology;[22]
- Section 7.1.3.6, Paleontological Resources;[23]
- Section 7.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 7.1.3.8, Geologic Hazards.[24]

7.1.3.2. 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 7.1.3-1.

Table 7.1.3-1: Relevant Kentucky Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Building Codes	Commonwealth of Kentucky	Check state seismic guidelines in building code.

Source: (Commonwealth of Kentucky, 2016)

7.1.3.3. Environmental Setting: Physiographic Regions and Provinces

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

Kentucky has three major physiographic regions: Appalachian Highlands (Appalachian Plateaus Province), Interior Plains (Interior Low Plateaus Province), and Atlantic Plain (Coastal Plain Province) (USGS, 2003b). The locations of these regions and their respective provinces are shown in Figure 7.1.3-1, and their general characteristics summarized in the following subsections.

[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).
[22] Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015f).
[23] Paleontology: "Study of life in past geologic time based on fossil plants and animals" (USGS, 2015c).
[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).

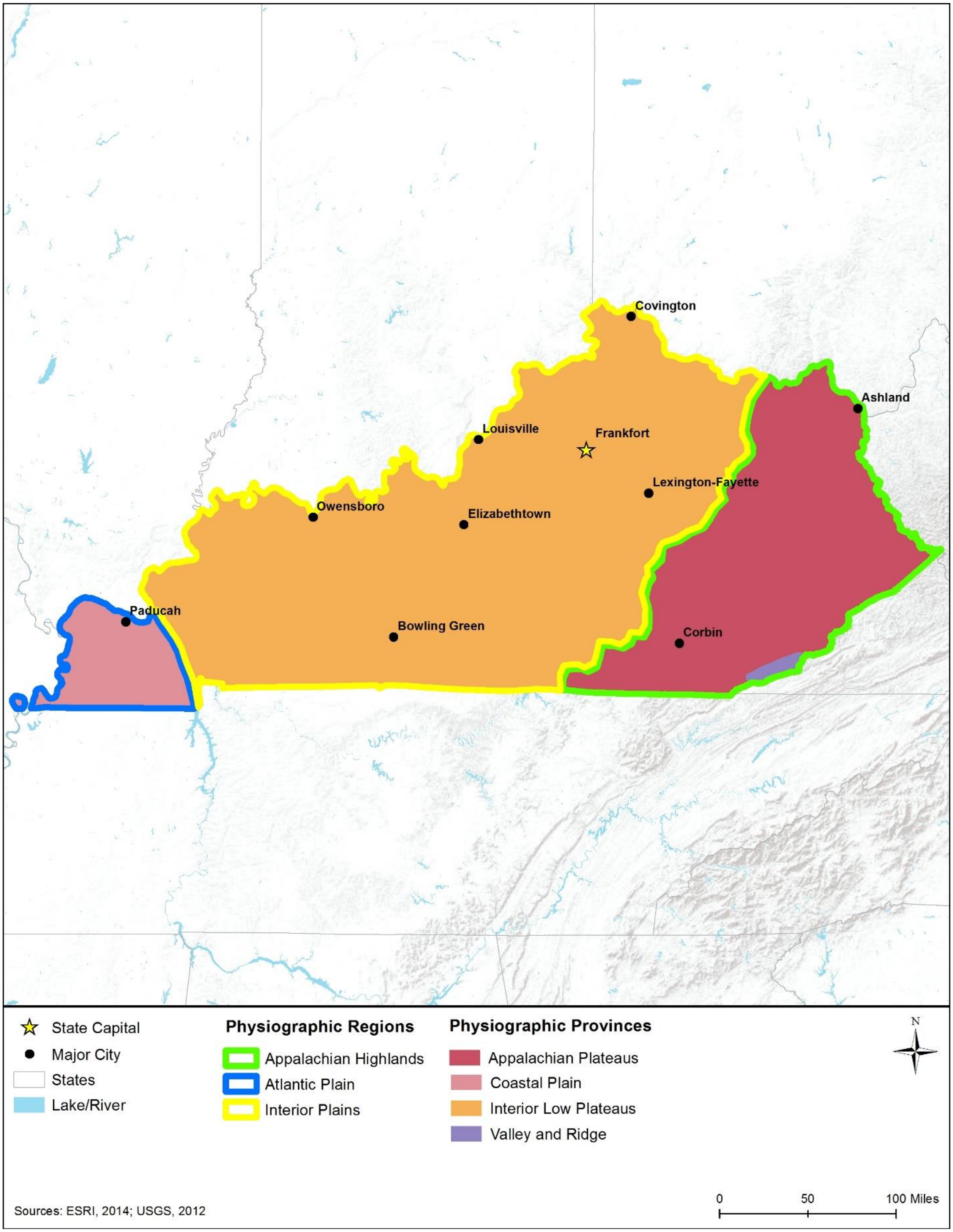


Figure 7.1.3-1: Physiographic Regions and Provinces of Kentucky

Appalachian Highlands Region

The Appalachian Highlands Region extends from Canada to Alabama. This region is composed of layers of folded sedimentary rock[25] created when the North American plate collided with Eurasian and African plates more than 500 million years ago (MYA).[26] Once similar in height to the present-day Rocky Mountains,[27] the Appalachian Highlands have eroded considerably (USGS, 2016a). The current Appalachian Highlands Region is characterized by prime and unique farmlands and is rich in mineral resources. (QAB, 1968).

As reported above, the Appalachian Highlands Region within Kentucky is composed of the Appalachian Plateaus and Valley and Ridge[28] Provinces (USGS, 2003b).

Appalachian Plateaus Province – The Appalachian Plateaus is comprised of eastern Kentucky, and is bordered to the west by the Interior Low Plateaus Province. The Appalachian Plateaus Province within Kentucky is locally referred to as the Cumberland Plateau. Eastern Kentucky is characterized by steep slopes that are underlain by "by shale[29] and sandstone[30] are mantled by complex accumulations of rock fragments and weathered debris (colluvium[31]) that move downslope by debris avalanche, landslide, creep, and sheet wash." Topographic relief varies between 200 and 2,000 feet (Newell, 2001). Black Mountain, in Harlan County, is Kentucky's highest point, at approximately 4,145 feet ASL (Kentucky Geological Survey, 2012a). The eastern edge of the Appalachian Plateaus is referred to as the Cumberland Escarpment,[32] which is composed of erosion-resistant sandstones and conglomerates.[33] "The manner in which the sandstones weather and are eroded along the escarpment results in sheer cliffs, steep-walled gorges, rock shelters, waterfalls, natural bridges and arches" (Kentucky Geological Survey, 2012a).

[25] Sedimentary Rock: "Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding" (USGS, 2014g).
[26] 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)
[27] The Rocky Mountains exceed 14,000 feet above sea level (NPS, 2004).
[28] The Valley and Ridge Province is not discussed in further detail due to its limited extent in Kentucky.
[29] Shale: "A fine-grained sedimentary rock, characterized by its grain size (< 1/256 mm) and fissility. It contains clay minerals and fine grains of quartz and feldspars, plus organic material, but the classification of "shale" still rests on particle size rather than mineralogy" (USGS, 2013b).
[30] Sandstone: "A sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material" (Carter, Driscoll, & Williamson, 2005).
[31] Colluvium: "A general term applied to unconsolidated material deposited by rain wash or slow continuous downslope creep, usually collecting at the base of hillsides" (USGS, 2005).
[32] Escarpment: "A cliff formed by faulting, erosion, or landslides. (Also called escarpment)" (USGS, 2015g).
[33] Conglomerate: "A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix. To call the rock a conglomerate, some of the constituent pebbles must be at least 2 mm (about 1/13th of an inch) across" (USGS, 2015g).

Interior Plains Region

The Interior Plains Region extends across much of the interior of the United States, roughly between the western edge of the Appalachian Highlands (near states including Ohio, Tennessee, and Alabama), and the eastern edge of the Rocky Mountain System (including states such as Montana, Wyoming, and Colorado) (Fenneman, 1916). Metamorphic[34] and igneous[35] 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 (251 to 66 MYA), much of the Interior Plains were covered by the oceans, resulting in the formation of sedimentary 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, mudstone,[36] and clay (USGS, 2014a).

Interior Low Plateaus – Within Kentucky, the Interior Low Plateaus Province (sometimes referred to as the Mississipian Plateau or Pennyroyal Region) includes much of the state with the exception of the Appalachian Plateaus in eastern Kentucky and the Coastal Plain in western Kentucky. In southern Kentucky, the Interior Low Plateau is underlain by limestone[37] that contributes to the formation of karst[38] topography. Sinkholes and caves are prevalent throughout this portion of the state. The Muldraugh Hills are another distinctive topographic feature within Kentucky's Interior Low Plateaus. The Muldraugh Hills are made up of "easily eroded Mississippian-age [(359 to 318 MYA)] shales that are capped by more resistant Mississippian-age limestones" (Kentucky Geological Survey, 2012b). In central Kentucky, the Knobs constitute one of the most distinctive topographic features in the state. The Knobs "[consist] of hundreds of isolated, steep sloping, often cone-shaped hills… They were originally continuous with the Mississippian Plateau [to the south], but were separated from the plateau by stream erosion. Many of the knobs are still capped by erosionally resistant limestones or sandstones" (Kentucky Geological Survey, 2012c). In northern Kentucky, topography is composed of gently rolling hills, with Ordovician (488 to 444 MYA) limestone outcrops common throughout the landscape (Kentucky Geological Survey, 2012d).

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

[34] Metamorphic Rock: "A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids" (USGS, 2015g).
[35] Igneous Rock: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)" (USGS, 2015g).
[36] Mudstone: "A very fine-grained sedimentary rock formed from mud" (USGS, 2015g).
[37] Limestone: "A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation." (USGS, 2015g)
[38] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater" (USGS, 2015g).

440 million years ago (MYA), dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain. (NPS, 2015a)

As reported above, the Atlantic Plain Region within Kentucky is composed of one physiographic province: the Coastal Plain Province (USGS, 2003b).

Coastal Plain Province: Within Kentucky, the Coastal Plain Province is limited to the westernmost portion of the state, including part of the Mississippi River Valley. Western Kentucky is underlain by unconsolidated sedimentary deposits from the Cretaceous Period through the present (146 MYA to present) (Kentucky Geological Survey, 2012e). These deposits are roughly 100 feet in thickness in the northern portions of the Province (USGS, 1995). Topography throughout the Coastal Plain is relatively flat, as topographic relief generally does not exceed 100 feet. "The lowest spot in the State, at only 260 feet above sea level, is found [in the Coastal Plain Province]" (Kentucky Geological Survey, 2012e).

7.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[39] 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,[40] subsidence,[41] and erosion (Thompson, 2015).

Surface deposits in Kentucky occur "as a relatively thin surficial veneer in all parts of Kentucky and as thick and extensive sequences in northern and western Kentucky" (McDowell & Newell, 2001). These deposits date to the Quaternary Period (2.6 MYA to present) and generally fall into one of three categories: 1) fluvial[42] deposits; 2) glacial and loess[43] deposits; and 3) alluvium[44] (McDowell & Newell, 2001).

Fluvial deposits in Kentucky are generally found along the Kentucky, Ohio, Licking, and Green Rivers. Along the Kentucky River, deposits can reach up to 100 feet in thickness. Deposits are "are composed of sand, silt, clay, and gravel. The sand is generally fine grained, yellowish to reddish brown, and quartzose; the silt and clay are commonly light brown or light gray. The

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[39] 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).
[40] 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).
[41] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000).
[42] Fluvial: "Term used to describe river or stream-related features or processes. Fluvial deposits are sediments deposited by the flowing water of a stream" (USGS, 2015g).
[43] Loess: "A wind-blown deposit of sediment made mostly of silt-sized grains" (USGS, 2015g).
[44] Alluvium: "Sand, gravel, and silt deposited by rivers and streams in a valley bottom" (USGS, 2015g).

gravel consists of rounded quartz and quartzite pebbles, cobbles, and boulders as much as 2 [feet] long and includes minor amounts of chert[45]." (McDowell & Newell, 2001)

Glacial deposits in Kentucky are limited to outwash,[46] till, and lacustrine[47] deposits, in the northern portion of the state in the Ohio River Valley. In some locations, deposits exceed several hundred feet in thickness. Outwash deposits are made up of "is composed of sand, gravel, silt, and clay, with minor amounts of organic material locally" (McDowell & Newell, 2001). Loess deposits, which are often composed of silt, are common throughout western Kentucky and have been observed in locations with glacial deposits (McDowell & Newell, 2001).

Alluvial deposits, dating from the late Pleistocene (2.6 MYA to 11,700 years ago) and Holocene Epochs (11,700 to present) occur on floodplains and terraces along most of Kentucky's major rivers. "Alluvium consists of boulders, cobbles, pellets, sand, silt, and clay in various proportions; it is as much as 200 [feet] thick along major rivers" (McDowell & Newell, 2001). Figure 7.1.3-2 depicts the main surficial composition of Kentucky.

7.1.3.5. Bedrock Geology

Bedrock geology analysis, and "the study of distribution, position, shape, and internal structure of rocks" (USGS, 2015b) reveals important information about a region's surface and subsurface characteristics (i.e., three dimensional geometry), including dip (slope of the formation),[48] rock composition, and regional tectonism.[49] These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (New Hampshire Department of Environmental Services, 2014).

Most of Kentucky's bedrock geology exposed at the land surface is composed of sedimentary rocks. Eastern Kentucky (as well of portions of western Kentucky) is made up of Pennsylvanian (318 to 299 MYA) shale, sandstone, conglomerates, and coals. These Pennsylvanian units have enabled Kentucky to be among the top coal producers nationwide (Kentucky Geological Survey, 2012f). Section 7.1.3.7, Northeastern Kentucky is underlain by Ordovician (488 to 444 MYA) shales and limestones, which are the oldest rocks that are visible at the surface of Kentucky (Kentucky Geological Survey, 2012g). The bedrock of southern, central, and portions of eastern Kentucky is dominated by Mississippian (359 to 318 MYA) limestones, shales, and sandstones. "The limestone also contains large cave systems, including the Mammoth Cave-Flint Ridge cave system, the longest in the world by many miles" (Kentucky Geological Survey, 2012h). Within western Kentucky, the Coastal Plain Province is underlain by Tertiary (66 to 2.6 MYA) sediment deposits (Kentucky Geological Survey, 2012i). Figure 7.1.3-3 shows the general bedrock geology for Kentucky.

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[45] Chert: "A very fine-grained sedimentary rock made of quartz. Usually made of millions of globular siliceous skeletons of tiny marine plankton called radiolarians" (USGS, 2015g).
[46] Outwash: "Glacial outwash is the deposit of sand, silt, and gravel formed below a glacier by meltwater streams and rivers" (USGS, 2015g).
[47] Lacustrine: Of "lakes, reservoirs, and large ponds" (Tiner, 1997).
[48] 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).
[49] Tectonism: "Structure forces affecting the deformation, uplift, and movement of the earth's crust" (USGS, 2015h).

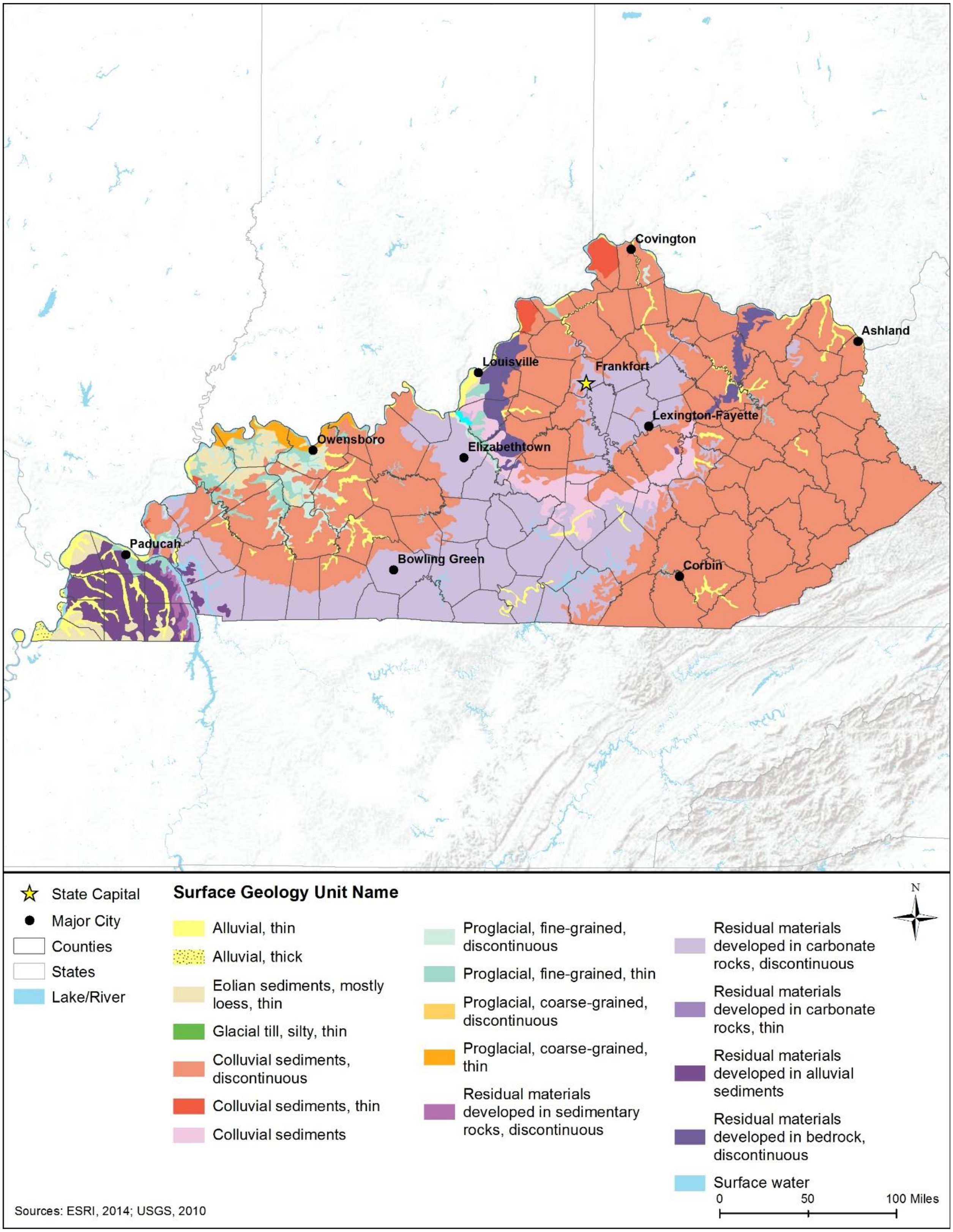
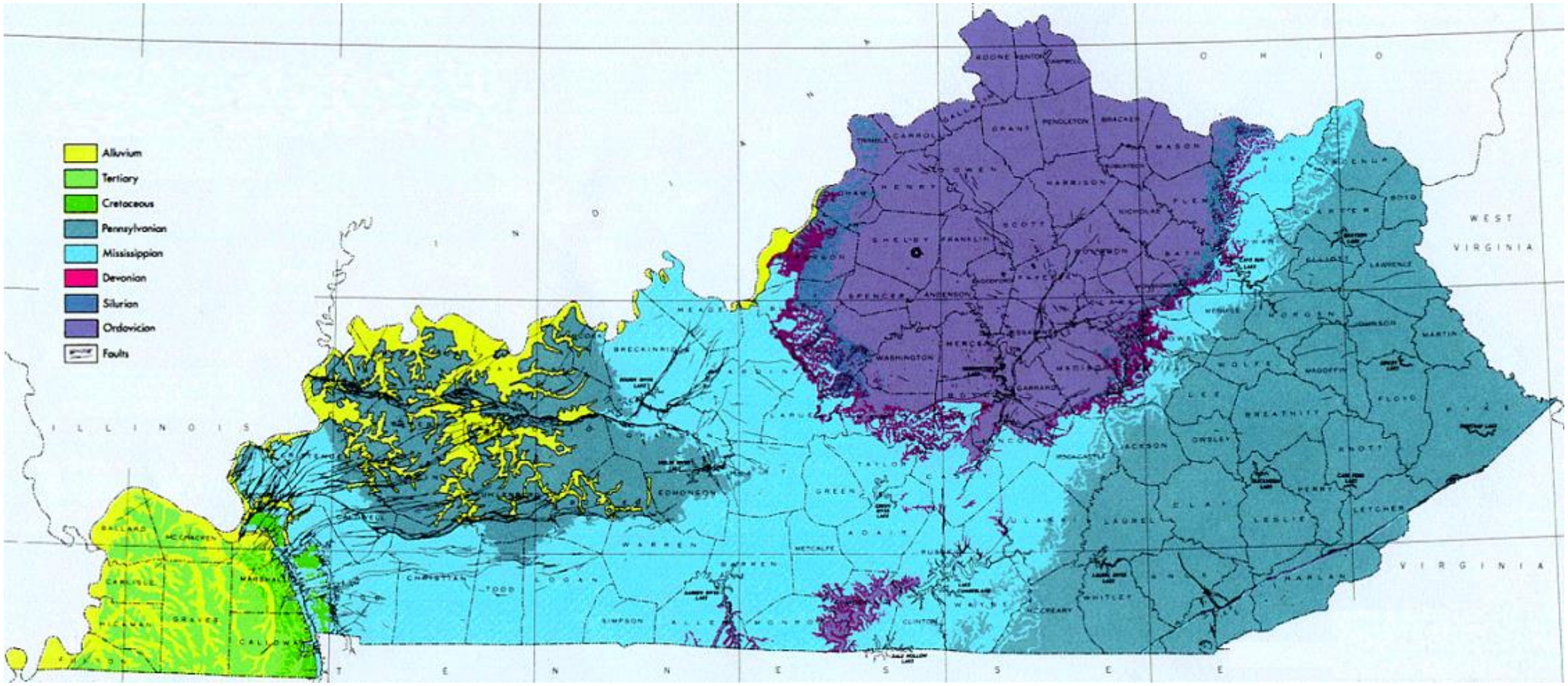


Figure 7.1.3-2: Generalized Surface Geology for Kentucky



Source: (Kentucky Geological Survey, 1979)

Figure 7.1.3-3: Generalized Bedrock Geology for Kentucky

7.1.3.6. Paleontological Resources

Source: (The Paleontology Portal, 2015)

Kentucky State Fossil: *Brachiopod*

During the Ordovician (488 to 444 MYA), Silurian (444 to 416 MYA), and Devonian (416 to 359 MYA) Periods, Kentucky was covered by a shallow sea that resulted in the deposition of carbonate[50] sediments, and the subsequent preservation of trilobites,[51] brachiopods,[52] corals, bryozoans,[53] and other invertebrates. In the late Devonian, the marine sea became oxygen deprived, resulting in few marine organisms during this time. Sea level fluctuated throughout the Carboniferous period (359 to 299 MYA), with shallow waters allowing for the preservation of "shark teeth, crinoids,[54] blastoids, and the corkscrew bryozoan *Archimedes.*" Plant fossils, including horsetails, ferns, and gymnosperms, were recorded in ancient river deltas. In western Kentucky, minimal Mesozoic (251 to 66 MYA) plant fossils are preserved. Stream deposition during the Tertiary Period (66 to 2.6 MYA), resulted in the accumulation of sedimentary rocks that contain plant fossils and microfossils (e.g., plant pollen). In northern Kentucky, during the Ice Ages of the Quaternary Period (2.6 MYA to present), glacial deposits include extensive fossils of "mastodons, mammoths, giant ground sloths, bison, elk, short-faced bear, lions, and mammals" (The Paleontology Portal, 2015).

7.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2014, Kentucky produced 3,376 thousand barrels of crude oil from three rotary rigs (EIA, 2017b). "Kentucky's crude oil production has averaged fewer than 10,000 barrels per day for almost two decades, and the state accounts for [0.1 percent] of total U.S. daily oil production" (EIA, 2015c). As of October 2016, Kentucky ranked in 21nd of 31 states in crude oil production. The majority of Kentucky's oil is produced in the western and south-central portions of the state (EIA, 2015c). Oil from Mississippian (359 to 318 MYA) limestone and sandstone are found in eastern and western Kentucky, while Ordovician limestone and dolomite has yielded oil in the southern portion of the state (KDNR, 2015a).

[50] Carbonate: "A sedimentary rock made mainly of calcium carbonate ($CaCO_3$). Limestone and dolomite are common carbonate sedimentary rocks" (USGS, 2015g).
[51] 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).
[52] 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).
[53] Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies" (Smithsonian Institution, 2016).
[54] 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 2015, Kentucky produced 85,775 million cubic feet of natural gas, which accounted for .3 percent of total nationwide production. This level of production ranked 19th of 33 natural gas producing states for 2015 (EIA, 2015c). Almost all of Kentucky's natural gas is produced in the eastern part of the state from Devonian black shale (KDNR, 2015a).

Minerals

As of 2015, Kentucky's total nonfuel mineral production was valued at $571M. This level of production 29th nationwide (in terms of dollar value) and accounted for 0.73 percent of the total production value in the country. As of 2015, Kentucky's leading nonfuel minerals were crushed stone, lime, portland cement, and both construction and industrial sand and gravel. Other minerals produced (as of 2013) in the state are ball clay, common clay and shale, sulfur, flurite, aluminum, ferroalloys, synthetic graphite, synthetic gypsum, natural gemstones, and steel (USGS, 2015d).

In 2015, Kentucky produced more than 61 Millionshort tons of bituminous coal,[55] which accounted for 6.8 percent of total nationwide production. "Kentucky's estimated total recoverable coal reserves are the fifth largest in the nation." Kentucky possesses roughly 25 percent of all coal mines in the country (EIA, 2016a).

7.1.3.8. Geologic Hazards

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

Earthquakes

Areas of greatest seismicity in Kentucky are concentrated in the southwestern portions of the state. Between 1973 and March 2012, there were 21 earthquakes of a magnitude 3.5 (on the Richter scale) or greater originating in Kentucky (but considerably more that were felt in Kentucky that originated in nearby states) (ETK, 2017). 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

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[55] Bituminous Coal: "A rank class of coals as defined by the American Society for Testing and Materials (ASTM) high in carbonaceous matter, having less than 86 percent fixed carbon, and more than 14 percent volatile matter on a dry, mineral-matter-free basis and more than 10,500 Btu on a moist, mineral-matter-free basis" (USGS, 1981).

typically do not reach magnitudes higher than 6.0 on the Richter scale.[56] Subduction zone earthquakes occur where Earth's tectonic plates collide. "When plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth". 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 7.1.3-4 depicts the seismic risk throughout Kentucky; 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).

Kentucky's Largest Earthquake

"The strongest earthquake in the history of Kentucky was recorded on July 27, 1980, near Sharpsburg in Bath County, Kentucky. It registered at a magnitude of 5.2 on the Richter scale… This earthquake was felt over all or parts of 15 States and in Ontario, Canada. Damage occurred in Indiana, Kentucky, and Ohio." (Kentucky Emergency Management, 2013)

Western Kentucky is highly susceptible to experiencing earthquakes due to its position within the New Madrid Seismic Zone (NMSZ). "The NMSZ is the most active seismic area in the United States east of the Rocky Mountains. The NMSZ is located in southeastern Missouri, northeastern Arkansas, western Tennessee, western Kentucky, and southern Illinois" (Kentucky Emergency Management, 2015). Kentucky's relative proximity to the Wabash Valley Seismic Zone (Kentucky Emergency Management, 2015), which is in southern Indiana and Illinois, and the Eastern Tennessee Seismic Zone, which runs between southwest Virginia and northeast Alabama, also elevates the state's earthquake risk (Kentucky Emergency Management, 2013). Three damaging earthquakes occurred along the NMSZ during 1811 and 1812; it is estimated that these earthquakes measured between 7.3 and 7.5 on the Richter scale (USGS, 2014c). "Geologic studies indicate that large earthquakes [also] occurred along the [NMSZ] in approximately 300 AD, 900 AD, and 1400 AD… [Some estimates suggest] that there is about a 10 percent chance of a magnitude 7-8 earthquake in the [NMSZ] in a 50 year time interval" (MDNR, 2015). Other estimates suggest that there is a 25 to 40 percent chance that Kentucky will experience a magnitude 6.0 earthquake within the next 50 years (Carey, Hounshell, & Kiefer, 2008).

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

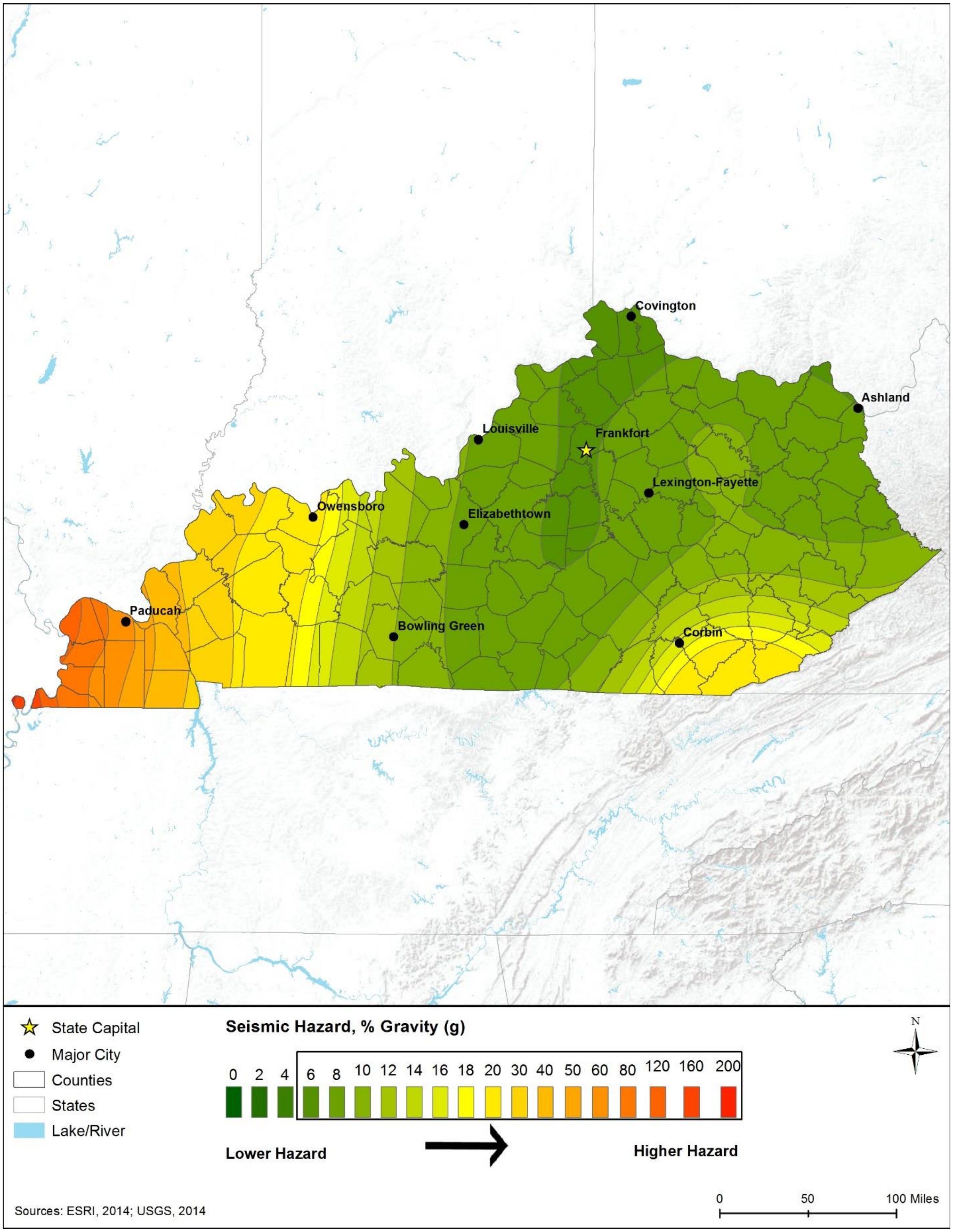

Figure 7.1.3-4: Kentucky 2014 Seismic Hazard Map

Landslides

Nearly 1,400 landslides have been recorded in Kentucky between 1975 and 2013 (Kentucky Emergency Management, 2013). "The term 'landslide' describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures" (USGS, 2003a). Geologists use the term "mass movement" to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale (USGS, 2003a).

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

While are parts of Kentucky are susceptible to landslide events, the eastern portion of the state (including the Appalachian Plateaus Province), areas along the Ohio River near Cincinnati (Ohio), and the far western part of the state along the Mississippi River most commonly experience landslide events. "Areas generally prone to landslides include preexisting landslides, highly developed hillsides, poorly compacted artificial fill slopes, and steep drainage hollows or concave slopes with moderate to thick soils" (Kentucky Geological Survey, 2015). Areas underlain by shale are particularly susceptible to experiencing landslides (Carey, Hounshell, & Kiefer, 2008). In addition, construction on top of ancient landslide remnants also has contributed to new landslide events, particularly in the town of Hickman adjacent to the Mississippi River (Kentucky Emergency Management, 2013). Figure 7.1.3-5 shows landslide incidence and susceptibility throughout Kentucky.

Significant Landslide Events in Kentucky

Between 2008 and 2010, four presidential disasters were declared in Kentucky as a result of landslide events. These events are briefly summarized below. (Kentucky Emergency Management, 2013)

- In July 2010, 8 inches of rain fell on Eastern Kentucky, resulting in mudslides that impacted 200 homes primarily located in Pike County.
- In May 2010, 2 to 7 inches of rain fell on eastern Kentucky, resulting in a mudslide that blocked Highway 89 in Estill County and a hillslope failure behind a house in Powell County.
- In May 2009, strong storms over the eastern portion of the state resulted in mudslides in 22 counties throughout the state.
- In April 2008, severe thunderstorms produced 4 to 8 inches of rain in a 24-hour period throughout the state, resulting in widespread landslide damages throughout Kentucky.

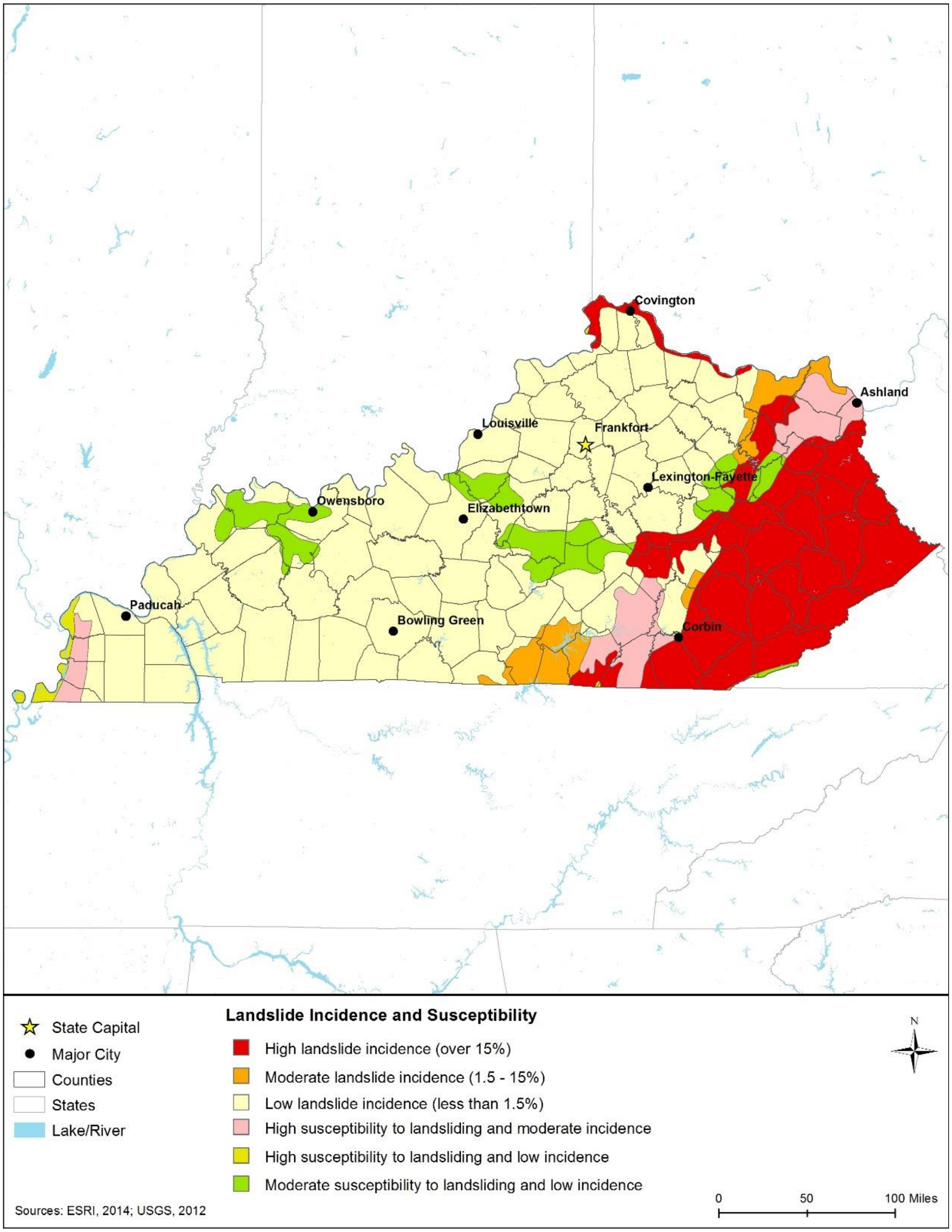

Figure 7.1.3-5: Kentucky Landslide Incidence and Susceptibility Hazard Map[57]

[57] Susceptibility hazards not indicated in Figure 7.1.3-5 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, 2014i)

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 Kentucky, the primary causes of land subsidence are karst topography and mine subsidence (Carey, Hounshell, & Kiefer, 2008). Nationwide, the primary causes of land subsidence are attributed to aquifer system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost (although permafrost is not an issue in Kentucky). More than 80 percent of subsidence in the United States is a consequence of over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains. If an aquifer is confined by layers of silt or clay, which do not transport groundwater, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000). Land subsidence can result in altered stream elevations and slopes; detrimental effects to infrastructure and buildings; and collapse of wells due to compaction of aquifer sediments. Subsided areas can become more susceptible to inundation, both during storm events and non-events. Lowered terrain is more susceptible to inundation during high tides. Additionally, land subsidence can affect vegetation and land use (USGS, 2013a).

Source: (Carey, Hounshell, & Kiefer, 2008)

Photo of Karst Collapse in Warren County, KY

In Kentucky, a significant cause of land subsidence is the collapse of karst. Roughly 55 percent of Kentucky, including the cities of Frankfort, Lexington, and Louisville within the Central Lowland Province, is underlain by carbonate rocks (e.g., limestone and dolostone) that are susceptible to the development of karst topography (Kentucky Emergency Management, 2013). Within Kentucky, "karst hazards include sinkhole flooding, sudden cover collapse, and leakage around dams" (Carey, Hounshell, & Kiefer, 2008). More than 100,000 sinkholes, with an average diameter of seven feet, have been identified throughout the state. As of 2013, Kentucky ranked 5th nationwide in states impacted by sinkholes. Mammoth Cave, in the central part of the state, is a significant karst feature, and "is the longest surveyed cave in the

Why is Kentucky Susceptible to Mine Collapse?

"Most of Kentucky's underground mines used a method called room-and-pillar mining, whereby 20 to 50 percent of the coal is left in the mine to support the overlying rock. In instances where the remaining coal pillars are insufficient to bear the weight of the overlying rock, subsidence of the mine roof will occur. Subsidence may occur decades or centuries after an underground mine is abandoned." (Commonwealth of Kentucky, 2014) world, with more than 400 miles of passages" (Kentucky Emergency Management, 2013). Figure 7.1.3-6 shows the location of areas in Kentucky that are susceptible to land subsidence due to karst topography.

A second significant cause of land subsidence in Kentucky is mine subsidence, particularly in areas where coal has been extracted in the eastern and western portions of the state. "Kentucky coal mining has suffered more roof fall accidents and production loss due to roof collapse problems than any other coal-producing state. The geologic factors related to roof collapse commonly include faults, fractures, weak and disturbed roof strata, and rider coals (thin coals separated from the main coal seam, often by a weak shale-ridden zone)" (Kentucky Emergency Management, 2013).

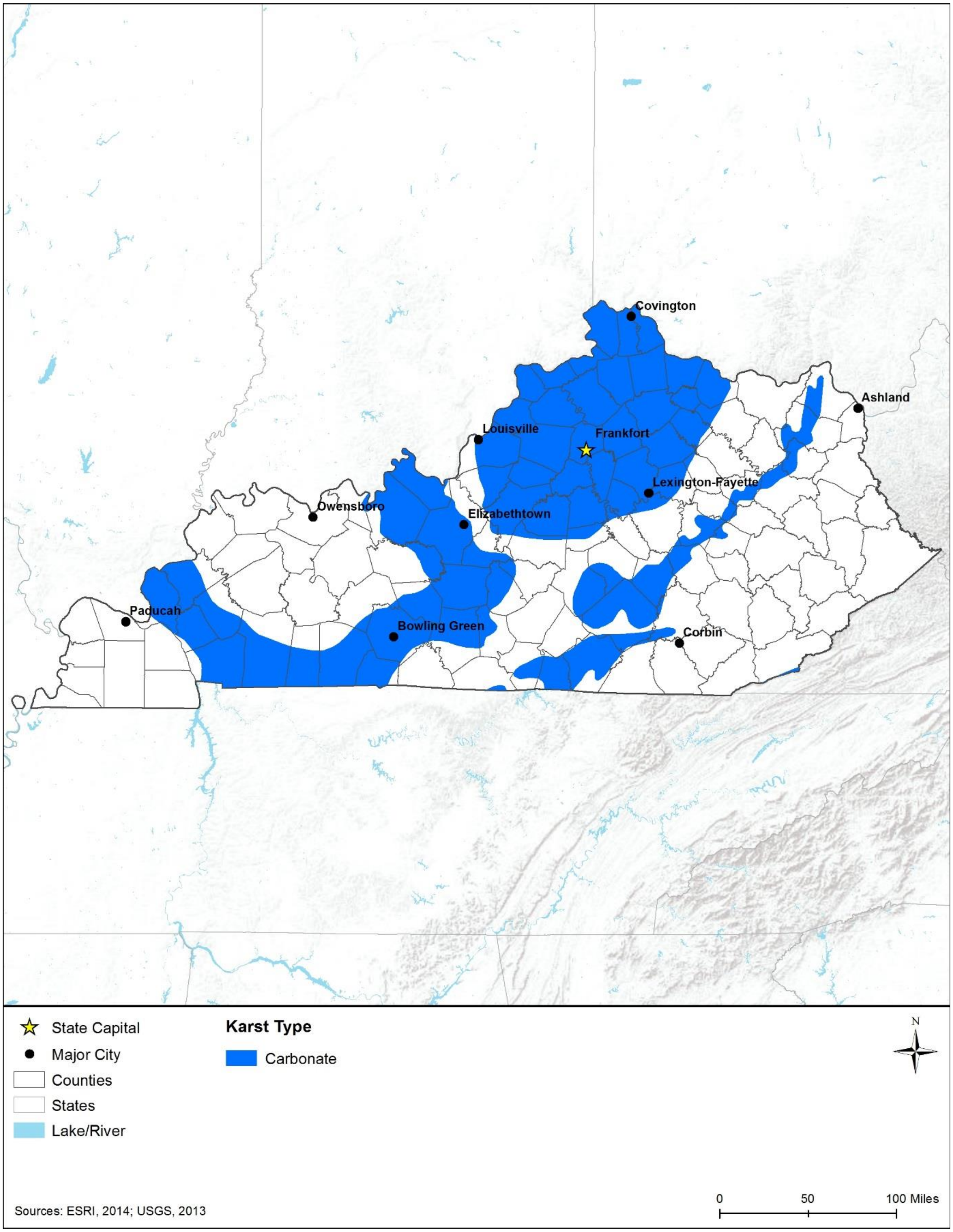

Figure 7.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Kentucky

7.1.4. Water Resources

7.1.4.1. Definition of the Resource

Water resources are defined as all surface waterbodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 7.1.5). These resources can be grouped into watersheds which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological health (USGS, 2014d).

7.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders Table 7.1.4-1 identifies the relevant laws and regulations for water resources in Kentucky.

Table 7.1.4-1: Relevant Kentucky Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Division of Water Title 401, Chapters 4, 5, 6, 8, 9 and 10	Kentucky Department for Environmental Protection (KDEP) Division of Water	Defines Kentucky water permit requirements.
Clean Water Act (CWA) Section 404 Nationwide Permit (NWP), Kentucky regional requirements	U.S. Army Corps of Engineers (USACE) Louisville District	Regional conditions apply to activities authorized by USACE NWPs in Kentucky.
CWA Section 401 Water Quality Certification	KDEP Division of Water	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S., especially when the proposed activity will be authorized by USACE NWPs, require a Water Quality Certification from KDEP indicating that the proposed activity will not violate water quality standards.
Kentucky Pollution Discharge Elimination System (KPDES) Program	KDEP Division of Water	Regulates the discharge of pollutants in stormwater discharges associated with small and large construction activities that disturb one or more acres.

Source: (Kentucky Legislature, 2017e) (KDEP, 2016b) (KDEP, 2016c) (KDEP, 2016a)

7.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine[58] and coastal waters. Kentucky has more than 90,000 miles of rivers and streams, and 45 major lakes and reservoirs. Kentucky surface waters have many uses, include drinking water, domestic, industrial/mining, agriculture, and thermoelectric power supply. (UKY, 2014).

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). Kentucky's waters (lakes, rivers, and streams) are divided into 7 major watersheds, or drainage basins. See www.water.ky.gov/watershed/pages/default.aspx for information and additional maps about each KDEP watershed's location, size, and water quality (KDEP, 2015g).

The Four Rivers Basin covers more than 4,700 square miles in western Kentucky and contains more than 10,700 miles of streams. The watershed includes two major lakes, Kentucky Lake and Lake Barkley (UKY, 2015a). West of the Four Rivers Basin are the Green and Tradewater Rivers Basin, which includes the Ohio River along its northern border. Salt River Basin drains approximately 5,200 square miles in northcentral Kentucky, and includes the Salt River and five minor Ohio River tributaries (KDEP, 1998a). The Kentucky River Basin drains a long and narrow area, extending from the state's northern border to the southeastern Kentucky border. Northeast of this basin is the Licking River Basin, which drains a diverse area of forested hills and farmland in the upper and middle regions, and urban/industrial development near the confluence of the Ohio River (KDEP, 1998b). Within Kentucky, the Upper Cumberland River Basin drains approximately 5,180 square miles along the southern border from southcentral to southeastern Kentucky (UKY, 2015b).

Freshwater

As shown in Figure 7.1.4-1 there are 10 major rivers in Kentucky: Ohio, Mississippi, Cumberland, Kentucky, Green, Barren, Big Sandy, Red, Salt, and Tennessee. The Ohio River flows along Kentucky's northern border, while the western border is formed by the Mississippi River. In southern Kentucky, the Cumberland River flows west toward the Lake Cumberland. The river and its tributaries provide recreational opportunities and alluvial valleys[59] for agriculture and development, and is used as a drinking water supply (UKY, 2015b). The Kentucky River headwaters originate in southeastern Kentucky and flow 225 miles north to join the Ohio River in northcentral Kentucky (KDFWR, 2014a). Within Kentucky, there are 228,382 acres of publicly owned lakes and reservoirs, and 18 reservoirs over 1,000 acres in size (Kentucky Emergency Management, 2013).

Major Kentucky lakes and reservoirs include Kentucky Lake, Lake Barkley, and Lake Cumberland (Figure 7.1.4-1). Kentucky Lake was formed when the Tennessee Valley Authority

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[58] Estuarine: related to an estuary, or a "partially enclosed body of water where fresh water from rivers and streams mixes with salt water from the ocean. It is an area of transition from land to sea" (USEPA, 2015a).
[59] Alluvial valleys contain clay, silt, or gravel materials left by river waters (USGS, 2015i).

(TVA) constructed the Kentucky Lake Dam on the Tennessee River in the southwestern portion of the state. The lake provides flood control for land along the lower Ohio and Mississippi River, in addition to hydroelectric power generation. Lake Barkley, located just east of Kentucky Lake, was formed by impounding Cumberland River and is connected to Kentucky Lake via a canal. (UKY, 2015a) Lake Cumberland is in southcentral Kentucky within the Upper Cumberland River Basin. This man-made lake is approximately 50,000 acres and one of the largest east of the Mississippi River. Lake Cumberland was constructed to provide hydroelectric power and flood control, and is now used by many visitors for recreational purposes. (UKY, 2015b)

7.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

A segment of the Red River in east-central Kentucky (Figure 7.1.4-1) is a federally designated National Wild and Scenic River. The segment consists of 9.1 miles designated as wild, and 10.3 miles designated as recreational. The river is characterized by "sandstone cliffs, rock shelters, natural stone arches and boulders," and is home to many wildlife species. The river's waters attract many canoeists and kayakers each year, and provide habitat for numerous fish species. (National Wild and Scenic Rivers System, 2015a) See Section 7.1.6 for detailed information on Kentucky fisheries resources.

State Designated Waters

In addition to federally designated Wild and Scenic Rivers, Kentucky's Wild Rivers Act of 1972 protects the "unique scenic, fish and wildlife, botanical, geological, cultural and recreational values" of the state's most pristine rivers. The Kentucky Wild Rivers Program, administered by the Division of Water, recognizes portions of nine rivers that possess "exceptional quality and aesthetic character" (KDEP, 2015h). The designated Kentucky Wild Rivers include Bad Branch, Big South Fork Cumberland River, Green River, Rockcastle River, Rock Creek, Little South Fork Cumberland River, Martin's Fork River, Red River, and Cumberland River (KDEP, 2015i) (Figure 7.1.4-1). These designated portions include the land on each side of the river up to a distance of 2,000 feet. The nine Wild Rivers include a total of 114 river miles and 26,382 acres of land (KDEP, 2015h).

Kentucky also recognizes Outstanding Resource Waters, which "meet the requirements for an outstanding state resource water classification and are of national ecological or recreational significance." These designated waters include Marsh Creek, Reelfoot Lake, Rock Creek, Rockcastle River, War Fork of Station Camp Creek, Big South Fork of Cumberland River, Red River, and the Underground River System within Mammoth Cave National Park (Figure 7.1.4-1). (KDEP, 2015j) (KDEP, 2004a)

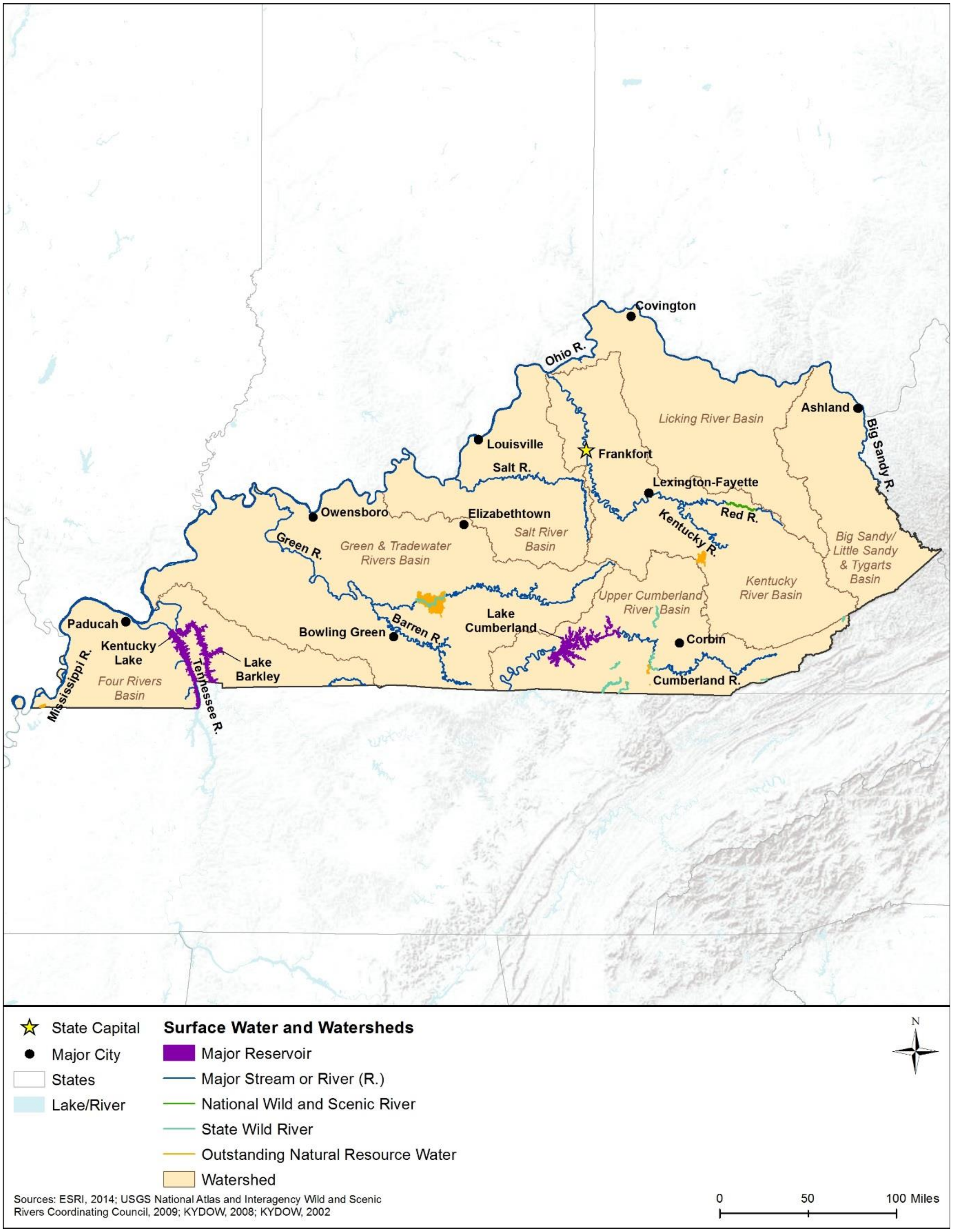

Figure 7.1.4-1: Major Kentucky Watersheds and Surface Waterbodies

7.1.4.5. Impaired Waterbodies

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue are used to evaluate water quality. Under Section 303(d) of the CWA, states are required to assess water quality and report a listing of impaired waters,[60] the causes of impairment, and probable sources. Table 7.1.4-2 summarizes the water quality of Kentucky's assessed major waterbodies by category, percent impaired, designated use,[61] cause, and probable sources. Figure 7.1.4-2 shows the Section 303(d) waters in Kentucky as of 2014.

As shown in Table 7.1.4-2, various sources affect Kentucky's waterbodies, causing impairments. Mercury and polychlorinated biphenyls are the two most common causes of impairments in Kentucky's lakes, reservoirs, and ponds. Approximately 41 percent of the assessed Kentucky lakes, reservoirs, and ponds are impaired due to pollutants from various sources, such as agriculture, municipal point source discharges, and urban runoff (USEPA, 2012c). These waterbodies are primarily used for domestic water supply; therefore, Kentucky recognizes the importance of preventing contamination and protecting human health and safety. For example, elevated levels of mercury in lakes, such as Lake Cumberland have resulted in fish consumption advisories issued by the state of Kentucky (KDFWR, 2014b).

Table 7.1.4-2: Section 303(d) Impaired Waters of Kentucky, 2012

Water Type[a]	Amount of Waters Assessed[b] (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	24%	67%	habitat/hydrology, fishing, and primary and secondary contact recreation	nutrients, sediment, pathogens[c]	agriculture, habitat alterations, municipal point source discharges, urban runoff/storm sewers and sewage
Lakes, Reservoirs, and Ponds	97%	41%	domestic water supply, fishing, habitat and secondary contact recreation	mercury, polychlorinated biphenyls, nutrients and organic enrichment	industry, municipal discharge/sewage, and agriculture

Source: (USEPA, 2012c)

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

[60] Impaired waters: waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters. (USEPA, 2015a)
[61] Designated Use: an appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply. (USEPA, 2015a)

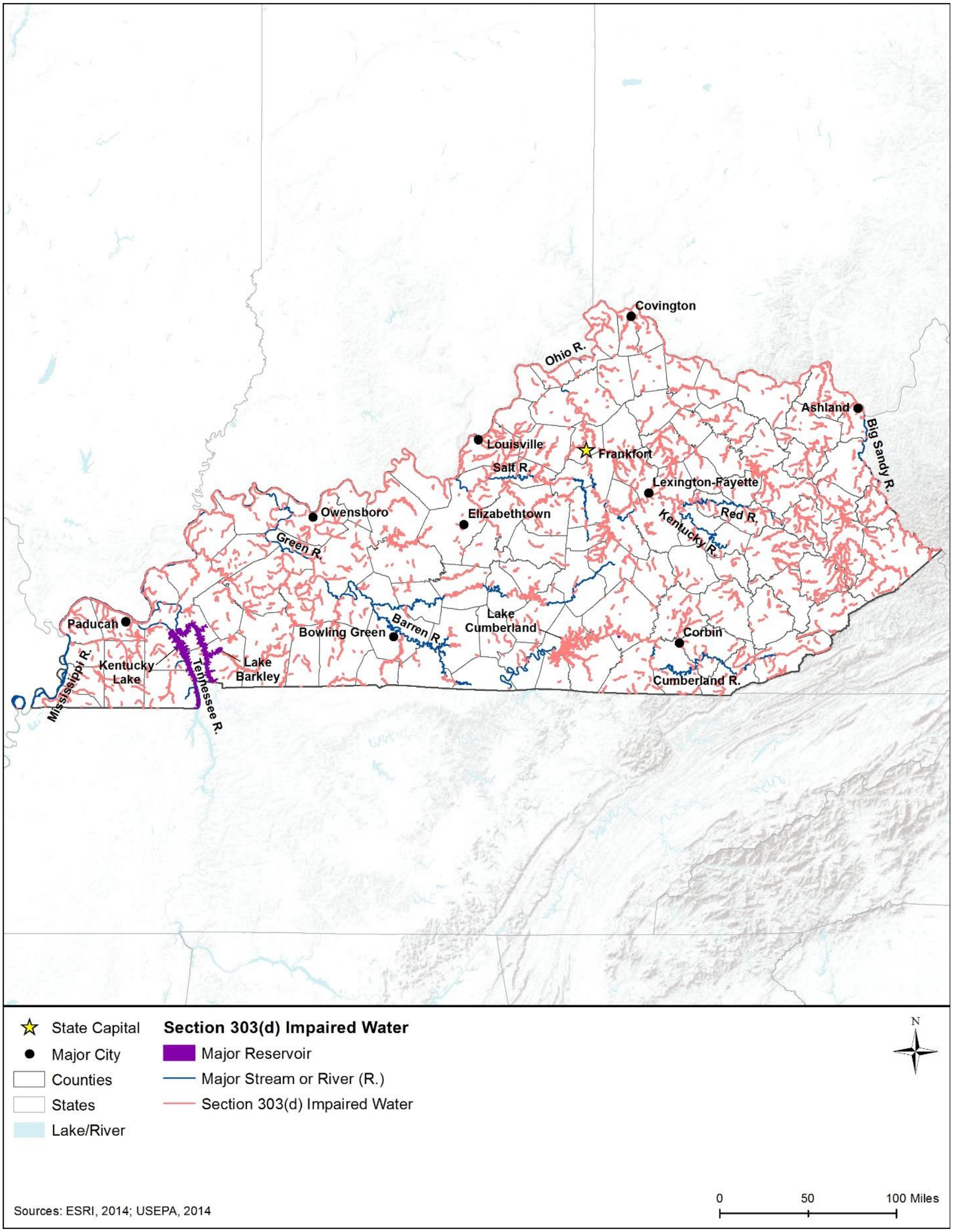

Figure 7.1.4-2: Section 303(d) Impaired Waters of Kentucky, 2014

Additionally, approximately 67 percent of the assessed Kentucky Rivers and streams are impaired due to various pollutants, such as nutrients (e.g., phosphorus) and sediments. For example, sediment runoff from construction sites causes siltation[62] of stream habitat within Kentucky. Nutrient loading is also caused or worsened by this runoff and can result in impairment of stream and river habitats. Kentucky implements Best Management Practices (BMPs), such as Stormwater Pollution Prevention Plans, for construction sites to control runoff pollutants and prevent further impairment of waters within the state (KDEP, 2009). For more information on Kentucky's water quality, visit Kentucky Department of Environmental Protection (KDEP) Division of Water, Watershed Watch found at http://water.ky.gov/wsw/pages/default.aspx (KDEP, 2015g).

7.1.4.6. 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).[63] Through FEMA's flood hazard mapping program, the agency identifies flood hazards and risks associated with the 100-year flood, which is defined as "a flood that has a 1 percent chance of occurring in any given year," to allow communities to prepare and protect against flood events (FEMA, 2013).

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

Riverine flooding is the primary type of floodplain in Kentucky, occurring along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In steep river valleys found in hilly 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).

[62] Siltation is the deposition or accumulation of silt (or small-grained material) in a body of water. (USGS, 2014b)
[63] To search for and locate CFR records, see the Electronic Code of Federal Regulations (e-CFR): www.ecfr.gov.

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 Kentucky, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, rapid snowmelt, decaying hurricanes or tropical storms, debris or ice jams, and dam and levee failure. Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. There are 300 communities designated as flood-prone areas in Kentucky. From 1970 to 2013, there have been 29 major flood-related Presidential Declarations within the state (Kentucky Emergency Management, 2013).

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 351 communities in Kentucky through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing 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, Kentucky had 24 communities participating in the CRS (FEMA, 2014d).[64]

7.1.4.7. 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. 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. (USGS, 1999)

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

Kentucky's principal aquifers consist of carbonate-rock aquifers,[65] sand and gravel aquifers of alluvial and glacial origin,[66] and sandstone aquifers.[67] Kentucky's groundwater resources provide approximately five percent of the water used within the state. More than 1.5 million Kentucky residents are served by public water-supply systems that rely on groundwater (UKY, 2014). Generally, the water quality of Kentucky's aquifers is suitable for drinking and daily water needs. Statewide, the most serious threats to groundwater quality include pesticide applications and other agricultural activities, leaking underground storage tanks, and inadequate or failing onsite septic systems (KDEP, 2004b). Table 7.1.4-3 provides details on aquifer characteristics in the state; Figure 7.1.4-3 shows Kentucky's principal aquifers. There are no sole source aquifers in Kentucky.

Table 7.1.4-3: Description of Kentucky's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin consist of sand, silt, and gravel deposits.	Northern border of the state	Quality of water is good and suitable for most purposes. Water is very hard. This aquifer yields the greatest amount of water and is the most used in the state. Numerous public supplies and industrial users withdraw water from the shallow wells and even some commercial buildings use water for heating and cooling.
Mississippian aquifers consist of limestone and sandstone.	Central Kentucky, south-east of Louisville	Water is suitable for most uses. While the water is very hard, there are low concentrations of dissolved solids and water is suitable for drinking. Contains small amounts of iron and even smaller amounts of nitrates or chloride. Deeper parts of the aquifer may contain saltwater. Water use is primarily for public, domestic, and commercial supply. Other uses are for agricultural, industrial, and mining purposes.
Ordovician aquifers consist of dolomite and limestone.	North central Kentucky, stretching from Covington to southeast of Frankfurt	Generally suitable for most uses. Water is hard and may contain concentrations of dissolved solids such as sulfate and iron that exceed levels for safe drinking water. Most water is withdrawn for public supply and also industrial, mining, and thermoelectric power purposes.
Silurian-Devonian aquifers consist of dolomite and limestone.	Spread throughout central Kentucky	Water is hard and generally is adequate or can be treated and made adequate. Concentrations of dissolved solids and iron exceeded secondary maximum contaminant levels. High fluoride levels make the water unsuitable for drinking. Industrial, mining, and thermoelectric power uses are the main uses.

[65] Carbonate-rock aquifers typically consist of limestone with highly variable water-yielding properties (some yield almost no water and others are highly productive aquifers) (Olcott, 1995a).
[66] 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, 2015i).
[67] Sandstone aquifers form from the conversion of sand grains into rock caused by the weight of overlying soil/rock. The sand grains are rearranged and tightly packed, thereby reducing or eliminating the volume of pore space, which results in low-permeability rocks such as shale or siltstone. These aquifer types are highly productive in many places and provide large volumes of water. (Olcott, 1995b)

Aquifer Type and Name	Location in State	Groundwater Quality
Pennsylvanian aquifers consist of sandstone and limestone.	Eastern and west-central Kentucky	Water is moderately hard and safe for drinking. Median concentration of nitrate is less than the detection limit. Water use is mainly domestic and agricultural supply. Mainly supports coal mining as this is the principal industry in the area.
Coastal Plain aquifer system (Mississippi Embayment aquifer system / Southeastern Coastal Plain aquifer system) consists of semi-consolidated sand.	Western part of the state and west of the Tennessee River	Contains soft water with low concentrations of dissolved solids. However, the water does contain iron in some areas that can make the water not safe for drinking. Overall, suitable for most uses including public, industrial, and domestic purposes.
Mississippi River Valley alluvial aquifer consists of sand, gravel, silt, and clay.	Western border of the state along the Mississippi River Valley	Suitable for general use though primarily use is for rural-domestic supplies since better water is available from a deeper aquifer. Water is very hard with concentrations of calcium bicarbonate and iron. Primary uses include agriculture and industrial.

Source: Source: (Moody, Carr, Chase, & Paulson, 1986) (Olcott P. G., 1992) (USGS, 1999) (KDEP, 2004b)

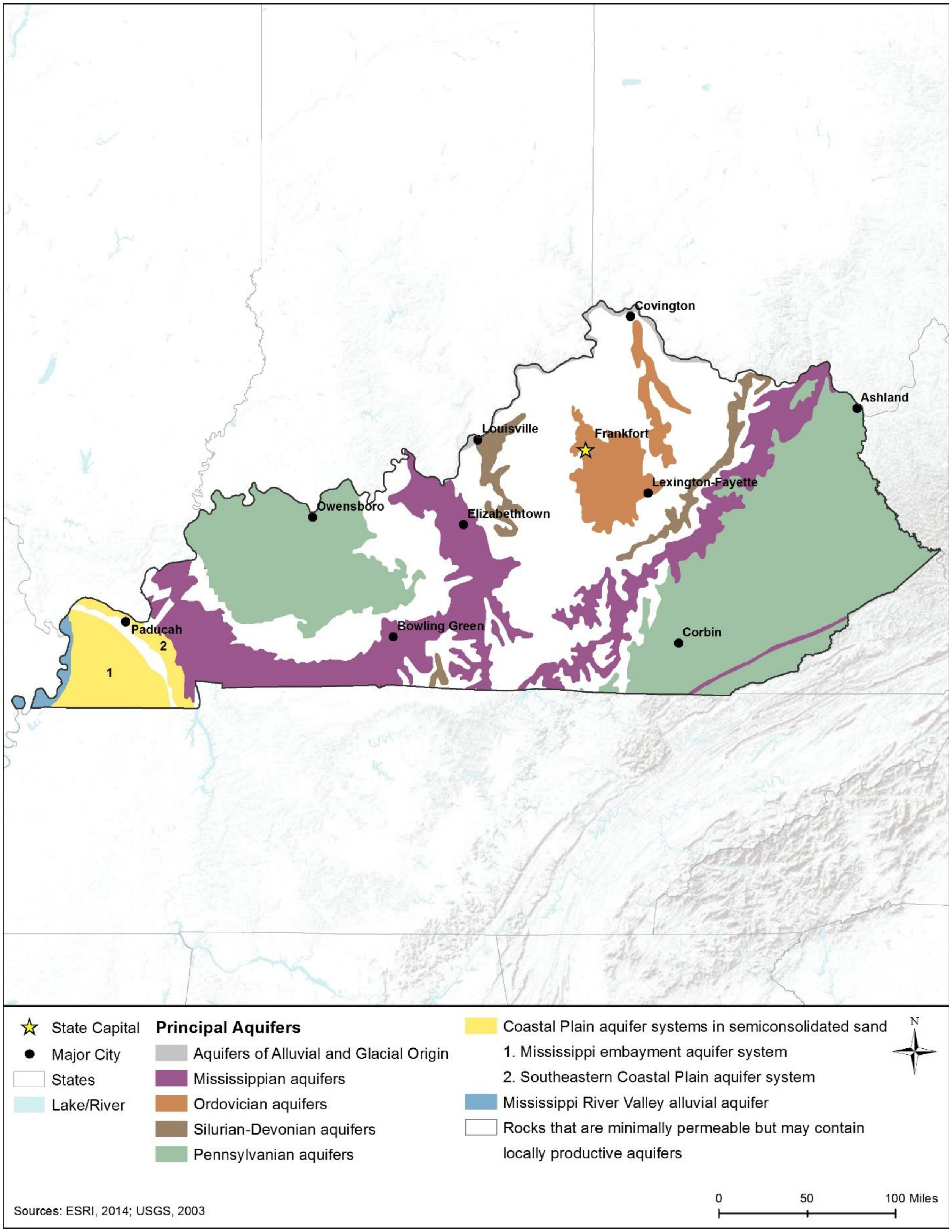

Figure 7.1.4-3: Principal Aquifers of Kentucky

7.1.5. Wetlands

7.1.5.1. Definition of the Resource

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

The U.S. Environmental Protection Agency (USEPA) estimates that "more than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half of such species use wetlands at some point in their lives" (USEPA, 2017a). 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, 2017a)

7.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 7.1.5-1 summarizes the major Kentucky state laws and permitting requirements relevant to the state's wetlands.

Table 7.1.5-1: Relevant Kentucky Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
CWA Section 404 Nationwide Permits (NWPs), Kentucky regional requirements	USACE Louisville District	Regional conditions apply to activities authorized by the USACE NWPs in Kentucky.
CWA Section 401 Water Quality Certification	Kentucky Department for Environmental Protection (KDEP) Division of Water	Regulates activities that may result in a discharge to waters of the U.S., especially when the proposed activity will be authorized by USACE NWPs.
Kentucky Pollution Discharge Elimination System (KPDES) Program	KDEP Division of Water	Regulates the discharge of pollutants in stormwater discharges associated with small and large construction activities that disturb one or more acres.

Source: (KDEP, 2016b) (Kentucky Legislature, 2017e) (KDEP, 2016a)

7.1.5.3. 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. Kentucky includes three of these Systems, as detailed in Table 7.1.5-2. The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats. (USFS, 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" (Cowardin, Carter, Golet, & LaRoe, 1979). 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" (Cowardin, Carter, Golet, & LaRoe, 1979).
- "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" (Cowardin, Carter, Golet, & LaRoe, 1979).
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.;
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent." The System is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, Carter, Golet, & LaRoe, 1979)

In Kentucky, the main type of wetland is palustrine (freshwater) wetlands found on river and lake floodplains across the state. Riverine and lacustrine wetlands comprise approximately three percent of the wetlands in the state. Therefore, they are not discussed in detail in this PEIS.

Table 7.1.5-2 uses 2014 NWI data to characterize and map Kentucky wetlands on a broad-scale.[68] 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 required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work, at the site-specific level once those locations are known. As shown in Figure 7.1.5-1, Kentucky is predominately palustrine wetlands. The map codes and colorings in Table 7.1.5-2 correspond to the wetland types in the figures.

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

Table 7.1.5-2: Kentucky 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, although often on river and lake floodplains, and more concentrated in the eastern portion of the state	292,910
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, although concentrated in the eastern portion of the state	26,984
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	113,981
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	2,315
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	5,090
Lacustrine wetland	**L2**	Lacustrine systems are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are less than 8.2 feet deep.	Central Kentucky	10,768
			TOTAL	**$159,138**

Source: (Cowardin, Carter, Golet, & LaRoe, 1979) (USFWS, 2015a) (FGDC, 2013) (USFWS, 2017)

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

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

[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)

Palustrine Wetlands

In Kentucky, palustrine wetlands include the majority of vegetated freshwater wetlands. The most common types of palustrine wetlands in the state are marshes and swamps. Marshes are dominated by emergent herbaceous vegetation, and are either continuously or frequently flooded. Swamps are characterized by shrubs and trees, most commonly the tupelo (*Nyssa* sp.) and bald cypress (*Taxodium distichum*) trees. There are also river swamps in Kentucky, referred to as bottomland hardwood forests or swamps (University of Kentucky Extension Service, 2001). These bottomland hardwood forests are the largest areas of wetlands in the state, and are typically found in poorly drained regions and on large floodplains in western Kentucky. (KDFWR, 2013a)

Based on the USFWS NWI 2014 analysis, the most common wetland type in the state is PFO/PSS (65 percent), followed by PUB/PAB (25 percent) and PEM (6 percent). There are currently about 452,000 acres of wetlands in the state, of which approximately 436,000 are palustrine (freshwater) (USFWS, 2017). Kentucky's wetlands one covered approximately 1.6 million acres, but is estimated that more than 80 percent have been lost to development, including agriculture and mining. (University of Kentucky Extension Service, 2001) (KDFWR, 2013a)

7.1.5.4. Wetlands of Special Concern or Value

Other important wetland sites in Kentucky include:

- There are more than 80 Wildlife Management Areas (WMAs) in Kentucky, and are designated to conserve natural areas, and provide opportunities for outdoor recreation; some of these areas contain wetlands (KDFWR, 2014n). To learn more about state WMAs, visit http://fw.ky.gov/Hunt/Pages/Public-Land-Hunting.aspx.
- National Natural Landmarks range in size from 7 acres to over 11,000 acres, and are owned by U.S. Forest Service (USFS), Kentucky Department of Fish and Wildlife Resources (KDFWR), Kentucky State Parks, and other private individuals (NPS, 2015b). Section 7.1.8, Visual Resources, describes Kentucky's National Natural Landmarks.

Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state. These include NRCS, Kentucky Department of Agriculture, the State of Kentucky, and easements managed by natural resource conservation groups such as Bluegrass Conservancy, The Nature Conservancy, and Kentucky Heritage Land Conservation Fund. 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 40,000 acres in conservation easements in Kentucky. (NCED, 2015)

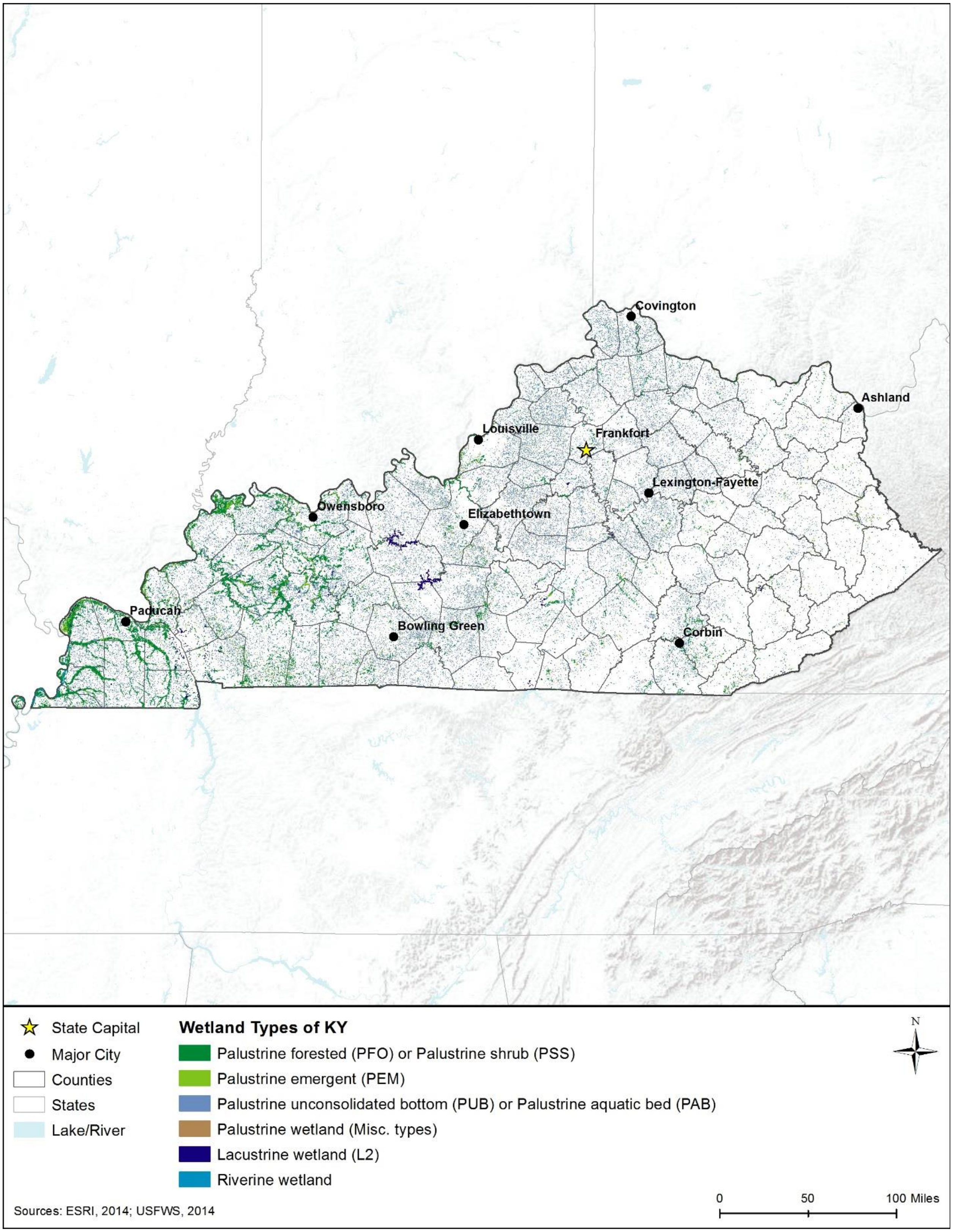

Figure 7.1.5-1: Wetlands by Type, in Kentucky, 2014

7.1.6. Biological Resources

7.1.6.1. Definition of the Resource

This Chapter describes the biological resources of Kentucky. Biological resources include terrestrial[69] vegetation, wildlife, fisheries and aquatic[70] habitats, and threatened[71] and endangered[72] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources, Kentucky supports a wide diversity[73] of biological resources, including large contiguous tracts of hardwood forests, wetlands, bogs, prairies, and exceptional stream and river ecosystems. Each of these topics is discussed in more detail below.

7.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Kentucky are summarized in detail in Appendix C, Environmental Laws and Regulations, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 7.1.6-1 summarizes major state laws relevant to the biological resources of Kentucky.

Table 7.1.6-1: Relevant Kentucky Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Summary
Endangered species of fish and wildlife (301 KAR 3:061.)	Kentucky Department of Fish and Wildlife Resources (KDFWR)	Prohibits the buying, transporting, selling, importing, processing, and possession of state and federally endangered fish and wildlife species.
Importation, possession, and prohibited aquatic species (301 KAR 1:122.).	KDFWR	This code requires transport permits for certain species and deems it illegal possess, propagate, buy, sell, barter, trade, transfer, loan, or release into public or private waters prohibited exotic species in order to protect against harmful invasive species and to ensure the health and viability of native and recreational species.
Kentucky Noxious Weed Law (KC 249.180)	Kentucky Department of Agriculture (KDA)	Requires and person holding or leasing land to remove Canada thistle (*Cirsium arvense*) from these properties.
Kentucky Invasive and Noxious Weed Removal (KC 176.051).	Kentucky Department of Transportation (KDT)	Requires the department to keep all state right-of-ways free of certain noxious weeds.
Transporting and holding of live native wildlife (301 KAR 2:081)	KDFW	Regulates collection, take, and possession of reptiles and amphibians in Kentucky.

Source: (Kentucky Legislature, 2017f) (Kentucky Legislature, 2017g) (USDA, 2016a)

[69] Terrestrial: "Pertaining to land" (USEPA, 2015b).
[70] Aquatic: "Pertaining to water" (USEPA, 2015b).
[71] 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)).
[72] 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)).
[73] Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015b).

7.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology,[74] soils, climate,[75] and water of a given geographic area and correlates with distinct areas identified as ecoregions.[76] Ecoregions are broadly defined areas that share similar characteristics, such as climate,[77] 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 (World Wildlife Fund, 2015) (National Wildlife Federation, 2015) (USDA, 2015a). Ecoregion boundaries often coincide with geographic regions of a state. In Kentucky, the climate is roughly similar throughout the state. The five main geographic regions of Kentucky include the Bluegrass region, Cumberland plateau, Western coal field, Penyroyal region, and Jackson purchase region (Maps of World, 2016). 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. Ecoregion boundaries often coincide with physiographic regions of a state. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions. This Section provides an overview of the terrestrial vegetation resources for Kentucky at USEPA Level III (USEPA, 2016a). As shown in Figure 7.1.6-1, the USEPA divides Kentucky into seven Level III ecoregions. The seven ecoregions support a variety of different plant communities, and boundaries for these ecoregions are considered transitional. In general, the vegetation is more forested and the topography more rugged in the eastern portion of the state, and agricultural practices are more common in the central and western part of Kentucky. Figure 7.1.6-1 provides a summary of the general abiotic characteristics, vegetative communities, and the typical vegetation found within each of the seven Kentucky ecoregions.

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

[75] Climate: "The average weather conditions in a particular location or region at a particular time of the year. Climate is usually measured over a period of 30 years or more" (USEPA, 2015b).

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

[77] Climate: "Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO)" (USEPA, 2015b).

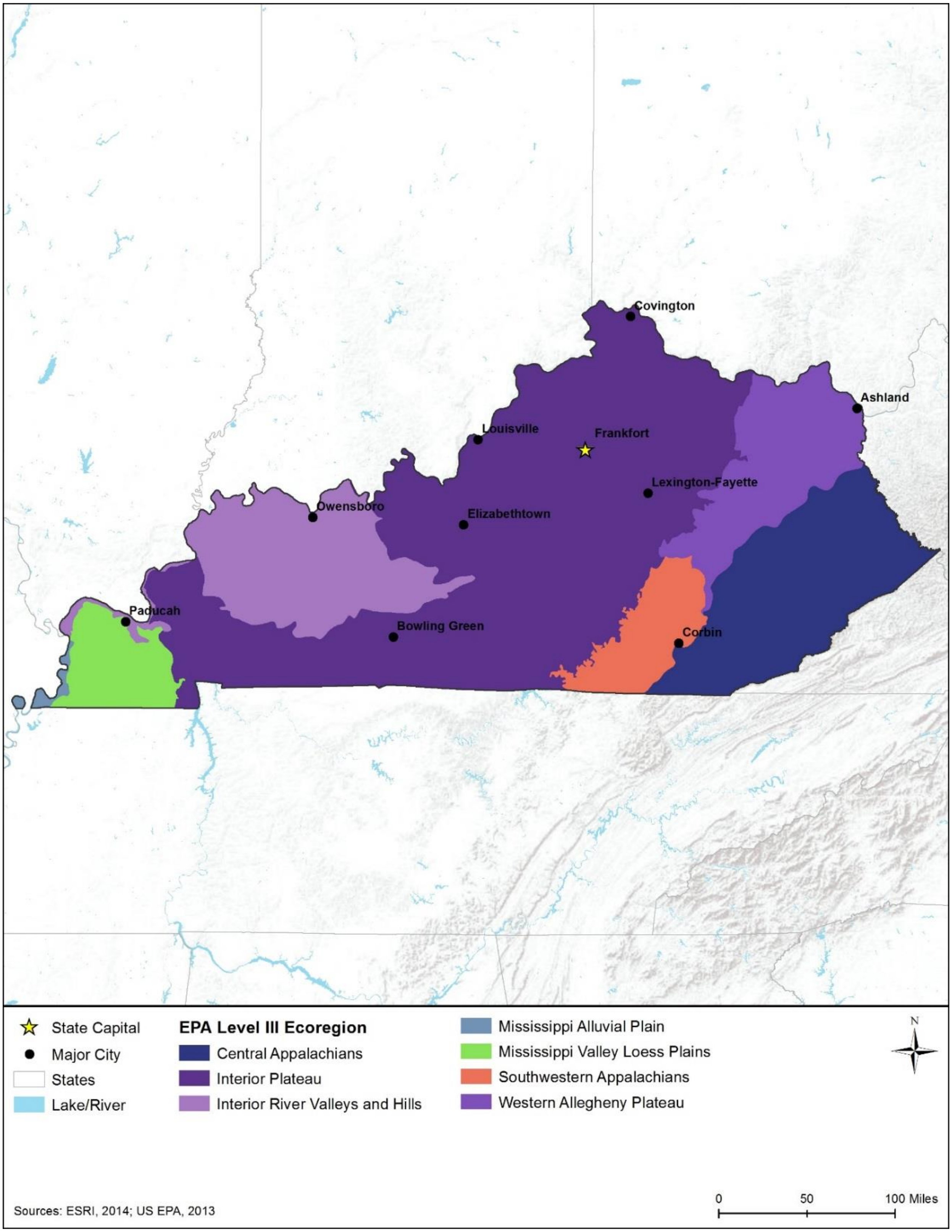

Figure 7.1.6-1: USEPA Level III Ecoregions in Kentucky

Table 7.1.6-2: USEPA Level III Ecoregions of Kentucky

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Cumberland Plateau				
69	Central Appalachians	A predominately forested plateau[b] with rugged terrain and a cool climate with extensive rainfall. Siltation and acidification of streams is common from coal mining in the region. Higher than neighboring regions elevations range from 1,200 to 4,600 feet above sea level.	Mixed Mesophytic forest of Chestnut oak, red maple, white oak, black oak, beech, yellow-poplar, sugar maple, ash, basswood, buckeye, and hemlock; Appalachian oak forest; northern hardwood forests of maple, beech, birch, and hemlock; small areas of red spruce and hemlock	**Deciduous Trees –** red oak (*Quercus rubra*), black cherry (*Prunus serotina*), sugar maple (*Acer saccaharum*), hickory (*Carya* spp.), and red maple (*Acer rubrum*) **Conifer Trees –** eastern white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), and red spruce (*Picea rubens*).
70	Western Allegheny Plateau	A rugged plateau composed of a mix of native forest, dairy, livestock, pasture and general farms dispersed throughout valleys and rounded hills. Slightly less rugged than the neighboring Central Appalachians.	Mixed mesophytic forest; Chestnut oak, red maple, white oak, black oak, beech, yellow-poplar, sugar maple, ash, basswood, buckeye, and hemlock occur; and Appalachian oak forests	**Deciduous Trees –** American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), mountain maple (*Acer spicatum*), white oak (*Quercus alba*), red oak, tulip-tree (*Liriodendron tulipifera*) **Conifer Trees –** eastern hemlock
68	Southwestern Appalachians	A low elevation mountainous region containing predominantly forestland with some cropland and pasture. The region stretches from Kentucky to Alabama and contains rougher topography with steep escarpments along the regions western border.	Upland forests dominated by mixed oaks with shortleaf pine, including white oak, southern red oak, and some hickories; mixed mesophytic forests with maple, buckeye, beech, ash, basswood, sweetgum, and oaks (restricted mostly to the deeper ravines and escarpment slopes.)	**Deciduous Trees –** American beech, tulip-tree, red oak, white oak, and sugar maple **Conifer Trees –** shortleaf pine (*Pinus echinata*)
Geographic Region: Jackson Purchase Region				
73	Mississippi Alluvial Plain	A broad flat alluvial plain with mild winters and hot summers. Southern floodplain forest are the dominant native vegetation, but today a large portion of this region has been converted to cropland.	River swamp forests containing baldcypress and water tupelo; hardwood swamp forests include water hickory, red maple, green ash, and river birch; higher, seasonally flooded areas, include sweetgum, sycamore, laurel oak, Nuttall oak, and willow oak	**Hardwood Trees** –bald cypress (*Taxodium distichum*), black gum (*Nyssa sylvatica*), sweet gum (*Liquidambar styraciflua*), overcup oak (*Quercus lyrata*), water oak (*Quercus nigra*), and willow oak (*Quercus phellos*)
74	Mississippi Valley Loess Plains	A region of loess capped hills surrounded by the lower Mississippi	Eastern rolling plains contain upland forests dominated by oaks, hickories, and both loblolly and shortleaf pine;	**Hardwood Trees** - southern red oak (*Quercus falcate*), white oak, and shagbark hickory (*Carya ovata*)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
		Alluvial Plain. Oak-hickory forest is the dominant land cover.	rugged Bluff Hills in the west contain oak hickory forest and southern mesophytic forests containing beech, maples, sweetgum, basswood, tulip poplar, southern magnolia, and American holly	
Geographic Region: Western Coal Field Region				
72	Interior River Valleys and Hills	This region is between the forested Ozark Highlands and the flatter and less forested Central Corn Belt. This glacier-carved region is characterized by wide and flat-bottomed valleys.	Bottomland deciduous forests and swamp forests mostly now mostly contain cropland and pastureland; some upland forests contain mixed oak forests of post oak, southern red oak, white oak, black oak, and shagbark hickory; mesic sites include beech, yellow-poplar, sugar maple, and northern red oak	**Hardwood Trees –** Sugar maple, American beech, silver maple, American elm, green ash, basswood, red oak, cottonwood (*Populus deltoids*), bitternut hickory (*Carya cordiformis*), white oak, river birch (*Betula nigra*)
Geographic Region: Bluegrass Region and Pennyroayl Region				
71	Interior Plateau	Greater relief and elevation than other ecoregions in the state. Soils are primarily derived from loess and residuum of underlying sandstone, siltstone, shale, and limestone (glacial till uncommon). Remains mostly forested.	Oak-hickory forest, with some areas of bluestem prairie, cedar glades, and mixed mesophytic forest; white oak, northern red oak, black oak, hickories, yellow poplar, red maple, and eastern red cedar	**Hardwood Trees –** black oak , white oak, bur oak (*Quercus macrocarpa*), northern pin oak (*Quercus ellipsoidalis*), chestnut oak (*Quercus prinus*), pignut hickory, bitternut hickory, shagbark hickory

Source: (USEPA, 2016b) (CEC, 2011)

[a]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, 2015b).
[b] Plateau: "An elevated plain, tableland, or flat-topped region of considerable extent" (USEPA, 2015b).

Communities of Concern

The state of Kentucky contains vegetative communities of concern that include rare natural plant communities, plant communities with greater vulnerability or sensitivity to disturbance, and communities that provide habitat for rare plant and wildlife species. The ranking system for these communities gives an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these areas to potential disturbances. This ranking system also gives an indication of the level of potential impact to a particular community[78] that could result from implementation of an action.

The Kentucky State Nature Preserves Commission (KSNPC) statewide inventory includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the KSNPC ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Kentucky. Communities ranked as an S1 by the KSNPC are considered critically imperiled and of the greatest concern. This rank is typically based on the range of the community, the number of occurrences, the viability of the occurrences, recent trends, and the vulnerability of the community. As new data becomes available, ranks are revised as necessary to reflect the most current information (KDFWR, 2013b).

Twenty-four natural communities are ranked as S1 communities[79] in Kentucky; these communities represent the rarest terrestrial habitat in the state, including: Appalachian seep/bog, Bottomland marsh, Bottomland ridge/terrace forest, Bluegrass woodland, Bluegrass mesophytic, cane forest, Calcareous seep/bog, Coastal Plain forested acid seep, Cumberland highlands forest, Cumberland Mountains pitch pine woodland, Cumberland Plateau gravel/cobble bar, Cumberland Plateau sandstone glade, Cypress (tupelo) swamp, Dolomite glade, Limestone/dolomite prairie, Limestone flat rock glade, Sandstone barrens (open woodland), Sandstone prairie, Sinkhole/depression marsh, Shawnee Hills sandstone glade, Tallgrass prairie, Wet depression/sinkhole forest, Wet meadow, Wet prairie, and Xerohydric flatwoods (KSNPC, 2015). These communities occur throughout the geographic regions of the state. Kentucky Appendix A provides a listing of the communities of conservation concern in Kentucky along with their distribution within the state.

[78] Community: "In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest" (USEPA, 2015b).
[79] S1 – Communities "at high risk because of extremely limited and/or rapidly declining population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state" (MFWP and MNHP, 2015).

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive[80] plants. Direct impacts to nuisance and invasive plants may be viewed as beneficial to the environment, but such impacts often result in the inadvertent and unintended spread and dispersal of these species. Construction sites in particular provide colonizing opportunities for nuisance and invasive species, and long-term maintenance activities can perpetuate a disturbance regime that facilitates a continued dispersal mechanism for the spread of these species. Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (GPO, 2011).

Noxious weeds and other invasive plants pose a large threat to Kentucky's agricultural 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[81]. In the state of Kentucky no specific species are listed as noxious weeds, but any species that is a threat to agriculture and agriculture production is considered a noxious weed (University of Kentucky Department of Entomology, 2015). The Kentucky Department of Transportation (KDT) and KDA are both responsible for eliminating certain listed weeds according to KCA 176.051 and 249.180 – 249.195. The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 United States Code [U.S.C.] 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the United States (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015b). A total of 9 weeds are regulated in Kentucky, all 9 species are terrestrial (USDA, 2016b). The following species by vegetation type are regulated in Kentucky:

- **Shrubs** – multiflora rose (*Rosa multiflora*); and
- **Forbs and Grasses** – Canada thistle (*Cirsium arvense*), Johnsongrass (*Sorghum halepense*), giant foxtail (*Setaria faberii*), kudzu (*Pueraria lobata*), kudzo (*Pueraria montana*), musk thistle (*Carduus nutans*), wild cucumber (*Sicyos angulatus*), black nightshade (*Solanum ptyanthum*). (USDA, 2016b)

[80] 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, 2015b).
[81] 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, 2015b).

7.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Kentucky, divided among mammals[82], birds,[83] reptiles and amphibians,[84] and invertebrates.[85] Terrestrial wildlife consist of those species that live predominantly on land. Terrestrial wildlife include common big game species, small game animals, furbearers, nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Kentucky. A discussion of non-native and/or invasive terrestrial wildlife species is also included within this section. Information regarding the types and location of native and non-native/invasive wildlife is useful for assessing the importance of any impacts to these resources or the habitats they occupy. According to the Kentucky Cooperative Extension Service of the University of Kentucky, the state is home to approximately 70 mammal species, 56 reptile species, 55 amphibian species, 380 resident and migratory bird species, and a large number of invertebrates (over 10,000) (KDFWR, 2015a) (KDFWR, 2014o) (KDFWR, 2014c) (KDFWR, 2014d) (KDFWR, 2014e) (KDFWR, 2014f) (UKY, 2008).

Mammals

Common and widespread mammalian species in Kentucky include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridana*), woodchuck (*Marmota monax*), and eastern chipmunk (*Tamias striatus*) (KDFWR, 2014o). Mammals such as the bobcat (*Lynx rufus*) and black bear (*Ursus americanus*) are uncommon or rare in Kentucky due to restricted habitat or secretive behavior (KDFWR, 2014h) (KDFWR, 2014i).

In Kentucky, white-tailed deer, black bear, and elk (*Cervus canadensis*) 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 12 species of furbearers may be legally hunted or trapped in the Kentucky: raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), opossum, coyote (*Canis latrans*), muskrat (*Ondatra zibethicus*), long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), mink (*Mustela vison*), bobcat (*Lynx rufus*), and river otter (*Lontra Canadensis*) (KDFWR, 2015b).

Kentucky has identified 16 mammals as Species of Greatest Conservation Need (SGCN). Three of these species are federally listed as endangered and one is listed as threatened under the ESA. Section 7.1.6.6, Threatened and Endangered Species, identifies these protected species. The SGCN list consists of at-risk species that are rare or declining, and can provide funding for efforts to reduce their potential to be listed as endangered. Although these species have been

[82] 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, 2015b).
[83] Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves” (USEPA, 2015b).
[84] 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, 2015b).
[85] Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015b).

targeted for conservation, they are not currently under legal protection, with the exception of those also listed under the ESA or the Kentucky ESA. The SGCN list is updated periodically and is used by the state of Kentucky to focus their conservation efforts and as a basis for implementing their State Wildlife Action Plan (SWAP) (KDFWR, 2013b).

Birds

The number of native bird species documented in Kentucky varies according to the timing of the data collection effort, changes in bird taxonomy,[86] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., forests, prairies, large rivers and lakes, plains, etc.) found in Kentucky support a large variety of bird species.

A total of 375 resident and migratory bird species have been documented in Kentucky (KDFWR, 2013a) . Among the 380 extant[87] bird species in Kentucky, 94 SGCN have been identified (KDFWR, 2013b). One federally endangered bird is located in Kentucky. Section 7.1.6.6, Threatened and Endangered Species, identifies this protected species.

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

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes occasionally year round but mainly during the migratory and winter months in the state of Kentucky (eBird , 2015) (KDFWR, 2015b). Golden eagles generally nest in mountains and cliffs. According to the KDFW, golden eagles are rare to Kentucky and "there are currently no documented breeding pairs of golden eagles in Kentucky...In fact, there has never been a documented golden eagle nest in Kentucky" (KDFWR, 2016).

A number of Important Bird Areas (IBAs) are being considered for identification Kentucky by a Technical Review Committee (The National Audubon Society, 2015). 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. 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

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

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.

As mentioned previously, Kentucky's IBAs are currently under review. To date, a total of five IBAs covering 57,239 acres have been identified in Kentucky. The largest IBA in Kentucky, Ballard County Bottoms, covers approximately 32,000 acres in the Mississippi Plain. However, it is anticipated that the review committee will list between 35 and 50 IBAs in the state when the review concludes. These areas would include breeding ranges,[88] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, forests, and wetland/riparian[89] areas (The National Audubon Society, 2015). One endangered bird species, the Least tern (*Sterna antillarum*), is federally listed in Kentucky. Section 7.1.6.6, Threatened and Endangered Species, identifies protected species.

Reptiles and Amphibians

A total of 56 native reptile and 55 amphibian species occur in the state of Kentucky, including 35 salamanders, 20 frogs and toads, 14 turtles, nine lizards, and 33 snakes (KDFWR, 2013a). These species occur in a wide variety of habitats throughout the state. Of the 111 native reptile and amphibian species, 25 amphibian and 27 reptile SGCN have been identified (KDFWR, 2013b). Collection, take, and possession of Kentucky reptile and amphibian species are regulated under Kentucky Administrative Rule 301 KAR 2:081. There are no federally listed reptile or amphibian species listed under the ESA in the state of Kentucky.

Invertebrates

Kentucky is home to a large 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. In the United States, one third of all agricultural output depends on pollinators.[90] 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). Currently no invertebrate SGCN are listed in the state of Kentucky. Twenty-one

[88] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015b).
[89] 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, 2015b).
[90] Pollinators: "Animals or insects that transfer pollen from plant to plant" (USEPA, 2015l).

invertebrates are federally listed in Kentucky, including 19 endangered and two threatened species. Section 7.1.6.6, Threatened and Endangered Species, identifies these protected species.

Invasive Wildlife Species

Kentucky has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select terrestrial wildlife species. KAR 301 2:082 regulates transportation and holding of live exotic wildlife. This regulation includes an extensive list of species that are prohibited in the state of Kentucky. However, Kentucky currently has no regulations concerning invasive insects. Some species such as the gypsy moth (*Lymantria dispar*), hemlock woolly adelgid (*Adelges tsugae*), emerald ash borer (*Agrilus planipennis*), and Asian longhorn beetle (*Anoplophora glabripennis*) are federally regulated to help prevent further spreading (University of Kentucky, College of Agriculture, 2016). In surrounding states, quarantines for these species are in place (University of Kentucky, College of Agriculture, 2016). Currently, federal quarantines are in place that restrict the transport of plant materials with the potential to contain the emerald ash borer (USDA, 2015c).

In Kentucky, feral hogs (*Sus scrofa*) are a nuisance mammal that can adversely impact several native large and small mammals, including squirrels and deer. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and can carry/transmit disease to livestock and humans (KDFWR 2014). In addition, mute swans (Cygnus olor) are a nuisance bird that can adversely impact native waterfowl and wetland birds causing nest abandonment or impacts to rearing young due to their aggressive behavior.

7.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Kentucky, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Kentucky landscape with regard to aquatic wildlife is the large river ecosystem of the Ohio River. No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Kentucky. (NOAA, 2016)

Freshwater Fish

Kentucky is home to approximately 260 species of freshwater fish grouped into numerous families, ranging in size from small darters and minnows to larger species such as salmon and sturgeon. A brief description of those families that contain common species, notable sport fish species, or species of concern is listed below (KDFWR, 2014j) (KDFWR, 2014k).

Kentucky is home to 13 species of freshwater catfishes, including the brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameiurus melas*), and the yellow bullhead (*Ameiurus natalis*). In addition, seven species of madtom are known to occur in the state, and four are listed as SGCN. All are smaller members of the catfish family that rarely reach an adequate size to be targeted by fishermen. Larger members of the catfish family include the channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and the blue catfish (*Ictalurus furcatus*). These species are widespread throughout the state and can be found in almost any habitat (KDFWR, 2011) (KDFWR, 2015a) (KDFWR, 2013b).

Approximately 70 species of minnows occur in Kentucky. The minnows/carps family contains the largest number of species in Kentucky. Eighteen of these species, including six species of shiner, are listed as SGCN. Common and widely distributed minnow species in Kentucky include the common carp (*Cyprinus carpio*), creek chub (*Semotilus atromaculatus*) and common shiner (*Notropis cornutus*). Minnows are not typically a popular sportfish, but are a commercially important fish and an important prey source for larger fish and other wildlife (KDFWR, 2015a) (KDFWR, 2013b).

Sixty-seven species of perches occur in Kentucky, with approximately 64 of these species being darters. Twenty-six species of darter are listed as SGCN. Darters are small members of the perch family that are not considered to be sport fish sought after by fishermen. Walleye (*Etheostoma fusiforme*) and sauger (*Sander canadensis*) are larger members of the perch family and are important sport fish in Kentucky. These species are common in the large rivers, lakes, and reservoirs throughout the state (KDFWR, 2013b) (KDFWR, 2015a).

Three species of pike occur in Kentucky waters, the muskellunge (*Esox masquinongy*), northern pike (*Esox Lucius*), and the chain pickerel (*Esox niger*). Chain pickerel are smaller members of the pike family and are typically found in vegetated swamps. Northern pike and muskellunge are native to the larger rivers of Kentucky, but were introduced into other areas of the state to create fishing opportunities and are now found in bays of lakes and reservoirs with dense weed growth and submerged logs. (KDFWR, 2013b) (KDFWR, 2015a)

There are three species of the sturgeon family in Kentucky: the shovelnose sturgeon (*Scaphirhynchus platorynchus*), the pallid sturgeon (*Scaphirhynchus albus*), and the lake sturgeon (*Acipenser fulvescens*). The lake sturgeon and pallid sturgeon are both listed as a SGCN. Because of their scarcity, sturgeon are no longer an important commercial fish species (KDFWR, 2014p). The depression in populations of sturgeon is the result of over-collection of these species for caviar beginning in early colonial times, as well as loss of habitat (KDFWR, 2013b) (KDFWR, 2015a).

The sunfish family includes approximately 21 species in Kentucky, many of which are common throughout the state and highly popular with sport fishermen. Two species, the dollar sunfish (*Lepomis marginatus)* and Redspotted sunfish *(Lepomis miniatus),* are listed as SGCN. The most commonly encountered species are the bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieu*). These sunfish species live in a wide variety of habitats, including rocky, cool lakes streams, and reservoirs (KDFWR, 2013b) (KDFWR, 2015a).

Kentucky waters are home to three species of the trout family including the brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*). Although trout are native to some streams in the state, the majority of these species have been stocked in select cold water streams of Kentucky to provide a trout fishery for sportsmen. Trout and salmon are popular game fish (KDFWR, 2013b) (KDFWR, 2015a).

Other fish listed as SGCN in Kentucky include the Alabama Shad (*Alosa alabamae*); the Paddlefish (*Polyodon spathula*); the Alligator Gar (*Atractosteus spatula*); the Burbot (*Lota lota*); the Inland silverside (*Menidia beryllina*); several species of Catostomidae ((Black Buffalo (*Ictiobus niger*), Blackfin sucker (*Thoburnia atripinnis*), and Blacktail redhorse (*Moxostoma poecilurum*), and the Lake chubsucker (*Erimyzon sucetta*)); several species of Amblyopsidae (Northern cavefish (*Amblyopsis spelaea*), Southern cavefish (*Typhlichthys subterraneus*), and Spring cavefish (*Forbesichthys agassizii*)); and four Lampreys (American brook lamprey (*Lampetra appendix*), Chestnut lamprey (*Ichthyomyzon castaneus*), Mountain brook lamprey (*Ichthyomyzon greeleyi*), and Northern brook lamprey (*Ichthyomyzon fossor*)) (KDFWR, 2014l).

Shellfish and Other Invertebrates

A total of 106 freshwater mussels are indigenous to the waters of Kentucky; however, a number of these have not been documented in the state for quite some time and are assumed to be extirpated from Kentucky waters. Freshwater mussels are an important food source for many wildlife species such as waterfowl, fish, muskrat, and other furbearers. Mussels are also important water quality indicators as they often require streams with a high oxygen content that have not been degraded by sedimentation. In Kentucky, 46 species of freshwater mussels are listed as SGCN. River diversions, impoundments, and dredging activities are the primary threats to freshwater mussel species (KDFWR, 2013b) (KDFWR, 2015a). The state is also home to a large number of federally threatened and endangered freshwater mussels. Section 7.1.6.6, Threatened and Endangered Species, identifies these protected species.

Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other well-known Kentucky freshwater invertebrates include a variety of crayfish, fairy shrimp, amphipods, and pillbug species. There 25 crayfish invertebrate SGCN listed in Kentucky (KDFWR, 2013b) (KDFWR, 2015a).

Invasive Aquatic Species

Kentucky has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select aquatic invasive species. According to 301 KAR 1:122, it is illegal to possess, sell, import, or release the following species into the waters of the state:

- Aquatic Invertebrates – Zebra mussels (*Dreissena polymorpha, D. bugensis*); and
- Fish – Black carp (*Mylopharyngodaon piceus*), round goby (*Neogobius melanostomus*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), grass carp (*Ctenopharyngodon idella*), snake heads (Genus *Channa*), walking catfish (Genus *Clarias*), sea lamprey (*Petromyzon marinus*), Mexican banded tetra (*Astyanax mexicanus*), and piranha (Subfamily *Serrasalminae*).

7.1.6.6. Threatened and Endangered Species

The USFWS is responsible for administering the ESA (16 U.S.C §1531 et seq.) in state of Kentucky. The USFWS Southeast Region Office has identified 35 federally endangered and 9 federally threatened species known to occur in Kentucky (USFWS, 2015c). Of these 44 federally listed species, 12 of them have designated critical habitat[91] (USFWS, 2015d), as can be seen in Figure 7.1.6-2. There are two species that are proposed for listing[92] that are believed or known to occur within Kentucky, including the Kentucky arrow darter (*Etheostoma spilotum*) and White fringeless orchid (*Platanthera integrilabia*) (USFWS, 2015e). The 44 federally listed species include 4 mammals, 1 bird, 6 fish, 23 invertebrates, and 10 plants (USFWS, 2015c), and are discussed in detail under the following sections. There are no federally listed reptile or amphibian species listed under the ESA in the state of Kentucky. USFWS has identified five candidate species[93] within the state (USFWS, 2016a). Candidate species are not afforded statutory protection under the ESA. However, the USFWS recommends consideration of these species during environmental planning because they could be listed in the future (USFWS, 2014a). The five candidate species include invertebrates (USFWS, 2016a).

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.

[91] 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)).
[92] Species proposed for listing are plants and animals that the USFWS finds "may be an endangered or threatened species throughout all or a significant portion of its range" (USFWS, 2015e).
[93] Candidate species are plants and animals that the USFWS has "sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities" (USFWS, 2015bq).

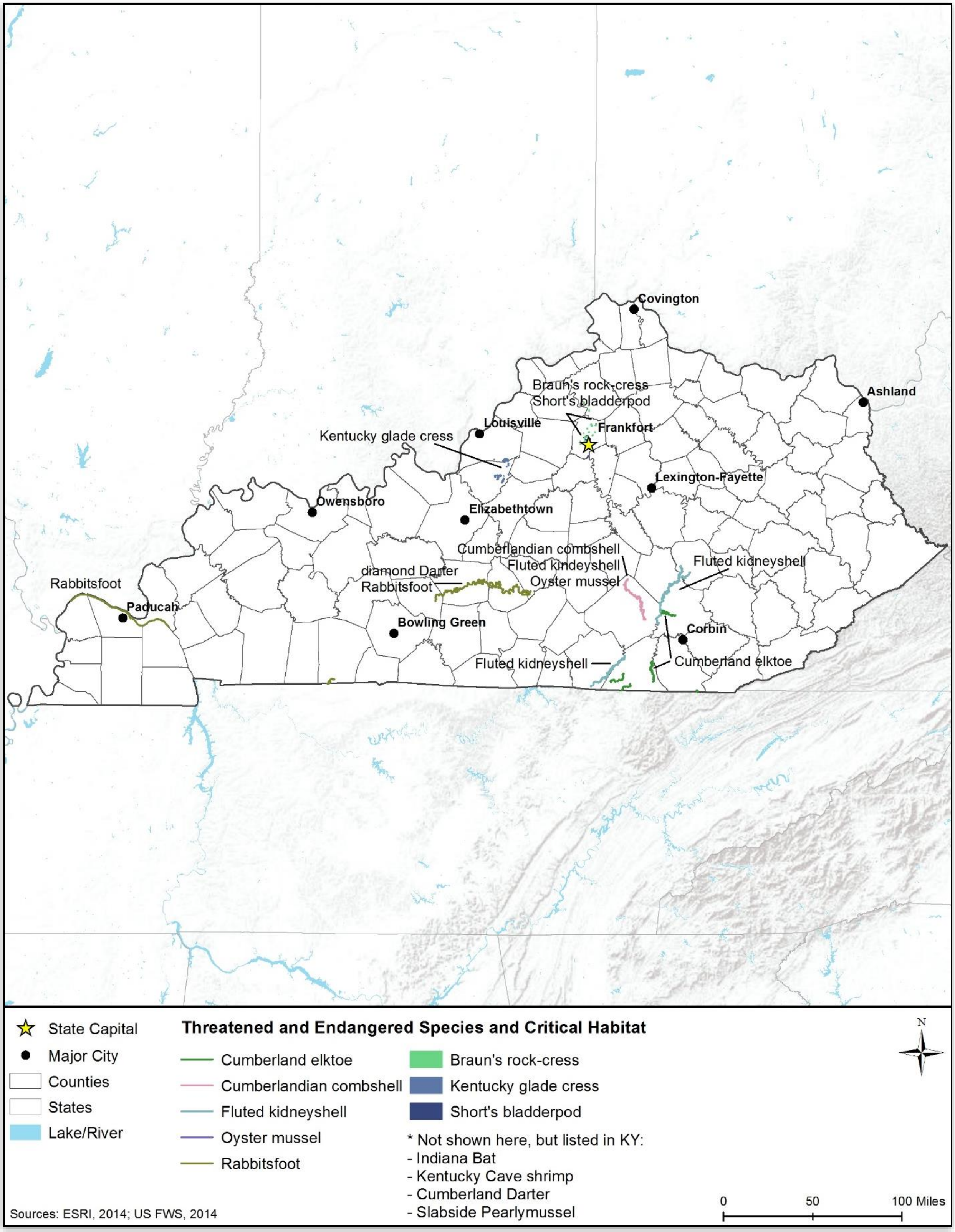

Figure 7.1.6-2: ESA Designated Critical Habitat in Kentucky

Mammals

Three endangered and one threatened mammal species are federally listed for Kentucky as summarized in Table 7.1.6-3. The gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and northern long-eared bat (*Myotis septentrionalis*) occur throughout Kentucky, while the Virginia big-eared bat (*Corynorhinus townsendii virginianus*) occurs only in the eastern region of the state (USFWS, 2015c). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Kentucky is provided below.

Table 7.1.6-3: Federally Listed Mammal Species of Kentucky

Common Name	Scientific Name	Federal Status	Critical Habitat in Kentucky	Habitat Description
Gray Bat	*Myotis grisescens*	Endangered	No	Caves in limestone karst regions near rivers; found throughout Kentucky.
Indiana Bat	*Myotis sodalis*	Endangered	Yes	Trees and snags, caves, and abandoned mines; found throughout Kentucky.
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	No	Trees and snags, caves, and abandoned mines; found throughout Kentucky.
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	Endangered	No	Caves in karst regions with large presence of oak hickory or beech maple hemlock trees; found in eastern Kentucky.

Source: (USFWS, 2015c) (USFWS, 2016b)

Gray Bat Photo credit: USFWS

Gray Bat. The gray bat is an insectivorous bat that weighs approximately 7 to 16 grams and it is longer than any other species in the genus *Myotis*. The gray bats have dark gray fur after molt in July or August and then the fur transitions to a chestnut brown (USFWS, 1997a). This species was 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) (USEPA, 2015p). In Kentucky, the gray bat is known to occur in 51 counties throughout the state (USFWS, 2015f).

Gray bats live in caves all year, hibernating in deep vertical caves during the winter and inhabits caves along rivers the rest of the year. Most caves are in limestone karst regions and 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 such as adding gates that alter the air flow, humidity, and temperature of caves (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. The 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, 2015g). In 1976, critical habitat was designated for the Indiana Bat. Approximately 75 percent of the known Indiana bat population hibernates in abandoned mines and caves. "The bats are entirely dependent on the shelter provided by these caves and mines during the winter. Their loss or subjection to excessive disturbance or modification would lead to the near or total extinction of the species" (USFWS, 1976). Regionally, this species is currently found in the central portion of the eastern U.S., from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Kentucky, the Indiana bat is believed or known to occur in every county in the state (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 they migrate 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 areas (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 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, disturbances to air flow in caves from the improper installation of security gates, habitat fragmentation and degradation, the use of pesticides or other environmental contaminants, and White Nose Syndrome (USFWS, 2004a) (USFWS, 2015g). White Nose Syndrome is a rapidly spreading fungal disease that afflicts hibernating bats (USGS-NWHC, 2015).


Photo credit: USFWS

Northern Long-eared Bat

Northern Long-eared Bat. The northern long-eared bat is a medium-sized, brown furred, insectivorous bat. This bat is medium-sized, reaching a length of 3 to 3.7 inches, with long ears relative to other members of the genus *Myotis* (USFWS, 2015i). The northern long-eared bat was listed as endangered in 013 (78 FR 72058 72059, December 2, 2013) and was relisted as threatened in 2015 (80 FR 17973 18033, April 2, 2015). In the U.S., its range includes most of the eastern and north central states (USFWS, 2015j). In Kentucky, the northern long-eared bat is believed or known to occur in every county in the state (USFWS, 2015j).

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 after hibernation. Pregnant females then migrate to summer areas to 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 temperature or air flow impacts to their hibernating habitat, forest management practices that are incompatible with this species' habitat needs, habitat fragmentation, and wind farm operations (USFWS, 2015i).

Virginia Big-eared Bat. The Virginia big-eared bat is a light to dark brown furred, insectivorous mammal measuring 1.5 to 2 inches long and weighting 7 to 12 grams. The Virginia big-eared bat was listed as endangered in 1979 (44 FR 69206 69208, November 30, 1979). Regionally, this species is known to occur only in Kentucky, North Carolina, Virginia, and West Virginia. In Kentucky, this species is believed or known to occur in nine counties in the eastern region of the state (USFWS, 2015k).

This species resides in caves for both the summer and winter time, usually in karst regions with large presence of oak hickory or beech maple hemlock trees. The Virginia big-eared bat prefers cold area in the entrance of caves and in the winter during hibernation they move deeper in the caves (USFWS, 1984a). The primary threats to the Virginia big-eared bat are human disturbance and pesticides. Additional threats habitat loss and degradation due to filling, removal of rock, and flooding of caves (VDGIF, 2015).

Birds

One endangered avian species is federally listed for Kentucky as summarized in Table 7.1.6-4. The least tern (*Sterna antillarum*) occurs along the Ohio and Mississippi Rivers in western Kentucky (USFWS, 2016b). Information on the habitat, distribution, and threats to the survival and recovery of this species in Kentucky is provided below.

Table 7.1.6-4: Federally Listed Bird Species of Kentucky

Common Name	Scientific Name	Federal Status	Critical Habitat of Kentucky	Habitat Description
Least Tern	*Sterna antillarum*	Endangered	No	Unvegetated sandbars along the Ohio and Mississippi Rivers in Kentucky.

Source: (USFWS, 2015c)

Least Tern. The least tern is a nine inch long, grey, and white gull, with black markings on its head (USFWS, 1990). The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). The least tern is a summer resident in Kentucky and breeds along several major river systems in the U.S., which include the Missouri, Mississippi, Ohio, Red, and Rio Grande River (USFWS, 1990) (USFWS, 2014b). In Kentucky, the least tern is believed or known to occur in nine counties along the Mississippi River and Ohio River in the western region of the state (USFWS, 1990) (USFWS, 2015l).

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, 2014b). 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).

Fish

Four endangered and one threatened fish species are federally listed for Kentucky as summarized in Table 7.1.6-5 (USFWS, 2016b). The blackside dace (*Phoxinus cumberlandensis*), Cumberland darter (*Etheostoma susanae*), and the duskytail darter (*Etheostoma percnurum*) can all be found in the eastern half of Kentucky (USFWS, 2016b). The pallid sturgeon (*Scaphirhynchus albus*) and relict darter (*Etheostoma chienense*) can be found in the western half of Kentucky (USFWS, 2016b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Kentucky is provided below.

Table 7.1.6-5: Federally Listed Fish Species of Kentucky

Common Name	Scientific Name	Federal Status	Critical Habitat of Kentucky	Habitat Description
Blackside Dace	*Phoxinus cumberlandensis*	Threatened	No	Small upland headwaters and creeks with cool water pools and riparian vegetation; found in the Cumberland River system in southeastern Kentucky.
Cumberland Darter	*Etheostoma susanae*	Endangered	Yes	Pools and shallow areas of streams with sand, silt, or bedrock substrates and low- to moderate-gradient; found in southeastern Kentucky.
Duskytail Darter	*Etheostoma percnurum*	Endangered	No	Upland rocky areas in gently flowing pools that are one to four feet deep, and in large creeks and rivers; found in McCreary County in southeastern Kentucky.
Palezone Shiner	*Notropis albizonatus*	Endangered	No	Clean, clear water in flowing pools with a substrate of bedrock, pebble, and gravel mixed with clean sand; found in southeastern Kentucky.
Pallid Sturgeon	*Scaphirhynchus albus*	Endangered	No	Bottom of dynamic channels in the Mississippi Rivers in southwestern Kentucky.
Relict Darter	*Etheostoma chienense*	Endangered	No	Pools with a slow current and a gravel/sand substrate; found in the Bayou du Chien watershed in western Kentucky.

Source: (USFWS, 2015c)

Blackside Dace Photo Credit: USFWS

Blackside Dace. The blackside dace is a small freshwater fish that grows up to 3 inches in length. This species has an olive to gold colored back with silver or red underline and two dark black stripes along each side. During breeding season, the males are distinguished by a bright red belly (USFWS, 1988a). The blackside dace was listed as threatened in 1987 (52 FR 22580 22585, June 12, 1987). Regionally, this species is known to occur in Kentucky, Tennessee, and Virginia. In Kentucky, the blackside dace is known to occur in eight counties in the southeastern region of the state along the Cumberland River system (USFWS, 1988a) (USFWS, 2015m).

Suitable habitats for the blackside dace consist of small upland headwaters and creeks. The blackside dace typically occurs in cool water pools with bedrock, undercut banks, or brush and associates with lush riparian vegetation. This species feeds on algae on rocks or objects in the water and during the winter they feed on aquatic insects and other unidentified organisms. Current threats to the blackside dace include siltation from mining, agriculture, and road construction as well as unregulated acid mine drainage (USFWS, 1988a).

Cumberland Darter. The Cumberland darter is a small darter with a yellow body and six brown saddles (USFWS, 2011a). This species was listed as endangered in 2011 (76 FR 48722 48741, August 9, 2011). Regionally, the Cumberland Darter occurs in the upper Cumberland River system in southeastern Kentucky and northeastern Tennessee (USFWS, 2012b). In Kentucky, the species is believed or known to occur in McCreary County and Whitley County in the southeastern region of the state (USFWS, 2015n).

In 2012, critical habitat for this species was designated in Kentucky and Tennessee (77 FR 63603 63668, October 16, 2012). In Kentucky, critical habitat includes segments of Bunches Creek, Calf Pen Fork, Youngs Creek, Barren Fork, Indian Creek, Cogur Fork, Kilburn Fork, Laurel Fork, Laurel Creek, Elisha Branch, Jenneys Branch, Wolf Creek, Jellico Creek, Rock Creek, and Capuchin Creek (USFWS, 2012b). The preferred habitats for the Cumberland darter include pools and shallow areas of streams with sand, silt, or bedrock substrates and low- to moderate-gradient. Potential threats to the species include sedimentation, habitat disturbance, and changes to channel morphology (USFWS, 2012b).

Duskytail Darter. The duskytail darter is a small fish that grows to approximately 2.5 inches in length and has a straw to olive color body with a white to light greyish belly and dark grey on top of its head. It is difficult to distinguish the sex, however, during breeding season the head of males tend to get darker and swollen (USFWS, 1994a). The duskytail darter was listed as endangered in 1993 (58 FR 25758 25763, April 27, 1993). Regionally, this species is known to occur in Kentucky, Tennessee, and Virginia. In 2002 and 2007, non-essential experimental populations were created in multiple regions of Tennessee (USFWS, 2015o). In Kentucky, this species is believed or known to occur in McCreary County in the southeastern region of the state (USFWS, 2015o).

Suitable habitats for the duskytail darter are upland rocky areas in gently flowing pools that are one to four feet deep, and also runs in large creeks and rivers. This species is an insectivore that feeds on microcrustaceans, fly (chironomid) larvae, and mayflies (heptageniids). Current threats to this species include silt and runoff from agricultural activities and impoundment (USFWS, 1994a).

Palezone Shiner. The palezone shiner is a small, slender minnow that reaches a little over 2 inches in length. It is a light, translucent yellow color with a narrow, dark stripe on its back and on its upper lip. It has a pigmentless stripe on its sides with a darkly pigmented border (USFWS, 1997e). The Palezone shiner was federally listed as endangered in 1993 (58 FR 25758 25763, April 27, 1993).

This species can be found in large creeks and small rivers in the Tennessee River system and the Cumberland River system in Tennessee and Kentucky. In Kentucky, this species can be found within the Little South Fork of the Cumberland River in Wayne County and McCreary County (USFWS, 1997e) (USFWS, 2015ah). The palezone shiner inhabits clean, clear water in flowing pools and upland streams with permanent flow having sandy substrates of bedrock, pebble, and gravel. Threats include habitat alteration and deteriorated water quality (USFWS, 1997e).

Pallid Sturgeon. The pallid sturgeon is one of two species of sturgeon found east of the Continental Divide; it is the larger of the two species, and weighs up to 60 pounds. The pallid sturgeon has a flattened snout and the part of the body just before the tail (caudal peduncle) is armored with cartilage plates (USFWS, 2015p). This species was listed as endangered in 1990 (55 FR 36641 36647, September 6, 1990).

The species' range extends the length of the Missouri and Mississippi Rivers (USFWS, 2015p). In Kentucky, the pallid sturgeon is believed or known to occur in three counties in the southwestern region of the state (USFWS, 2015p). The Pallid sturgeon prefers large rivers with strong currents; they can withstand a wide range of turbidity conditions. The key reason for this species' decline has been habitat fragmentation and alteration from the damming of major rivers and other large tributaries (USFWS, 2014c).

Relict Darter. The relict darter is a small fish that grows to approximately 2.5 inches in length. This species is light tan in color with brown mottling and saddles along the sides. Breeding males will exhibit darker coloring on the back and sides (USFWS, 1993a). This species was listed as endangered in 1993 (58 FR 68480 68486, December 27, 1993).

Regionally, this species occurs in three counties in the western region of Kentucky (USFWS, 2015q). This species is endemic to the Bayou du Chien watershed. The relict darter typically occurs in stream headwaters, within pools that exhibit a slow current and a gravel/sand substrate. This species prefers habitat where instream cover is present in the form of undercut banks and overhanging vegetation or woody debris (USFWS, 2013c).

Threats to the relict darter include habitat loss and degradation due to channelization, vegetation removal, siltation, draining of adjacent wetlands, and runoff from agricultural operations. The removal of vegetation with the relict darter's range poses a major threat to this species because it relies on riparian plants and wood debris for cover and reproductive habitat (USFWS, 2013c).

Invertebrates

Nineteen endangered, two threatened, and five candidate invertebrate species are federally listed for Kentucky as summarized in Table 7.1.6-6. The clubshell (*Pleurobema clava*) and northern riffleshell (*Epioblasma torulosa rangiana*) are found in central Kentucky. Cumberland Bean (Pearlymussel) (*Villosa trabalis*), Cumberland elktoe (*Alasmidonta atropurpurea*), Cumberlandian combshell (*Epioblasma brevidens*), and oyster mussel (*Epioblasma capsaeformis*) are found in southeastern Kentucky. Fanshell (*Cyprogenia stegaria*), pink mucket (pearlymussel) (*Lampsilis abrupta*) sheepnose mussel (*Plethobasus cyphyus*), spectaclecase (*Cumberlandia monodonta*), and snuffbox mussel (*epioblasma capsaeformis*) are found throughout the state. The fatpocketbook (*Potamilus capax*) is found in western Kentucky. Orangefoot pimpleback (pearlymussel) (*Plethobasus cooperianus*) is found in southwestern Kentucky. Fluted kidneyshell (*Ptychobranchus subtentum*), littlewing pearlymussel (*Pegias fabula*), purple cat's paw (*Epioblasma obliquata obliquata*), rabbitsfoot (*Quadrula cylindrica cylindrical),* tan riffleshell *(Epioblasma florentina walker),* and ring pink mussel (*Obovaria retusa*) are found in southern Kentucky. Rough pigtoe (*Pleurobema plenum*) occurs in south-central Kentucky. Slabside pearlymussel (*Pleuronaia dolabelloides*) is found in Logan County, Kentucky. The Kentucky cave shrimp (*Palaemonias ganteri*) occurs in cave habitats throughout Kentucky and can be found specifically within Mammoth Cave National Park. The Big Sandy Crayfish (*Cambarus callainus*) occurs in eastern Kentucky. Four candidate species occur in Kentucky, rattlesnake-master borer moth (*Papaipema eryngii*), icebox cave beetle (*Pseudanophthalmus frigidus*), Loiusiville cave beetle (*Pseudanophthalmus troglodytes*), tatum cave beetle (*Pseudanophthalmus parvus*), and Clifton cave beetle (*Pseudanophthalmus caecus*). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Kentucky is provided below. (USFWS, 2016b)

Table 7.1.6-6: Federally Listed Invertebrate Species of Kentucky

Common Name	Scientific Name	Federal Status	Critical Habitat in Kentucky	Habitat Description
Big Sandy Crayfish	*Cambarus callainus*	Threatened	No	Clean, fast-flowing streams and rivers with slab boulders on substrates of bedrock, cobble, or sand in the Big Sandy River basin. Found in five counties in the easternmost part of Kentucky.
Clubshell	*Pleurobema clava*	Endangered	No	River and streams with clean, loose sand, and gravel; found in central Kentucky.
Cumberland Bean (Pearlymussel)	*Villosa trabalis*	Endangered	No	Small rivers and streams with clean fast flowing water and sand and gravel substrates in riffle and shoal areas; found in southeastern Kentucky.
Cumberland Elktoe	*Alasmidonta atropurpurea*	Endangered	Yes	Medium-sized rivers with mud, sand, and gravel substrates; found in southeastern Kentucky.
Cumberlandian Combshell	*Epioblasma brevidens*	Endangered	Yes	Rivers of swift currents with sand and gravel substrates in riffle and shoal areas; found in southeastern Kentucky.

Common Name	Scientific Name	Federal Status	Critical Habitat in Kentucky	Habitat Description
Fanshell	*Cyprogenia stegaria*	Endangered	No	Large rivers with sand and gravel and moderate current; found throughout Kentucky.
Fat Pocketbook	*Potamilus capax*	Endangered	No	Streams, tributaries, and channels in western Kentucky.
Fluted Kidneyshell	*Ptychobranchus subtentum*	Endangered	Yes	Medium-sized creeks to large rivers: found in southern Kentucky.
Kentucky Cave Shrimp	*Palaemonias ganteri*	Endangered	Yes	Large, base level passages of caves within Mammoth Cave National Park, Kentucky.
Littlewing Pearlymussel	*Pegias fabula*	Endangered	No	Medium size rivers and streams with high gradient and cool clear water; found in southern Kentucky.
Northern Riffleshell	*Epioblasma torulosa rangiana*	Endangered	No	Clean, firmly packed, coarse sand and gravel in riffles and streams; found in central Kentucky.
Orangefoot Pimpleback (Pearlymussel)	*Plethobasus cooperianus*	Endangered	No	Sand and gravel substrate of rivers; found in southwestern Kentucky.
Oyster Mussel	*Epioblasma capsaeformis*	Endangered	Yes	Medium-sized rivers and sometimes large rivers in areas with coarse sand; found in southeastern Kentucky.
Pink Mucket (Pearlymussel)	*Lampsilis abrupta*	Endangered	No	Riffle areas, with a moderate current and mud or sand substrates, throughout Kentucky.
Purple Cat's Paw	*Epioblasma obliquata obliquata*	Endangered/ Non-Essential Experimental Population	No	Shallow water on sand to boulder substrates in a swift current; found within the Green River in southern Kentucky.
Rabbitsfoot	*Quadrula cylindrica cylindrical*	Threatened	Yes	Shallow area of streams and rivers with sand and gravel along the banks; found in the Allegheny forest region in French Creek and in limited areas of the Allegheny and Shenango Rivers.
Ring Pink (Mussel)	*Obovaria retusa*	Endangered	No	Shallow water over silt-free sand and gravel bottoms of large rivers; found in southern Kentucky.
Rough Pigtoe	*Pleurobema plenum*	Endangered	No	Shoal areas of medium to large rivers with sand and gravel river bottoms; found in south-central Kentucky.
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered	No	Shallow shoal areas above coarse sand or gravel in three counties located throughout Kentucky.
Slabside Pearlymussel	*Pleuronaia dolabelloides*	Endangered	No	Large creeks and rivers with sand and gravel bottoms and moderate current; found in Logan County, Kentucky.
Snuffbox Mussel	*Epioblasma triquetra*	Endangered	No	Small to medium sized creeks, lakes, and rivers with swift current over sand and gravel.

Common Name	Scientific Name	Federal Status	Critical Habitat in Kentucky	Habitat Description
Spectaclecase	*Cumberland monodonta*	Endangered	No	Large rivers in firm mud and in sheltered areas (i.e., beneath rock slabs, between boulders, or under tree roots).
Tan riffleshell	*Epioblasma florentina walkeri*	Endangered	No	Sand and gravel river bottoms, typically in swift running shallow water at the source of rivers, streams, and creeks.

Source*:* (USFWS, 2015c) (USFWS, 2015e) (USFWS, 2015r)

Big Sandy Crayfish. The Big Sandy crayfish is a freshwater crustacean that ranges from 3 to 4 inches, with a streamlined body that has two spines. The beak-like part of the shell that extends between its eyes has no spines or bumps. The shell color can be olive brown to light green, with the separation between the head and body outlined in light blue, aqua, or turquoise. The plates covering the abdomen are outlined in red, and the legs are light green to green blue to green in color. Regionally, this species is found in Kentucky, Virginia, and West Virginia. In Kentucky, it can be found in five counties in the easternmost part of the state. (USFWS, 2015s)

It inhabits the Big Sandy River basin in eastern Kentucky, in clean, fast-flowing streams and rivers with slab boulders on substrates of bedrock, cobble, or sand. The main threat to the Big Sandy crayfish is habitat degradation due to land-disturbing activities that increase erosion and sedimentation in their stream habitat. Other threats include degraded water quality and stream dredging. (USFWS, 2015t)

Clubshell. The clubshell is a small to medium size mussel with a yellow to brown shell (USFWS, 1997b). This species was federally listed as an endangered in 1993 (58 FR 5638 5642, January 22, 1993). Regionally, this species is known to occur from Michigan south to Tennessee and Illinois east to New York, with an experimental population in Alabama (66 FR 32250 32264, June 14, 2001) (USFWS, 2015u). Currently the clubshell is known to only occur in five percent of its historical range (USFWS, 1997b). In Kentucky, the clubshell occurs in five counties in the central region of the state (USFWS, 2015u).

Suitable habitat for the clubshell consists of clean, loose sand, and gravel in medium to small rivers and streams. For their reproductive cycle they require stable, undisturbed habitat and sufficient fish hosts to assist in the complete development of the mussel's larval. Current threats to the clubshell include water quality degradation, sedimentation from development, agricultural runoff, and pollution. Additionally, invasive non-native species, such as zebra mussels, are becoming a major threat as they are attacking and killing the clubshell. (USFWS, 1997b).

Cumberland Bean (Pearlymussel). The Cumberland bean is a long, oval shaped freshwater mussel that grows to approximately 2.2 inches. Its shell is smooth and olive green, yellowish to brown, or blackish colored with dark green rays (USFWS, 2011b). The Cumberland bean was federally listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976) and an experimental population was established in Alabama and Tennessee in 2001 and 2007 respectively (USFWS, 2015v). Regionally, this species is known to occur in Alabama, Kentucky, North Carolina, and Virginia. In Kentucky, the Cumberland bean is believed or known to occur in five counties in the southeastern region of the state (USFWS, 2015v).

Suitable habitats for the Cumberland bean consist of small rivers and streams having clean fast-flowing water over sand and gravel substrates. Similar to other mussels, this species' reproduction cycle is tied to the fantail darter (*Etheostoma flabellare*) and striped darter (*Etheostoma virgatum*) as their host fish. Current threats to this species include channelization, impoundments, siltation, and pollution (USFWS, 2011b).

Cumberland Elktoe. The Cumberland elktoe is a freshwater mussel with a thin shell that is yellow brown with green rays (USFWS, 2004b). The species was federally listed as endangered in 1997 (62 FR 1647 1658, January 10, 1997). The species is endemic to the Cumberland River system and is known from Kentucky and Tennessee; in Kentucky, it is believed or known to occur in six counties in the southeastern portion of the state (USFWS, 2015w) (USFWS, 2004b).

Critical habitat for the species has been defined in Rock Creek (McCreary County Kentucky), Big South Fork and tributaries (Fentress, Morgan, and Scott Counties, Tennessee, and McCreary County, Kentucky), Sinking Creek (Laurel County, Kentucky), Marsh Creek (McCreary County, Kentucky), and Laurel Fork (Claiborne County, Tennessee, and Whitley County, Kentucky) (USFWS, 2004c). The Cumberland elktoe is found buried in the main stems of medium-sized rivers, in both shallow pool areas and areas with flowing water, with mud, sand, and gravel substrates. Threats to this species include impoundments, sedimentation, non-point source pollution, and pesticides (USFWS, 2004b).

Cumberlandian Combshell. The Cumberlandian combshell is a freshwater mussel approximately two to three inches long. Its yellow shell is marked by lines of fine green broken dots and dashes (USFWS, 2004b). The species was federally listed as endangered in 1997 (62 FR 1647 1658, January 10, 1997) and designated with critical habitat in 2004 (69 FR 53136 53180, August 31, 2004). In 2001, experimental populations were introduced in portions of the Tennessee River valley of Alabama (66 FR 32250 32264, June 14, 2001). It is known to occur in Alabama, Kentucky, Mississippi, and Virginia (USFWS, 2015bp). In Kentucky, it is known to occur in McCreary County and Pulaski County in the southeastern region of the state. Critical habitat for the Cumberlandian combshell in Kentucky includes Big South Fork and Buck Creek (USFWS, 2004c).

Suitable habitats for the Cumberlandian combshell are shoals in fast moving rivers having sand and gravel substrates (USFWS, 2004b) (USFWS, 2015x). Populations of the Cumberlandian combshell are declining, isolated, and susceptible to fluctuations in water quality and temperature. Historically, the species experienced significant challenges to water quality degradation from coal mining, construction activities, riverine development (such as channelization and building of dams), and collection by pearl hunters (USFWS, 2004b).

Fanshell. The fanshell is a freshwater mussel having a light green to yellow shell with green rays (USFWS, 1991). It was federally listed as endangered in 1990 (55 FR 25591 25595, June 21, 1990). This species is known to occur in Alabama, Illinois, Indiana, Kentucky, Ohio, Virginia, and West Virginia with a non-essential experimental population established in Tennessee in 2007 (72 FR 52434 52461, September 13, 2007) (USFWS, 2015y). In Kentucky, this species is known to occur in 19 counties throughout the state (USFWS, 2015y).

Suitable habitat for the fanshell consists of large moderate flowing rivers with sand and gravel bottoms. This species needs a stable substrate to bury itself in, leaving only its feeding siphons and the edge of its shell exposed. Fanshells require a host fish to complete their larval development as the fanshell larvae attach to the host's gill. Threats to the fanshell include habitat alteration from dams and reservoirs, water quality degradation, siltation, pollution, and industrial runoff (USFWS, 1997c).

Fat Pocketbook. The fat pocketbook is a mussel with a globose shell. This species has as smooth shell that is typically yellowish brown and lacks rays (USFWS, 1989a). This species was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976). Regionally, this species is known or believed to occur in Arkansas, Illinois, Indiana, Kentucky, Louisiana, Mississippi, and Missouri (USFWS, 2015z). In Kentucky, the fat pocketbook occurs in six counties in the western region of the state (USFWS, 2015z). This species is typically found in streams, tributaries, and channels with sand, mud, or gravel, or substrates (USFWS, 2007a).

Threats to this species includes habitat loss and degradation due to water impoundment, channel maintenance, and dredging (USFWS, 2007a). The creation of impoundments in the fat pocketbook's range has inundated habitats and altered water flow (USFWS, 2007a). Dredging may lead to the accidental removal of individuals, increased erosion, and reduce habitat stability (USFWS, 2012g).

Fluted Kidneyshell. The fluted kidneyshell is a large-sized mussel reaching up to 5 inches in length (USFWS, 2013d) (USFWS, 2015aa). The shell is oval, greenish yellow and brownish in color, and appears inflated. The fluted kidneyshell was federally listed as endangered in 2013 (78 FR 59269 59287, October 28, 2013). The species is restricted to the Cumberland River and Tennessee River systems (USFWS, 2013d). In Kentucky, this species is believed or known to occur in eight counties in the southern half of the state (USFWS, 2015aa).

The fluted kidneyshell has been eliminated from more than 50 percent of the total number of streams from which it was historically known, and the current overall population of the species range wide is declining (USFWS, 2013d). In 2013, critical habitat was designated for this species in Tennessee and Kentucky (78 FR 59555 59620, October 28, 2013). In Kentucky, critical habitat consists of segments of Horse Link Creek, Middle Fork Rockcastle River, Rockcastle River, Buck Creek, Rock Creek, Little South Fork Cumberland River, and Big South Fork Cumberland River (USFWS, 2013e).

The fluted kidneyshell occurs in medium-sized creeks to large rivers, inhabiting sand and gravel substrates in relatively shallow riffles and shoals with fast or swift current. Species threats include dams/impoundments, mining activities, poor water quality, excessive sedimentation, and environmental contaminants (USFWS, 2013d).

Photo Credit: USFWS

Kentucky cave shrimp

Kentucky Cave Shrimp. The Kentucky cave shrimp is a small freshwater crustacean that grows up to 1.2 inches in total length. This species lacks pigment and eyesight (USFWS, 2010). The Kentucky cave shrimp was listed as endangered in 1983 (48 FR 46337 46342, October 12, 1983). Regionally, the Kentucky cave shrimp is believed or known to occur in four counties in south-central Kentucky (USFWS, 2015ab). This species is endemic to the Mammoth Cave National Park region in Kentucky. Critical habitat was designated for the Kentucky cave shrimp in 1983 (48 FR 46337 46342, October 12, 1983). Critical habitat consists for this species consists of a segment of the Roaring River within Mammoth Cave National Park (USFWS, 1983).

Habitat requirements for this species include "large, base level passages of caves characterized by slow flow, abundant organic matter, and coarse to fine grain sand and coarse silt sediments" (USFWS, 2010). The primary threat to this species is groundwater contamination. Contamination can be caused by runoff and seepage from auto accidents, agricultural operations, industrial operations, and wastewater treatment plants (USFWS, 2010).

Littlewing Pearlymussel. The littlewing pearlymussel is a freshwater mussel that grows up to 1.5 inches. The shell of this species is light green or dark yellowish with dark rays, with a chalky appearance (USFWS, 2015ac). The littlewing pearlymussel was federally listed as endangered 1988 (53 FR 45861 45865, November 14, 1988) (USFWS, 2015bo). Historically, the littlewing pearlymussel was known to occur in numerous rivers associated with the Tennessee and Cumberland River systems. It is known to occur in Alabama, Kentucky, North Carolina, and Virginia (USFWS, 1989b). In Kentucky, this species is currently believed or known to occur in four counties in the southern region of the state (USFWS, 2015bn).

Suitable habitats for the littlewing pearlymussel consist of medium sized rivers and streams with cool clear water. Usually, these mussels are found behind large rocks. Specific factors for the decline of populations is not known but is believed that threats are similar to other mussels which include dams, dredging, and water quality degradation (USFWS, 1989b) (USFWS, 2015ac).

Northern Riffleshell. The northern riffleshell is a small brownish yellow to yellowish green freshwater mussel that can grow up to three inches long (USFWS, 1994b). It was federally listed as endangered in 1993 throughout its range (58 FR 5638 5642, January 22, 1993). It is regionally known to occur in Indian, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia (USFWS, 2015ad). In Kentucky, this species is believed or known to occur in three counties in the central region of the state (USFWS, 2015ad).

The preferred habitat for this species is clean, firmly packed, coarse sand and gravel in riffles and streams. For its reproduction lifecycle it requires a stable, undisturbed habitat, and a sufficient source of host fish. The current threats to the survival of the northern riffleshell include dams and reservoirs as they reduce sand and gravel in habitats, as well as, affects the distribution of host fish. The non-native zebra mussels has also become a major threat as they are spreading rapidly and killing the northern riffleshell (USFWS, 1997d).

Orangefoot Pimpleback (Pearlymussel). The orangefoot pimpleback, also known as the orange-footed pearlymussel, measures between 3.5 and 4 inches long, with a large and heavy shell marked by irregular growth rings and numerous bumps on its yellowish brown to chestnut brown surface (USFWS, 1984b).

It was among the first invertebrate species to gain federal protection in 1976, under the Endangered Species Act (41 FR 24062 24067, June 14, 1976). A non-essential experimental population was established in 2007 (72 FR 52434 52461, September 13, 2007).

This species is known or believed to occur in Alabama, Illinois, and Kentucky, with a non-essential experimental population in Tennessee. In Kentucky, this species occurs in four counties in the southwestern region of the state (USFWS, 2015ae).

The orangefoot pimpleback buries itself in the bottom of rivers in sand and gravel areas with only its feeding siphons and the edge of its shell remaining above the substrate. As larvae, it is parasitic and attaches itself to the gills of a host fish until it has grown a shell (USFWS, 2015af). Threats to this species include dams and reservoirs, which separate upstream and downstream populations and eliminate sand and gravel substrate, siltation from industrial activity and development, and pollution from agricultural and industrial runoff (USFWS, 2015af) (USFWS, 1984b).

Oyster Mussel. The Oyster mussel is distinguishable by its dull to sub-shiny, yellowish-green shell with numerous narrow dark green streaks (62 FR 1647 1658, January 10, 1997)(USFWS, 2015ag) (DOI, 1997). The inside of the shell is whitish to bluish-white in color. The oyster mussel was federally listed as endangered in 1997 (62 FR 1647 1658, January 10, 1997) and criticl habitat was designated in 2004 (69 FR 53136 53180, August 31, 2004).

This species historically occurred throughout much of the "Cumberlandian" region of the Tennessee and Cumberland River drainages in Alabama, Kentucky, Tennessee, and Virginia. By 1991, the oyster mussel was considered to be extremely rare, with small populations located in streams of the Tennessee River system (USFWS, 2004b). Nonessential experimental populations were created in 2001 in Alabama, and in 2007 in Tennessee (USFWS, 2015ag).

In Kentucky, this species is believed or known to occur in McCreary County and Pulaski County in the southeastern region of the state (USFWS, 2015ag). Critical habitat in Kentucky consists of segments of Big South Fork and Buck Creek (USFWS, 2004c). The oyster mussel inhabits small to medium-sized creeks and sometimes large rivers, in areas with coarse sand to boulder substrate and moderate to swift currents. Species threats include habitat loss from human-induced water quality degradation, including dams/impoundments, channelization, and mining activities, resulting in deforestation, industrial contamination, sedimentation in the upper Tennessee River system (USFWS, 2004b).

Pink Mucket (Pearlymussel). The pink mucket has a smooth yellowish-brown colored round shell that is approximately 4 inches long. This species was federally listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976). The pink mucket was historically known to occur from Oklahoma east to Virginia and Illinois south to Louisiana, however, due to different factors the populations of these species have decreased and are now only known to occur in small populations in Alabama, Arkansas, Illinois, Kentucky, Louisiana, Missouri, Ohio, and Virginia (USFWS, 1985).

In Kentucky, this species is believed or known to occur in eight counties throughout the state (USFWS, 2015ai). Suitable habitat for the pink mucket consists of moderate to fast-flowing rivers and their tributaries with mud and sand in shallow riffle areas. Threats to the survival of this species include dams that disrupt the natural flow, impoundment, and water quality degradation (USFWS, 2015aj).

Purple Cat's Paw. The purple cat's paw is a freshwater mussel with a medium-sized shell that is that is almost square in shape. The outer skin is smooth and shiny, has distinct growth lines, and is yellowish-green, yellow, or brownish in color with fine, faint, wavy green rays. The interior of the shell is purplish to deep purple in color (USFWS, 1992). The purple cat's paw was federally listed as endangered in 1990 (55 FR 28209 28213, July 10, 1990), with a non-essential experimental population established in 2001 (66 FR 32250 32264, June 14, 2001).

Regionally, this species occurs in Alabama, Kentucky, and Ohio. In Kentucky, this species occurs in the Green River in Butler County and Warren County (USFWS, 1999) (USFWS, 2015ak). The nonessential experimental population occurs in Alabama, Illinois, Kentucky, and Ohio (USFWS, 2015ak). The purple cat's paw inhabits shallow water on sand to boulder substrates in a swift current to avoid being buried in silt. Threats to this species include reproduction difficulty due to its rarity, gravel dredging of rivers, pollution due to runoff from agricultural practices, and the spread of Zebra mussels, an exotic invasive species (USFWS, 2015al).

Rabbitsfoot. The rabbitsfoot can grow up to 6 inches in length. The shell of the rabbitsfoot is generally yellowish, greenish, or olive in color and turns yellowish brown with age (USFWS, 2015am). The rabbitsfoot was federally listed as threatened in 2013 (78 FR 57076 57097, September 17, 2013). It has been estimated that these mussels have been eliminated from about 64 percent of its existing historical range and only about 10 of the populations that exists are considered to be large enough to be viable for long term. It occurs in 13 states (USFWS, 2011c).

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, 2011c).

Critical habitat was designated in 2015 at 31 stream segments where the mussels are known to occur (80 FR 24691 24774, April 30, 2015) (Figure 7.1.6-2). Critical habitat for the rabbitsfoot mussel is located along three rivers: 22.1 miles of the Tennessee River, from Kentucky Lake Dam to its confluence with the Ohio River in McCracken and Livingston Counties; 28.5 miles of the Ohio River from the confluence with the Tennessee River into Illinois in McCracken and Ballard Counties; and 109.1 miles of the Green River from the Green River Lake Dam to the Mammoth Cave National Park in Edmonson, Green, Hart, and Taylor Counties (USFWS, 2015an). The current threats to the rabbitsfoot mussel include the loss of habitat, isolation of populations, range restrictions, sedimentation, and presence of exotic non-native species (USFWS, 2011c).

Ring Pink (Mussel). The ring pink mussel is a freshwater mussel with a thick oval shell measuring about 3 to 4 inches in length and height, and living up to 50 years or more. The yellow-green to brown-black outer shell is darker colored in older specimens and does not have rays. The inner shell is a pink to deep purple color with a white border(USFWS, 2004d). The ring pink mussel was federally listed as endangered in 1989 (54 FR 40109 40112, September 29, 1989).

The endangered population of this species occurs in Alabama, Tennessee, and Kentucky. In Kentucky, this species is believed or known to occur in six counties in the southern half of the state (USFWS, 2015ao). It inhabits shallow water over silt-free sand and gravel bottoms of large rivers. Threats to the ring pink mussel result from its restricted range and small population numbers, gravel dredging of rivers, and pollution (USFWS, 2015ap).

Rough Pigtoe. The rough pigtoe is a thick-shelled, triangular-shaped freshwater mussel. The mussel appears inflated, and has a dirty-yellow or rust-colored shell marked by uneven growth markings. The rough pigtoe was federally listed in 1976 (41 FR 24062 24067, June 14, 1976). It is only known to occur in five streams around the Mississippi watershed, including the Tennessee, Cumberland, Clinch, Green, and Barren Rivers (USFWS, 1984c).

Regionally, the species' range extends from western Virginia to north Alabama and southern Indiana. In Kentucky, this species is believed or known to occur in five counties in the south-central region of the state (USFWS, 2015aq). The rough pigtoe is primarily observed in shoal areas of medium to large rivers, burying itself in the sand or gravel river bottom. Threats to the rough pigtoe include damming, the buildup of sediments, and pollution which result in habitat degradation for the species (USFWS, 1984c). A recent threat includes suffocation and competition from the zebra mussel (*Dreissena polymorpha*), which reproduces rapidly and at a high rate (USFWS, 2015ar).

Sheepnose Mussel. The sheepnose mussel grows about 5 inches with a light yellow to dull yellowish brown color shell having darker ridges (USFWS, 2012c). After multiple status reviews since 2004, the USFWS listed the sheepnose mussel as endangered in 2012 (77 FR 14914 14949, March 13, 2012). This species historically occurred mostly along the Mississippi River, and populations can now be found in Alabama, Illinois, Indiana, Iowa, Kentucky, Minnesota, Missouri, Ohio, Pennsylvania, Virginia, West Virginia, and Wisconsin (USFWS, 2012c) (USFWS, 2015as). In Kentucky, the species is believed or known to occur in three counties throughout the state (USFWS, 2015as).

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

Slabside Pearlymussel. The slabside pearlymussel has brownish colored shells with green rays, and grows to about 3.5 inches (USFWS, 2012e). After multiple status reviews, the USFWS listed the slabside pearlymussel as endangered in 2013 (78 FR 25041 25044, April 29, 2013). Regionally, this species is known to occur only in the Tennessee and Cumberland River systems within the states of Alabama, Kentucky, Mississippi, Tennessee, and Virginia (USFWS, 2012e). In Kentucky, this species occurs in Logan County (USFWS, 2015au). In 2013, critical habitat was designated for this species in Virginia, Tennessee, Alabama, and Mississippi (78 FR 59555 59620, September 26, 2013).

The preferred habitat for the slabside pearlymussel consists of large creeks and moderate-sized rivers with sand and gravel bottoms and moderate current. The slabside pearlymussel, as most other mussel, are always at the bottom of relatively shallow creeks and rivers feeding on diatoms, algae and other microorganisms. The slabside pearlymussel is a summer brooder; once larvae are released from the females starting in mid-May to August, they must attach to a fish host to be fully developed by mid-summer (USFWS, 2012e).

The primary threat to the survival of the slabside pearlymussel is the loss and degradation of suitable habitats. River impoundments are the major cause of this decline. These activities change the temperature of water, alter the natural flow, and decrease the abundance of host fish. Water quality degradation from polluted discharges, runoff, and siltation us also threatening the survival of the species (USFWS, 2012e).

Snuffbox Mussel. The snuffbox mussel grows from 1.8 to 2.8 inches in length with a yellow, green, or brown triangular to oval shell with green rays (USFWS, 2012d). This species was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012). The snuffbox total population has reduced by 62 percent from its historical range. Currently this species only occurs in 79 streams and 14 rivers compared to 210 streams and lakes in its historical range (USFWS, 2012d). It still occurs in 14 states, including 17 counties in Kentucky (USFWS, 2015at).

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

Spectaclecase. The spectaclecase mussel is a large (up to 9 inches long) freshwater mussel. Its brownish to black shell is large with a somewhat curved appearance and moderate inflation. This species was first listed as federally endangered in 2012 (77 FR 14914 14949, March 13, 2012). The spectaclecase mussel has suffered a 55 percent decrease in distribution and presently only occurs in 20 of the 44 streams it once inhabited. Most populations are now fragmented and limited to short reaches of streams in the 11 states it occurs: Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky, Minnesota, Missouri, Tennessee, Virginia, and Wisconsin. The spectacle case is believed to be found in 13 counties in Kentucky, including: Barren, Butler, Edmonson, Green, Hart, Jefferson, Livingston, Marshall, McCracken, McCreary, Pulaski, Warren, and Wayne; however, its range is fragemented and restrited to short stream reaches. (USFWS, 2015bm) (USFWS, 2016c)

Suitable habitat for the spectaclecase mussel includes sheltered areas in large rivers. This species seeks out areas that are sheltered from the force of the river current beneath rock slabs, in firm mud banks, and in between tree roots. Spectaclecase mussels are long-lived and spend their entire adult lives partially or completely embedded in river bottom substrate; some specimens have been estimated to be up to 70 years old. This species of mussel has a parasitic life stage and is dependent on a host fish for successful rearing and relocation of larvae young. The current major threat to the survival of this species is dam construction. Dams alter the natural flow and temperature regime of rivers, blocking fish passage which is necessary to prevent fragmentation and connect populations. Sedimentation of rivers, pollution, channelization, and invasive zebra mussels also pose threats to this species (USFWS, 2015bm).

Tan riffleshell. The endangered Tan rifflesheel (*Epioblasma florentina walkeri*) is a medium size freshwater mussel with a brown to yellow shell that was believed to be extinct prior to survey work in the mid-1980's when it was re-discovered. The mean length of Tan rifflesheel populations found in the Big South Fork River of Kentucky are approximately 1.7 inches. (USFWS, 2013h)

The Tan riffelshell is known to occur in the Big South Fork River and its tributaries and in the counties of McCreay, Pulaski, and Wayne in Kentucky. Fragmentation and isolation of Tan riffleshell populations from dams and sedimentation pose threats to the species, incuding activities that introduce eroded soil into Tan riffleshell streams (e.g., coal mining activities, gas exploration, well development, unpaved roads, and agriculture). (USFWS, 2013h) (USFWS, 2016d)

Plants

Five endangered, five threatened, and one proposed threatened plant species are federally listed for Kentucky as summarized in Table 7.1.6-7. The Kentucky glade cress (Leaven*worthia exigua laciniata*) and running buffalo clover (*Trifolium stoloniferum*) can be found in the northern region of the state, while the Short's bladderpod (*Physaria globosa*) and Braun's rock-cress (*Arabis perstellata*) can be found in the north-central region of the state. The Cumberland rosemary (*Conradina verticillata*), Cumberland sandwort (*Arenaria cumberlandensis*), and Short's goldenrod (*Solidago shortii*) can all be found in the southeastern region of Kentucky. The Virginia spiraea (*Spiraea virginiana*) can be found in the eastern region of the Kentucky, while the white-haired goldenrod (*Solidago albopilosa*) can be found in the east-central region of the state. The Price's potato-bean (*Apios priceana*) can be found in the south western region of the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Kentucky is provided below. (USFWS, 2016b)

Table 7.1.6-7: Federally Listed Plant Species of Kentucky

Common Name	Scientific Name	Federal Status	Critical Habitat in Kentucky	Habitat Description
Braun's Rock-cress	*Arabis perstellata*	Endangered	Yes	Slopes of calcareous mesophysic and sub-xeric forest types, often around rock outcrops; found in three counties in north-central Kentucky.
Cumberland Rosemary	*Conradina verticillata*	Threatened	No	Sandy or gravelly stream banks, sandbars, and gravel/boulder bars associated with floodplains or islands; found in McCreary County in southeastern Kentucky.
Cumberland Sandwort	*Arenaria cumberlandensis*	Endangered	No	Sandstone rock ledges and sandstone "rock houses" within the Big South Fork watershed; found in McCreary County in southeastern Kentucky.
Kentucky Glade Cress	*Leavenworthia exigua laciniata*	Threatened	Yes	Limestone glades with shallow soil; found in Jefferson and Bullitt counties, Kentucky.
Price's Potato-bean	*Apios priceana*	Threatened	No	Open, wooded areas, in forest gaps and in open, low areas near streams and rivers; found in southwestern Kentucky.
Running Buffalo Clover	*Trifolium stoloniferum*	Endangered	No	Disturbed mesic habitats with filtered sunlight in northern Kentucky.
Short's Bladderpod	*Physaria globosa*	Endangered	Yes	Steep, rocky wooded slopes, fragmented rock areas, and along the tops, bases, and ledges of cliffs and bluffs; found in north-central Kentucky.
Short's Goldenrod	*Solidago shortii*	Endangered	No	A variety of dry and mostly open areas in full sun or partial shade; found in southeastern Kentucky.
Virginia Spiraea	*Spiraea virginiana*	Threatened	No	Rocky often flood scoured banks of high velocity streams and rivers; found along the Appalachian Mountains in eastern Kentucky.
White-haired Goldenrod	*Solidago albopilosa*	Threatened	No	Partially shaded areas behind the dripline of rock ledges in the Red River Gorge; found in east-central Kentucky.

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

Braun's Rock-cress. The Braun's rock-cress (*Arabis perstellata*) is a perennial plant endemic to north-central Kentucky and north-central Tennessee. The species reaches approximately 31 inches in height with leaves up to 2 inches long and small white or lavender flowers. The stem and leaves are covered by white hairs. The plant flowers from March to May (USFWS, 1997f). The Braun's rock-cress was listed as endangered in 1995 (60 FR 56 61, January 3, 1995). In Kentucky, the species is known to occur in Franklin, Owen, and Henry Counties; critical habitat for the species has been identified at seventeen locations in Franklin County and Owen County (USFWS, 2015av).

Suitable habitat for this species consists of "slopes of calcareous mesophysic and sub-xeric forest types" (USFWS, 1997f). This species is frequently found around rock outcrops. Threats to Braun's rock-cress include disturbance from construction/development, competition from invasive/exotic plants, and grazing or other direct disturbance (USFWS, 1997f).

Cumberland Rosemary. The Cumberland rosemary is an evergreen shrub known from the Cumberland Plateau province in Kentucky and Tennessee. The species is in the mint family and has aromatic leaves and pinkish flowers (USFWS, 1996a). Cumberland rosemary was listed as threatened in 1991 (56 FR 60937 60941, November 29, 1991). In Kentucky, this species is known to occur in McCreary County in the southeastern region of the state (USFWS, 2015aw).

Suitable habitat for this species consists of sandy or gravelly stream banks, sandbars, and gravel/boulder bars associated with floodplains or islands. Periodic flooding is important to maintain openness and enhance sand deposition (USFWS, 1996a). Threats to Cumberland rosemary include dam construction, human disturbance from recreation and oil/gas mining, and natural disturbances/competition (USFWS, 1996a).

Cumberland Sandwort. The Cumberland sandwort is a perennial plant known from the Cumberland Plateau province in Kentucky and Tennessee. The species grows to 6 inches tall in tufts, with white flowers and narrow leaves up to about 1 inch long. The species flowers in July through August (USFWS, 1996b). Cumberland sandwort was listed as endangered in 1988 (53 FR 23745 23748, June 23, 1988). In Kentucky, this species is known to occur in McCreary County in the southeastern region of the state (USFWS, 2015ax).

Suitable habitat for this species consists of sandstone rock ledges and sandstone "rock houses" within the Big South Fork watershed. Threats to Cumberland sandwort include human disturbance from recreation and timber activities (USFWS, 1996a).

Kentucky Glade Cress. The Kentucky glade cress is an annual species that is approximately 2 to 4 inches tall. This species has flowers with four petals that are white to lilac in color and occur on a leafless stems. The leaves occur on thin stems that are arranged in a rosette (USFWS, 2015ay). The Kentucky glade cress was listed as threatened in 2014 (79 FR 25683 25688, May 6, 2014).

Regionally, this species is endemic to Kentucky and occurs in Bullitt and Jefferson Counties. The Kentucky glade cress is adapted to shallow soils and can be found growing in limestone glades (USFWS, 2013f). This species is typically found in areas of limestone glades near to rock outcrops where gravelly soil is present (USFWS, 2013f). In 2014, six units in Jefferson and Bullitt Counties were designated as critical habitat for this species (79 FR 25689 25707, May 6, 2014). Primary threats to this species include habitat loss and degradation due to development and land conversion. Conversion of limestone glades to residential property, lawns, golf courses, pastures, and industrial property has reduced to amount of suitable habitat available to the Kentucky glade cress (USFWS, 2013f).

Price's Potato-bean. The Price's potato-bean is a perennial vine with leaves measuring 8 – 12 inches long, alternate, and composed of 5 to 9 leaflets. The greenish-white or brownish pink flowers are tipped with magenta and measure 0.4 inches long, blooming from mid-July to mid-

August (USFWS, 1993b). The Price's potato-bean was listed as threatened in 1990 (55 FR 429 433, January 5, 1990). Its habitat is comprised of open, wooded areas, in forest gaps and in open, low areas near streams and rivers, and prefers lightly disturbed area (USFWS, 1993b) (USFWS, 2015az). Regionally, this species can be found in Alabama, Illinois, Kentucky, Mississippi, and Tennessee. In Kentucky, this species occurs in four counties in the southwestern region of the state (USFWS, 2015ba).

The narrow habitat requirements of this species mean that habitat succession and lack of regular, light disturbance threaten populations. Major threats to this species include cattle, which graze and trample the plant, timber harvesting, and herbicides, especially in rights-of-way where this species has been known to flourish (USFWS, 1993b) (USFWS, 2015az).

Running Buffalo Clover. The running buffalo clover is a perennial species with leaves exhibiting three leaflets and white flowers that are about 1 inch wide (USFWS, 2015bb). This species produces runners which extend horizontally from the base of stems and can produce roots at every node (USFWS, 2015bb). The running buffalo clover was federally listed as endangered in 1987 (52 FR 21478 21481, June 5, 1987).

The running buffalo clover is known or believed to occur in Arkansas, Indiana, Kentucky, Missouri, Ohio, and West Virginia. In Kentucky, the running buffalo clover is known to occur in 15 counties in the northern half of the state (USFWS, 2015bc). This species prefers disturbed mesic habitats with filtered sunlight, however this species has been located in a variety of other habitat types. The main threat to this species is direct and indirect human disturbance (USFWS, 2011d). Human disturbance that impacts this species includes development, removal of wildlife, and the introduction of non-native species (USFWS, 2011e).

Short's Bladderpod. The Short's bladderpod is a plant in the mustard family that can grow up to 20 inches in height. It gets its name from the globe-shaped fruits it produces. Small yellow flowers grow in clusters on top of solitary or groups of stems from April to June (USFWS, 2015bd). The Short's bladderpod was federally listed as endangered in 2014 (79 FR 44712 44718, August 1, 2014). Regionally, this species is known or believed to occur in Indiana, Kentucky, and Tennessee. In Kentucky, it is known to occur in 11 counties in the north-central portion of the state (USFWS, 2015be). Critical habitat was established in 2014 (79 FR 50989 51039, August 26, 2014) in Franklin, Clark, and Woodford Counties in Kentucky (USFWS, 2014d).

It inhabits steep, rocky wooded slopes, fragmented rock areas, and along the tops, bases, and ledges of cliffs and bluffs. It usually grows near rivers or streams and on south to west facing slopes. Threats to the Short's bladderpod include construction and maintenance of roads, soil erosion due to flooding and water level manipulation, shading due to forest succession, and competition due to invasive, nonnative place species (USFWS, 2014e).

Short's Goldenrod. The Short's goldenrod is a perennial herb with a single or multiple ribbed stems growing from 1.5 to 4 feet in height. The leaves grow alternately and crowded, and are largest near the middle of the stem, becoming smaller towards the top. The small, yellow flowers grow in groups of 10 to 14 on small stalks (USFWS, 1988b). The Short's goldenrod was federally listed as endangered in 1985 (50 FR 36085 36089, September 5, 1985).

Regionally, it is known or believed to occur in Indiana and Kentucky. In Kentucky, this species occurs in four counties in the northeastern region of the state (USFWS, 2015bf). It inhabits a variety of dry and mostly open areas in full sun or partial shade. It usually grows in cedar glades, open eroded areas, and woodland edges. Threats to the Short's goldenrod include competition from exotic invasive species, an increase in visitors to the Blue Licks Battlefield State Resort Park, and further changes in land use such as agricultural practices, succession, and construction (USFWS, 2007b)

Virginia Spiraea. The Virginia spiraea is a perennial shrub species with many branches. The shrub ranges in height from 3 to 7 feet tall with elliptic leaves 2 to 3 inches long. The shrub's white flowers appear in June and July at the ends of branches (WVDNR, 2015). The Virginia spiraea was first listed as threatened in 1990 (55 FR 24241 24247, June 15, 1990). Regionally, this species occurs along 24 stream systems in Georgia, Tennessee, North Carolina, Kentucky, West Virginia, Virginia, and Ohio. In Kentucky, it is known to occur in six counties along the Appalachian Mountains in the eastern half of the state (USFWS, 2015bg).

The Virginia spiraea inhabits rocky often flood scoured banks of high velocity streams and rivers. It is believed that scour is important to the species as it discourages tree growth and prevents canopy closure. Flood frequency and intensity have a large influence on development of suitable habitat for the species. Major threats to the species include dam and reservoir construction that remove or eliminate the species habitat altogether. Damage to the plants from people using the river for recreation is another common threat. Physical damage to the plant stems from hikers, fishermen, boaters, and rafters has been observed at many documented sites of Virginia spiraea. This activity is often a result of an attempt to clear the river bank for fishing or camping sites (USFWS, 2015bg) (WVDNR, 2015).

White-haired Goldenrod. The white-haired goldenrod is a perennial species that can grow to a height of approximately 12 to 39 inches. The leaves of this species are dark green on top and pale on the bottom and are 2.5 to 4 inches long. Larger leaves occur at the base of the stem and get smaller are they get closer to the top of the stem. White hairs cover both sides of the leaves and all of the stems. The flowers of the white haired goldenrod are yellow and occur in clusters (USFWS, 2015bh). This species was listed as threatened in 1988 (53 FR 11612 11615, April 7, 1988) and was proposed for delisting in 2015 (80 FR 52717 52732, September 1, 2015).

This species is endemic to Kentucky and occurs in three counties in the east-central region of the state (USFWS, 2015bi) (USFWS, 1993c). The white-haired goldenrod is restricted to partially shaded areas behind the dripline of rock ledges in the Red River Gorge (USFWS, 2015bh). The primary threat to this species is trampling by hikers and archeologists. Trampling can damage plants, seeds, and underground rhizomes which reduces plant growth and distribution. (USFWS, 1993c)

7.1.7. Land Use, Recreation, and Airspace

7.1.7.1. Definition of the Resource

The following summarizes major land uses, recreational venues, and airspace considerations in Kentucky, 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” (FAO, 2000). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth’s surface; land cover includes vegetation and man-made development (USGS, 1976).

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. (OECD, 2017)

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

Airspace

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

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

The FAA Air Traffic Services Unit (the Unit) manages the National Airspace System (NAS) and international airspace assigned to U.S. control and is responsible for ensuring efficient use, security, and safety of the nation's airspace. FAA field and regional offices (e.g., Aircraft Certification Offices, Airports Regional Offices, Flight Standards District Offices [FSDOs], Regional Offices & Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (FAA, 2015d) (FAA, 2016a). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

7.1.7.2. Specific Regulatory Considerations

Land use planning in Kentucky 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 Kentucky state laws that would alter the existing conditions relating to airspace for this PEIS. There are state statutes that address structures built on or near an airport. Kentucky Revised Statutes 183, Aviation, Part 183.861, of Title XV - Roads, Waterways, and Aviation authorizes the Kentucky Airport Zoning Commission to approve and permit the land within and around "all military airports in the Commonwealth; all public-use airports, heliports, and seaplanes bases in the Commonwealth; and all state-licensed, private-use airports which have a paved runway in excess of two thousand nine hundred (2,900) feet" (Kentucky Legislature, 2015a) (KYTC, 2015b).

7.1.7.3. Land Use and Ownership

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

Land Use

Table 7.1.7-1 identifies the major land uses by coverage type in Kentucky. Forests and woodlands comprise the largest portion of land use, with 53 percent of the land area in Kentucky occupied by this category. Agricultural land is the second largest area of land use, with 33 percent of the total land area. Developed areas account for approximately seven percent of the total land area in Kentucky. The remaining percentage of land includes public land and other land cover (Table 7.1.7-1) that are not associated with specific land uses. (USGS, 2011)

Table 7.1.7-1: Major Land Use in Kentucky by Coverage Type

Land Use	Square Miles	Percent of Land
Forest and Woodland	21,515	54%
Agricultural Land	13,310	34%
Developed Land	2,793	7%

Source: (USGS, 2011)

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 in the Cumberland Mountain geographic region. This area is comprised of mountainous regions covered by deciduous and coniferous forests. Many hardwood species occur in Kentucky's eastern forests, such as ash, elm hickory, maple, and oak. Section 7.1.6 presents additional information about terrestrial vegetation. The remaining percentage of land includes public land, surface water, and other land covers, shown in Figure 7.1.7-1, that are not associated with specific land uses (USGS, 2011).

National Forests

National forests in Kentucky comprise approximately six percent of the state's total forestland, and include two national forests: Daniel Boone National Forest and a portion of the Jefferson National Forest. These national forests occur in the eastern portion of the state, covering 984 square miles (USGS, 2014e). The forests are managed for multiple uses and values, including recreation activities (e.g., camping, hiking), timber production, and maintenance of fish and wildlife habitat.

State Forests

The Kentucky Department for Natural Resources (KDNR), Division of Forestry manages 10 state forests, which are scattered across the state and cover approximately 75 square miles. These forests are managed for multiple uses and values, including timber production, hiking, wildlife viewing, hunting, fishing, and fish and wildlife habitat protection. Table 7.1.7-2 presents the names and associated square miles of each of the 10 state forests (KDNR, 2015b).

Table 7.1.7-2: Kentucky State Forests

State Forest	Square Miles
Big Rivers Wildlife Management Area and State Forest	10.5
Green River State Forest	1.7
Kentenia State Forest	6.4
Kentucky Ridge State Forest	23.8
Knobs State Forest and Wildlife Management Area	2.4
Marion County Wildlife Management Area and State Forest	2
Marrowbone State Forest and Wildlife Management Area	3.1
Pennyrile State Forest	22.9
Rolleigh Peterson Educational Forest	0.2

State Forest	Square Miles
Tygarts State Forest	1.5
Total	**74.5**

Source: (KDNR, 2015b)

Private Forest and Woodland

The large majority of Kentucky's forests and woodlands (approximately 91 percent) are owned by private individuals (78 percent) and private companies and corporations (13 percent) (KDNR, 2015c). Private forestlands 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 7.1.6, Biological Resources and Section 7.1.8, Visual Resources.

Agricultural Land

Agricultural land exists throughout the state on 13,310 square miles, or 33 percent of the total land area (Figure 7.1.7-1) (USGS, 2011). Approximately 77,064 farms exist in Kentucky, with an average size of 1.5 square miles (USDA, 2012a). Kentucky's top agricultural products are grains, oilseeds, beans, and peas (33 percent of total agricultural receipts); poultry and eggs (22 percent of total agricultural receipts); cattle and calves (20 percent of total agricultural receipts); and tobacco (seven percent of total agricultural receipts) (USDA, 2012b).

Developed Land

Developed land in Kentucky is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 7.1.7-1). Although only seven percent of Kentucky's land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 7.1.7-3 lists the top five developed metropolitan areas within the state and their associated population estimates.

Table 7.1.7-3: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Louisville-Jefferson County, KY/IN	832,366
Cincinnati, OH/KY/IN	328,060
Lexington-Fayette, KY	290,263
Bowling Green, KY	78,306
Elizabethtown-Radcliff, KY	73,467
Total State Population	**4,413,457**[a]

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

[a] The population estimate for 2016 was 4,436,974. (U.S. Census Bureau, 2017)

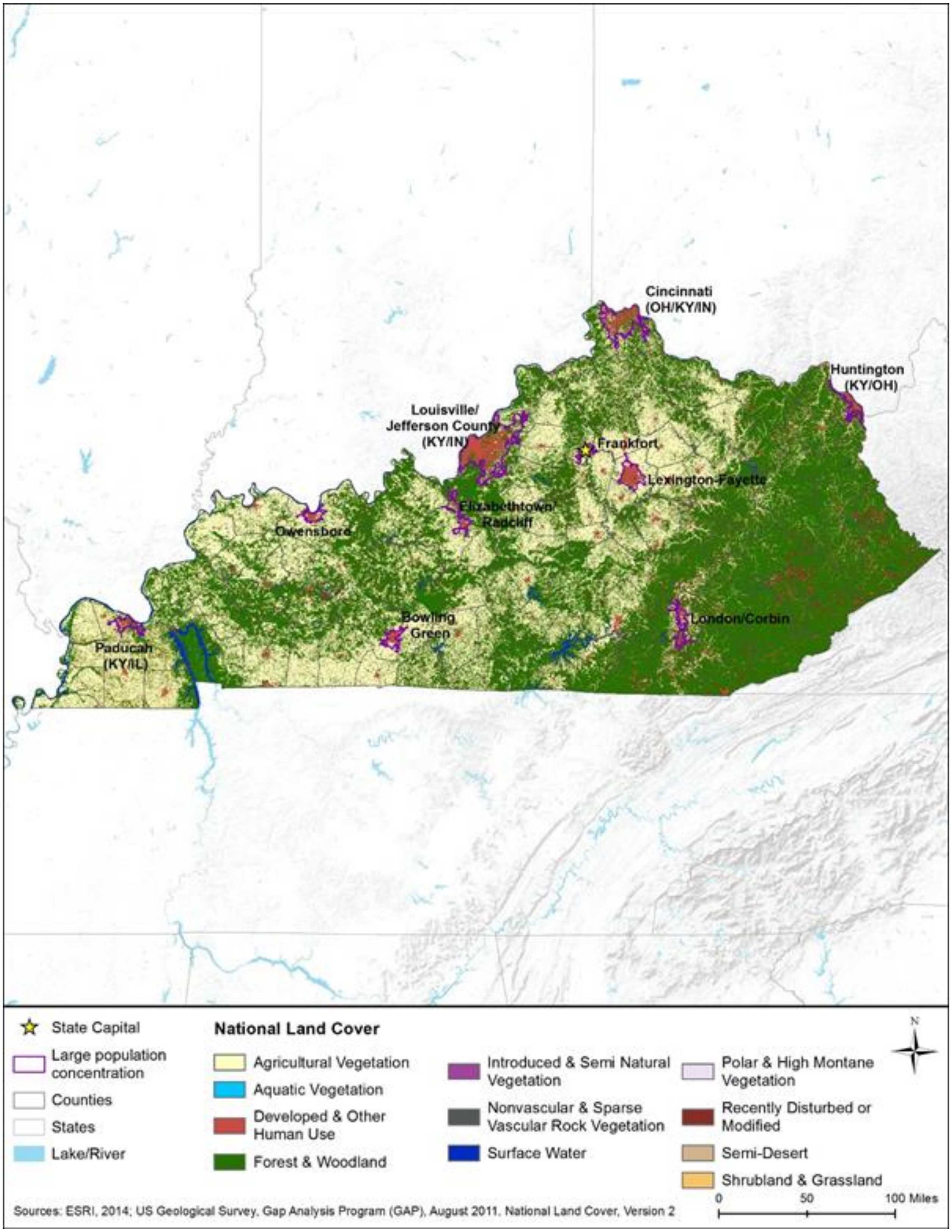

Figure 7.1.7-1: Major Land Use Distribution by Coverage Type

Land Ownership

Land ownership within Kentucky has been classified into four main categories: private, federal, state, and tribal (Figure 7.1.7-2). [94]

Private Land

The large majority of land in Kentucky is privately owned (approximately 40,161 square miles or 94 percent of the total land in the state) (Figure 7.1.7-2), with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 7.1.7-1) (USGS, 2014f). 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.[95]

Federal Land

The federal government manages 1,916 square miles, or approximately five percent, of land in Kentucky, including national forests, national and historic parks, national wildlife refuges, and military facilities (Figure 7.1.7-2) (USGS, 2014e). Five federal agencies manage the majority of federal lands throughout the Kentucky (Table 7.1.7-4 and Figure 7.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.

Table 7.1.7-4: Federal Land in Kentucky

Agency	Square Miles	Representative Type
U.S. Forest Service (USFS)	1,250	Forests and Wilderness
Department of Defense (DoD)	495	Military Installations and Lakes
NPS[a]	147	National and Historic Parks and Recreation Area
USFWS	14.5	Wildlife Refuges
Tennessee Valley Authority (TVA)	9.7	Lake
Total	**1,916.2**	

Source: (USGS, 2014f)

[a] Additional trails and corridors pass through Connecticut that are part of the National Park System.

[94] 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.

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

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

- The USFS manages 1,250 square miles of land comprised of the Daniel Boone and Jefferson National Forests and the Land between the Lakes National Recreation Area (USGS, 2014f).
- The Department of Defense (DoD) (including the USACE) manages 495 square miles of land and surface water comprised of Fort Campbell, Fort Knox, the Lexington-Blue Grass Army Depot, and 11 lakes (Barkley, Dale Hollow, Cumberland, Rough River, Cave Run, Laurel River, Buckhorn, Carr Fork, Fishtrap, Dewey, and Grayson Lakes) (USGS, 2014f).
- The NPS manages 147 square miles of land comprised of four National Parks and two NPS affiliated areas.
- The USFWS manages 14.5 square miles of land comprised of one national wildlife refuge: Clarks River National Wildlife Refuge (USGS, 2014f).
- The TVA manages 9.7 square miles of surface water comprised of Kentucky Lake (USGS, 2014f).

State Land[96]

The State of Kentucky owns, leases or manages approximately 358 square miles of land, or approximately 0.8 percent of the total land in the state (Figure 7.1.7-2) (USGS, 2014f). These lands are managed primarily by the KDFW, Kentucky State Parks, and KDNR. The KDFW manages 203 square miles of these lands within more than 80 wildlife management areas. These lands are managed for hunting, fishing, boating, and other wildlife-related activities (KDFWR, 2015c). The Kentucky State Parks manages approximately 59 square miles of land comprised of 49 state parks that are scattered throughout the state and managed as resort parks and recreational and historic parks (Kentucky Department of Parks, 2015c). The KDNR, Division of Forestry manages 10 state forests, which are scattered across the state and cover approximately 75 square miles. These forests are managed for multiple uses and values, including timber production, hiking, wildlife viewing, hunting, fishing, and fish and wildlife habitat protection (KDNR, 2015b).

Tribal Land

There are no federally recognized American Indian Tribes or reservations currently located in the state of Kentucky.

[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.

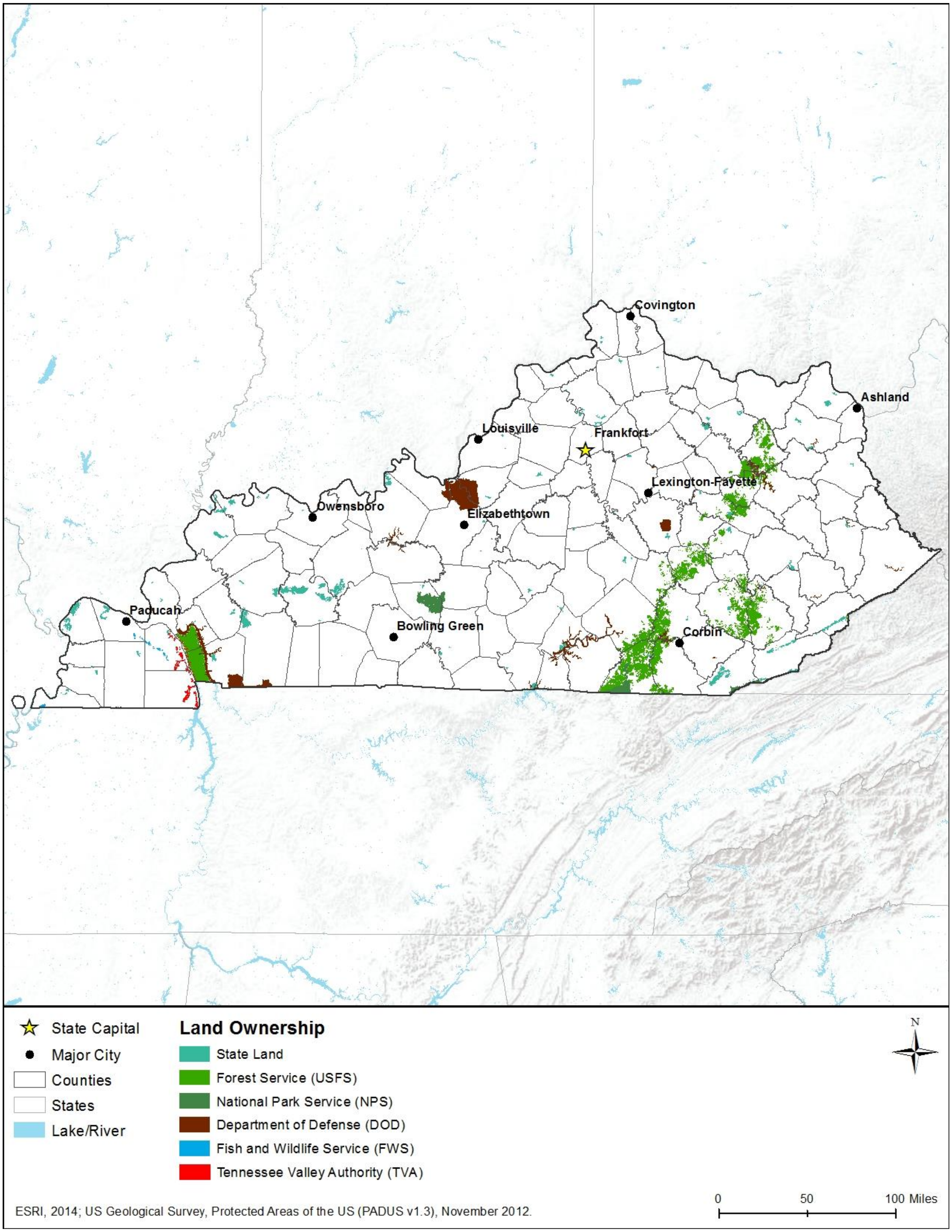

Figure 7.1.7-2: Land Ownership Distribution

7.1.7.4. Recreation

Kentucky terrain is mountainous in its eastern regions that are bordered by the western side of the Appalachian Mountains, and neighboring states West Virginia and Virginia. The Ohio River lies between its northern borders with Ohio and Indiana, and it joins the Mississippi River on Kentucky's western border with Illinois and Missouri. The state of Tennessee lies to the south. On the community level, cities and towns provide an assortment of indoor and outdoor recreational facilities including: community and recreation centers, theaters, museums, athletic fields and courts, golf courses, multi-use trails, playgrounds, picnicking areas, theme/amusement parks, boat launches and marinas. Availability of community-level facilities is typically commensurate to the population's distribution and interests, and the natural resources prominent in the vicinity.

There are 49 State Parks (Kentucky Department of Parks, 2015a). Kentucky has over 49,000 river miles and many lakes that make water-based recreation very popular with residents and visitors. The Red River flowing through the Red River Gorge Geological Area, has 9-miles classified as "wild and scenic" and 10 more classified as "recreational" (National Wild and Scenic Rivers System, 2015b). There are 13 National Recreation Trails in the state, covering a combined total of almost 600 miles (American Trails, 2015a). Federally, the National Park Service (NPS), the USFS, USFWS, and the USACE manage areas in Kentucky with substantial recreational attributes.

This section discusses key recreational opportunities and activities representative of various regions of Kentucky. The state can be categorized by four distinct recreational regions, each of which are presented in the following sub-sections. For information on visual resources such as National Scenic Byways and state-designated Byways, see Section 7.1.8, Visual Resources; and for information on culturally/historically significant resources (e.g., National Historic Sites, National Historic Landmarks, sites on the National Register of Historic Places, and Natural Heritage Areas), see Section 7.1.11, Cultural Resources.

Western Region

Recreational activities here are heavily influenced by the region's proximity to the four rivers converging there—The Ohio, Mississippi, Tennessee, and Cumberland (Figure 7.1.7-3).[97] Owensboro's International Bluegrass Music Museum and Henderson's W.C Handy Blues Festival are well-known to followers of those music genres. As is Owensboro's International Bar-B-Q Festival, that uniquely features grilled lamb and burgoo stew (in addition to classic chicken and pork entrees) and has been a well-attended event for over 35 years. Bargain hunters and shoppers swarm to the annual Highway 60 and/or Highway 41 "Yard Sales," where local

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[97] 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.

businesses, groups, and individuals set up craft booths, food stands, and yard sales on their properties adjacent to these highways. John James Audubon State Park's Museum and Nature Center is a popular destination for those who appreciate his life work and artistic accomplishments. (Kentucky Department of Travel and Tourism, 2015h)

The Kentucky portion of the National Great River Road National Scenic Byway passes through four counties in this region that border the Mississippi River. A rich assortment of cultural, historical, natural history, boutique shopping, recreation, and festival events occur along this heavily visited tourist route (Kentucky Great River Region Organization, Inc., 2015). Kentucky Lake, Lake Barkley, and the Land Between the Lakes National Recreation Area between them, provides an expansive area with excellent opportunities for water-based recreation, as well as camping, hiking, hunting, fishing, horse and OHV riding (USDA, 2015d). Pennyrile Forest State Resort Park and Lake has a lodge, cottages, campgrounds, restaurant, golf course, mountain bike, horse, and canoe trails. It is a popular destination for weddings, reunions, and retreats.

North Central Region

The North Central Region lies roughly between the cities of Elizabethtown and Louisville on the east, Cincinnati, Ohio to the north, Morehead to the east, and Berea to the south (Figure 7.1.7-3). Louisville, the state's largest city, offers museums, galleries, performing arts, music, and sports venues. The Kentucky Derby Horse Race is held at its Churchill Downs race track, and nearby Shelbyville has over 80 farms raising saddlebred horses. Five bourbon distilleries located in the Bardstown area are popular for tours and tastings; as is the Oscar Getz Museum of Whiskey History. Brandenburg's Otter Creek Outdoor Recreation Area has a variety of opportunities for camping, fishing, hunting, multi-use trails, archery and rifle ranges, and a disc golf course. The Rough River Lake and State Park Resort are popular with boaters and Taylorsville Lake State Park with equestrians. (Kentucky Department of Travel and Tourism, 2015a)

Covington and Newport lie directly across the Ohio River from the Cincinnati, Ohio metropolis (you can even walk to the downtown area by way of each of the town's suspension bridges). The Newport Aquarium is well-visited. Sparta draws NASCAR fans to its Kentucky Speedway. Several Revolutionary and Civil War historic sites present in this region. The Licking River and its many tributaries provide excellent fishing opportunities (Kentucky Department of Travel and Tourism, 2015b). Berea is an artisan town filled with arts and craft studios and workshops that draw visitors to wanting to take classes and shop for unique items. The famed "Kentucky Bluegrass" region is centered near Lexington, and the Kentucky Horse Park, American Saddlebred Museum, and Smithsonian-affiliated "International Museum of the Horse" are top attractions (Kentucky Department of Travel and Tourism, 2015c).

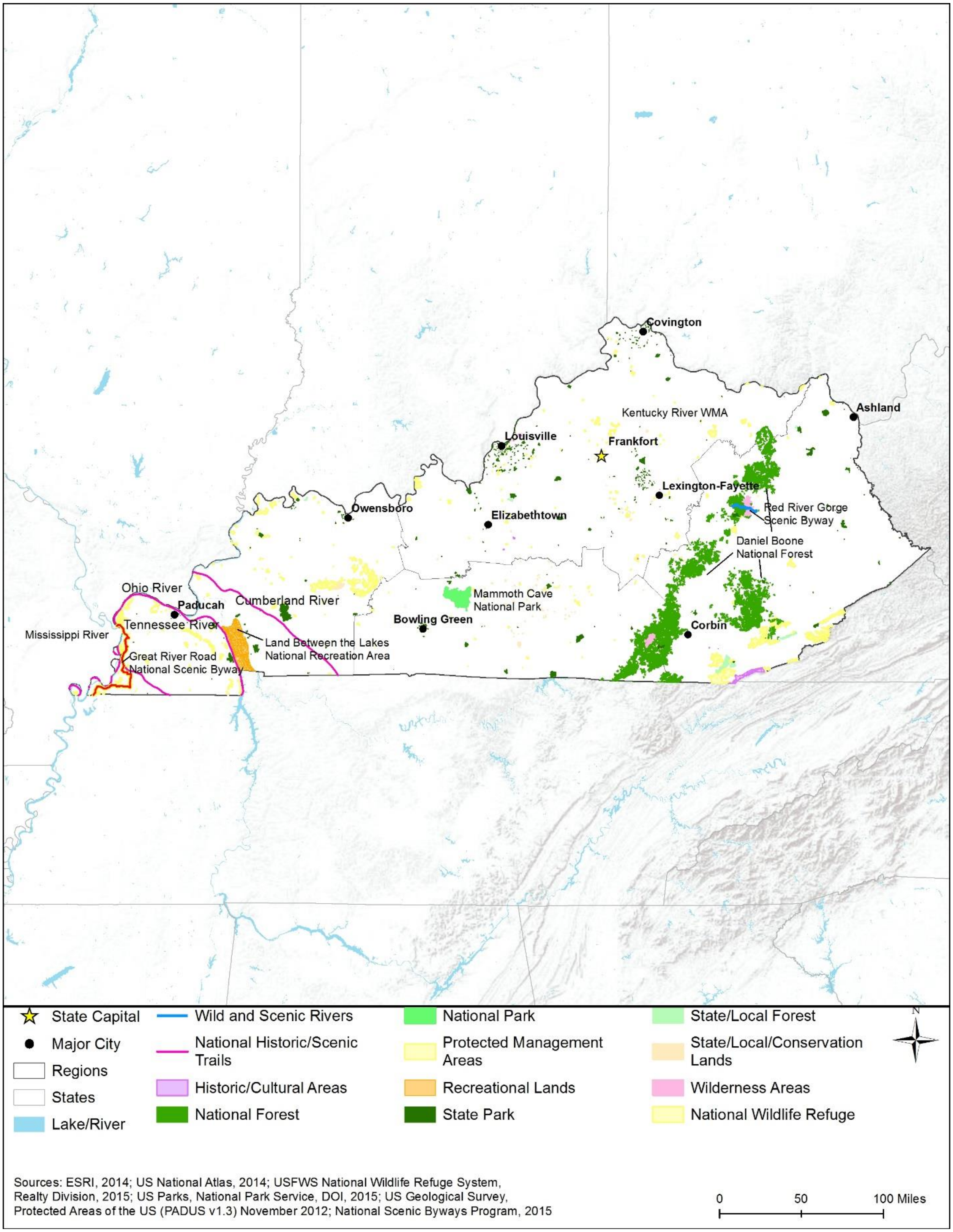


Figure 7.1.7-3: Kentucky Recreation Resources

South Central Region

The South Central Region lies roughly between the cities of Bowling Green and Somerset, south of Danville, and shares its southern border with the state of Tennessee (Figure 7.1.7-3). General Motors' Corvette Assembly Plant is located in Bowling Green, and fans come to tour the plant and visit the museum. Nearby Mammoth Cave National Park is a highly popular tourist attraction, but there are also at least eight other special caves to visit in this region. (Kentucky Department of Travel and Tourism, 2015d) There are several large lakes in this region, but Lake Cumberland, the third largest in the state, is best known for its popularity as a premier houseboating and birding location (Kentucky Department of Parks, 2015b). A portion of the Big South Fork National River and Recreation Area extends from Tennessee into Kentucky, south of Somerset. This area amid the Daniel Boone National Forest (that extends north and east) is a paradise for outdoor recreationists. Whitewater boating, mountain biking, horseback riding, camping, hiking, hunting, and fishing opportunities are abundant. (Kentucky Department of Travel and Tourism, 2015e)

Eastern Region

East of Lexington to the West Virginia and Virginia borders, the Eastern Region is the most rugged part of the state. The western slope of the Appalachian Mountains, 708,000 acres of Daniel Boone National Forest, and pristine rivers and lakes make this a prime spot for campers and hikers, fishermen and hunters (Figure 7.1.7-3). The small town of Corbin celebrates its fame as the home of Colonel Sanders and his famous "Kentucky Fried Chicken," with a museum and café that are popular tourist attractions. There are six State Parks in this region, and Cumberland Falls, Red River Gorge, and Cumberland Gap National Historic Park are also heavily visited sites (Kentucky Department of Travel and Tourism, 2015f). Several notable trail systems are located in this region: Redbird Crest Trail System, developed for OHV and horseback riders, mountain bikers, and hikers; the Sheltowee Trace National Recreation Trail that traverses 273-miles through the Daniel Boone National Forest (USDA, 2015e); and the 213-mile Jenny Wiley National Recreation Trail that travels north from Jenny Wiley State Park to the Ohio River (National Recreation Trails Program, 2015). The 15 counties of this region's northern highlands have each been home to at least one famous country music star, celebrated with the 144-mile Country Music National Scenic Byway. There are numerous places nearby for visitors to stop and see commemorative displays or home sites (Kentucky Department of Travel and Tourism, 2015g).

7.1.7.5. Airspace

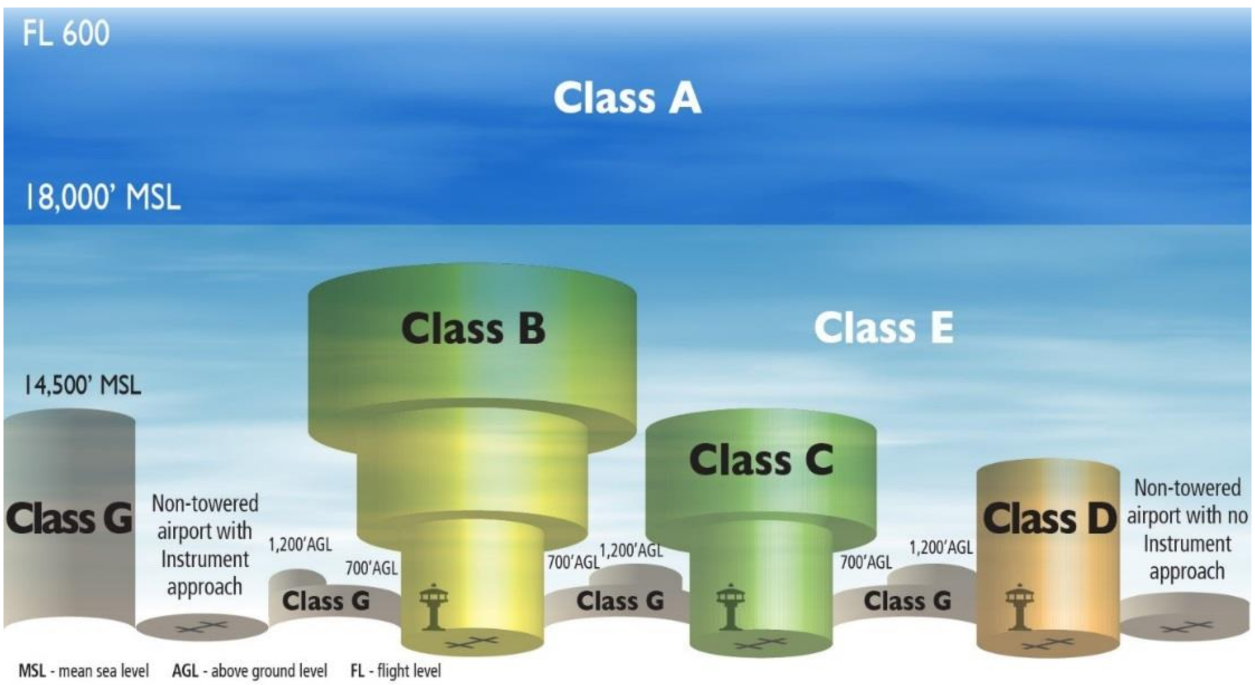
The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs). The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations,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

Airspace Categories

There are two categories of airspace or airspace areas:

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

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 7.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[98] service is based on the airspace classification (FAA, 2008).



Source: (FAA, 2008)

Figure 7.1.7-4: National Airspace Classification Profile

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

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL).[99] 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).[100]
- **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 7.1.7-5).

[99] 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).
[100] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015e).

Table 7.1.7-5: 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 IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic."
Alert Areas	"Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance."
Controlled Firing Areas (CFAs)	"Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path."
National Security Areas (NSA)	"Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual (AIM) Office, Airspace and Rules, and disseminated via Notices to Airmen (NOTAM). Inquiries about NSAs should be directed to Airspace and Rules."

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

Other Airspace Areas

Other airspace areas, explained in Table 7.1.7-6, 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 7.1.7-6: 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 Final PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

7.1.7.6. Aerial System Considerations

Unmanned Aerial Systems

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

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

Balloons

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

7.1.7.7. Obstructions to Airspace Considerations

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

- "Any construction or alteration exceeding 200 ft. above ground level
- Any construction or alteration:
    - 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, 2015f).

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.

Kentucky Airspace

The Kentucky Department of Aviation resides in the Kentucky Transportation Cabinet. The stated mission of the Kentucky Department of Aviation is as follows: "to provide a safe and secure air transportation system that ensures the mobility of people and goods, enhances economic prosperity, and preserves the quality of our environment and communities" (KYTC, 2015c). The Kentucky Airport Zoning Commission is responsible for "protection of the public investment in Kentucky airports and its facilities, the interest of the public in developing a sound air transportation system within the Commonwealth" (KYTC, 2015b). The Commission has "jurisdiction over land use issues at all military airports; all public-use airports, heliports, and seaplane bases; and all state-licensed, private-use airports having a paved runway in excess of 2,900 feet" (Kentucky Legislature, 2015b). There is one FAA FSDO for Kentucky located in Louisville (FAA, 2016b).

Kentucky 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 7.1.7-5 presents the different aviation airports/facilities residing in Kentucky, while Figure 7.1.7-6 and Figure 7.1.7-7 present the breakout by public and private airports/facilities. There are approximately 600 airports within Kentucky as presented in Table 7.1.7-7 and Figure 7.1.7-5 through Figure 7.1.7-7 (USDOT, 2015).

Table 7.1.7-7: Type and Number of Kentucky Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	59	93
Heliport	0	105
Seaplane	0	0
Ultralight	0	4
Balloonport	0	0
Gliderport	0	0
Total	**59**	**202**

Source: (USDOT, 2015)

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

- One Class B –
  - Cincinnati/Northern Kentucky International, Covington.
- Two Class C –
  - Lexington, Blue Grass; and
  - Standiford Field, Louisville.
- Five Class D –
  - Fort Campbell, Campbell Army Airfield (AAF);
  - Fort Know, Godman AAF;
  - Louisville Bowman Field;
  - Owensboro-Daviess County; and
  - Paducah, Barkley Regional. (FAA, 2015g)

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

- Fort Campbell (Restricted)
  - R-3701A – Surface to and including 5,000 feet MSL;
  - R-3702A – Surface to 10,000 feet MSL;
  - R-3702B – 10,000 feet MSL to FL 220;

  - R-3702C – FL 220 to FL 270;
  - R-3704A – Surface to 10,000 feet MSL; and
  - R-3704B – 10,001 feet MSL to 20,000 feet MSL. (FAA, 2015h)

The two MOAs for Kentucky are as follows:

- Campbell –
  - 1 – 500 feet AGL to and including 10,000 feet; and
  - 2 – 1,500 feet AGL to 10,000 feet MSL; excluding the area below 2,500 feet AGL described as follows: Beginning at lat. 36°31’30”N., long. 87°45’30”W.; to lat. 36°26’30”N., long. 87°40’00”W.; to lat. 36°23’00”N., long. 87°39’00”W.; to lat. 36°23’35”N., long. 87°37’02”W.; to lat. 36°22’15”N., long. 87°38’30”W.; to lat. 36°29’00”N., long. 87°50’00”W.; thence to the point of beginning. (FAA, 2015h)

The SUAs for Kentucky are presented in Figure 7.1.7-8; there are no TFRs (FAA, 2015i). There is an Alert Area in the Fort Campbell area, A-371 – Surface to 2,000 feet MSL (see Figure 7.1.7-8) (FAA, 2015h). There is also a National Security Area (NSA 0016)[101] located around Richmond (see Figure 7.1.7-8) within a three NM radius centered at lat. 37°42’00”N., long. 084°13’00”W and with an altitude restriction of surface to, but not including, 5,000 feet MSL (FAA, 2015h). The restrictions associated with the Alert Area and NSA, when active, may impact the airspace in these areas. MTRs in Kentucky, presented in Figure 7.1.7-9, consist of six Visual Routes, three Instrument Routes, and six Slow Routes.

UAS Considerations

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

Obstructions to Airspace Considerations

Pursuant to Kentucky law, the Kentucky Airport Zoning Commission must approve structures built on or near an airport (e.g., buildings; antenna and water towers; electrical power lines above ground; runway, taxiway, and apron extensions; parking lots, and construction cranes) and permits must be obtained. Two forms, TC 56-50 and FAA Form 7460-1, must be submitted 90-days prior to the start date of the proposed construction or alteration. (KYTC, 2015b)

[101] National Security Area (NSA) consists of defined vertical and lateral dimensions in the airspace where there is increased security of ground facilities. Pilots are expected to voluntarily avoid flying through the NSA. Additional security levels may result in further restrictions of the NSA, which FAA Headquarters would issue and disseminate with a NOTAM. (FHWA, 2014b)

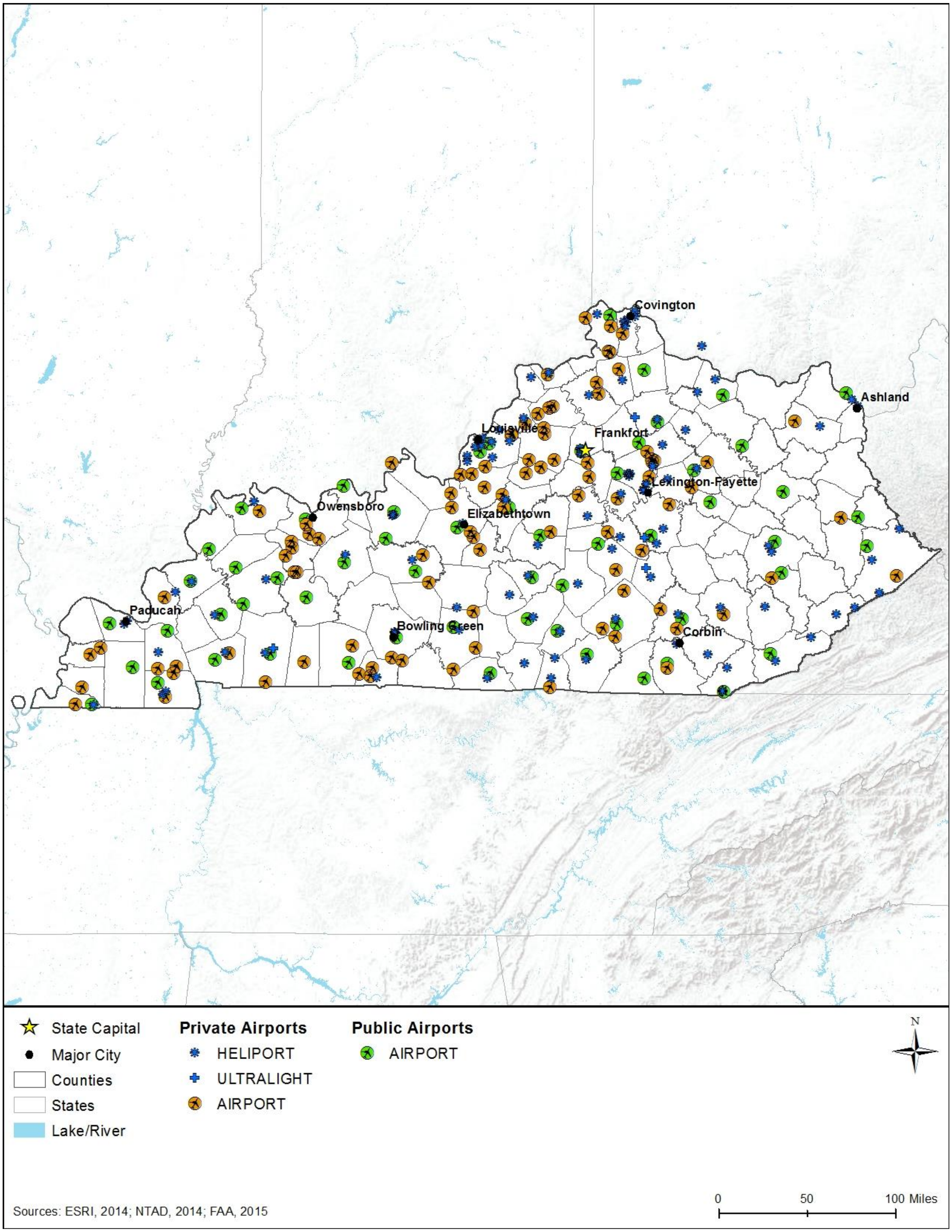


Figure 7.1.7-5: Composite of Kentucky Airports/Facilities

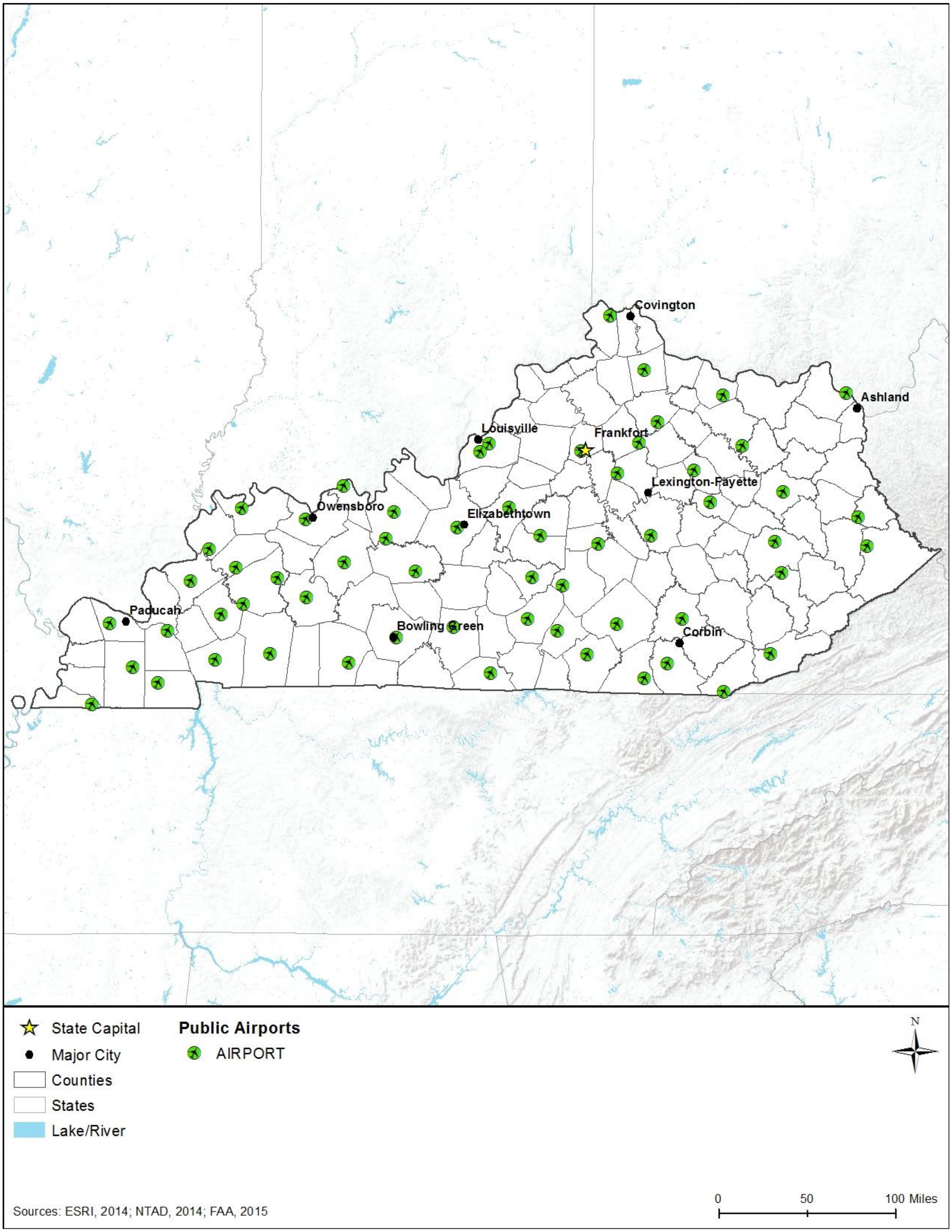


Figure 7.1.7-6: Public Kentucky Airports/Facilities

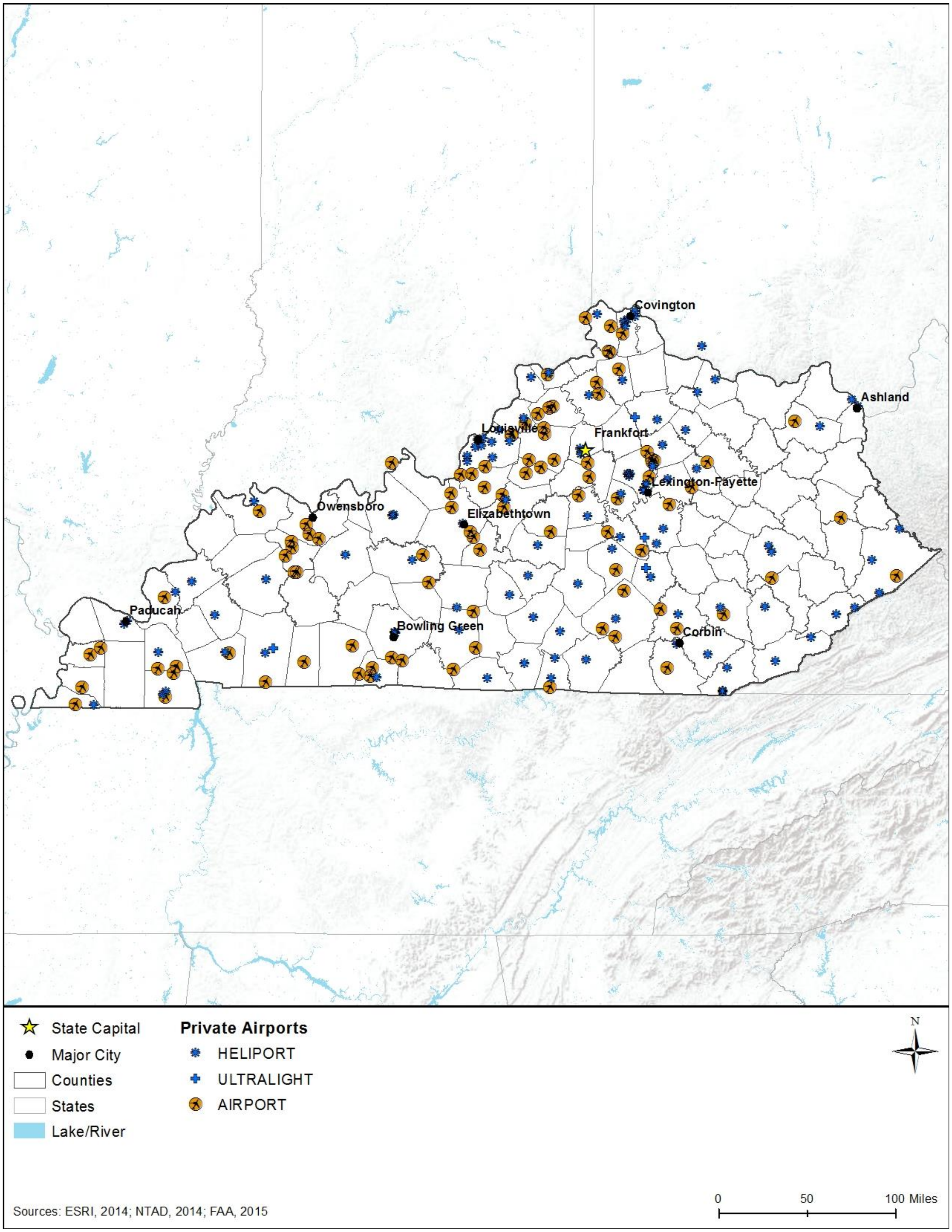


Figure 7.1.7-7: Private Kentucky Airports/Facilities

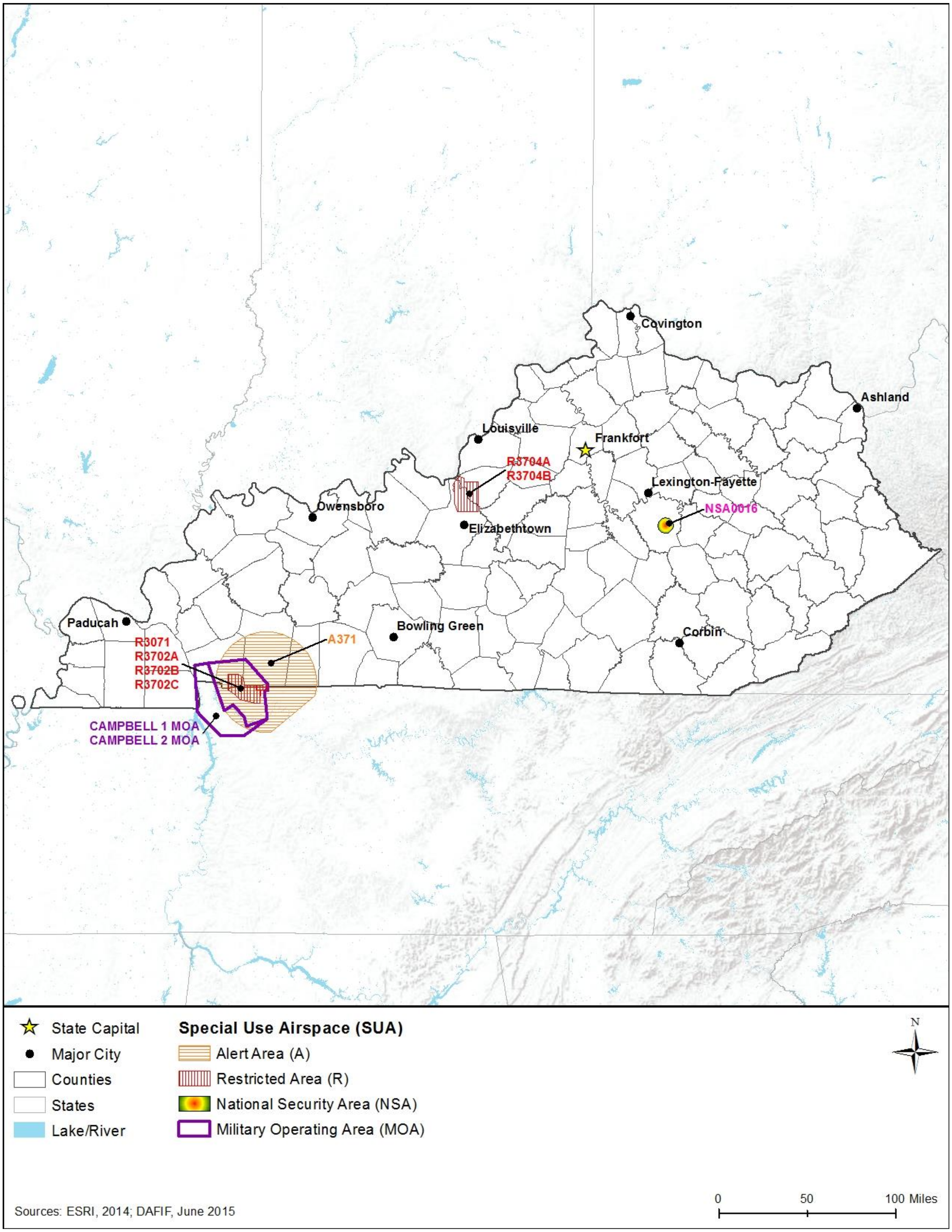


Figure 7.1.7-8: SUAs in Kentucky

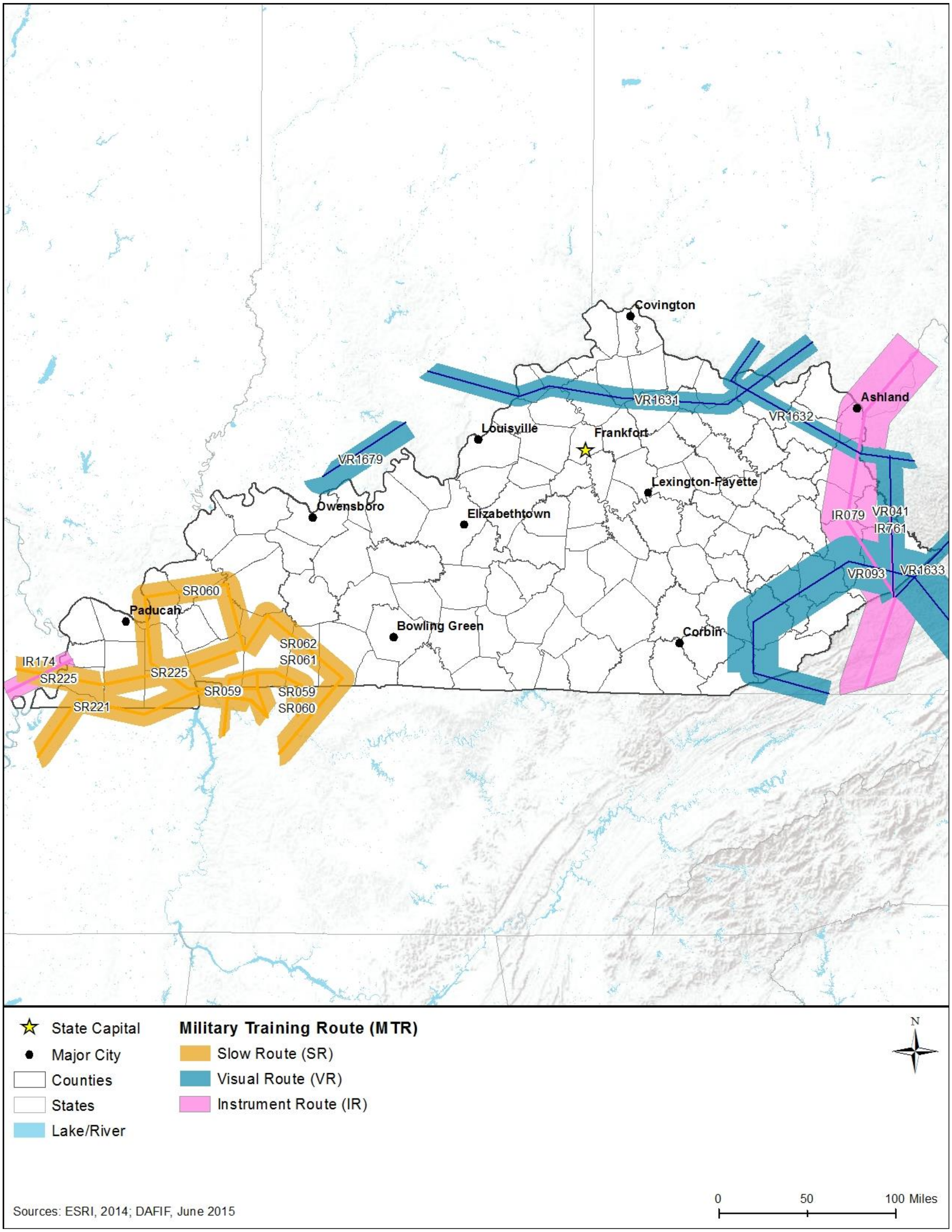


Figure 7.1.7-9: MTRs in Kentucky

7.1.8. Visual Resources

7.1.8.1. Definition of the Resource

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

7.1.8.2. Specific Regulatory Considerations

Table 7.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 7.1.8-1: Relevant Kentucky Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Revised Statutes (KSR) 171.3801	Kentucky Heritage Council	Establishes the Kentucky Heritage Council to preserve and protect "all meaningful vestiges of Kentucky's heritage for succeeding generations" including projects related to "conservation and [recognition] of buildings, structures, sites, and other landmarks associated with archaeological, cultural, economic, military, natural, political, or social aspects of [the state's] history."
KRS 146.200-360	Kentucky Energy and Environment Cabinet	Establishes the Kentucky Wild Rivers System to recognize "certain streams of Kentucky possess outstanding and unique scenic, recreational, geological, fish and wildlife, botanical, historical, archaeological and other scientific, aesthetic, and cultural values."
KRS 146.410-535	Kentucky Nature Preserves Commission	Establishes the Kentucky Nature Preserves System "to secure for the people of present and future generations the benefits of an enduring resource of natural areas by establishing a system of nature preserves, protecting these areas and gathering and disseminating information regarding them, establishing and maintaining a registry of natural areas, and otherwise encouraging and assisting in the preservation of natural areas and features."
KRS 177.571-576	Kentucky Transportation Cabinet	Establishes the Kentucky Scenic Byways and Highways "to preserve and present scenic byways and scenic highways for vehicular, bicycle, and pedestrian travel in an unhurried and leisurely environment."
KRS 148.029	Kentucky Department of Parks	Designates "camping, hiking, or other family oriented recreation areas [as]…wildlife sanctuaries for the purpose of affording protection to the wildlife thereon as natural, integrated, interrelated, ecological communities."

Source: (FindLaw, 2017) (Kentucky Legislature, 2017h) (Kentucky Legislature, 2017i) (Kentucky Legislature, 2017i)

In addition to the state laws and regulations, in Kentucky local jurisdictions have the authority to establish historic preservation programs to carry out their historic preservation responsibilities to protect important historic visual resources within the state.

7.1.8.3. Character and Visual Quality of the Existing Landscape

Kentucky's landscape is composed of four distinct areas: Cumberland Plateau, Bluegrass Region, Western Coal Field, and swampy lowlands. The Cumberland Plateau to the east consists of dense forests, hills and mountains, while the Bluegrass Region in the north central part of the state is dominated by rolling hills and meadows of bluegrass, from where the state gets its nickname, "The Bluegrass State." The Western Coal Field is hilly on the border of the Ohio River, and the swampy lowlands comprise the southwestern portion of the state that makes up part of the Mississippi River floodplain. Kentucky is home to the longest cave system in the world, the Mammoth Cave area, with over 365 miles of caverns (World Atlas, 2015). The largest manager of public lands in Kentucky is the USFS with 694,000 acres. Additionally, the USACE, USFWS, and the NPS also maintain lands in the state (Natural Resources Council of Maine, 1995) (USGS, 2017) (USGS, 2001).

According to the U.S. Department of Agriculture's (USDA) Economic Research Center, forestlands are the most prevalent visual resource within Kentucky, comprising 46 percent of the total land cover. Crop lands are a close second, accounting for 30 percent of total land cover (See Figure 7.1.7-1 in Section 7.1.7, Land Use, Recreation, and Airspace) (USDA, 2015f). Visual resources within forested areas are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape. Croplands are the second most prevalent visual resource in Kentucky and 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, 2014). 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 7.1.7 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.

7.1.8.4. 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 7.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Kentucky, there are 3,380 NRHP listed sites, which include 32 National Historic Landmarks, 1 National Battlefield, 2 National Historical Parks, and 1 National Historic Trail (NPS, 2014e). Some State Historic Sites and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time.

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

National 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, 2015n). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 2016). 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 Kentucky, there are 32 NHLs, including sites such as Churchill Downs, Middle Creek Battlefield, Old State House, Shakertown at Pleasant Hill Historic District, and Zachary Taylor House (see Figure 7.1.8-1) (NPS, 2015e). By comparison, there are over 2,500 NHLs in the United States, with little more than 1 percent of these located in Kentucky (NPS, 2015o). Figure 7.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Battlefield

Kentucky has one National Battlefield, which is preserved by the NPS to "commemorate persons, events, and activities important in the nation's history" (NPS, 2003a). Fort Donelson National Battlefield is the site of a Ulysses S. Grant's Civil War victory that strengthened the Union and created a pathway for winning the war (see Figure 7.1.8-1) (NPS, 2015f). This battlefield may contain aesthetic and scenic values associated with history.

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). One National Historic Trail passes through Kentucky and surrounding states (see Figure 7.1.8-1) Trail of Tears National Historic Trail. The Trail of Tears National Historic Trail commemorates the survival of the Cherokee people removed from Georgia, Arkansas, and Tennessee to Indian Territory in Oklahoma (NPS, 2015d).

National Historical Parks

Kentucky has two National Historical Parks, which are preserved by the NPS to "commemorate persons, events, and activities important in the nation's history" (NPS, 2003a). The national historical parks in Kentucky are Abraham Lincoln Birthplace National Historical Park and Cumberland Gap National Historical Park (NPS, 2015g). These sites may contain aesthetic and scenic values associated with history. Locations of the above are identified on the map in Figure 7.1.8-1.

State Historic Sites and Parks

The Kentucky Department of Parks maintains 13 state historic sites as part of the states parks system as listed in Table 7.1.8-2 and displayed on the map in Figure 7.1.8-1 (Kentucky Department of Parks, 2015a). These sites may contain aesthetic and scenic values associated with history.

Table 7.1.8-2: Kentucky Historic Sites and Parks

Historic Site/Park Name	
Big Bone Lick State Historic Site	Old Mulkey Meeting House State Historic Site
Boone Station State Historic Site	Perryfield Battlefield State Historic Site
Butler-Turpin State Historic House	Waveland State Historic Site
Dr. Thomas Walker State Historic House	Whitehall State Historic Site
Isaac Shelby Cemetery State Historic Site	Wickcliffe Mounds State Historic Site
Jefferson Davis State Historic Site	William Whiteley House State Historic Site
My Old Kentucky Home	

Source: (Kentucky Department of Parks, 2015a)

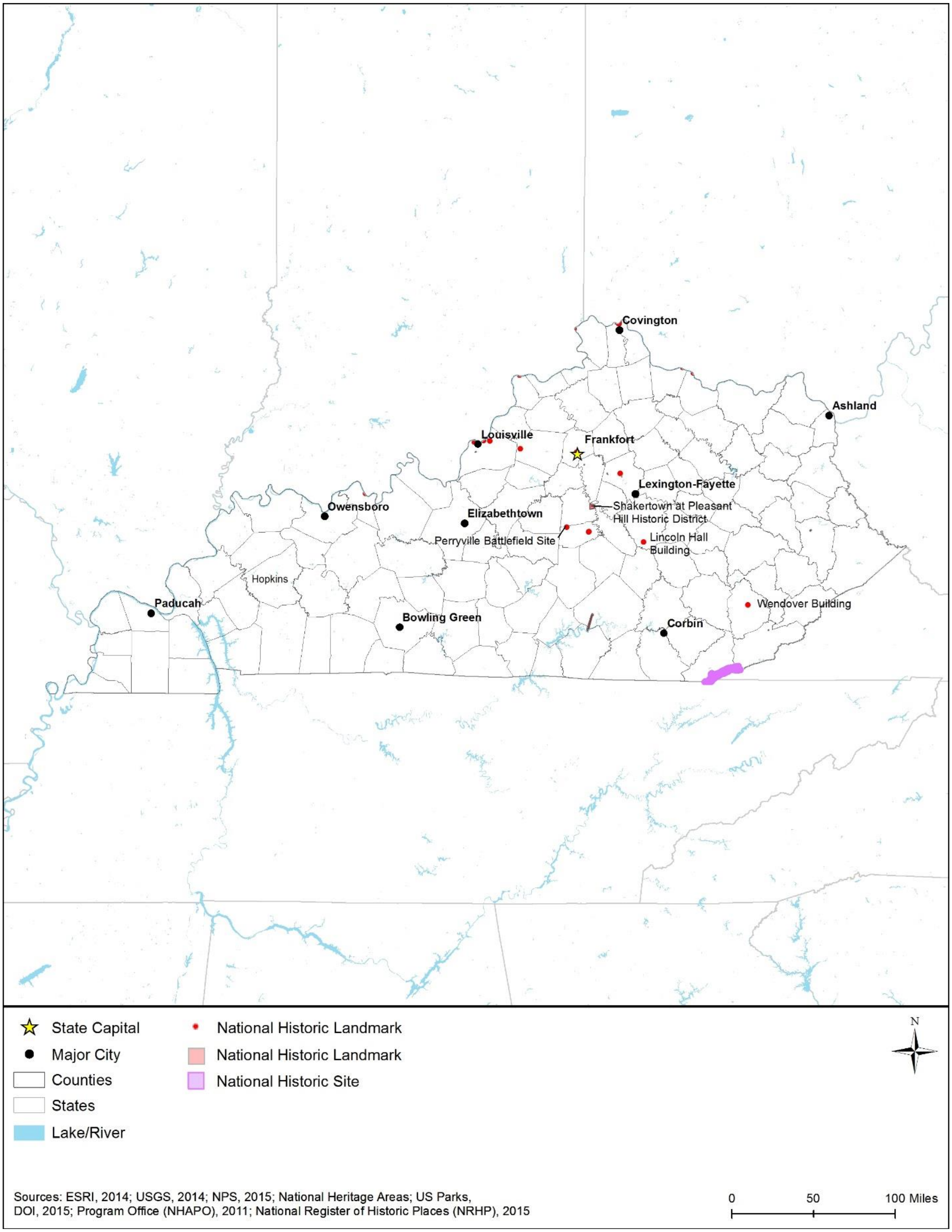


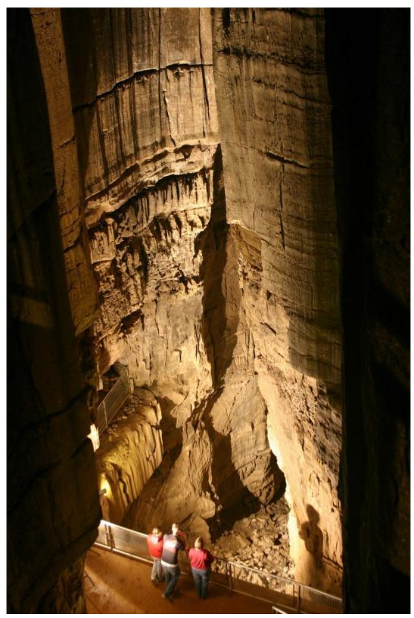
Figure 7.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

7.1.8.5. Parks and Recreation Areas

Parks and recreation areas include State Parks, State Forests, National Parks, National Forests, National Monuments, 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 7.1.7-1, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in Kentucky. For additional information about recreation areas, including national and state parks, see Section 7.1.7, Land Use, Recreation, and Airspace.

National Parks

National Parks, owned and managed by the NPS, contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use. In Kentucky, there are four National Parks and two NPS affiliated areas with significant natural visual resources (NPS, 2015h). Table 7.1.8-3 identifies all NPS units located in Kentucky. For additional information regarding parks and recreation areas, see Section 7.1.7, Land Use, Recreation, and Airspace.



Source: (NPS, 2015i)

Figure 7.1.8-2: Mammoth Cave National Park

Table 7.1.8-3: Kentucky National Park Service Areas

NPS Area Name	
Abraham Lincoln Birthplace National Historical Park	Fort Donelson National Battlefield
Big South Fork National River & Recreation Area	Mammoth Cave National Park
Cumberland Gap National Historical Park	Trail of Tears National Historic Trail

Source: (NPS, 2015d)

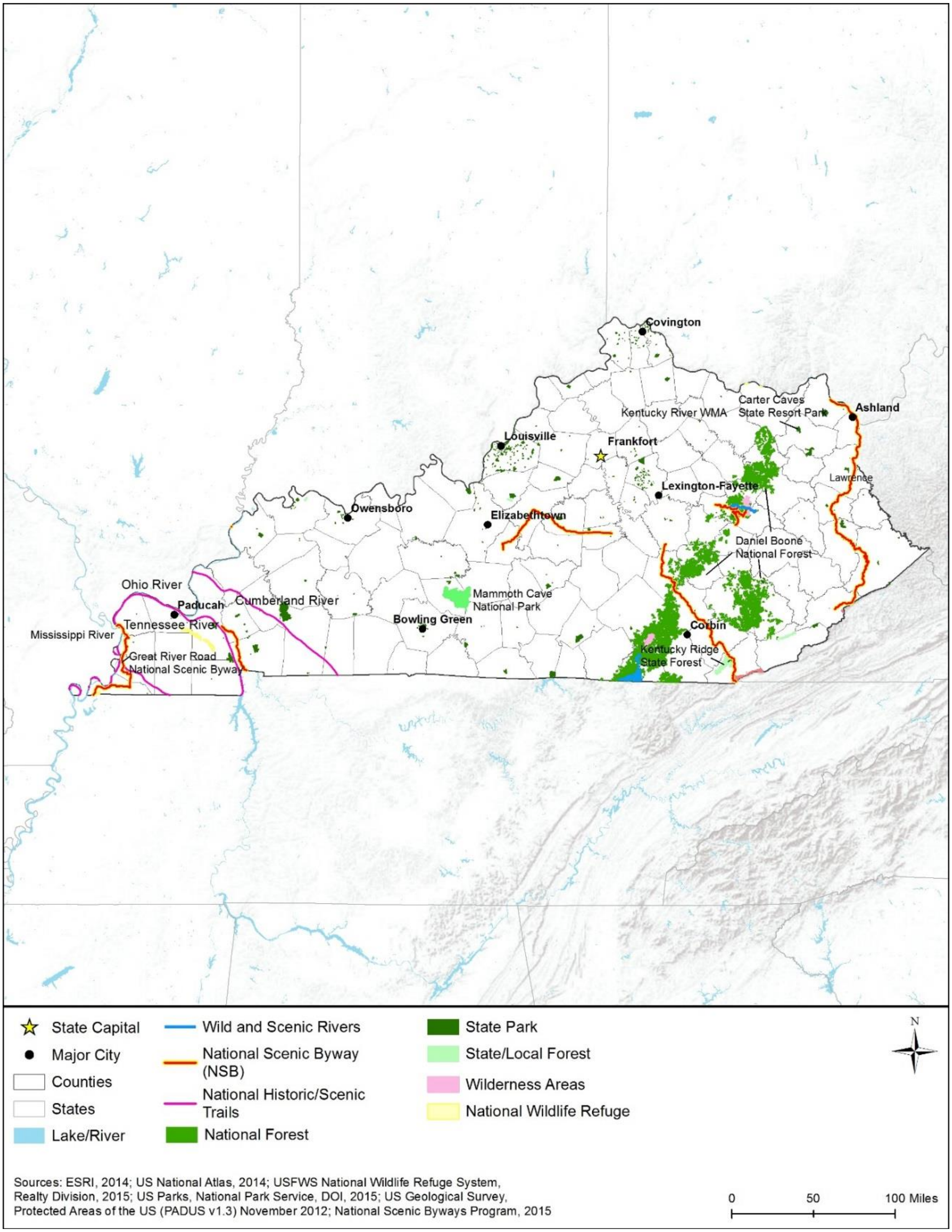


Figure 7.1.8-3: Natural Areas that May be Visually Sensitive

National Forests

There are three National Forests in Kentucky managed by the USFS: Daniel Boone National Forest, George Washington National Forest, and Jefferson National Forest (USFS, 2015a). The George Washington National Forest consists of 1.8M acres across three states, 961 acres of which are in Kentucky (USFS, 2015b). The USFS conducts inventories of the forest lands and assigns scenic resource categories from which they manage for scenic and visual resources (USFS, 1995). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USFS, 1995).

U.S. Forest Service National Recreation Area

National Recreation Areas are "lands and waters set aside for recreation use" (NPS, 2003b). In Kentucky, there is one National Recreation Area that is managed by the USFS: the Land Between the Lakes National Recreation Area (see Figure 7.1.8-3).[102] This Recreation Area is comprised of "170,000 acres of forests, wetlands, and open lands…between Kentucky and Barkley Lakes in…Kentucky and Tennessee" (USFS, 2015c). Visual resources in this Recreation Area include lakes, natural shoreline, wildlife, birds, and prairie (USFS, 2015c).

U.S. Army Corps of Engineers Recreation Areas

There are 26 USACE recreation and flood risk management areas within the state (see Table 7.1.8-4 and Figure 7.1.8-3) (USACE, 2017). 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 7.1.8-4: U.S. Army Corps of Engineers Recreation Areas

Recreation Area Name		
Barkley Lake	Green River Lake	Ohio River – John T. Myers Lock and Dam
Barren River Lake	Green River + Two Locks	Ohio River – Markland Pool
Buckhorn Lake	Kentucky River	Ohio River – McAlpine Pool
Carr Creek Lake	Lake Cumberland	Ohio River – Newburgh Pool
Cave Run Lake	Laurel River Lake	Paintsville Lake
Dale Hollow Lake	Martins Fork Lake	Rough River Lake
Dewey Lake	Nolin River Lake	Taylorsville Lake
Fishtrap Lake	Ohio River – Cannelton Pool	Yatesville Lake
Grayson Lake	Ohio River – Greenup Pool	

Source: (USACE, 2015)

[102] 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.

Tennessee Valley Authority Recreation Areas

The TVA "manages public lands for multiple benefits" and "protects natural resources while providing recreational opportunities across the Valley" (TVA, 2015a). The TVA is the land and water steward for 160,300 acres and 2,000 miles in Kentucky including Kentucky Reservoir and Kentucky Dam, and considers the impacts of activities on the environment "to ensure the unique and beautiful Valley resources [are] preserved" (TVA, 2015a). The TVA manages recreational, natural, and cultural resources in these areas to improve water quality, shoreline conditions, recreation, and biodiversity (TVA, 2015a). For additional information regarding parks and recreation areas, see Section 7.1.7, Land Use, Recreation, and Airspace.

State and Federal Trails

Kentucky is home to hundreds of miles of scenic hiking trails within the state parks and forests. These trails have aesthetic resources such as rolling, tree covered hills, lake vistas, river cliffs, bluffs, and woodlands (Kentucky Department of Parks, 2015d). Additionally, the Kentucky Department of Parks is currently developing Pine Mountain State Scenic Trail as a linear state park that includes 120 miles through natural areas from the Breaks Interstate Park to Cumberland Gap National Historic Park to showcase the "wild highlands and [conserve] the natural and cultural heritage of Appalachia for future generations" (Kentucky Department of Parks, 2015e). For additional information about trails in the state parks and forests, visit 'Trails' on the Kentucky State Parks' website (Kentucky Department of Parks, 2015d).

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, 2015b). In Kentucky there are 13 National Recreation Trails administered by the USFS, USACE, and state government (American Trails, 2015c).

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Kentucky residents and visitors. The Kentucky Department of Parks manages 37 state parks and recreation areas (see Figure 7.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (Kentucky Department of Parks, 2015a).

Table 7.1.8-5 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks, visit the Kentucky Department of Parks website (Kentucky Department of Parks, 2015a).

Table 7.1.8-5: Examples of Kentucky State Parks and Associated Visual Attributes

State Park	Visual Attributes
Cumberland Falls State Park	Historic DuPont Lodge, Cumberland Falls waterfalls, cliffs, river, Moonbow, Indian artifacts
Grayson Lake State Park	Ferns, mosses, lichens, "lizard head rock," beech-hemlock stands, Grayson Lake, golf course, rock formations, waterfalls
John James Audubon State Park	Waterfowl, birds, lake shoreline, Audubon Memorial Museum, nature center, woods
Kingdom Come State Park	Natural sandstone bridge, giant rock exposure, mountain top views, lake, wooded forests
Mineral Mound State Park	Lake, native hills, wooded forests, golf course, waterfowl

Source: (Kentucky Department of Parks, 2015a)

Source*:* (Kentucky Department of Parks, 2015a)

Figure 7.1.8-4: Cumberland Falls State Park

State Forests

The Kentucky Division of Forestry manages ten state forests for "biological diversity and sustainable use," most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive. Table 7.1.8-6 contains a list of Kentucky state forests. (Energy and Environment Cabinet, 2015a)

Table 7.1.8-6: Kentucky State Forests

Forest Name	
Big Rivers State Forest	Marion County State Forest
Green River State Forest	Marrowbone State Forest
Kentenia State Forest	Pennyrile State Forest
Kentucky Ridge State Forest	Rolleigh Peterson State Forest
Knobs State Forest	Tygarts State Forest

Source: (Energy and Environment Cabinet, 2015a)

7.1.8.6. Natural Areas

National Rivers and Recreation Areas

NPS defines National Rivers as "ribbons of land bordering free-flowing streams which have not been dammed, channelized, or otherwise altered" (NPS, 2003b). Additionally, NPS designates National Recreation Areas as "lands and waters set aside for recreation use" (NPS, 2003b). In Kentucky there is one combined National River and Recreation Area, the Big South Fork National River and Recreational Area (see Figure 7.1.8-3) (NPS, 2015d). This River and Area includes 125,000 acres protecting the Big South Fork portion of the Cumberland River. The River and Area has scenic resources that include gorges, sandstone bluffs, forested plateau, pristine streams, arches, and chimneys (NPS, 2015j).

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. The 19.4 miles of the Red River have been designated a National Wild and Scenic River in Kentucky (see Figure 7.1.8-3) (National Wild and Scenic Rivers System, 2015b). The designated portion of the Red River is contained within the Daniel Boone National Forest and, as such, is managed by the USFS (NPS, 2015k).

The Kentucky Wild Rivers Act of 1972 established the Kentucky Wild Rivers Program to preserve the "unique scenic, fish and wildlife, botanical, geological, cultural and recreational values of [Kentucky's] most pristine rivers" (KDEP, 2015h). The Kentucky Wild Rivers Program recognizes portions of nine (9) state rivers including their land corridors with a combined total of 114 miles of water and 26,382 acres of land. The Program limits activities in these areas to prevent impairment of water quality and natural conditions (KDEP, 2015h).

National Wildlife Refuges and State Wildlife Management Areas

National Wildlife Refuges (NWRs) are a network of lands and waters managed by the USFWS. These lands and waters are "set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats" (USFWS, 2015bj). There is one NWR in Kentucky: Clarks River NWR (USFWS, 2015bk). Clarks River NWR compromises the "largest remaining bottomland hardwood forests in the region" (USFWS, 2015bl). Visual resources within this NWR include a variety of wildlife, such as fish, shellfish, mammals, songbirds, as well as open water, wetlands, grasslands, hardwood trees, and croplands (USFWS, 2012f) (USFWS, 2013g).

The KDFW "owns, leases or manages more than 80 wildlife management areas (WMAs) for public use" (KDFWR, 2014g). For additional information on wildlife refuges and management areas, see Section 7.1.6, Biological Resources.

State Preserves and Natural Areas

The Kentucky Energy and Environment Cabinet's State Nature Preserves Commission both State Nature Preserves (SNP) and State Natural Areas (SNA). SNPs are preserved for their natural significance and protected for science and educational purpose. SNAs are jointly managed as Wildlife Management Areas (WMA) with the KDFW and protected similarly to SNPs (Energy and Environment Cabinet, 2015b). Together there are 56 preserves and natural areas comprising 27,121 acres of land across the state, which are managed for minimal recreation including hiking, hunting, fishing, and scientific research (Energy and Environment Cabinet, 2015c). Additionally, natural and conservation areas also include six properties owned and managed (often jointly) by a variety of entities including the Kentucky State Nature Preserve Commission (KSNPC), Kentucky River Authority, Kentucky Division of Forestry, Kentucky Division of Conservation – Purchase of Agricultural Conservation Easements (PACE) Program, USFWS, the NPS, Cherokee Nation, KDFW, University of Kentucky, local government and private organizations, such as The Nature Conservancy (The Nature Conservancy, 2015a). These properties include Bad Branch Nature Preserve, Dupree Nature Preserve, Hazeldell Meadow Nature Preserve, Jim Beam Nature Preserve, Mantle Rock Nature Preserve, and Brown, Crutcher and Wallace Nature Preserve (The Nature Conservancy, 2015a). Mantle Rock Nature Preserve is "replete with biological, historical, and archaeological treasures" and includes a natural sandstone bridge, bluffs, shelters, fluorite deposits and a stream, and is a site on the Trail of Tears National Historic Trail (The Nature Conservancy, 2015b).

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, 2014b). These landmarks may be considered visual resources or visually sensitive. In Kentucky there are seven (7) NNLs (see Table 7.1.8-7). Some of the natural features located within these areas include the "largest protected tracts of old-growth forest in Kentucky," the "longest natural bridge in the region," and the birthplace of vertebrate paleontology in the U.S. (NPS, 2012b).

Source*:* (NPS, 2012c)

Figure 7.1.8-5: Creelsboro Natural Bridge

Table 7.1.8-7: Kentucky National Natural Landmarks

NNL Name	
Big Bone Lick	Ohio Coral Reef (Falls of the Ohio)
Creelsboro Natural Bridge	Red River Gorge
Henderson Sloughs	Rock Creek Research Natural Area
Lilley Cornett Woods	

Source: (NPS, 2012b)

National Wilderness Areas

In 1964 Congress enacted the Wilderness Act of 1964 to "establish a National Wilderness Preservation System for the permanent good of the whole people" to provide "clean air, water, and habitat critical for rare and endangered plants and animals" (Wilderness.net, 2015). This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value" (Wilderness.net, 2015). A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. 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. Other designated wilderness areas are managed by the USFS, BLM, and the USFWS (NPS, 2015l). Kentucky is home to two (2) federally managed Wilderness Areas: Beaver Creek Wilderness and Clifty Wilderness (Wilderness.net, 2015).

7.1.8.7. 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. Kentucky has six (6) designated National Scenic Byways noted in Table 7.1.8-8 and shown on the map in Figure 7.1.8-3. Country Music Highway traverses 144 miles of the eastern part of the state, recounting its heritage related to American Indians, pioneers, coal mining, music, the Civil War, and the state's natural resources. The Great River Road is 2,069 miles following the Mississippi River through the history of the cultures originating from its corridors. (USDOT, 2015)

Table 7.1.8-8: Kentucky National Scenic Byways

State Byway Name	Mileage
Country Music Highway	144
Great River Road	2,069
Lincoln Heritage Scenic Highway	71
Red River Gorge Scenic Byway	46
Wilderness Road Heritage Highway	94
Woodlands Trace	43

Source: (USDOT, 2015)

Similar to National Scenic Byways, the Kentucky Transportation Cabinet designates state scenic byways and highways based on five criteria: significance of intrinsic qualities (archaeological, cultural, historic, natural, recreational, and scenic), unique experience, preparedness, continuity and wayfinding, and community involvement and endorsement (KYTC, 2014b). The Kentucky Byways Program recognizes 32 state scenic byways noted in Table 7.1.8-9 (KYTC, 2014c).[103]

Table 7.1.8-9: Kentucky State Scenic Byways

State Byway Name	Mileage
Big Bone Lick	19
Blues to Seagrass Scenic Byway (Everly Brothers Rock-N-Roll Trail)	99
Blues to Seagrass Scenic Byway (Bill Monroe Bluegrass Trail)	111
Boone Creek Scenic Byway	8
Cordell Hull Highways	51
Country Music Highway[a]	144
Cumberland Cultural Heritage Highway	187
Duncan Hines Scenic Byway	65
Great River Road – Segment 1	40
Great River Road – Segment 2	22
Hughes Lane	2
Iron Works Pike	7
KY 89	35
KY 160 – Black Mountain	10
Old Frankfurt Pike	14
Old Kentucky Turnpike	28
Old Richmond Road (US 25)/ Grimes Mill Road	6
Pine Mountain Road	8
Pisgah Pike	5
Red River Gorge Scenic Byway[a]	45
Rice, Van Metter and Elkchester Roads	2
River Road	7
Riverboat Row	1
Shakertown Road	2
The Trace	30
The Zollcoffer-Thomas Scenic Byway (KY 235 Mill Springs Battlefield)	10
US 42	14
US 68 Segment 1	52
US 68 Segment 2	26
US 68 Segment 3	24
Versailles-Midway Road	6
Wilderness Road Heritage Highway[a]	93

Source: (KYTC, 2014c)

[a] Also a designated National Scenic Byway.

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

7.1.9. Socioeconomics

7.1.9.1. 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. 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 7.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: Land Use, Recreation, and Airspace (Section 7.1.7), Infrastructure (Section 7.1.1), and Visual Resources (Section 7.1.8).

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 United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most

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

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.

7.1.9.2. 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.

7.1.9.3. Communities and Populations

This section discusses the population and major communities of Kentucky. It 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 7.1.9-1 presents the 2014 population and population density of Kentucky in comparison to the South region[106] and the nation. The estimated population of Kentucky in 2014 was

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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. Additionally, the data contained in the FirstNet tables may incorporate data from multiple sources and may not be readily available in one table on the Census site.

[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.

4,413,457. The population density was 112 persons per square mile (sq. mi.), which is lower than the population density of the region (114 persons/sq. mi.) and higher than that of the nation (90 persons/sq. mi.). In 2014, Kentucky was the 26th largest state by population among the 50 states and the District of Columbia, 37th largest by land area, and had the 23rd greatest population density (U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015e).

Table 7.1.9-1: Land Area, Population, and Population Density of Kentucky

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Kentucky	39,486.34	4,413,457	112
South Region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

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

Population growth is an important subject for this PEIS given FirstNet's mission. Table 7.1.9-2 presents the population growth trends of Kentucky from 2000 to 2014 in comparison to the South region and the nation. The state's annual growth rate decreased between the 2000 to 2010 period and 2010 to 2014 period, from 0.71 percent to 0.42 percent. In the 2010 to 2014 period, Kentucky showed a lower growth rate and the region showed a greater rate (1.14 percent) compared to the nation's growth rate of 0.81 percent. The same pattern was true in the 2000 to 2010 period.

Table 7.1.9-2: Recent Population Growth of Kentucky

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
Kentucky	4,041,769	4,339,367	4,413,457	297,598	74,090	0.71%	0.42%
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%

Source: (U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015d)

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

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 7.1.9-3 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 Kentucky's population will increase by approximately 465,000 people, or 10.5 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.63 percent, which is somewhat higher than the historical growth rate from 2010 to 2014 of 0.42 percent. The projected growth rate of the state is considerably lower than that of the region (0.97 percent) and the nation (0.80 percent).

Table 7.1.9-3: Projected Population Growth of Kentucky

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
Kentucky	4,413,457	4,757,927	4,998,884	4,878,406	464,949	10.5%	0.63%
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%

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

Population Distribution and Communities

Figure 7.1.9-1 presents the distribution and relative density of the population of Kentucky. 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, 2015g).

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, 2015h). 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.

Table 7.1.9-4 provides the populations of the 10 largest population concentrations in Kentucky, 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 by far was the Kentucky portion of the Louisville/Jefferson County area, which had 832,366 people. The state had no population concentrations over 1 million or between 500,000 and 1 million, with the

[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.

exception of Louisville. The smallest of these 10 population concentrations was the Frankfurt area, with a 2010 population of 35,734. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Bowling Green area, with an annual growth rate of 2.99 percent. There were five other areas with a growth rate over 1.00 percent (Kentucky portion of the Cincinnati area, Elizabethtown/Radcliff, Lexington-Fayette, London/Corbin, and Kentucky portion of the Louisville/Jefferson County area).

Table 7.1.9-4 also shows that the top 10 population concentrations in Kentucky accounted for 42.6 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 74 percent of the entire state's growth.

Table 7.1.9-4: Population of the 10 Largest Population Concentrations in Kentucky

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)[a]
Bowling Green	58,314	78,306	80,355	4	19,992	2.99%
Cincinnati (OH/KY/IN) (KY Portion)	280,328	328,060	331,285	2	47,732	1.58%
Elizabethtown/Radcliff	64,504	73,467	75,082	5	8,963	1.31%
Frankfort	34,961	35,734	36,072	10	773	0.22%
Huntington (KY/OH) (KY Portion)	56,446	56,594	55,852	7	148	0.03%
Lexington-Fayette	250,994	290,263	295,424	3	39,269	1.46%
London/Corbin[b]	29,469	37,367	37,445	9	7,898	2.40%
Louisville/Jefferson County (KY/IN) (KY Portion)	740,635	832,366	839,624	1	91,731	1.17%
Owensboro	67,665	70,543	70,895	6	2,878	0.42%
Paducah (KY/IL) (KY Portion)	47,049	47,762	47,901	8	713	0.15%
Total for Top 10 Population Concentrations	**1,630,365**	**1,850,462**	**1,869,935**	**NA**	**220,097**	**1.27%**
Kentucky (statewide)	**4,041,769**	**4,339,367**	**4,361,333**	**NA**	**297,598**	**0.71%**
Top 10 Total as Percentage of State	**40.3%**	**42.6%**	**42.9%**	**NA**	**74.0%**	**NA**

Source: (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j)

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

[b] The 2000 population presented here is the sum of populations for the London urban cluster and the Corbin urban cluster; the Census Bureau combined these two areas in 2010 to form what is now the London/Corbin urban cluster.

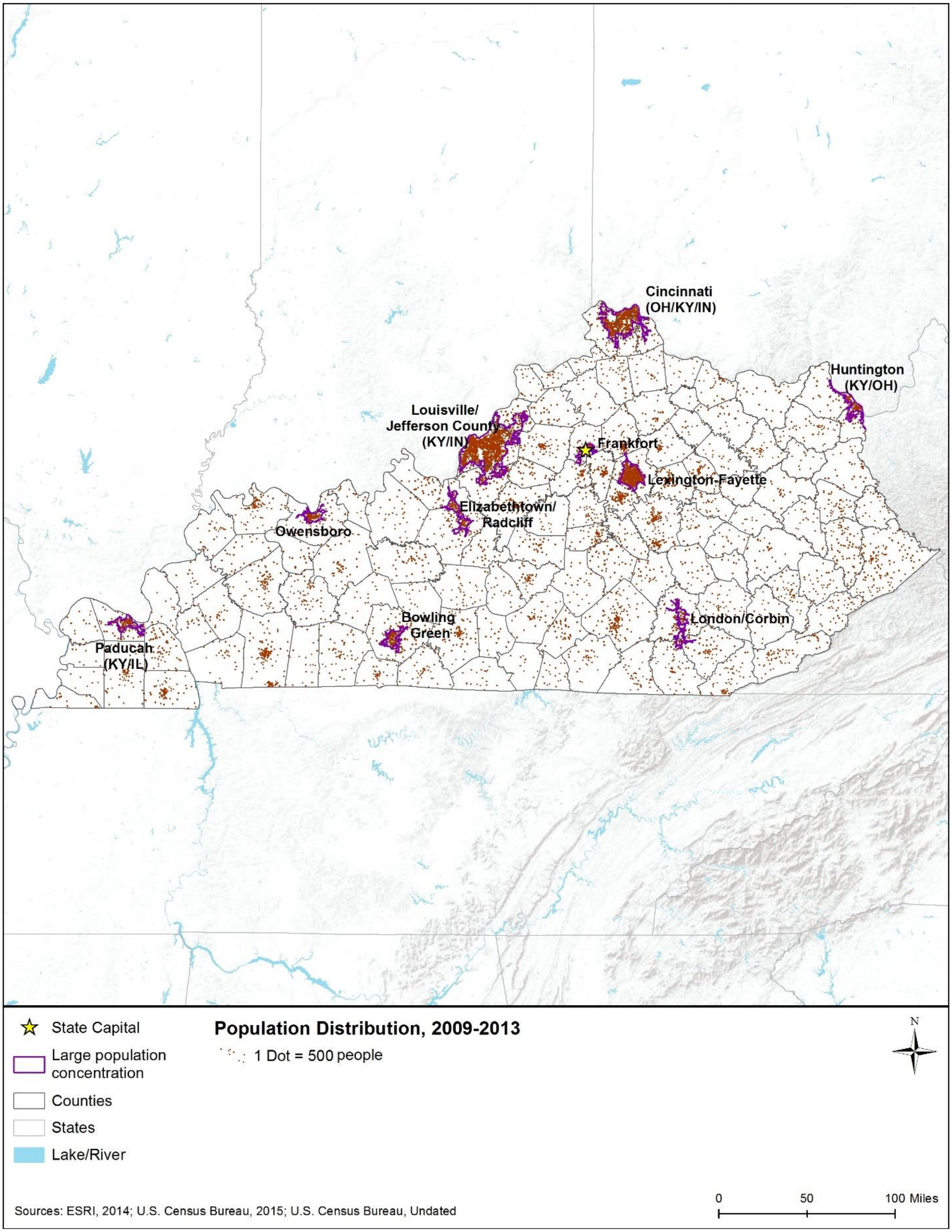

Figure 7.1.9-1: Population Distribution in Kentucky, 2009–2013

7.1.9.4. 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 7.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 7.1.9-5 compares several economic indicators for Kentucky 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 7.1.9-5, the per capita income in Kentucky in 2013 ($23,668) was $1,343 lower than that of the region ($25,011), and $3,173 lower than that of the nation ($28,184) (BLS, 2015b) (U.S. Census Bureau, 2015m) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 7.1.9-5 shows that in 2013, the MHI in Kentucky ($43,307) was $3,255 lower than that of the region ($46,562), and $8,943 lower than that of the nation ($52,250) (BLS, 2015b) (U.S. Census Bureau, 2015m) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o).

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[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." (U.S. Census Bureau, 2015u)

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 7.1.9-5 compares the unemployment rate in Kentucky to the South region and the nation. In 2014, Kentucky's statewide unemployment rate of 6.5 percent was slightly higher than the rate of the region (6.1 percent) and the nation (6.2 percent)[109] (BLS, 2015b) (U.S. Census Bureau, 2015m) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o).

Table 7.1.9-5: Selected Economic Indicators for Kentucky

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Kentucky	$23,668	$43,339	6.5%
South Region	$25,011	$46,562	6.1%
United States	$28,184	$52,250	6.2%

Source: (BLS, 2015; U.S. Census Bureau, 2015n; U.S. Census Bureau, 2015q; U.S. Census Bureau, 2015r)

Figure 7.1.9-2 and Figure 7.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015n) and unemployment in 2014 (BLS, 2015) varied by county across the state. These maps also incorporate the same population concentration data as Figure 7.1.9-1 (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015h). Following these two maps, Table 7.1.9-6 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 Kentucky.

Figure 7.1.9-2 shows that, in general, counties with a MHI above the national median were located in the north-central portion of the state. The remainder of the state had MHI levels below the national average, with the range for the lowest MHI concentrated throughout the eastern and southeastern portions of the state. Table 7.1.9-6 is consistent with those observations. It shows that MHI was higher than the statewide average only in four of the five population concentrations located in the north-central portion of Kentucky (Kentucky portions of the Cincinnati and Louisville/Jefferson County areas, and the Elizabethtown/Radcliff and Lexington-Fayette areas). MHI in all other population concentrations was below the state average. MHI was lowest in the London/Corbin area and the Kentucky portion of the Huntington areas. These are the second and fourth smallest of the areas shown in the table.

Figure 7.1.9-3 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 concentrated in the north-central portion of the state, but also distributed through the western portion of the state. The lowest unemployment rates were in the

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

eastern third of the state. When comparing unemployment in the population concentrations to the state average (Table 7.1.9-6), half of the population concentration areas had unemployment rates higher than the state average.

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 7.1.9-7 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 in Kentucky matched the percentage for the South region and was almost identical to that of the nation. The percentage of government workers was slightly higher in the state than in the region and nation. Self-employed workers were a slightly lower percentage in the state than in the region and nation.

By industry, Kentucky has a mixed economic base and some notable figures in the table are as follows. Kentucky in 2013 had a considerably higher percentage (more than two percentage points) of persons working in “manufacturing” than did the region or the nation and in “educational services, and health care and social assistance” compared to the region. It had a considerably lower percentages of workers in “professional, scientific, management, administrative, and waste management services” than the region or nation.

Table 7.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Kentucky, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Bowling Green	$39,556	10.3%
Cincinnati (OH/KY/IN) (KY Portion)	$56,756	8.2%
Elizabethtown/Radcliff	$46,478	10.8%
Frankfort	$43,395	9.8%
Huntington (KY/OH) (KY Portion)	$38,786	11.6%
Lexington-Fayette	$47,682	8.3%
London/Corbin	$31,460	13.1%
Louisville/Jefferson County (KY/IN) (KY Portion)	$48,420	9.9%
Owensboro	$42,495	8.2%
Paducah (KY/IL) (KY Portion)	$42,359	8.5%
Kentucky (statewide)	**$43,036**	**9.8%**

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

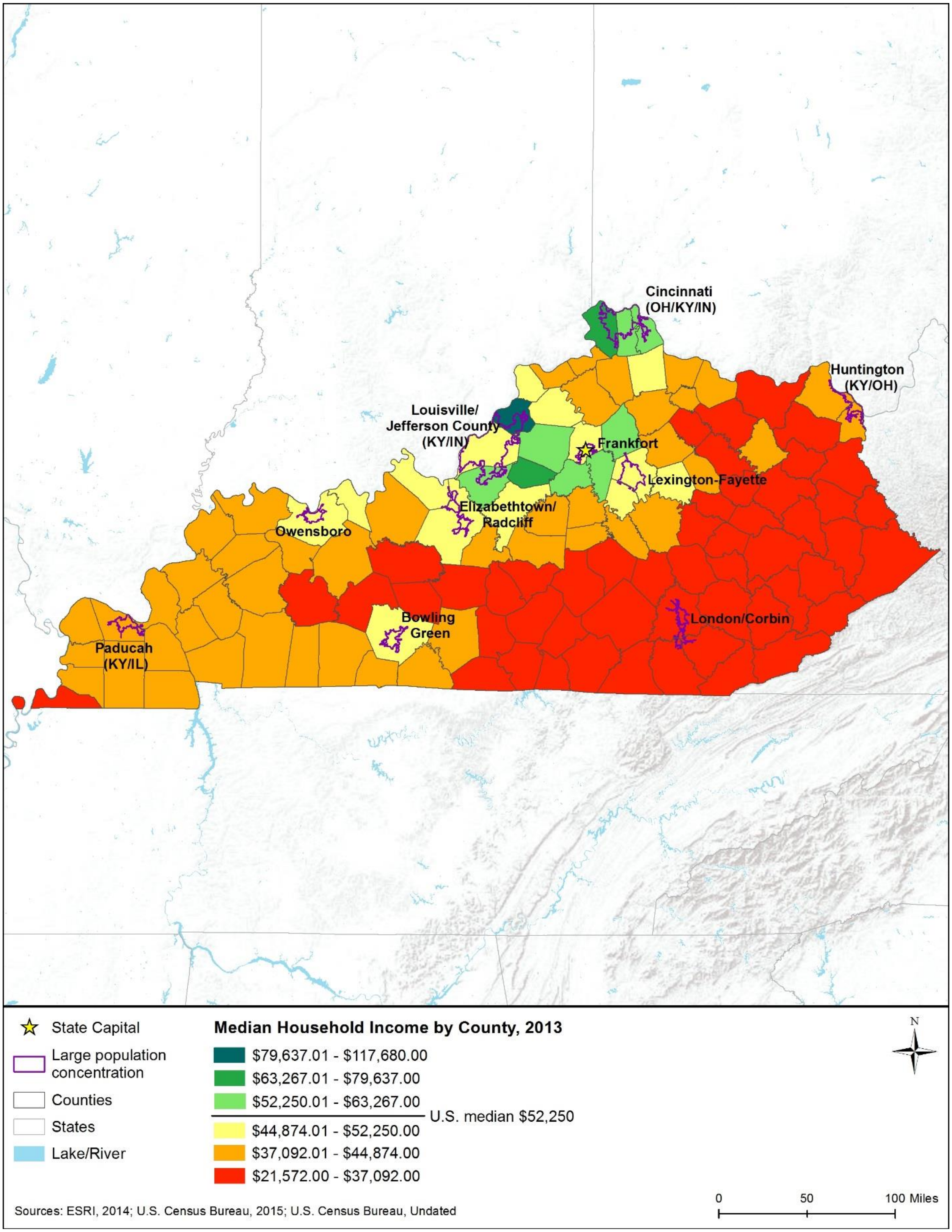


Figure 7.1.9-2: Median Household Income in Kentucky, by County, 2013

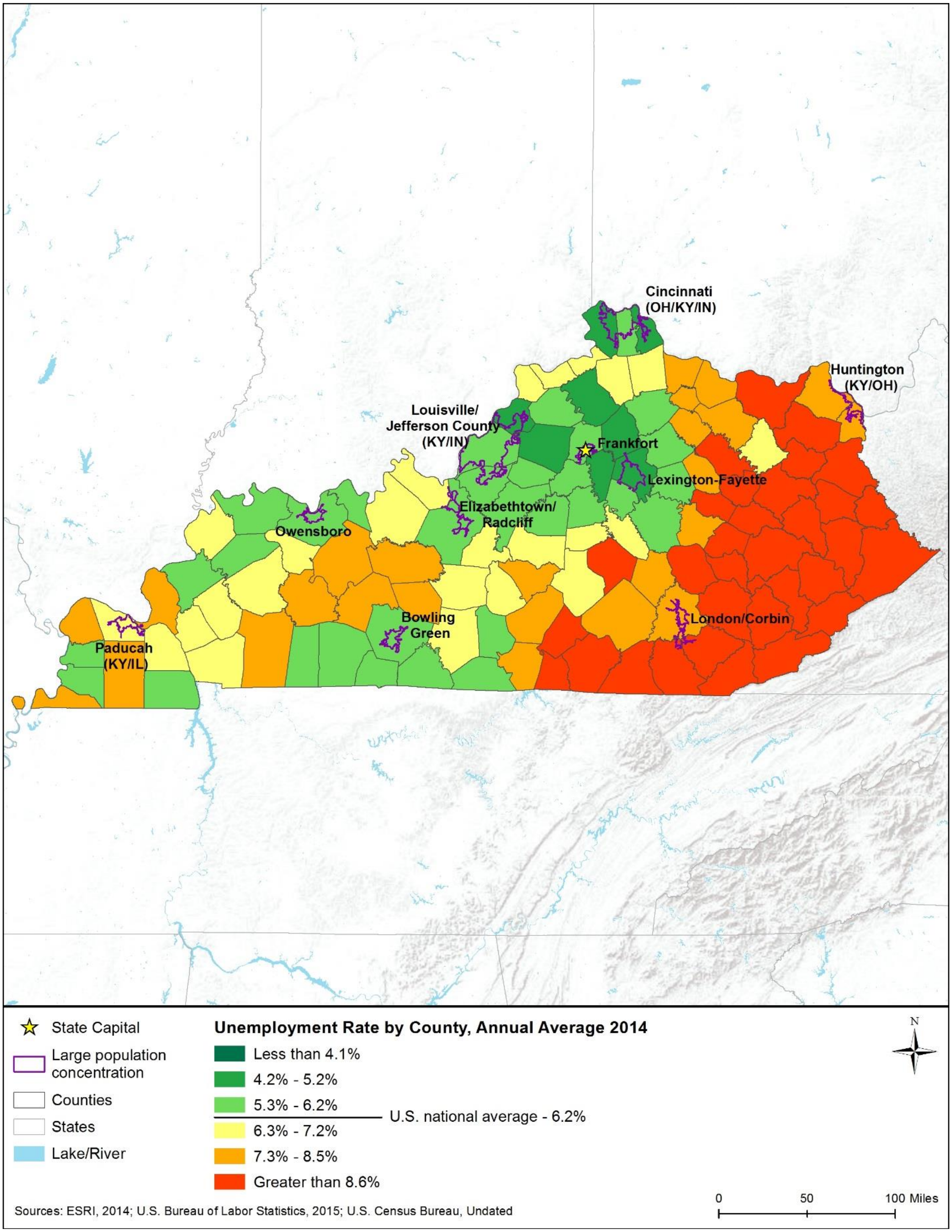


Figure 7.1.9-3: Unemployment Rates in Kentucky, by County, 2014

Table 7.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Kentucky	South Region	United States
Civilian Employed Population 16 Years and Over	1,894,116	45,145,155	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	79.4%	79.4%	79.7%
Government workers	15.1%	14.5%	14.1%
Self-employed in own not incorporated business workers	5.4%	5.9%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	2.7%	2.4%	2.0%
Construction	6.0%	6.9%	6.2%
Manufacturing	14.3%	9.9%	10.5%
Wholesale trade	2.7%	2.8%	2.7%
Retail trade	11.7%	12.1%	11.6%
Transportation and warehousing, and utilities	5.8%	5.2%	4.9%
Information	1.5%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	5.4%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	8.0%	10.5%	11.1%
Educational services, and health care and social assistance	24.4%	22.0%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.4%	9.9%	9.7%
Other services, except public administration	4.7%	5.2%	5.0%
Public administration	4.4%	4.8%	4.7%

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

Table 7.1.9-8 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 7.1.9-7 for 2013.

Table 7.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Kentucky, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Bowling Green	4.5%	3.6%	1.6%	7.8%
Cincinnati (OH/KY/IN) (KY Portion)	5.0%	6.8%	2.3%	10.3%
Elizabethtown/Radcliff	3.9%	4.6%	1.5%	9.0%
Frankfort	6.4%	3.2%	1.4%	7.8%
Huntington (KY/OH) (KY Portion)	5.9%	6.1%	2.0%	7.3%
Lexington-Fayette	4.5%	3.1%	2.2%	10.6%
London/Corbin	4.3%	3.5%	3.3%	10.4%

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Louisville/Jefferson County (KY/IN) (KY Portion)	4.9%	7.8%	2.3%	9.7%
Owensboro	6.1%	5.3%	1.1%	7.1%
Paducah (KY/IL) (KY Portion)	5.2%	5.2%	1.6%	9.1%
Kentucky (statewide)	**6.1%**	**5.9%**	**1.7%**	**7.7%**

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

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 7.1.9-9 compares Kentucky to the South region and nation on several common housing indicators.

As shown in Table 7.1.9-9, in 2013, Kentucky had a slightly higher percentage of housing units that were occupied (88.1 percent) than the region (85.7 percent) or nation (87.6 percent). Of the occupied units, Kentucky had a slightly higher percentage of owner-occupied units (67.4 percent) than the region (64.6 percent) or nation (63.5 percent). For detached single-unit housing (also known as single-family homes), Kentucky in 2013 had a somewhat higher percentage (67.7 percent) compared to the region (63.8 percent) and nation (61.5 percent). The homeowner vacancy rate in Kentucky (2.1 percent) was very close to the rate for the region (2.2 percent) and the nation (1.9 percent). This rate reflects "vacant units that are for sale only" (U.S. Census Bureau, 2015u). The vacancy rate among rental units was lower in Kentucky (6.7 percent) than in the region (8.5 percent) and slightly higher compared to the nation (6.5 percent).

Table 7.1.9-9: Selected Housing Indicators for Kentucky, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Kentucky	1,936,634	88.1%	67.4%	2.1%	6.7%	67.7%
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, 2015v)

Table 7.1.9-10 provides housing indicators for the largest population concentrations in the state by 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 7.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Kentucky, 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
Bowling Green	32,921	92.6%	51.0%	1.3%	6.7%	57.3%
Cincinnati (OH/KY/IN) (KY Portion)	139,577	90.3%	69.0%	3.1%	8.4%	64.1%
Elizabethtown/Radcliff	31,779	87.4%	50.2%	2.0%	11.8%	56.6%
Frankfort	17,485	89.6%	57.0%	3.0%	8.8%	62.3%
Huntington (KY/OH) (KY Portion)	24,990	89.7%	68.1%	2.4%	7.0%	76.3%
Lexington-Fayette	133,494	90.6%	54.9%	2.2%	5.9%	59.0%
London/Corbin	16,860	91.0%	58.6%	1.6%	7.2%	57.2%
Louisville/Jefferson County (KY/IN) (KY Portion)	371,086	90.8%	64.3%	2.3%	8.0%	66.3%
Owensboro	31,526	89.4%	63.7%	3.4%	9.8%	72.1%
Paducah (KY/IL) (KY Portion)	23,535	86.0%	62.1%	2.2%	7.4%	66.5%
Kentucky	1,930,158	87.8%	68.4%	2.2%	7.3%	67.3%

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

Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 7.1.9-11 provides indicators of residential property values for Kentucky 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, 2015u). The table shows that the median value of owner-occupied units in Kentucky in 2013 ($120,900) was lower than the corresponding values for the South region ($137,752) and the nation ($173,900).

Table 7.1.9-11: Residential Property Values in Kentucky, 2013

Geography	Median Value of Owner-Occupied Units
Kentucky	$120,900
South Region	$137,752
United States	$173,900

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

Table 7.1.9-12 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 areas had median property values lower than the state median value (the Kentucky portions of the Huntington and Paducah areas, and the London/Corbin and Owensboro areas). All other population concentrations had property values somewhat higher than the state value. The Lexington-Fayette area had the highest median value ($163,900). The lowest values were in the same two areas (the Kentucky portion of the Huntington area and the London/Corbin area) that had the lowest median household incomes (Table 7.1.9-12).

Table 7.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Kentucky, 2009–2013

Area	Median Value of Owner-Occupied Units
Bowling Green	$148,000
Cincinnati (OH/KY/IN) (KY Portion)	$150,900
Elizabethtown/Radcliff	$137,000
Frankfort	$137,400
Huntington (KY/OH) (KY Portion)	$90,200
Lexington-Fayette	$163,900
London/Corbin	$95,300
Louisville/Jefferson County (KY/IN) (KY Portion)	$151,200
Owensboro	$107,500
Paducah (KY/IL) (KY Portion)	$118,200
Kentucky (statewide)	**$120,400**

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes[110] are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized.

Table 7.1.9-13 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.

[110] Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006).

General and selective sales taxes may change, reflecting expenditures during system development and maintenance. Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006).

Table 7.1.9-13 shows that the Kentucky state government in 2012 received more total revenue on a per capita basis compared to its counterpart in the region and less total revenue than its counterparts in the nation. Kentucky local governments received considerably less total revenue per capita than their counterparts in the region and nation. The Kentucky state government obtained higher levels of property taxes per capita than state governments in the region or nation, and local governments in Kentucky obtained considerably lower levels of property taxes per capita than local governments in the region or nation, while per capita public utility taxes were lower. General sales taxes were similar on a per capita basis for the Kentucky state government compared to its counterparts elsewhere. Local governments in Kentucky received no revenues from general sales taxes. Selective sales taxes were roughly similar on a per capita basis for the Kentucky state government and state governments in the region and nation. Selective sales taxes and public utility taxes specifically, were lower on a per capita basis for Kentucky local governments compared to their counterparts in the region and nation. Individual and corporate income tax revenues, on a per capita basis, were higher for the Kentucky state government than for counterparts in the region and lower than for counterparts in the nation. Kentucky local governments obtained higher revenue per capita from individual income taxes than local governments in the region or nation. Corporate income taxes were a relatively small source of revenue on a per capita basis for Kentucky local governments.

Table 7.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue		Kentucky		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	($M)	$25,684	$14,764	$524,374	$449,683	$1,907,027	$1,615,194
	Per capita	$5,863	$3,370	$5,148	$4,414	$6,075	$5,145
Intergovernmental from Federal	($M)	$8,057	$550	$160,706	$18,171	$514,139	$70,360
	Per capita	$1,839	$55	$1,578	$178	$1,638	$224
Intergovernmental from State	($M)	$0	$4,643	$0	$115,088	$0	$469,147
	Per capita	$0	$468	$0	$1,130	$0	$1,495
Intergovernmental from Local	($M)	$32	$0	$2,815	$0	$19,518	$0
	Per capita	$7	$0	$28	$0	$62	$0
Property Taxes	($M)	$530	$2,601	$2,073	$109,687	$13,111	$432,989
	Per capita	$121	$262	$20	$1,077	$42	$1,379
General Sales Taxes	($M)	$3,052	$0	$82,651	$25,836	$245,446	$69,350
	Per capita	$697	$0	$811	$254	$782	$221

Type of Revenue		Kentucky		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Selective Sales Taxes	($M)	$1,982	$575	$41,447	$9,394	$133,098	$28,553
	Per capita	$453	$58	$407	$92	$424	$91
Public Utilities Taxes	($M)	$65	$305	$5,101	$4,745	$14,564	$14,105
	Per capita	$15	$31	$50	$47	$46	$45
Individual Income Taxes	($M)	$3,512	$1,126	$38,637	$1,226	$280,693	$26,642
	Per capita	$802	$113	$379	$12	$894	$85
Corporate Income Taxes	($M)	$575	$114	$8,099	$114	$41,821	$7,210
	Per capita	$131	$12	$80	$1	$133	$23

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

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

7.1.10. Environmental Justice

7.1.10.1. Definition of the Resource

Executive Order (E.O.) 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 E.O. (See Section 1.8, Overview of Relevant Federal Laws and Executive Orders).[111] The fundamental principle of environmental 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 E.O., each federal agency must "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Executive Office of the President, 1994). In response to the E.O., the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. DoC, 2013b).

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

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

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

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

In 2014, the USEPA issued the Policy on Environmental Justice for Working with Federally Recognized Tribes and Indigenous Peoples, which establishes principles to ensure that achieving environmental justice is part of the USEPA's work with federally recognized tribes and Indigenous Peoples in all areas of the U.S. and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands, and others living in Indian country. The policy, which is based on Executive Order 12898 as well as USEPA strategic plan and policy documents, contains 17 principles pertaining to the policy's four focus areas. These four focus areas are:

- Direct implementation of federal environmental programs in Indian country, and throughout the U.S.;
- Work with federally recognized tribes/tribal governments on environmental justice;
- Work with Indigenous Peoples (state recognized tribes, tribal members, etc.) on environmental justice; and
- Coordinate and collaborate with federal agencies and others on environmental justice issues of tribes, Indigenous Peoples, and others living in Indian country.

The policy includes accountability for the implementation of the policy, a definitions section, and an appendix that contains a list of implementation tools available. (USEPA, 2014e)

7.1.10.2. Specific Regulatory Considerations

Kentucky currently does not have a formal environmental justice policy for ensuring environmental equity for low income or racial minorities (University of California Hastings, 2010). However, the state has various approaches to ensure community involvement and safety when implementing actions. The KDEP is required to obtain a certificate to ensure they address "social and economic impacts of the proposed facility on the affected community" when siting certain types of waste management and disposal facilities (Kentucky Legislature, 1991) and the Kentucky Environmental Quality Commission promotes and facilitates public involvement regarding environmental issues (Kentucky Environmental Quality Commission, 2015). In addition, the Kentucky Transportation Cabinet has a guidance for environmental justice analysis to address low-income and minority populations that might be affected by roadway projects (KYTC, 2014d) (University of California Hastings, 2010). Federal laws relevant to environmental justice are summarized in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

7.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 7.1.10-2 presents 2013 data on the composition of Kentucky's population by race and by Hispanic origin. All of the state's minority races have lower percentages of the total population in Kentucky than they do in the South region and the nation. For instance, Black/African American individuals make of 8.0 percent of the population in Kentucky compared to 18.4 percent in the region and 12.6 percent in the nation. The state's population of persons identifying as White (87.7 percent) is considerably higher than that of the South region (72.3 percent) or the nation (73.7 percent).

The percentage of the population in Kentucky that identifies as Hispanic (3.3 percent) is considerably lower 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. Kentucky's All Minorities population percentage (14.3 percent) is considerably lower than that of the South region (42.3 percent) or the nation (37.6 percent).

Table 7.1.10-1 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Kentucky (18.8 percent) is similar to that of the South region (18.2 percent) and considerably higher than the figure for the nation (15.8 percent).

"All Minorities" is defined as all persons who consider themselves Hispanic or of any race other than White. Because some Hispanics identify as both Hispanic and of a non-White race, "All Minorities" is less than the sum of Hispanics and non-White races.

Table 7.1.10-1: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Kentucky	18.8%
South Region	18.2%
United States	15.8%

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

Table 7.1.10-2: Population by Race and Hispanic Status, 2013

Geography	Total Population (estimated)	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Kentucky	4,395,295	87.7%	8.0%	0.2%	1.2%	0.0%	0.9%	2.0%	3.3%	14.3%
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%

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

7.1.10.4. 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. (See footnote 105 on how the data was calculated.)

Figure 7.1.10-1 visually portrays the results of the environmental justice population screening analysis for Kentucky. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015g; U.S. Census Bureau, 2015ab; U.S. Census Bureau, 2015l; U.S. Census Bureau, 2015k) and Census Bureau urban classification data (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015h).

Figure 7.1.10-1 shows that Kentucky has many areas with high potential for environmental justice populations. The distribution of these high potential areas is particularly prevalent in the eastern third of the state and fairly even across the remainder of the state. These areas occur both within and outside of the 10 largest population concentrations. This includes some of the state's most sparsely populated areas, such as southeastern parts of the state. Areas of moderate potential for environmental justice populations are fairly evenly distributed through the state.

It is important to understand how the data behind Figure 7.1.10-1 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 7.1.10-1 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 7.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

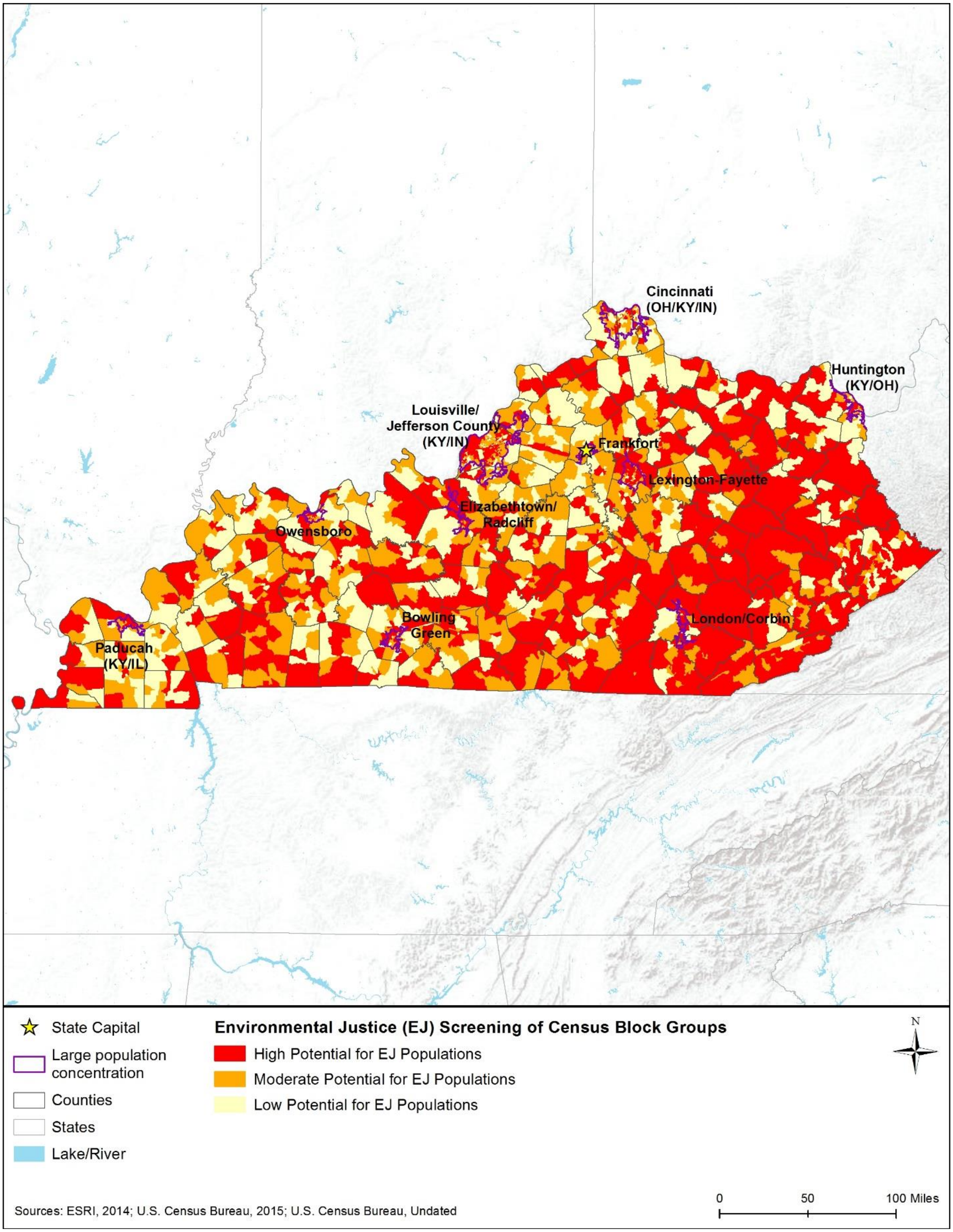


Figure 7.1.10-1: Potential for Environmental Justice Populations in Kentucky, 2009–2013

7.1.11. Cultural Resources

7.1.11.1. 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 the:

- Statutory language and implementing regulations for Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- The NPS program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015m); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to a American Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

7.1.11.2. Specific Regulatory Considerations

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

Kentucky has a state law and associated regulations that parallel both NEPA and the NHPA (refer to Table 7.1.11-1). However, federal laws and regulations supersede state laws and regulations. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations.

Table 7.1.11-1: Relevant Kentucky Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Revised Statutes (KSR) 171.3801	Kentucky Heritage Council	Establishes the Kentucky Heritage Council to preserve and protect "all meaningful vestiges of Kentucky's heritage for succeeding generations" including projects related to "conservation and [recognition] of buildings, structures, sites, and other landmarks associated with archaeological, cultural, economic, military, natural, political, or social aspects of [the state's] history."
Kentucky State Burial Site KSR 164.705	Kentucky Heritage Council and local law enforcement	These laws prohibit the physical abuse or mistreatment of human remains, burials, grave markers, and associated objects. If a burial is uncovered during development or construction, work must stop immediately in the area and local law enforcement should be notified. Following determination that the site does not constitute a crime scene and the remains are a prehistoric or historic human burial, the Council may assist the project proponent, developer, and/or landowner in contacting appropriate parties, considering options to avoid the burial(s), and advising on the legal process for potentially moving the remains.

Source: (Kentucky Legislature, 2013) (University of Louisville, 2017)

7.1.11.3. Cultural and Natural Setting

Human beings have inhabited the Kentucky region for more than 13,500 years. The majority of evidence of the state's early human habitation comes from the study of archeological sites of pre-European contact and historic populations. In addition to the hundreds of archaeological sites listed in the state's inventory, there are 118 archeological sites in Kentucky listed in the NRHP. (NPS, 2014c).

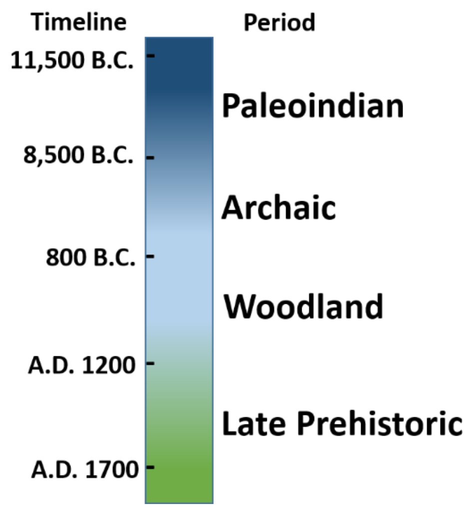
Archaeologists typically divide large study areas into regions. Kentucky has three major physiographic regions: Appalachian Highlands (Appalachian Plateaus Province), Interior Plains (Interior Low Plateaus Province), and Atlantic Plain (Coastal Plain Province). The locations of these regions and their respective provinces are shown in Figure 7.1.3-1 of this document.

Most archeological evidence in Kentucky is found in relatively shallow deposits on the surface or within one to two feet of the surface. However, in some cases, natural factors have buried sites beneath multiple layers of sediment or organic materials, such as in floodplain deposits found along streams and rivers or peat deposits in wetlands. These alluvial deposits can range 1-from 10 feet below the current ground surface, with older sites in the deeper sediments. Disturbed ground, including urban areas, may contain archaeological resources in deeper or shallower strata than undisturbed areas (Kentucky Heritage, 2008; Pauketat, 2012).

The following sections provide additional detail about Kentucky's prehistoric periods (approximately 11500 B.C. to A.D. 1700) and the historic period since European contact and exploration in the late 1600s. There is some overlap between the prehistoric period and the historic period, as American Indians continued to carry on their traditional way of life in parts of Kentucky after European contact. Section 7.1.11.4 presents an overview of the initial human habitation in Kentucky and the cultural development that occurred before European contact. Section 7.1.11.5 discusses the federally recognized American Indians with a cultural affiliation to the state. Section 7.1.11.6 provides a current list of significant archaeological sites in Kentucky and tools that the state has developed to ensure their preservation. Section 7.1.11.7 documents the historic context of the state since European contact, and Section 7.1.11.8 summarizes the architectural context of the state during the historic period.

7.1.11.4. Prehistoric Setting

Archaeologists divide Kentucky's prehistoric past into four periods: Paleoindian Period (11500 - 8500 B.C.), Archaic Period (8500 - 800 B.C.), Woodland Period (800 B.C. - A.D. 1200), and Late Prehistoric Period (A.D. 1200 - 1700) (Kentucky Heritage, 2008). Figure 7.1.11-1 shows a timeline representing these periods of early human habitation of present day Kentucky. Kentucky is part of the Interior Plains archaeological culture of North America. Evidence of human occupation is prevalent in each of Kentucky's three physiographic regions. Due to advancements in archaeological techniques and the association of newly discovered artifacts with similar ones previously assigned to a particular range of the archaeological record, the dates associated with a particular phase in North American human development continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).



Source: (Institute of Maritime History, 2015;
Kentucky Heritage, 2008)

Figure 7.1.11-1: Timeline of Prehistoric Human Occupation

Paleoindian Period (11500 – 8500 B.C.)

The Paleoindian Period represents the earliest human habitation of the Kentucky region. The earliest people lived in small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear projectile points (Clovis or Folsom fluted points). Studies show that that similar technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier, Inizan, & Feblot-Augustins, 2002). During the Paleoindian Period many large mammals that are now extinct, such as giant bison, mammoths, and ground sloths, were being hunted. As the technologies changed and the large animals decreased in numbers, the people began to exploit various other plant and animal species for sustenance (Kentucky Heritage, 2008).

Most of the oldest known evidence of human settlement in Kentucky comes from the discovery of Clovis and Folsom projectile points. The artifacts from the Paleoindian Period are not distributed evenly throughout Kentucky, and vary in accordance with their geographic and topographic settings. Out of the 11,257 projectile points discovered in the United States dating from the Paleoindian period, 290 are from Kentucky (Anderson & Faught, 1998).

Archaic Period (8500 – 800 B.C.)

By the Archaic Period, the climate was becoming much more like it is today in Kentucky. Most of the large migratory mammals that were previously hunted had become or were becoming extinct, so the people pursued smaller game, such as deer and rabbits. Archaic Period hunters used notched and stemmed (not fluted) stone projectile, as well as the spearthrower (atlatl) "to improve the accuracy of their throwing" (Kentucky Heritage, 2008). Nutting stones found at Archaic Period campsites indicate people were also beginning to rely more on gathering plants for food. By 1000 B.C., some archaic peoples had begun to grow their own food, eventually "planting seeds in areas cleared especially for that purpose" (Kentucky Heritage, 2008).

Archaeological evidence of ceramics manufacturing during the early Archaic Period is limited, but the knowledge for making pottery for food storage and ceremonial purposes appears to have come into the area about 3,000 years ago (Kentucky Heritage, 2008; Jefferies, Thompson, & Milner, 2005; Conaty, 1987).

Around 5,000 years ago, the cultivation and domestication of plants became an important supplement to the diet of Archaic Period people occupying present day Kentucky. People began to settle into semi-permanent camps that they occupied depending upon the season and the availability of resources in an area. (Kentucky Heritage, 2008).

Riverbank shell middens are common archaeological sites in west-central Kentucky (Milner & Jefferies, 1998). These sites provide evidence of changing economic, social, and ritual practices, including the importance of river and wetland resources to support a more sedentary lifestyle. Waterways also provided a means of transportation and facilitated trade with distant groups to mitigate food shortages (Jefferies, Thompson, & Milner, 2005).

The Carlston Annis Shell Mound sites (Butler County) and the Peter Cave site (Leitchfield, KY) indicate that the types of plant material exploited for food and other purposes began to change in the Late Archaic Period. Archaeologists researching these shell mound sites have identified 72 plant species, including hickory nut, squash, and acorns (Crawford, 1982).

Paleoethnobotanical research of the Cold Creek Shelter site in eastern Kentucky has revealed the origins of agricultural practices in Kentucky and the eastern regions of the United States, including domesticated *Cucurbita*, seeds of native annual crops such as sumpweed, maygrass, and goosefoot (*Chenopodium* spp.). This early agriculture eventually led to the cultivation of corn and beans. The use of storage pits and rockshelter occupation provides further evidence that Archaic Period people were transitioning to an agricultural and sedentary lifestyle (Gremillion, 1993).

Woodland Period (800 B.C. – A.D. 1200)

During the Woodland Period, inhabitants of Kentucky lived primarily lived in seasonal camps as their Archaic Period forbears had done. Cultural advancements during the Woodland Period include expansion and productivity agriculture, advancements in pottery and development of the bow and arrow for a more efficient means for hunting, warfare, and possibly fishing (Kentucky Heritage, 2008).

The pottery manufactured during the Woodland Period was thick, fragile, and not very transportable. However, the pots provided the means for cooking, storing food and water, and other cultural and survival benefits resulting from more reliable food storage and cooking (Kentucky Heritage, 2008).

Prehistoric Period (A.D. 1200 – A.D. 1700)

Populations continued to increase during the Late Prehistoric Period as people became more sedentary and sources of food throughout the year more reliable. The evidence of gardening and the tools (such as the hoe) associated with horticultural activities is prevalent in Kentucky. People relied heavily on the planting, growing, and harvesting of corn and beans. "These plants supplied the Mississippian [Late Prehistoric] people of western Kentucky and Fort Ancient [Late Prehistoric] peoples of eastern Kentucky with as much as 60% of their diet" (Kentucky Heritage, 2008; Fuerst, 2005).

Another advancement of the Late Prehistoric Period was the development of better housing structures. Throughout Kentucky, rectangular houses were built for year-round shelter, as well as fortified (stockade) villages. Villages supported as many as 2,000 people, and were composed of a chiefdom of hereditary rulers (Kentucky Heritage, 2008; Fuerst, 2005). "New pottery vessel forms were developed during this period…[including] jars, bowls, plates, bottles, and colanders. Handles were added to jars and human and animal effigies were attached to some bowls and bottles" (Kentucky Heritage, 2008).

7.1.11.5. Federally Recognized Tribes of Kentucky

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are no federally recognized Tribes in Kentucky (National Conference of State Legislators, 2015; GPO, 2015). Figure 7.1.11-2 shows the general historic location of officially federally recognized tribes that were known to exist in this region of the United States, but are no longer present in the state.

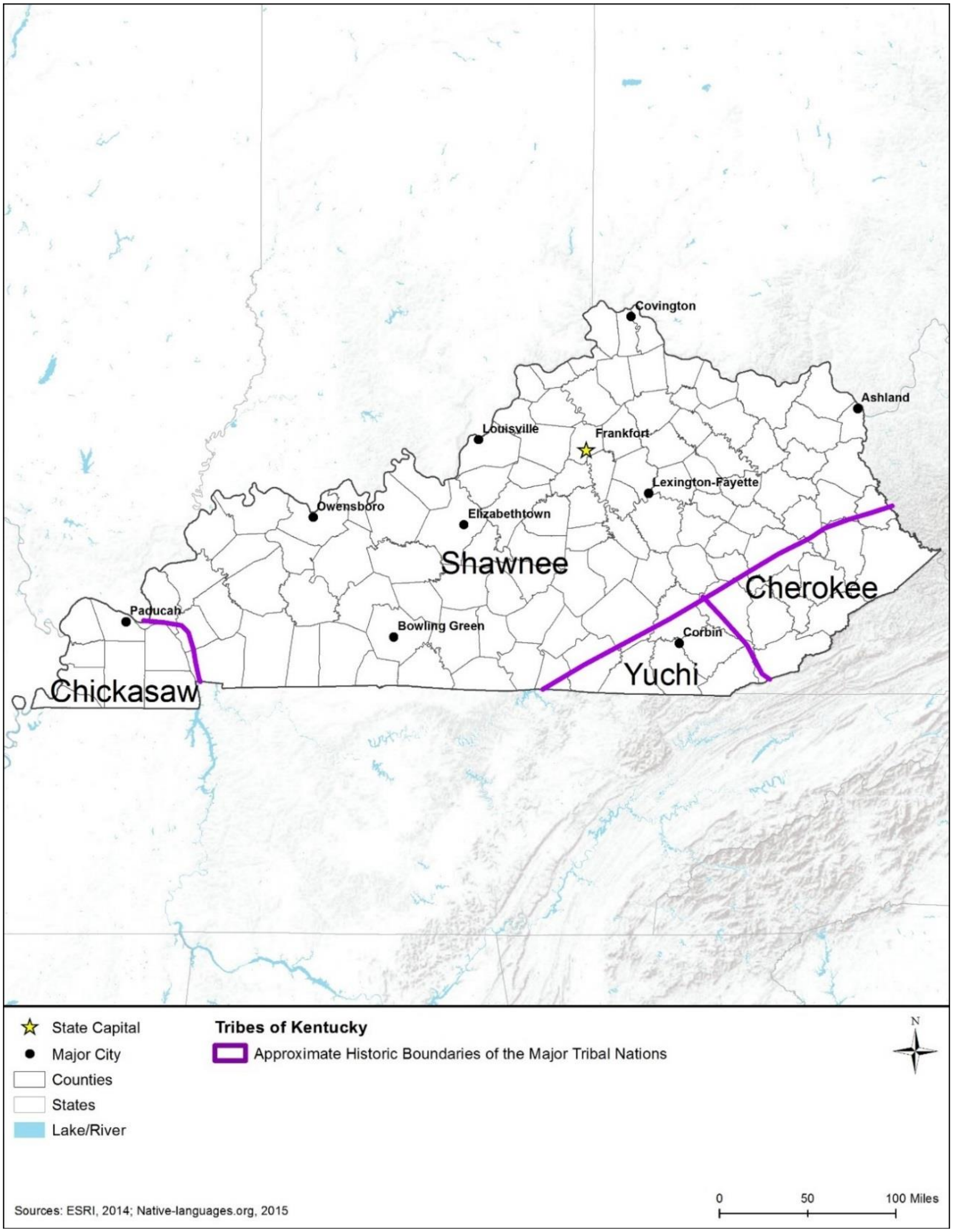


Figure 7.1.11-2: Approximate Historic Boundaries of Major Tribes in Kentucky[112]

[112] Figure 7.1.11-2 is provided for context and is not intended to be exact as the various sources that were consulted contain varying ancestral territory boundaries. Instead, this figure and corresponding ancestral territory boundaries are provided to show that the historic ancestral territories and the current ancestral interests of a given tribe within a given state are often times complex as ancestral territory boundaries shifted and overlapped over time.

7.1.11.6. Significant Archaeological Sites of Kentucky

As previously mentioned in Section 7.1.11.3 there are 118 archaeological sites in Kentucky listed on the NRHP. Table 7.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites is listed on the NPS NRHP website at http://www.nps.gov/nr/ (NPS, 2014d).

Kentucky State Cultural Resources Database and Tools

Kentucky Heritage Council/State Historic Preservation Office (KHC/SHPO)

The Kentucky Heritage Council works to preserve the cultural resources of Kentucky. The office is responsible for identifying, preserving, and protecting the historic resources of the state. The KHC maintains inventories of listed and previously identified historic resources, along with historic contexts that aid in evaluating the significance of historic resources and archaeological sites (http://heritage.ky.gov/default.htm).

Table 7.1.11-2: Archaeological Sites on the National Register of Historic Places in Kentucky

Closest City	Site Name	Type of Site
Adairville	Red River Presbyterian Meetinghouse Site and Cemetery	Historic
Adairville	Savage Cave Archeological Site	Prehistoric
Ashland	Indian Mounds in Central Park	Prehistoric
Asphalt	Asphalt Rock Pictographs (15ED24)	Prehistoric
Athens	Guilfoil Village Site (15FA176)	Prehistoric
Augusta	Turtle Creek Site (15BK13)	Prehistoric
Backusburg	Archeological Site 15CW64	Prehistoric
Bardwell	Marshall Site (15CE27)	Prehistoric
Bardwell	Turk Site (15CE6)	Prehistoric
Benton	Archeological Site No. 15Ml109	Prehistoric
Bighill	Archeological Site No. 15MA25	Prehistoric
Bristle Town	Site BN54	Prehistoric
Cave City	Wigwam Village No. 2	Prehistoric
Cloverport	Tar Springs Petroglyphs (15BC129)	Prehistoric
Columbia	Archeological Site 15AD33	Prehistoric
Columbia	Archeological Site 15AD54	Prehistoric
Danville	Harlan's Station Site	Historic
East Bernstadt	Wildcat Mountain Battlefield (Boundary Increase)	Historic
Elkton	Hadden Site (15TO1)	Prehistoric
Eriline	Red Bird River Shelter Petroglyphs (15CY52)	Prehistoric
Fixer	Perdue Petroglyphs (15LE111)	Prehistoric
Frankfort	Archeological Site 15FR34	Prehistoric
Frankfort	Archeological Site 15FR368	Prehistoric

Closest City	Site Name	Type of Site
Frankfort	Archeological Site 15FR368 (Boundary Increase)	Prehistoric
Frenchburg	Archeological Site 15MF355	Prehistoric
Frenchburg	Spratt's Petroglyphs (15MF353)	Prehistoric
Frenchburg	Webb, W. S., Memorial Rock Shelter	Prehistoric
Furnace	Ashley Petroglyphs (15ES27)	Prehistoric
Furnace	State Rock Petroglyph Site (15PO106)	Prehistoric
Glens Fork	Archeological Site 15AD36	Prehistoric
Hanson	Archeological Site 15HK8	Prehistoric
Harrodsburg	Archeological Site 15ME15	Prehistoric
Harvieland	Archeological Site 15FR26	Prehistoric
Harvieland	Archeological Site 15FR52	Prehistoric
Hebbardsville	Archeological Site KHC-3 (15HE635)	Prehistoric
Hebbardsville	Archeological Site KHC-4 (15HE580)	Prehistoric
Hebron	Johnson, Cave, House	Prehistoric
Hickman	Running Slough Site (15FU67)	Prehistoric
Hickman	Sassafras Ridge (15FU3)	Historic
Holt	Holt Bottoms Archeological District	Historic
Hopkinsville	McRay Site (15CH139)	Prehistoric
Hopkinsville	Pilot Rock Petroglyphs (15CH200)	Prehistoric
Indian Lake	Jeffry Cliff Petroglyphs (15HA114)	Prehistoric
Jeffersontown	Rockdale	Prehistoric
Kirtley	Archeological Site KHC-6 (15OH97)	Prehistoric
Kirtley	Jimtown Site (15OH19)	Prehistoric
Knowlton	White's Rockshelter Petroglyphs	Prehistoric
Kuttawa	Whalen Site (125LY48)	Prehistoric
Lair	Archeological Site No. 15HR4	Prehistoric
Lenore	Archeological Site 15NE3	Prehistoric
Lewisburg	Page Site (15LO1)	Prehistoric
Lexington	Sparks Indian Rock House Petroglyphs (15ES26)	Prehistoric
Lexington	Elam Mound Archeological Site	Prehistoric
Lexington	Mt. Horeb Archeological District	Prehistoric
Lexington	Ramey Mound	Prehistoric
Lexington	Rockefeller Mound	Prehistoric
Livermore	Archaeological Site 15MCL18	Prehistoric
Livermore	Archeological Site No. 15MCL17	Prehistoric
Logansport	Russell Shell Mound (15BT11)	Prehistoric
London	Wildcat Battlefield Site	Historic
Louisville	KYANG Site (15JF267)	Prehistoric
Louisville	Rockledge	Prehistoric
Maceo	Archeological Site 15DA39	Prehistoric
Mays Lick	Fox Farm	Historic
Mays Lick	Van Meter Site	Prehistoric

Closest City	Site Name	Type of Site
Monticello	Read Shell Mound (15BT10)	Prehistoric
Morgantown	Turkey Rock Petroglyphs (15BT64)	Prehistoric
Moscow	White Site (15FU24)	Prehistoric
Mount Olive	Bear Track Petroglyphs (15LE112)	Prehistoric
Moutardier	Saltsman Branch Petroglyphs (15GY66)	Prehistoric
Moutardier	Saltsman Branch Shelter Petroglyphs (15GY67)	Prehistoric
Mundfordville	Salts Cave Archeological Site	Prehistoric
Nada	High Rock Petroglyphs (15PO25)	Prehistoric
Nada	Martin Fork Petroglyphs	Prehistoric
Nada	McKinney Bluff Petroglyphs (15PO107)	Prehistoric
Nada	Nada Tunnel 1 Petroglyphs	Prehistoric
Nebo	Archeological Site 15HK79	Prehistoric
New Concord	Fort Heiman Site	Historic
Nicholasville	Sandy Bluff	Prehistoric
Nonesuch	Archeological Site 15WD61	Prehistoric
Oil Springs	Sparks Shelter Archeological Site	Prehistoric
Old Landing	Old Landing Petroglyphs (15LE113)	Prehistoric
Olive Hill	Saltpeter Cave	Prehistoric
Paducah	Archeological Site 15MCN51	Prehistoric
Paradise	Indian Knoll	Prehistoric
Paris	Buckner Site (15BB12)	Prehistoric
Payneville	Payneville Petroglyphs (15MD308)	Prehistoric
Petersburg	Green, M.B., Site	Prehistoric
Petersburg	Rogers Site	Prehistoric
Prentiss	Rayburn Johnson Shell Mound (15BT41)	Prehistoric
Redbush	Hill, Ray, Archeological Site	Prehistoric
Redbush	Lonnie Hill Site	Prehistoric
Reedyville	Reedyville Petroglyphs (15BT65)	Prehistoric
Relief	Sherman Archeological Site	Prehistoric
Richmond	Fort Boonesborough Site	Prehistoric
Richmond	Noland Mound (15MA14)	Prehistoric
Round Hill	Archeological Site 15MA24	Prehistoric
Rumsey	James Giles Shell Midden (15HE589)	Prehistoric
Rumsey	Archeological Site No. 15MCL16	Prehistoric
Shepherdsville	Ashworth Rock Shelters Site	Prehistoric
Slade	Raised Spirits Rockshelter	Prehistoric
Slade	Shepherd Site	Prehistoric
Smallhous	Smallhous Shell Mound (15OH10)	Prehistoric
South Portsmouth	Lower Shawneetown	Prehistoric
South Portsmouth	Lower Shawneetown Archeological District	Historic
South Portsmouth	Portsmouth Earthworks, Group A	Historic
South Union	Watkins Site (15L012)	Prehistoric

Closest City	Site Name	Type of Site
Stanton	Haystack Rock Shelter	Prehistoric
Stanton	Martin Site	Prehistoric
Stanton	Seldon Skidmore Site	Historic
Union	Archaeological Site 15BE36	Prehistoric
White Plains	Archeological Site 15HK46 and 47	Prehistoric
Wickliffe	Wickliffe Site 15BA4	Prehistoric
Willow Grove	Snag Creek Site (15BK2)	Prehistoric
Wilmore	Bethel Academy Site (15JS80)	Prehistoric
Winchester	Mound Hill Archeological Site	Prehistoric
Woodbury	Woodbury Shell Midden (15BT67)	Prehistoric
Zachariah	Pine Crest Shelter (15LE70)	Prehistoric

Source: (NPS, 2014d)

7.1.11.7. Historic Context

Kentucky was first explored by Europeans during the late 17th century, with the explorer Rene-Robert Cavelier, Sieur de La Salle, claiming much of the Ohio River watershed for France in 1669. While France maintained its claim until the end of the French and Indian War (1754 to 1762), English colonists began exploring in Kentucky in the 1670s with Virginian fur traders such as James Needham and Gabriel Arthur coming in 1673 and demonstrating the possibility of further settlement in the Cumberland Gap that began in the mid-18th century. Frontiersmen, such as Daniel Boone, explored the area, but "usually only stayed long enough in the territory to hunt or trap, select their own land, mark it, build an improvement cabin, and plant a small corn crop before returning east" (Kentucky Heritage Council, 2010).

In 1775, Kentucky's first two lasting settlements, Harrodsburg, and Boonesborough, were established. Settlers usually reached Kentucky either over the Wilderness Road, passing through the Cumberland Gap, or by traveling down the Ohio River. During the American Revolution, the area's American Indians were largely allied with the British, which resulted in raids on settlers during the conflict. While some settlements were abandoned, other persevered and developed into Lexington, Georgetown, and other towns. Settlement increased with migration from eastern states, as well as from Europe. "Early industries in Kentucky consisted of grist mills, potteries, small salt works, and blacksmith shops. Production in the home, including weaving, tanning, sewing, and whiskey distilling, was also prevalent during the initial settlement period. The earliest principal crop was corn, but tobacco, flax, hemp, and wheat… [were]…grown" (Kentucky Heritage Council, 2010).

During the Antebellum Era, steamboat transportation resulted in the growth of towns located along navigable rivers, such as Louisville. The first railroads in the Kentucky were built in the 1830s, and further spurred economic growth throughout the state. Coal production grew in importance starting in the mid-19th century, especially in the eastern portion of the state. While agriculture remained dominant, industries like iron making and glass production had begun to expand, and "by 1860, Louisville was the twelfth largest manufacturing center in the nation and the largest in the South" (Kentucky Heritage Council, 2010).

In 1838 and 1839, as part of Andrew Jackson's Indian removal policy, the Cherokee nation, as well as other Southern and Southeastern tribes, were forced to give up lands east of the Mississippi River and migrate to areas in present-day Oklahoma. This journey, parts of which traversed the state, is known as the “Trail of Tears,” and became a cultural memory for the Cherokee and other removed tribes because of its devastating physical and cultural effects (NPS, 2016f). During the Civil War, Kentucky remained in the Union despite being a slaveholding state. While several small battles occurred, it was not a center of conflict. Both Abraham Lincoln and Jefferson Davis were from Kentucky (Kentucky Heritage Council, 2010).

After the Civil War, many freed African Americans left rural areas in search of manufacturing jobs in Louisville and other urban areas in Kentucky and other states. Tobacco production began to replace hemp in certain areas, with civil conflict arising over tobacco production disputes during the early 20th century. Horse racing became important during the late 19th century, and “although the first Kentucky Derby was held in May 1875, it wasn’t until 1903 when businessman, horse racing enthusiast, and master promoter Matt Winn, along with other prominent Louisville citizens, purchased Churchill Downs, and made the Derby the tradition that is today” (Kentucky Heritage Council, 2010).

During World War I (WWI), farmers, miners, and industrial workers experienced prosperity associated with wartime production; however, prices fell shortly afterwards and state’s economy shrank. “During Prohibition, 1920-1933, the closing of bourbon distilleries created widespread unemployment. In Louisville, there was a loss of 6,000 to 8,000 distillery jobs” (Kentucky Heritage Council, 2010). The economic impact was further exacerbated by the Great Depression, which significantly affected the coal mining industry as well. “By 1937, more than 5,500 Kentucky men were working for the Civilian Conservation Corps (CCC)…(and) Kentucky roads, bridges, dams, public buildings, as well as state park picnic shelters, tourist cabins, and trails were constructed by CCC workers” (Kentucky Heritage Council, 2010).

During World War II (WWII), manufacturing increased, which fueled urbanization, while farm production declined; agriculture has continued to decline in the post-WWII years. While Kentucky continues to be a top producer of coal, “cultural traditions, such as bluegrass music, whiskey distilling, and quilting have become the focus of popular cultural tourism initiatives” (Kentucky Heritage Council, 2010).

Kentucky has 3,380 National Register of Historic Places (NRHP) listed sites, as well as 32 National Historic Landmarks (NHL) (NPS, 2014e). Kentucky contains no National Heritage Areas (NHA) (NPS, 2015m). Figure 7.1.11-3 shows the location of NRHP sites within the state of Kentucky.[113]

[113] See Section 7.1.7.4 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

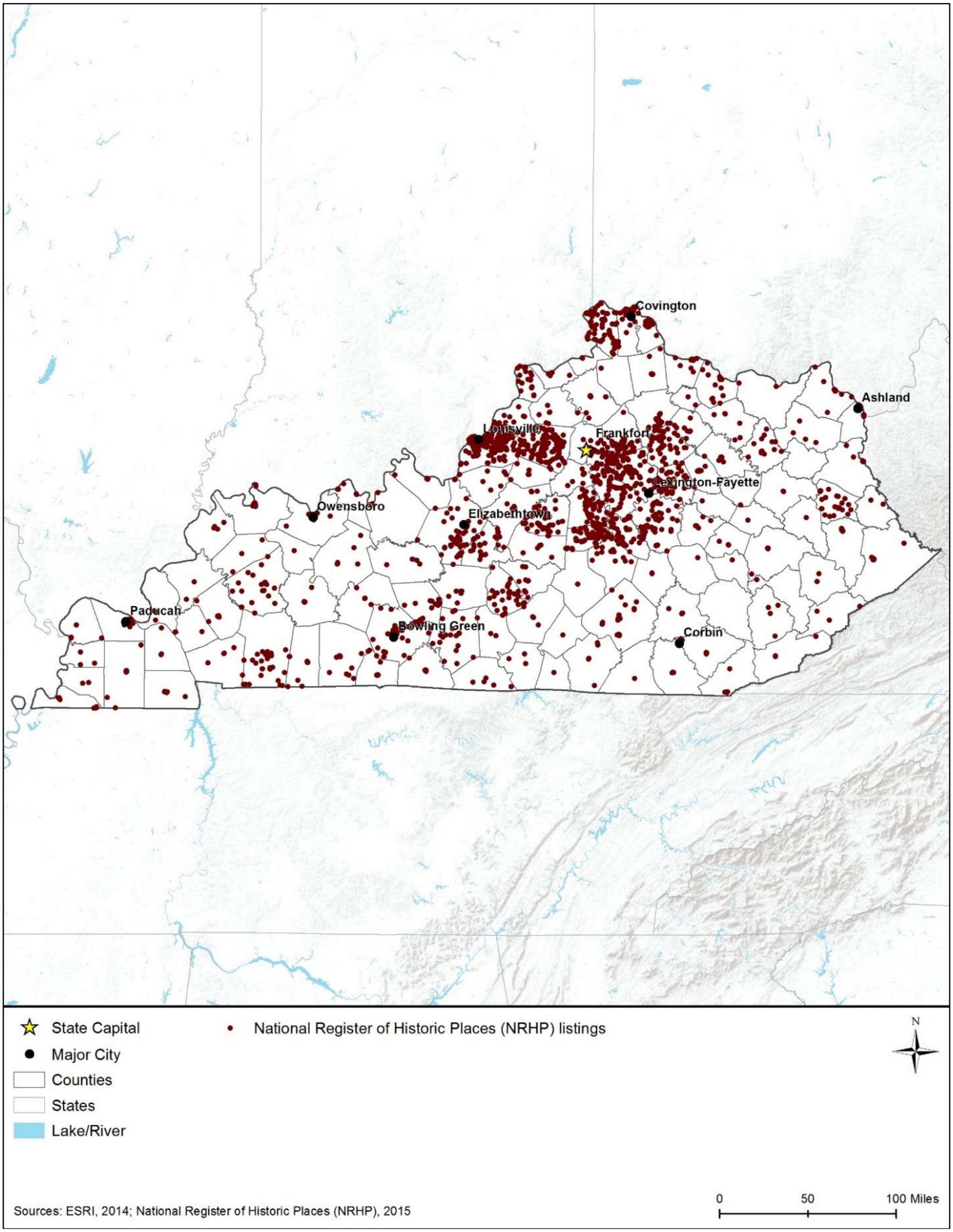


Figure 7.1.11-3: National Register of Historic Places (NRHP) Sites in Kentucky

7.1.11.8. Architectural Context

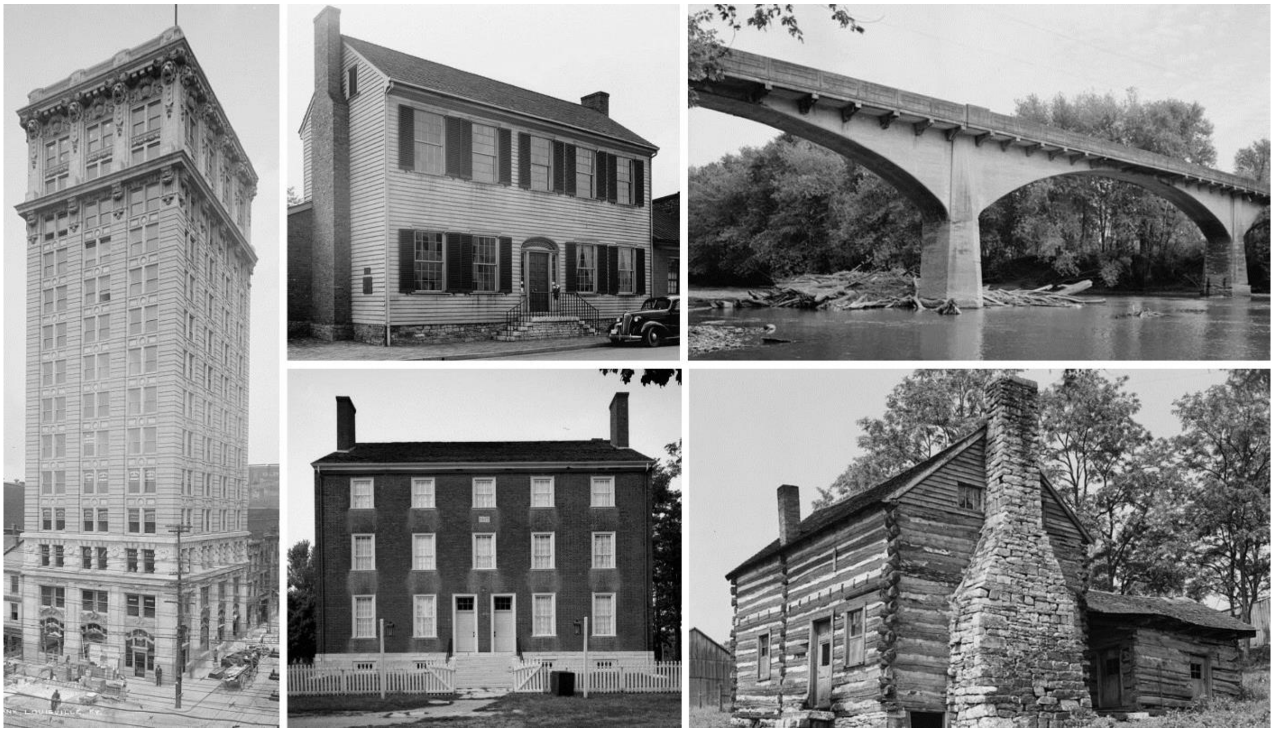
Early houses in Kentucky resembled those found in the Carolinas, Pennsylvania, and Virginia, all of which supplied settlers to Kentucky. One to one and a half story log houses, either single or double pen, with exterior chimneys were common. While log structures continued to be built throughout the 19th century, frame, brick, and stone houses were built in increasing numbers; national trends also began to replace regional characteristics. "Although there are many standard house types (within Kentucky), including the single or double pen house, dogtrot house, hall and parlor house, five bay I-house with an added rear service ell, shotgun house…foursquare house, and the bungalow, field survey continues to reveal wide variation and diversity" among the state's historic homes (Kentucky Heritage Council, 2010).

Historic commercial architecture is common throughout the state, with many facilities near popular transportation routes. Examples of early commercial architecture include inns, taverns, shops, and mills. In general, "commercial buildings constructed during the late 19th century and early 20th century have three distinct sections that gave the façade an overall unified appearance: a storefront with long display windows, upper floor(s), and cornice" (Kentucky Heritage Council, 2010). During the 20th century, suburban commercial developments began to grow as clientele came to rely on automobile transportation (Kentucky Heritage Council, 2010). Agricultural resources are common and important to the history of the state, with tobacco barns being an example, along with barns associated with the horse racing industry. Horse racing facilities, such as Churchill Downs, are yet another related historic resource.

Civic and institutional buildings have historically been important, with jails, courthouses, seats of government, and schools being examples. During the Great Depression, "communities in Kentucky benefited from new courthouses, jails, schools, post offices, roads, bridges, as well as park facilities, such as picnic pavilions and recreational cabins, through the skills of CCC workers and local laborers" (Kentucky Heritage Council, 2010). Religious buildings are common, and while Christianity has traditionally been dominant, other faiths are represented as well. "Religious buildings share many commonalities with public buildings, as they tend to be among the most prominent buildings within a given community" (Kentucky Heritage Council, 2010). The Shaker Village at Pleasant Hill, which is no longer an active community, is now a NHL (Kentucky Heritage Council, 2010).

Additional resource types include industrial buildings, such as "mill sites, potteries, wheat threshing sites, oil vats, pump houses, tar and lye leaching sites, quarries, coal mine shafts, and mining communities" (Kentucky Heritage Council, 2010). Kentucky is also the center of America's historic bourbon whiskey distilling industry and has a number of historic distillery complexes. Bridges are important to the history of the state and take many forms, with covered bridges constituting a rare resource type that are mostly closed to automobile traffic. As the 20th century progressed, "automobile usage and the need to widen, repair, or modernize roads has increased pressure to replace Kentucky's historic bridges" (Kentucky Heritage Council, 2010).

Kentucky has a variety of historic resources related to African American history, including sites dating from before the Civil War that are associated with slavery in the region, to sites associated with the Civil Rights activities of the 20th century. Resources associated with military action range from fortifications associated with early settlement activities and territorial disputes with indigenous populations, such as Fort Boonesborough, to training facilities associated with WWI and WWII. In addition, "54 road corridors have been surveyed and recorded in the architectural database" (Kentucky Heritage Council, 2010).



Left – Lincoln Saving Bank (Louisville, KY) – (Detroit Publishing Company, 1900)
Top Middle – Dr. Ephraim McDowell House (Danville, KY) – (Historic American Buildings Survey, 1933a)
Top Right – Andrew J. Sullivan Bridge (Williamsburg, KY) – (Historic American Engineering Record, 1968)
Bottom Middle – Shaker East Family Dwelling House (Shakertown, KY) – (Historic American Buildings Survey, 1933b)
Bottom Right – Marrs Log House (Harrodsburg, KY) – (Historic American Buildings Survey, 1933c)

Figure 7.1.11-4: Representative Architectural Styles of Kentucky

7.1.12. Air Quality

7.1.12.1. 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[114] 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)[115] or micrograms per cubic meter (μg/m^3) determined over various periods of time (averaging time).[116] This section discusses the existing

[114] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[115] Equivalent to 1 milligram per liter (mg/L).
[116] 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, 2015o).

air quality in Kentucky. USEPA designates areas within the United States as attainment,[117] nonattainment,[118] maintenance,[119] or unclassifiable[120] 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.

The Commonwealth of Kentucky has two separate and distinct air regulatory authorities that enforce federal, state, and local regulations for protecting air quality – the KDEP Division of Air Quality (DAQ) and the Louisville Metro Air Pollution Control District (LMAPCD). The KDEP is responsible for the entire state with exception of Jefferson County (covered by LMAPCD). Each air regulatory authority maintains its own air regulations, state implementation plan (SIP), and ambient air quality standards (KDEP DAQ, 2016).

7.1.12.2. 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, nitrogen dioxide (NO_2), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and sulfur dioxide (SO_2). The NAAQS establish various standards, either primary[121] or secondary,[122] 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 (USEPA, 2017b). 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). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs. (USEPA, 2016d)

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[117] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015m).
[118] Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015m).
[119] Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment (USEPA, 2015m).
[120] Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant (USEPA, 2015m).
[121] 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, 2014d).
[122] 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, 2014d).

In conjunction with the federal NAAQS, Kentucky maintains its own air quality standards, the Kentucky Ambient Air Quality Standards (KY AAQS). Kentucky has additional AAQS for hydrogen sulfide, gaseous fluorides, total fluorides, and odor. Table 7.1.12-1 presents an overview of the KY AAQS as defined by KDEP DAQ.

Table 7.1.12-1: Kentucky Ambient Air Quality Standards (KY AAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m³	ppm	µg/m³	ppm	
CO	8-hour	10,000	9	Same as Primary		Standard is not to be exceeded more than once per year.
	1-hour	40,000	35	Same as Primary		
Lead	3-month	1.5	-	Same as Primary		Maximum arithmetic mean averaged over a calendar quarter.
NO_2	Annual	100	0.05	Same as Primary		Annual arithmetic mean, not to be exceeded.
PM_{10}	24-hour	150	-	Same as Primary		The standard is attained when the expected number of days per calendar year with a 24 hour average concentration above 150 µg/m3.
	Annual	50	-	Same as Primary		Annual arithmetic mean, not to be exceeded.
O_3	1-hour	235	0.12	Same as Primary		The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm (235 µg/m3) is equal to or less than one.
SO_2	Annual	80	0.03	-	-	Annual arithmetic mean, not to be exceeded.
	24-hour	365	0.14	-	-	Not to be exceeded more than once per year.
	3-hour	-	-	1,300	0.5	Not to be exceeded more than once per year.
Hydrogen Sulfide	1-hour	-	-	14	0.01	This average is not to be exceeded more than once per year.
Gaseous Fluorides (HF)	Annual	400	0.5	-	-	Annual Arithmetic Mean, not to exceed.
	1-month	-	-	0.82	0.001	Maximum 1-month average, not to exceed.
	1-week	-	-	1.64	0.002	Maximum 1-week average, not to exceed.
	24-hour	800	1.0	2.86	0.0035	Maximum 24-hour average, not to exceed.
	12-hour	-	-	3.68	0.0045	Maximum 12-hour average, not to exceed.
Total Fluorides[a]	Growing Season	-	-	-	40	Average concentration of monthly samples over growing season (not to exceed 6 consecutive months), not to be exceeded.
	2-month	-	-	-	60	2-month average, not to be exceeded.
	1-month	-	-	-	80	2-month average, not to be exceeded.
Odors	-	-	-	-	-	At any time when 1 volume unit of ambient air is mixed with 7 volume units of odorless air, the mixture must have no detectable odor.

Source: (KDEP DAQ, 2007)

[a] Total Fluorides – "Dry weight basis (as fluoride ion) in and on forage for consumption by grazing ruminants" (KDEP DAQ, 2007).

Title V Operating Permits/State Operating Permits

Kentucky 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, 2015c). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015f). Chapter III subpart 201-6 of NYSDEC regulation describes the applicability of Title V operating permits. Kentucky 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 7.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014a).

Table 7.1.12-2: Major Air Pollutant Source Thresholds

Pollutant	Tons per Year (TPY)
Any Pollutant	100
Single Hazardous Air Pollutant (HAP)	10
Total/Cumulative HAPs	25

Source: (USEPA, 2014b)

Exempt Activities

KAR 52:0200 (Title V Permits) Section 2 (Exemptions) lists the exemptions from Title V Permitting. Sources that are only required to obtain a permit because they are subject to the federal Standards for Performance for New Residential Wood Heaters and KAR Asbestos Standards are exempt from obtaining a Title V permit. (KDEP DAQ, 2014a)

Emissions sources that are below the potential to emit (PTE) in Table 7.1.12-3 are not required to obtain a permit or state registration as long as they are not subject to an NSPS or NESHAP.

Table 7.1.12-3: Registration Thresholds (based on PTE)

Pollutant	TPY
HAP	<2
Total/Cumulative HAPs	<5
Regulated air pollutant other than a HAP	<10

Source: (KDEP DAQ, 2014a)

Temporary Emissions Sources Permits

KDEP DAQ may authorize a temporary permit for use of an emission unit that replaces a similar unit that has been taken offline for maintenance if they meet the requirements of 401 KAR 52:040 (State-origin permits) Section 18. (KDEP DAQ, 2014c)

State Preconstruction Permits

Kentucky does not have additional preconstruction permits, however all emission permits and registrations must be obtained prior to construction of the emissions source. Construction or modification of a stationary sources should review applicable stationary source requirements, or contact KDEP DAQ for additional assistance (KDEP, 2016d).

Registration

KDEP DAQ require sources that emit or have the potential to emit in Table 7.1.12-4 to obtain a permit unless they are exempt. Exempt sources are required to obtain a permit under 401 KAR 52.020 (Title V Permits), 401 KAR 52.030 (Federally Enforceable Permits for Nonmajor Sources), and 401 KAR 52:040 (State-origin permits) (KDEP DAQ, 2014b).

Table 7.1.12-4: Registration Thresholds (based on PTE)

Pollutant	TPY
HAP	<2 and >10
Total/Cumulative HAPs	<5 and >25
Regulated air pollutant other than a HAP	<10 and >25

Source: (KDEP DAQ, 2014b)

General Conformity

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

The estimated pollutant emissions are compared to *de minimis*[123] levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 7.1.12-4). As a result, lower *de minimis* thresholds for VOCs and NO_2 could apply depending on the attainment status of a county.

[123] 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, 2016).

Table 7.1.12-5: *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	50
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: (GPO, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 7.1.12-5, 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 7.1.12-5, 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 (USEPA, 2010). To demonstrate conformity,[124] 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).

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

State Implementation Plan Requirements

The Kentucky SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Kentucky's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Kentucky's SIP actions are codified under 40 CFR Part 52 Subpart S. A list of all SIP actions for all six criteria pollutants can be found on KDEP DAQ's website:
http://air.ky.gov/Pages/SIPRevisionsandSubmittals,EmissionAllocations.aspx.

7.1.12.3. Specific Regulatory Considerations for the Louisville Metro Air Pollution Control District (LMAPCD)

National and State Ambient Air Quality Standards

The Louisville Metro Air Pollution Control District (LMAPCD) monitors and regulates Louisville and Jefferson County air quality. In conjunction with the federal NAAQS, LMAPCD maintains its own air quality standards as defined by the LMAPCD Regulations Part 3 (Ambient Air Quality Standards). These AAQS are the same as the NAAQS (Appendix E), with the exception of annual $PM_{2.5}$ which is 15 μg/m^3 instead of 12 μg/m^3. LMAPCD also has the same standards as KDEP DAQ for hydrogen sulfide, gaseous fluorides, and total fluorides as shown in Table 7.1.12-1. (LMAPCD, 2013a)

Title V Operating Permits/State Operating Permits

LMAPCD 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, 2013a). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2013a). LMAPCD Regulation 2.16 (Title V Operating Permits) describes the applicability of Title V operating permits. LMAPCD regulations 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 7.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Exempt Activities

LMAPCD exempts specific types of activities as defined in LMAPCD Regulation 2.02 (Air Pollution Regulation Requirements and Exemptions), Section 2 (Exempt Stationary Sources). "The following stationary sources are exempt from the requirement to obtain a permit to construct or operate:

- Stationary sources that are not subject to an applicable requirement in 40 CFR Parts 60, 61, or 63 and have an uncontrolled potential to emit less than:
    - 5 tons per year of a regulated air pollutant, and
    - 1,000 pounds per year of a hazardous air pollutant
- Stationary sources that operate…" (LMAPCD, 2013a)

- "Indirect heat exchangers, except furnaces that combust waste oil regardless of size, of the following types:
  - Those less than 10 million BTU/hr capacity using distillate oil, propane, butane, LPG, or natural gas as fuel…
- …Portable diesel or gasoline storage tanks with a maximum capacity of less than 500 gallons. Portability is defined as being in one location less than one year…" (LMAPCD, 2013b)

Temporary Emissions Sources Permits

LMAPCD Regulation 2.02 (Air Pollution Regulation Requirements and Exemptions), Section 3 (Temporary Exemptions) gives LMAPCD the authority to "exempt the temporary construction, modification, or operation of an affected facility[125] from the requirements to obtain a permit for a period of up to 180 days." (LMAPCD, 2013a)

Preconstruction Permits

LMAPCD Regulation 2.03 (Authorization to Construct or Operate; Demolition/Renovation Notices and Permit Requirements) requires stationary sources that construct/reconstruct, modify, or operate any affected source (or related equipment) to obtain a construction and operation permit before beginning construction or operation. Combined permits to construct and operate are available for stationary sources with PTE less than that in Table 7.1.12-2 and 100,000 TPY of CO_2e.[126] (LMAPCD, 2013a)

General Conformity

The LMAPCD follows the federal General Conformity regulations and do not maintain their own (LMAPCD, 2013a). See Section 7.1.12.2 for a general discussion of the Federal General Conformity regulations.

State Implementation Plan Requirements

The LMAPCD SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. LMAPCD's SIP is a conglomeration of separate actions taken for each of the pollutants. All of LMAPCD's SIP actions are codified under 40 CFR Part 52 Subpart S (under Kentucky). A list of all SIP actions for all six criteria pollutants can be found on USEPA's website at https://www3.epa.gov/airquality/urbanair/sipstatus/reports/ky_areabypoll.html.

[125] Affected facility is a facility that does a process or has equipment that APCD Regulations would apply. (LMAPCD, 2013a)
[126] 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, 2016g).

7.1.12.4. 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 (USEPA, 2016f). Figure 7.1.12-1 and Table 7.1.12-6 present the current nonattainment areas in Kentucky as of January 30, 2015. The year(s) listed in the table for each pollutant indicate when the USEPA promulgated the standard for that pollutant; note that, for PM2.5, O_3, and SO_2, these standards listed are in effect. Table 7.1.12-6 contains a list of the counties and their respective current nonattainment status of each criteria pollutant. The year(s) listed in the table for each pollutant indicate when USEPA promulgated an ambient air quality standard for that pollutant; note that, for lead, $PM_{2.5}$, O_3, and SO_2, both standards listed are in effect. Unlike Table 7.1.12-6, Figure 7.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10}, and $PM_{2.5}$ merge in the figure to count as a single pollutant.

Table 7.1.12-6: Kentucky Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implanted Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Boone						M		M	X-5		
Boyd						M		M		M	
Bullitt						X-4		M			
Campbell						M		M	X-5		X-6
Christian								M			
Daviess											
Edmonson											
Fayette											
Greenup											
Hancock											
Jefferson						X-4		M			X-6
Kenton						M		M	X-5		
Lawrence						M					
Livingston											
Marshall											
Muhlenerg										M	
Oldham								M			
Scott											

Source: (USEPA, 2017c)

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

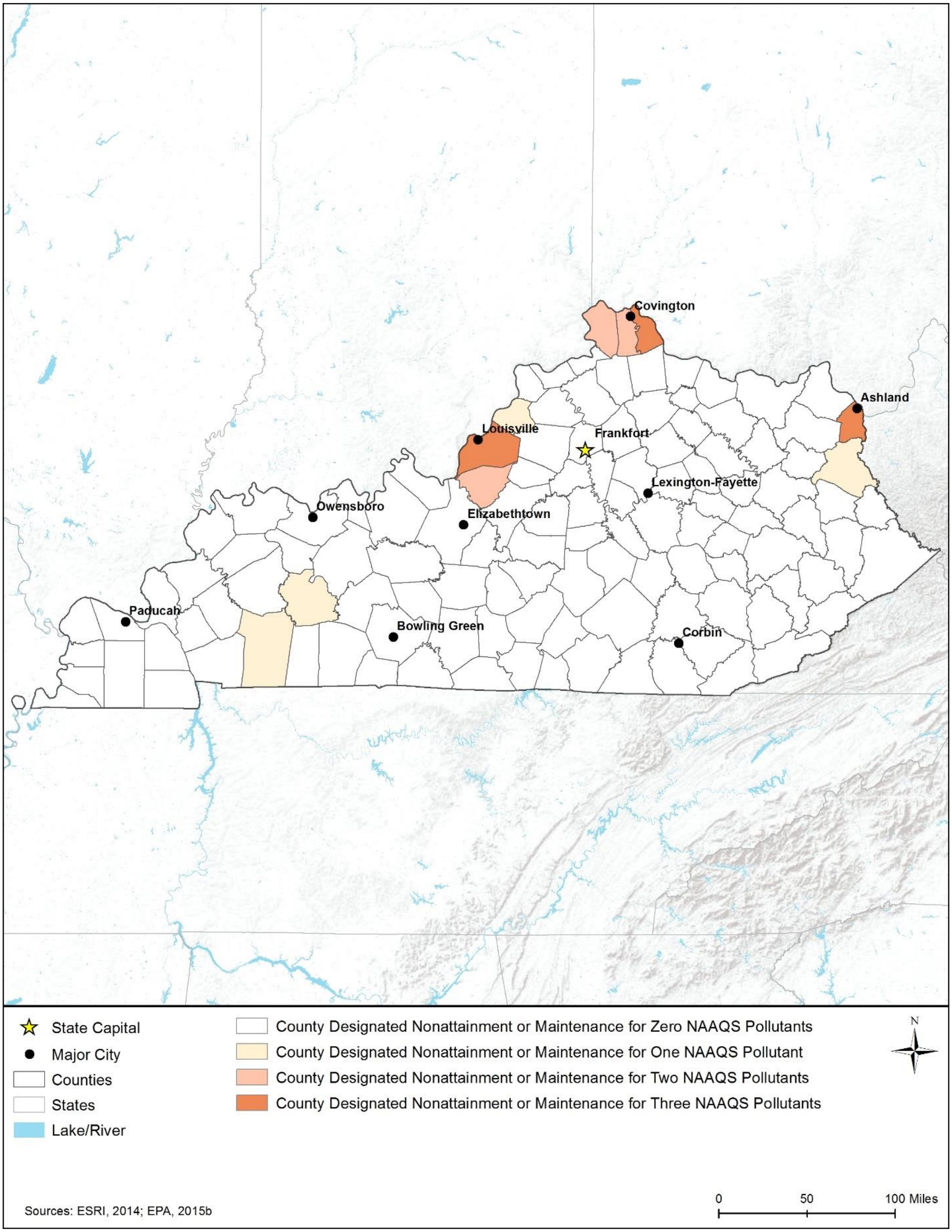


Figure 7.1.12-1: Nonattainment and Maintenance Counties in Kentucky

Air Quality Monitoring and Reporting

The KDEP DAQ measures air pollutants at 34 sites (operated by KDEP DAQ, Louisville Metro Air Pollution Control District (LMAPCD), and the National Park Service) across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network. Annual Kentucky State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. KDEP DAQ reports real-time pollution levels of O_3 and $PM_{2.5}$ on their website (http://eppcapp.ky.gov/daq/) and LMAPCD on the AirNOW[127] website (http://www.airnow.gov/) to inform the public, as O_3 and $PM_{2.5}$ are the main pollutants of concern in Kentucky.

Throughout 2014, O_3 measurements exceeded the federal standard of 0.075 ppm four times at two stations in Jefferson County. Also in 2014, SO_2 measurements exceeded the 1-hour federal standard of 0.075 ppm 27 times in two locations, once in Campbell County and 26 times in Jefferson County. No other criteria pollutants exceed federal standards. (KDEP DAQ, 2015)

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. § 7470).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers[128] 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

[127] AirNow is a government website that posts daily Air Quality Index for more than 400 cities.
[128] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers[129] (the normal useful range of USEPA-approved Gaussian plume models" (USEPA 1992).

Kentucky contains one Federal Class I areas; all land within the state is classified as Class II (USEPA, 2012b). 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). Missouri does have one Class I area where the 100-kilometer buffer intersects a few Kentucky counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office (USEPA, 2012b). Figure 7.1.12-2 provides a map of Kentucky 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 7.1.12-2 correspond to the numbers and Class I areas listed in Table 7.1.12-7.

Table 7.1.12-7: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Mammoth Cave NP	51,303	KY
2	Mingo Wilderness	8,000	MO

Source: (USEPA, 2012b)

[a] The numbers correspond to the shaded regions in Figure 7.1.12-1.

[129] The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

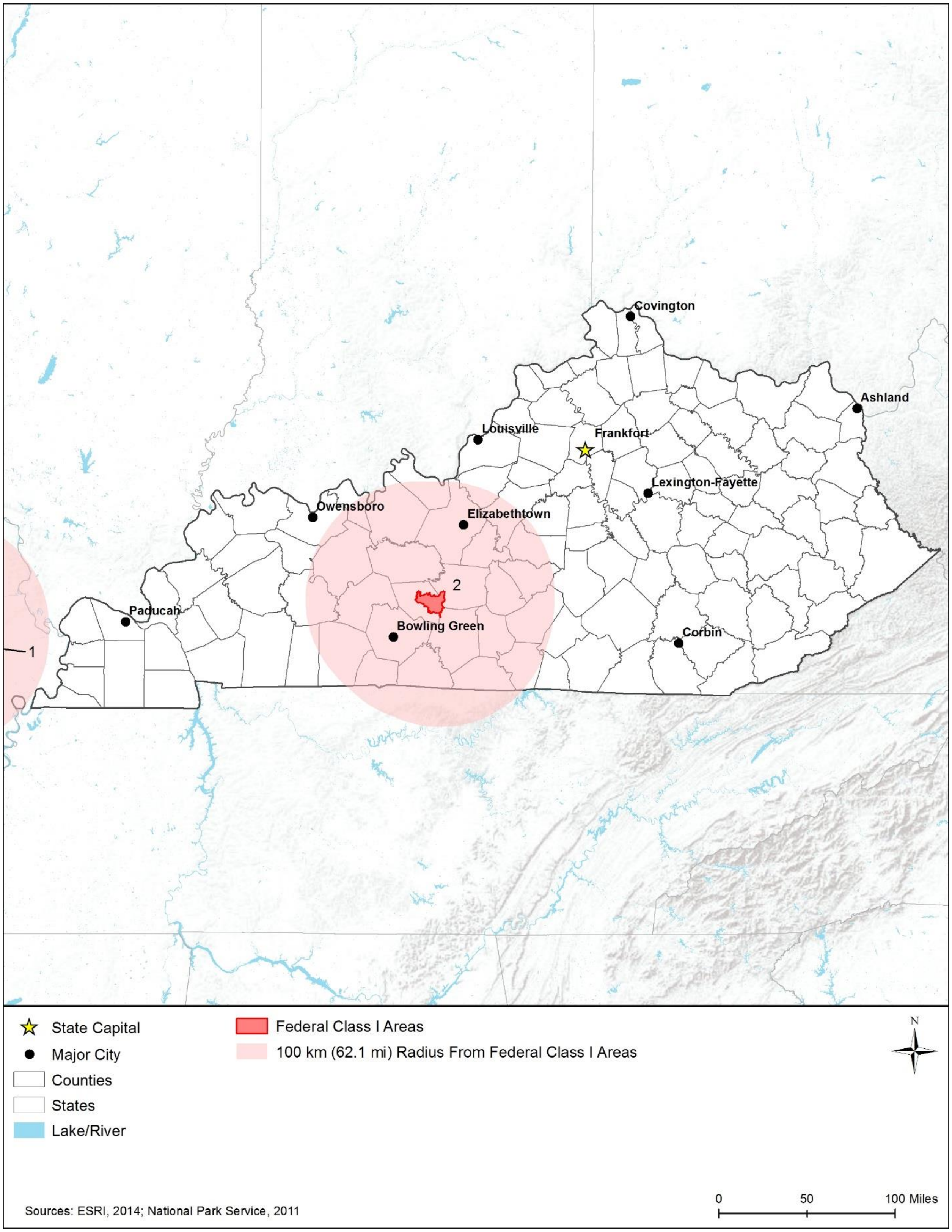


Figure 7.1.12-2: Federal Class I Areas with Implications for Kentucky

7.1.13. Noise and Vibrations

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

7.1.13.1. 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, 2017a). 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.

Physiological effects such as hearing loss and anxiety. The effects of noise can be classified into three categories:

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

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

Fundamentals of Noise and Vibrations

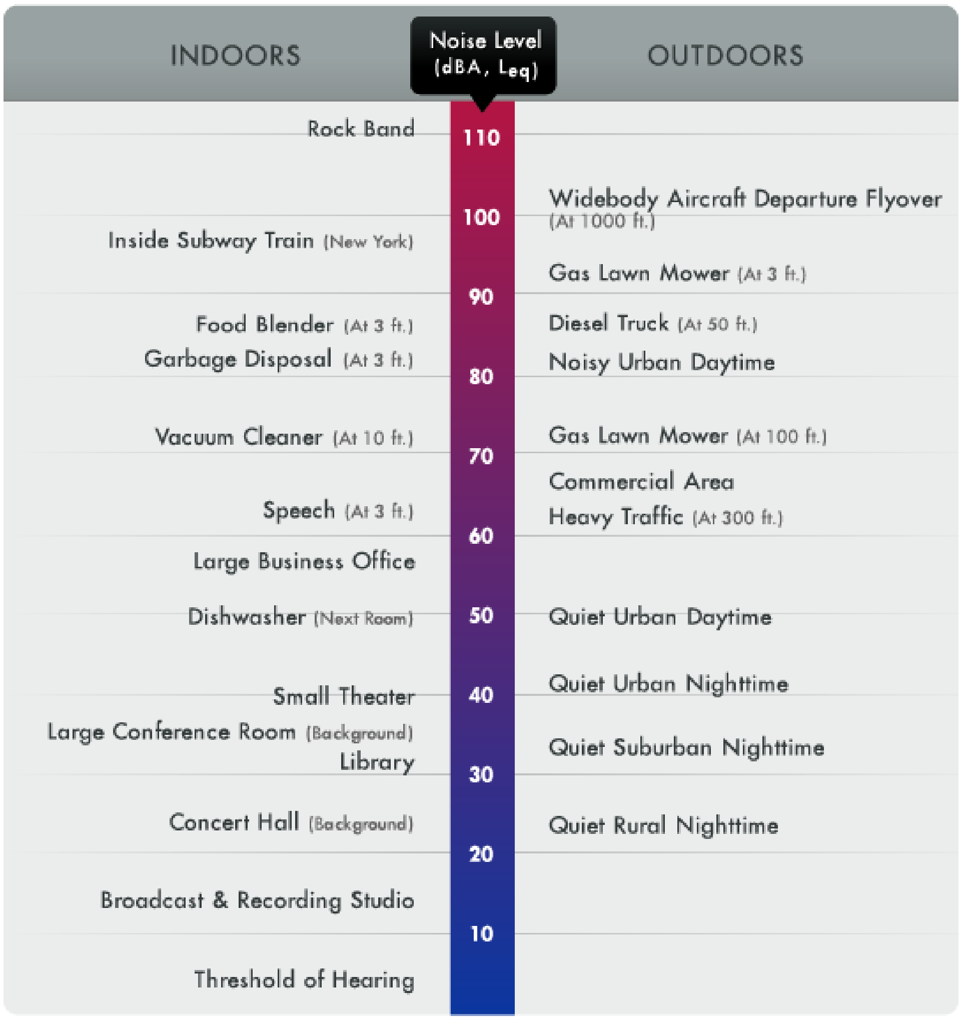
For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB ("threshold of hearing") to about 140 dB ("threshold of pain")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

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

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

- The duration of a sound; and
- The changes in frequency characteristics or pressure levels through time.

Figure 7.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.



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

Figure 7.1.13-1: Sound Levels of Typical Sounds

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

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

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

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

Related to noise, vibration is a fluctuating motion described by displacement with respect to a reference point. Depending on the intensity, vibrations may create perceptible ground shaking and the displacement of nearby objects as well as rumbling sounds. Table 7.1.13-1 lists vibration source levels produced by typical construction machinery and activities at a distance of 25 feet in units of vibration decibels (VdB). The vibration thresholds for human perceptibility and potential building damage are 65 and 100 VdB, respectively (FTA, 2006).

Table 7.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)

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

Source: (FTA, 2006)

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

7.1.13.2. Specific Regulatory Considerations

As identified in Appendix C, Environmental Laws and Regulations, 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.

Kentucky has two state-wide noise regulations. Title 15, Chapter 189 of the Kentucky Motor Vehicle Code sets regulations for the noise levels that can be set by various types of motor vehicles. Similarly, Title 18, Chapter 224, Subchapter 30 of the Kentucky Legislative Code deals with general noise control, including noise levels from residential and business properties (Kentucky Legislative Research Council, 2015). There are no state-wide noise laws dealing with construction.

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 Louisville or Lexington, 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).

7.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Kentucky varies widely based on the area and environment of the area. The population of Kentucky can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 7.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Kentucky may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Kentucky. As such, this section describes the areas where the population of Kentucky 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) (DOI, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Louisville (and its neighboring boroughs and cities), and Lexington.
- **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, 2015j). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports 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 Kentucky, Cincinnati/Northern Kentucky International Airport (KCVG) and Louisville International Airport (KSDF) have more than 490,000 annual operations combined (FAA, 2015k). These operations result in increased ambient noise levels in the surrounding communities. See Section 7.1.7, Land Use, Recreation, and Airspace, and Figure 7.1.7-6 and Figure 7.1.7-7 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, 2015c). 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, 2015c). See Section 7.1.1, Infrastructure, and Figure 7.1.1-1 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 (FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (FRA, 2015). Kentucky has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend mainly from Louisville to other cities in Kentucky, Ohio, Tennessee, West Virginia, Virginia, Indiana, and Illinois, such as the CSX rail line. There are also a number of other rail corridors that join these major rail lines and connect with other cities (KDEP DAQ, 2014d). See Section 7.1.1, Infrastructure, and Figure 7.1.1-1 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 the wilderness. 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, 2014f). Kentucky has four national parks and seven National Natural Landmarks (NRCS, 2015b) (Kentucky Department of Parks, 2016). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 7.1.7, Land Use, Recreation, and Airspace, and Figure 7.1.7-3 for more information about national and state parks for Kentucky.

7.1.13.4. Sensitive Noise and Vibration Receptors

Noise and vibration-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 or vibrations 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 Kentucky have at least one school, church, or park, in addition to likely having other noise-and vibration sensitive receptors. There are most likely thousands of sensitive receptors in Kentucky.

7.1.14. Climate Change

7.1.14.1. Definition of the Resource

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

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012d). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e),[130] 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 CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

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

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 7.2.14, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation/drought; and 3) severe weather events.

7.1.14.2. Specific Regulatory Considerations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C, Environmental Laws and Regulations, Environmental Laws and Regulations. The Council on Environmental Quality (CEQ) published draft National Environmental Policy Act (NEPA) guidance on the consideration of the effects of climate change and greenhouse gas in February of 2010. Revised draft guidance was published in December 2014 and in August 2016 (after publication of the Draft PEIS) CEQ published its final guidance. This guidance is applicable to all federal agency actions and is meant to facilitate compliance within the legal requirements of NEPA. The CEQ guidance describes how federal agency actions should evaluate GHG and climate change effects in their NEPA reviews, using GHG emissions as a proxy for assessing a proposed action's potential effect on climate change.

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[130] 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, 2016g).

CEQ defines GHGs to include CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which is in accordance with Section 19 (m) of *Executive Order 13693*. The final CEQ guidance suggests that agencies consider "(1) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions (e.g. to include, where applicable, carbon sequestration); and (2) the effects of climate change on a proposed action and its environmental impacts." The final guidance recommends that agencies quantify an action's projected direct and indirect GHG emissions when data inputs are reasonably available to support calculations. The final guidance states that "agencies should be guided by the principle that the extent of the analysis should be commensurate with the quantity of the projected GHG emissions and take into account available data and GHG quantification tools that are suitable for and commensurate with the proposed agency action." In addition, CEQ recommends agencies evaluate project emissions and changes in carbon sequestration and storage, when appropriate, in assessing a proposed action's potential climate change impacts. The analysis should assess direct and indirect climate change effects of a proposed project including connected actions, the cumulative impacts of its proposed action, and reasonable alternatives. CEQ advises that climate change effects on the environmental consequences of a proposed action should be described based on available studies, observations, interpretive assessments, predictive modeling, scenarios, and other empirical evidence. The temporal bounds should be limited by the expected lifetime of the proposed project. Mitigation and adaptation measures should be considered in the analysis for effects that occur immediately and in the future. Kentucky has not established goals and regulations to reduce GHG emissions to combat climate change.

7.1.14.3. Kentucky's Greenhouse Gas Emissions

Estimates of Kentucky'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_2), 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, 2014f). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

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

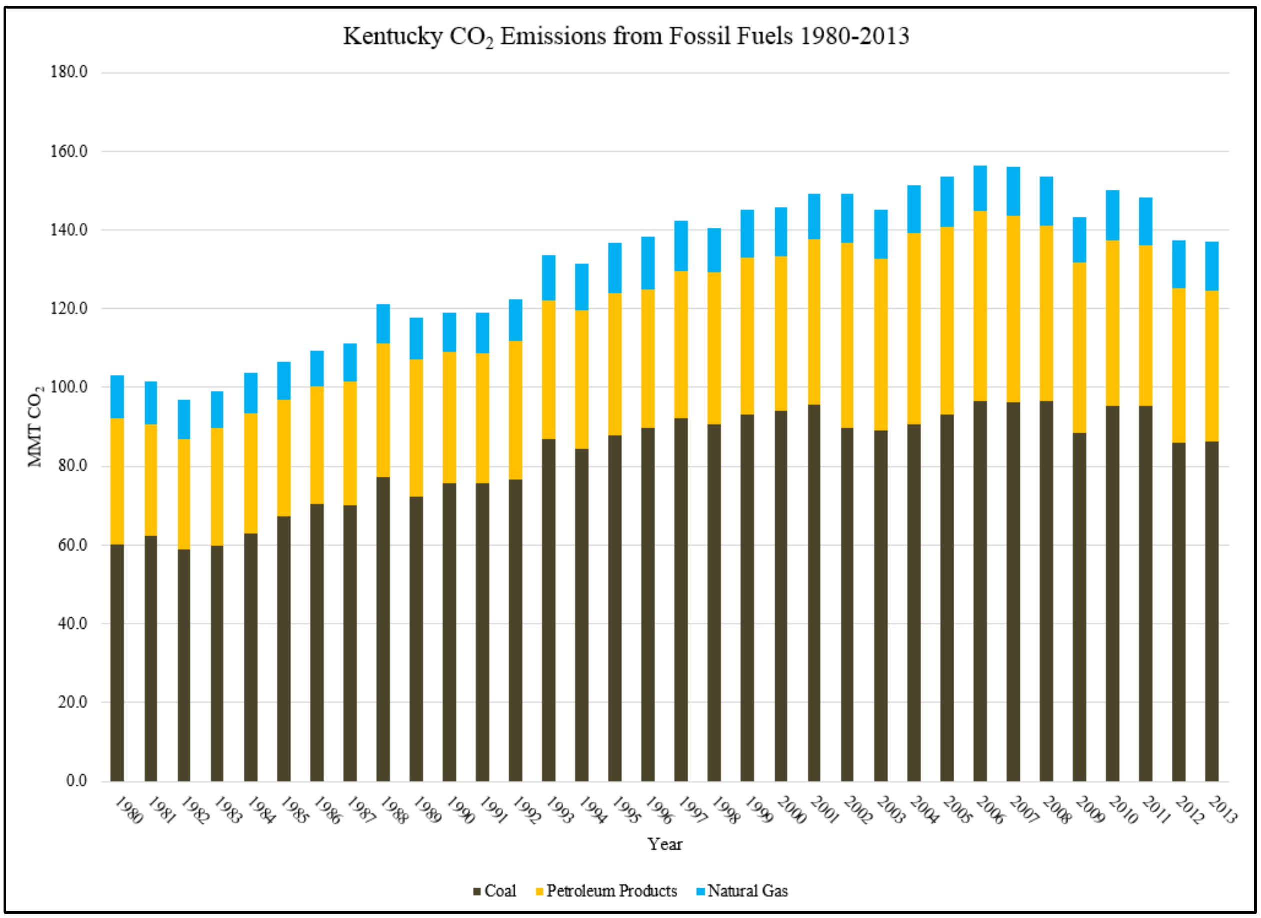
According to the EIA, Kentucky emitted a total of 139.4.0 million metric tons (MMT) of CO_2 in 2014. The electric power sector as a whole was the highest emitter, accounting for approximately 62 percent of total CO_2 emissions from fossil fuel. Coal accounted for approximately 97 percent of CO_2 emissions within the electric power sector (Table 7.1.14-1) (EIA, 2014a). The transportation sector was the next largest emitter at approximatelt 22 percent. Petroleum-related emissions accounted for approximately 98 percent of CO_2 emissions within the transportation sector (Table 7.1.14-1) (EIA, 2014a). Annual emissions between 1980 and 2013 are presented in Figure 7.1.14-1.

Between 1980 and 2006, Kentucky's CO_2 emissions increased steadily from just over 100 MMT/year to a high 157.0 MMT. From this maximum they have declined to their current levels (EIA, 2014a). Declines came mostly from coal, but also from petroleum products. Kentucky was ranked 12th among the 50 states and the District of Columbia in 2014 for CO_2 emissions and was ranked 7th for per-capita CO_2 emissions. (EIA, 2014b)

Table 7.1.14-1: Kentucky CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2014

Fuel Type (MMT)		Source (MMT)	
Coal	86.3	Residential	3.7
Petroleum Products	39.3	Commercial	2.6
Natural Gas	13.9	Industrial	15.9
		Transportation	30.8
		Electric Power	86.4
TOTAL	**139.4**	**TOTAL**	**139.4**

Source: (EIA, 2014a)



Source: (EIA, 2014a)

Figure 7.1.14-1: Kentucky CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

The Kentucky Department of Environmental Quality commissioned The Center for Climate Change Strategies to prepare a 1990 – 2030 greenhouse gas emission inventory and forecast for the state of Kentucky (CCS, 2010). According to the inventory, Kentucky emitted 185 MMT CO_2e of greenhouse gases in the reference year 2005. For comparison, total U.S. GHG greenhouse were 7,379 MMT CO_2e in the same year (USEPA, 2014c). Emissions are dominated by CO_2, but also include CH_4, N_2O, and small quantities of perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6) (CCS, 2010). Kentucky's GHG emissions have been rising faster than the national average, increasing by an estimated 34 percent between 1990 and 2005. They are projected to increase to approximately 248 MMT CO_2e by 2030 (CCS, 2010).

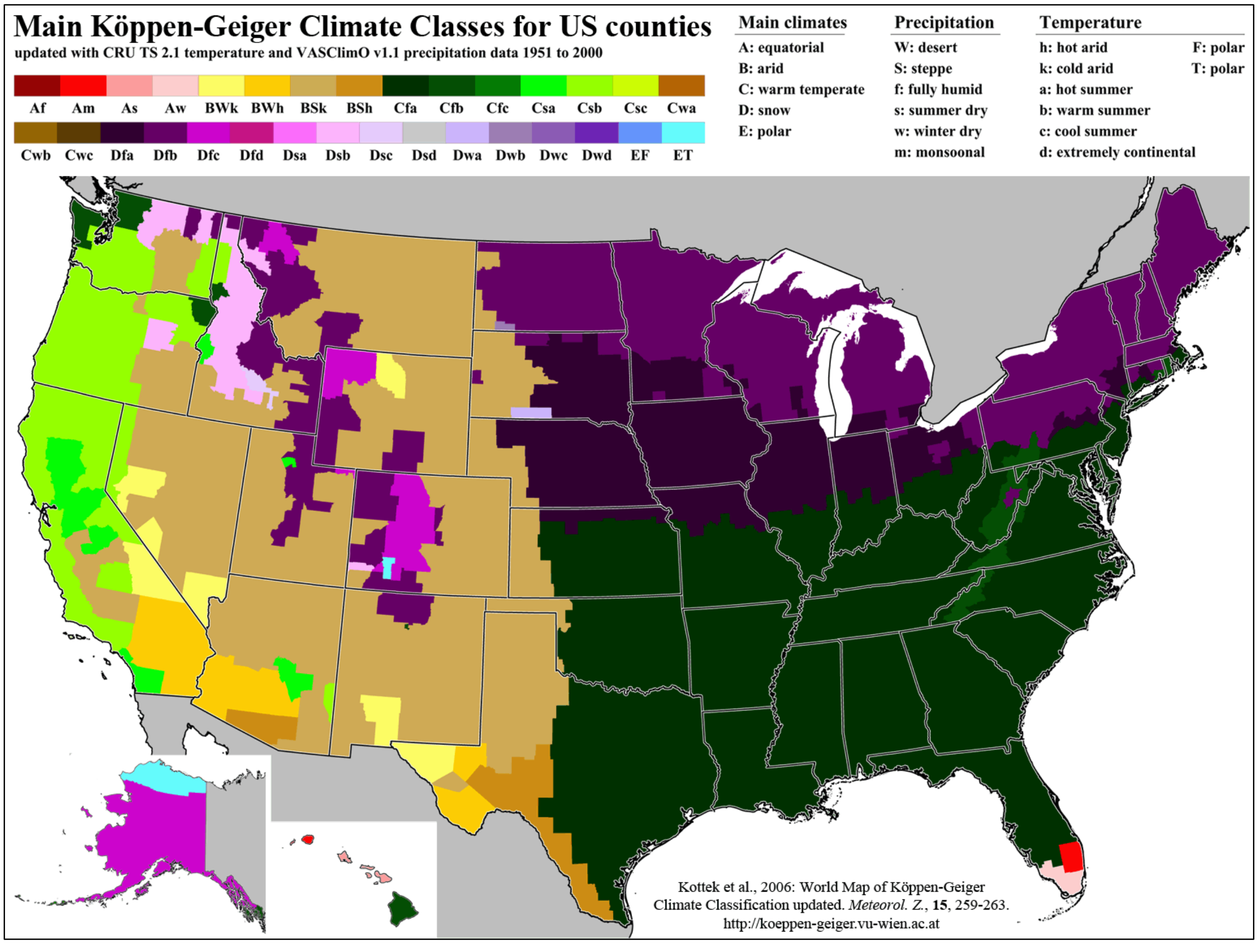
Kentucky is a large producer of bituminous coal from underground and surface mines. Between 1990 and 2005, coal emissions increased annually and the state now "accounts for almost one-tenth of total U.S. coal production" (EIA, 2015d). Kentucky ships more than half the coal produced within the state to 20 other states for electricity generation. Although electricity generated from coal has decreased in the last decade, coal is still Kentucky's primary resource for electricity generation. Kentucky will likely continue to be a net exporter of coal, but coal-related GHG emissions in Kentucky will likely decline because several large coal power plants are scheduled for shut down in the future (CCS, 2010) (EIA, 2015d).

The transportation sector has and continues to make a significant contribution to state GHG emissions largely because Kentucky is an important transportation hub for the nation. Between 1990 and 2005 transportation fuel use increased by 37 percent, and are projected to increase by another 53 percent to 57 MMT CO_2e by 2030 (CCS, 2010). However, evolving emission regulations and vehicle fuel economy standards are anticipated to slow down GHG emissions from this sector over time (CCS, 2010).

7.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "composite or generally prevailing weather conditions of a region, throughout the year, averaged over a series of years" (NWS, 2009). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2009). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2006).

The entirety of Kentucky falls into climate group C. Climates classified as (C) are generally warm, with humid summers and mild winters. During winter months, the mean climate feature is the mid-latitude cyclone (NWS, 2009). Kentucky has one sub-climate category, which is described in the following paragraphs.



Source: (Kottek, 2006)

Figure 7.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Cfa – The Köppen-Geiger climate classification system classifies the entirety of Kentucky 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, 2009) (NWS, 2006)

This section discusses the current state of Kentucky's climate with regard to air temperature, precipitation, and extreme weather events (e.g., severe flooding, tornadoes, strong winds, lightning, and winter storms) in the state's climate region, Cfa.

Air Temperature

With warm summers and cool winters, Kentucky's climate is largely influenced by the Gulf of Mexico. Average temperatures during summer months range from 85°F in northern and eastern regions of the state, to 90°F in western regions of the state. Overnight temperatures range from the low to upper 60s across the same regions. During winter months, average high temperatures range from the high 30s in northern regions of the state, to the mid-40s in southern regions of the state. Average low temperatures during winter months range from approximately 20°F in northern regions of the state, to 25°F in southern regions of the state. The highest temperature to occur in Kentucky was on July 28, 1930 with a high of 114°F in Greensburg (SCEC, 2015). The lowest temperature to occur in Kentucky was on January 19, 1994 with a low of negative 37°F (SCEC, 2015) (Foster, 2015)

Cfa – Frankfort, the capital of Kentucky, is located within the climate classification zone Cfa. (NOAA, 2015b). The average annual temperature in Frankfort is approximately 55.3°F; 34.7°F during winter months; 74.7°F during summer months; 54.7°F during spring months; and 56.7°F during autumn months (NOAA, 2015b). Murray, located in far southwestern Kentucky, is also within the climate classification zone Cfa. The average annual temperature in Murray is approximately 59.2°F; 38.9°F during winter months; 77.9°F during summer months; 59.2°F during spring months; and 60.3°F during autumn months (NOAA, 2015b).

Precipitation

Generally, precipitation throughout Kentucky is well distributed and constant year round, with averages over 40 inches falling in the north and over 50 inches falling in the south. Historically, autumn is typically Kentucky's driest month. The wettest year in Kentucky's history was in 1950, "when average precipitation across the state was 62.93 inches" (Foster, 2015). The greatest 24-hour precipitation accumulation occurred on June 28, 1960 with a total of 10.4 inches in Dunmor (SCEC, 2015). The greatest 24-hour snowfall accumulation occurred on March 3, 1942 with a total of 26 inches in Simers (SCEC, 2015).

Cfa – Frankfort, the capital of Kentucky, is located within the climate classification zone Cfa. (NOAA, 2015b). The average annual precipitation accumulation in Frankfort is 54.62 inches; 10.56 inches during winter months; 11.84 inches during summer months; 12.92 inches during spring months; and 10.30 inches during autumn months (NOAA, 2015b). Murray, located in far southwestern Kentucky, is also within the climate classification zone Cfa. The average annual precipitation accumulation in Murry is 55.59 inches; 14.43 inches during winter months; 12.64 inches during summer months; 15.55 inches during spring months; and 12.97 inches during autumn months (NOAA, 2015b).

Severe Weather Events

"Flash floods, usually resulting from intense but short-lived thunderstorms or from storms training over an area, occur throughout Kentucky, but are a particular concern in the rugged terrain of eastern Kentucky, which is characterized by steep slopes and narrow valleys" (Foster, 2015). Flooding along major rivers are also a regular occurrence, with one of the largest and most destructive occurred along the Ohio River in January, 1937. During this flood, most of the river's tributaries were flooded, with over 20 inches of rainfall recorded in many parts of the state. In total, this flood caused over $3.3 billion in damages across several states, including Kentucky. More recently, in 2010, flash flooding throughout southern Kentucky resulted in $30 million in damages. (NWS, 2015a)

Droughts also occur periodically throughout the state. When droughts do occur, they usually are the result of "oppressive heat" (Foster, 2015). One of the state's worst droughts occurred in 1930. This year was also the driest year on record, "with an average precipitation total of 29.39 inches across the state" (Foster, 2015).

Tornadoes are also common to the state of Kentucky and "have occurred in every month and at all times of the day" (Durkee, 2015). Between 1951 and 1998, approximately 485 tornadoes occurred, with translates into approximately 10 per year. Historically and statistically, the majority of Kentucky's tornadoes have occurred during the month of April. In 1974, approximately 39 tornadoes touched, making it the most active tornado year in the state's history. In April and May, 1974 approximately 29 tornadoes touch down, making these two months the most active in the state's history. During one of the worst tornado outbreaks in U.S. history, 27 tornadoes touched down on April 3, 1974. As a result, 31 people were killed, 257 were injured, approximately 400 homes were either damaged or destroyed, and over $110 million was estimated in damages. (Durkee, 2015)

7.1.15. Human Health and Safety

7.1.15.1. Definition of the Resource

The Affected 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 Affected 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) emissions, vehicle traffic, or the transportation of hazardous materials and waste. RF emissions are discussed in Section 2.4, RF Emissions. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 7.1.1, Infrastructure.

There are unique infectious diseases throughout the continental U.S. Because of the great variety of diseases, as well as the variables associated with contracting them, this PEIS will not be evaluating infectious diseases. For information on Infectious Diseases, please visit the Center for Disease Control and Prevention website at www.CDC.gov.

7.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (USEPA), the U.S. Department of Health and Human Services, and others protect human health and the environment. In Kentucky, this resource area is regulated by the Kentucky Labor Cabinet's Department of Workplace Standards, Kentucky Occupational Safety and Health (KOSH) program, and the Kentucky Department for Environmental Protection (KDEP), which regulates waste and environmental pollution. Health and safety of the general public is regulated by the Kentucky Department for Public Health (KDPH). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Kentucky has an OSHA-approved "State Plan," which has jurisdiction over all private and public sector employees, except federal employees (OSHA, 2015a). Occupational safety regulations are enforced at the state level by KOSH, and at the federal level by OSHA.

Federal laws relevant to protect occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 7.1.15-1 below summarizes the major Kentucky laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 7.1.15-1: Relevant Kentucky Human Health and Safety Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Kentucky Revised Statutes: Chapter 224.1-400 to 410	Kentucky Department for Environmental Protection (KDEP)	Addresses sites that are not eligible for the federal Superfund program, and outlines state requirements for cleanup.
Kentucky Revised Statutes: Chapter 224.1-415	KDEP	Outlines program eligibility requirements and owner responsibilities for cleaning up contaminated property.
Kentucky Administrative Regulations: Title 401, Chapter 100.030	KDEP	Details state cleanup standards for sites in the Voluntary Cleanup Program.
Kentucky Administrative Regulations: Title 803, Chapter 2	Kentucky Labor Cabinet's Department of Workplace Standards, Kentucky Occupational Safety and Health (KOSH) program	Lists occupational safety and health regulations specific to the Commonwealth of Kentucky, establishes the Kentucky OSHA "State Plan."
Kentucky Revised Statutes: Chapter 39E	Kentucky Emergency Response Commission (KERC)	Establishes the KERC to implement federal Emergency Planning and Community Right-to-Know (EPCRA) regulations related to hazardous substances, response to releases, reporting requirements, and training requirements.

Source: (Kentucky Legislature, 2017j) (Kentucky Legislature, 2017k) (Kentucky Legislature, 2017e) (Kentucky Legislature, 2017l) (Kentucky Legislature, 2017m)

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

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes[131] are examples of confined space work is necessary. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. The general public can be at risk of stepping or driving motor vehicles into open trenches, or falling into uncovered confined spaces. (OSHA, 2016c)

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

[131] 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.

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work. (OSHA, 2016c)

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (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 and Vibrations – Sources of excess noise and vibrations 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 10.1.13, Noise) (OSHA, 2002). Fugitive noise and vibrations may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area (OSHA, 2016c).

Hazardous materials and hazardous waste –Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require treatments, such as pesticide application. Secondary hazardous materials, like exhaust fumes, may be a greater health risk than the primary hazardous material (i.e., 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, 2016c)

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

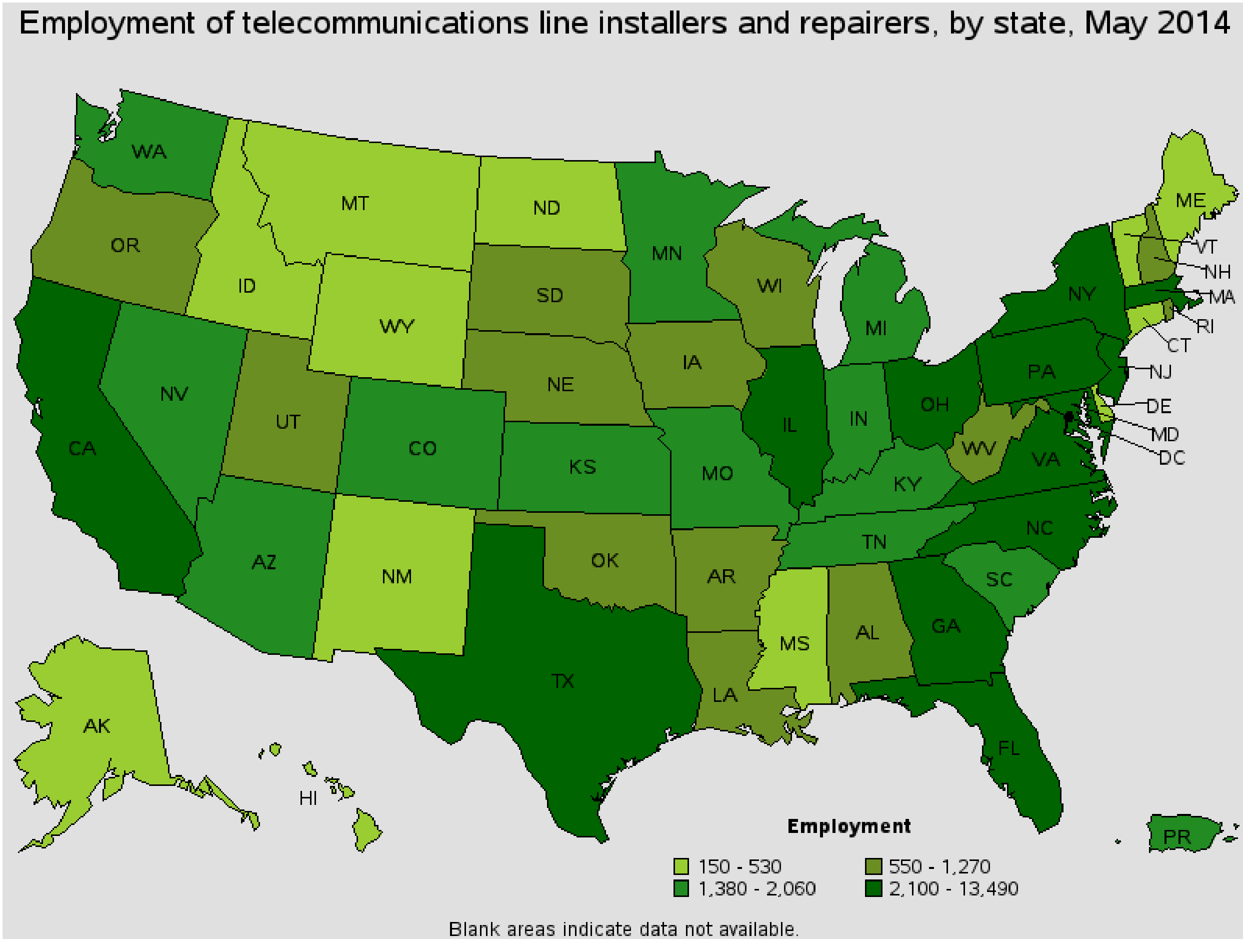
Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation,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

Telecommunication Worker Occupational Health and Safety

The 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 2,680 telecommunication equipment installers and repairers and, 1,440 telecommunication line installers and repairers (Figure 7.1.15-1) working in Kentucky (BLS, 2015c). Kentucky reported 1.2 cases of nonfatal injuries per 100 full-time workers in the telecommunications industry in 2013, and 2.2 cases in 2012 and 2011 (BLS, 2015d). Nationwide, there were 2.2 nonfatal occupational injury cases in 2014 per 100 full-time workers in the telecommunications industry (BLS, 2015e).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; and 7 due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of total occupational fatalities (4,585 total). Kentucky has not had any fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available. Within the broader installation, maintenance, and repair occupations (SOC code 49-0000), Kentucky had 64 fatalities, with the highest fatality year being 2005, with 11 fatalities (BLS, 2015g).



Source: (BLS, 2015f)

Figure 7.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites, due to limited access. Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards. In Kentucky, KDPH maintains the Electronic Public Health Record System (KY-EPHRS) to centralize public health data and comply with state and federal reporting requirements (KDPH, 2015). Public health data is also reported at the federal level 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, between 1999 and 2013, there were 129 fatalities due to a fall from, out of, or through a building or structure; 26 fatalities due to exposure to electric transmission lines; and 36 fatalities due to being caught, crushed, jammed or pinched in or between objects (CDC, 2015).

7.1.15.4. Contaminated Properties at or near Telecommunication Sites

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

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[132] 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 KDEP, Division of Waste Management, Superfund Branch is responsible for overseeing and assisting the USEPA under the Federal Superfund Section, and taking responsibility for conducting cleanup of sites under the State Superfund Section (KDEP, 2015k). As of September 2015, Kentucky had 60 RCRA Corrective Action sites,[133] 181 brownfields, and 14 proposed or final Superfund/NPL sites (USEPA, 2015g). Based on a November 2015 search of USEPA's Cleanups in My Community (CIMC) database, there is one Superfund site in Kentucky where groundwater migration is not under control (Paducah Gaseous Diffusion Plant near Kevil, KY, Figure 7.1.15-2) (USEPA, 2015h).

KDEP's Brownfield Redevelopment Program oversees brownfield cleanup and redevelopment, and the Voluntary Environmental Cleanup Program (VERP) allows responsible parties the flexibility to report and clean up a property following specific standards (KDEP, 2015l). One example of a state brownfield site is the Owensboro Riverfront site, situated on the banks of the Ohio River in Owensboro, KY. The site was formerly a manufactured gas plant, and then redeveloped for the Executive Inn hotel and conference center in 1977. In 2008, the hotel was damaged by a fire and demolished. A subsequent environmental assessment identified previous contamination, and a site management plan was developed by the KDEP and USPEA to reduce public exposure. The site was redeveloped with a park, convention center, condominiums, and two hotels (KDEP, 2014).

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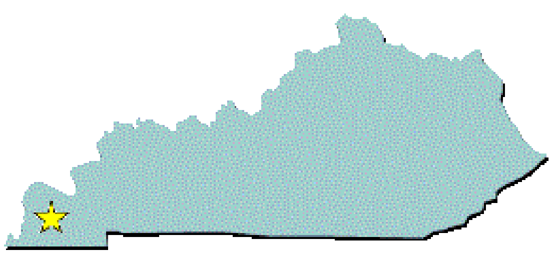
[132] The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) enacted in 1980, commonly referred to as the Superfund Program, governs abandoned hazardous waste sites, and collects a tax on chemical and petroleum industries. CERCLA was amended by the Superfund Amendments and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

[133] Data gathered using USEPA's CIMC search on November 12, 2015, for all sites in the State of Kentucky, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active).

Spotlight on Kentucky Superfund Sites: Paducah Gaseous Diffusion Plant

Paducah Gaseous Diffusion Plant (PGDP) is a 650-acre site located 10 miles west of Paducah, KY, in the West Kentucky Wildlife Management Area (Figure 7.1.15-2). The site was formerly used as a uranium enrichment plant, owned by the U.S. Department of Energy (DOE), which produced enriched uranium and nuclear fuel rods for power plants from 1952 until 2013. Decades of hazardous and radioactive waste operations have contaminated the soil, groundwater, surface water, and sediment throughout the site. The USEPA, KDEP, and DOE are working to clean up the site; however, due to the large volume of waste materials and size of the site, estimated completion is not until 2040. Access to the site is currently restricted. (USEPA, 2015n)

The Agency for Toxic Substances and Disease Registry (ATSDR) has identified "no apparent public health hazard" for the surrounding community, which means that the public may be exposed to contamination, but it is not expected to cause adverse health effects. However, the ATSDR noted that transportation accidents associated with the removal of hazardous or radioactive materials from the site would constitute an "urgent public health hazard." (ATSDR, 2009)



Source: (DOE, 2015b)

Figure 7.1.15-2: Aerial view of the Paducah Gaseous Diffusion Plant

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 natural of an area and the over-all chemical use, and can be used to track trends in release 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 September 2015, Kentucky had 430 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, Kentucky released 72.5M pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the electric utilities industry. This accounted for 1.77 percent of nationwide TRI releases, ranking Kentucky 11 of 56 U.S. states and territories based on total releases per square mile (USEPA, 2015i).

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of November 12, 2015, Kentucky had 140 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015j).

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 7.1.15-3 provides an overview of potentially hazardous sites in Kentucky.

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 waterbodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of October 2015, there are three USEPA-regulated telecommunications site in Kentucky (USEPA, 2015k). Sites such as this are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Kentucky had three fatalities in 2011 within the installation, maintenance, and repair occupations (SOC code 49-0000) from exposure to "harmful substances or environments," although these were not specific to telecommunications (BLS, 2015g). By comparison, the BLS reported three fatalities in 2011 and no fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517) from exposure to harmful substances or environments (BLS, 2015h). 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).

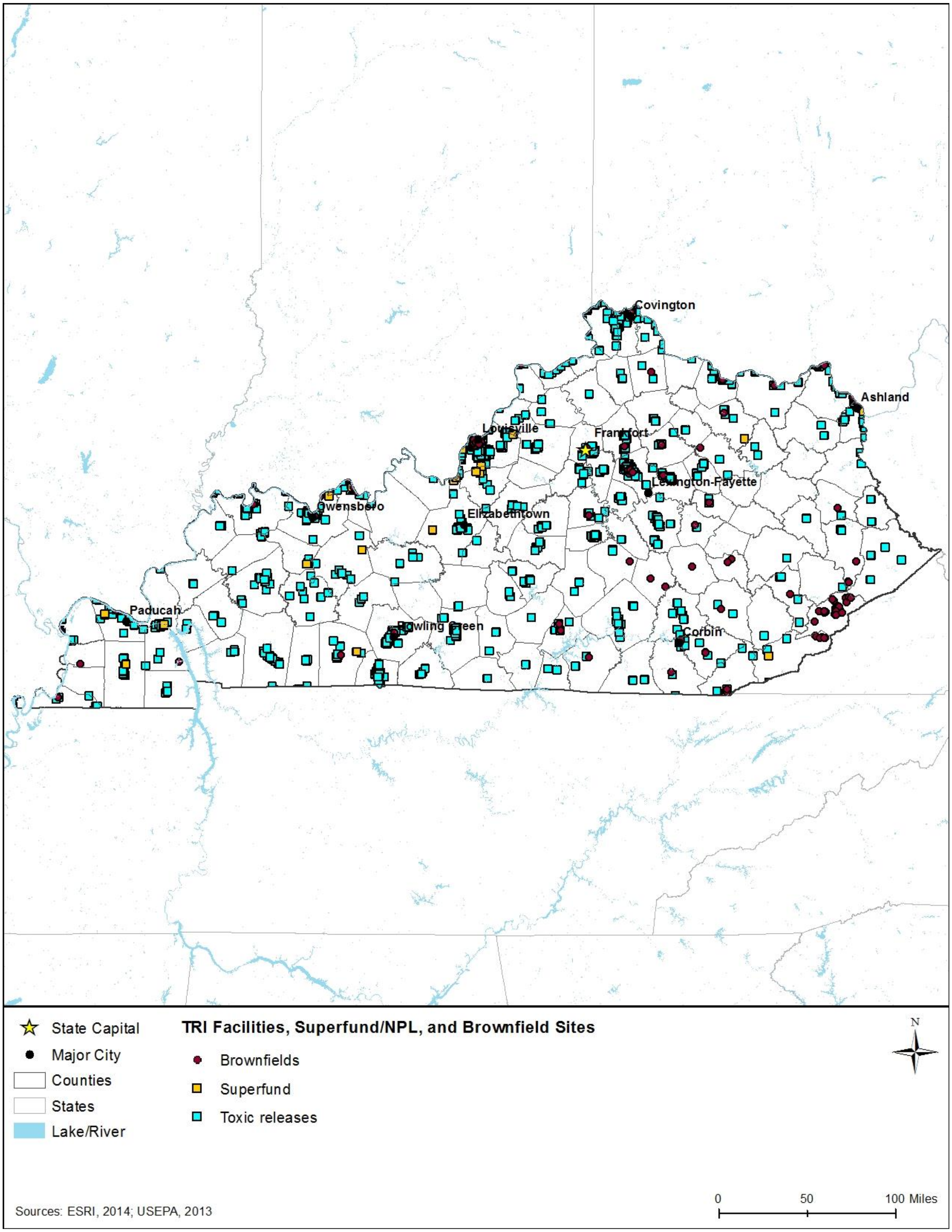


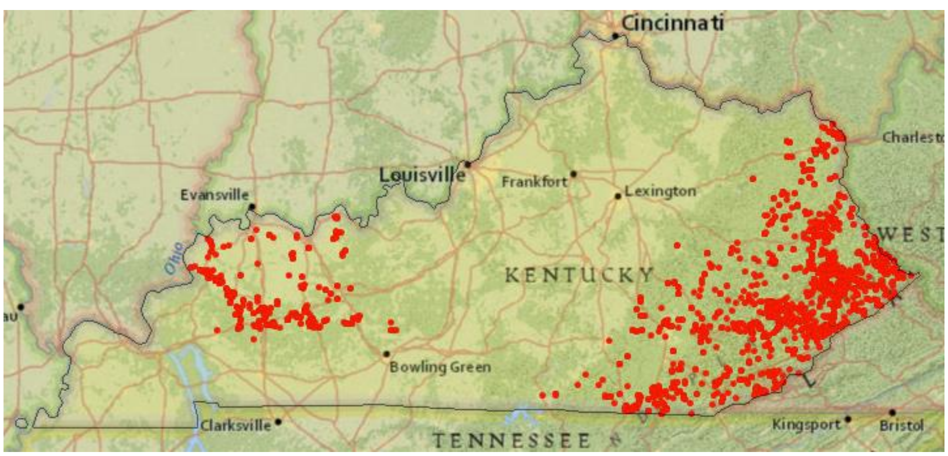
Figure 7.1.15-3: TOXMAP Superfund/NPL and TRI Facilities in Kentucky (2013)

Public Health and Safety

As described earlier, access to telecommunication sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunication 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.

7.1.15.5. Abandoned Mine Lands at or near Telecommunications Sites

Another health and safety hazard in Kentucky includes surface and subterranean mines. In 2015, the Kentucky mining industry ranked 29th for non-fuel minerals (primarily portland cement, crushed stone, clays, lime, and sand and gravel), generating a value of $571M (USGS, 2016b). In 2013, the most recent data available, Kentucky had 370 coalmining operations (151 underground and 219 surface), primarily in eastern Kentucky (USEPA, 2013c). 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 (Federal Mining Dialogue, 2015).



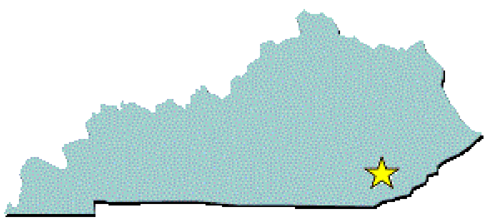
Source: (DOI, 2015b)

Figure 7.1.15-4: High Priority Abandoned Mine Land in Kentucky (2015)

The KDNR, Division of Abandoned Mine Lands administers the state AML Program by grants from the Surface Mining Control and Reclamation Act (SMCRA). The AML section is responsible for managing AML health and safety hazards resulting from pre-1977 mining operations (KDNR, 2015d). The KDNR, Division of Mine Reclamation and Enforcement (DMRE) is responsible for inspecting all surface and underground coal mining permits in the state to assure compliance with SMCRA (KDNR, 2015e). Figure 7.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Kentucky, where Priority 1 and 2 sites pose a significant risk to human health and safety, and Priority 3 sites pose a risk to the environment. As of November 2015, Kentucky had 2,444 Priority 1 and 2 AMLs, with 1,658 unfunded problem areas (DOI, 2015a).

Spotlight on Kentucky Manmade Disaster Sites: Darby Mine No. 1

On May 20, 2006, an explosion occurred in an underground coalmine east of Harlan County, KY along State Route 38, known as Darby Mine No. 1 (Figure 7.1.15-5). Six miners were present at the time of the explosion, performing routine maintenance and using an electric buggy equipped with oxygen and acetylene welding tanks to remove metal roof straps. The explosion occurred while cutting one of the metal roof straps near a sealed-off section of the mine, which contained methane gas. Five miners were killed, and the sixth severely wounded. (U.S. Department of Labor, Mine Safety and Health Administration, 2007)



Source: (KDNR, 2015f)

Note: White arrows indicate surface portals

Figure 7.1.15-5: Surface View of Darby No. 1 Mine

Telecommunication Worker Occupational Health and Safety

Telecommunication workers are often early responders to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. 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 new construction operations.

Public Health and Safety

Subterranean coalmines 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, coalmine 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 (DOI, 2015c).

7.1.15.6. Environmental Setting: Natural & Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the general public. Telecommunications, including public safety communications, can be unavailable (temporarily or permanently) during disaster events. Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). Floodwaters are often contaminated by hazardous chemicals and sanitary wastes, 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 the first or second responders to natural and manmade disasters 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, KDPH 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 211 NRC-reported incidents for Kentucky in 2015 with known causes, only 5 were attributed to natural disaster (flood and natural phenomenon), while the majority (206) were attributed to manmade disasters (equipment failure and operator error) (USCG, 2015). According to the NRC, several hazardous material release incidents occurred due to flooding between May 2 and 3, 2010 (see Figure 7.1.15-6). One incident involved a release of 100 gallons of creosote-contaminated water from a drip pad in Guthrie, KY, and another involved a discharge of fuel from a floating storage tank in Bowling Green, KY (USCG, 2010). Such incidents present unique, hazardous challenges to telecommunication workers during natural or manmade disasters.

Spotlight on Kentucky Natural Disaster Sites: 2010 Kentucky Flooding

On May 1, 2010, heavy rainfall caused flash flooding across central Kentucky as rivers in the mountainous regions of the western part of the state overflowed their banks (Figure 7.1.15-6). The flooding was exacerbated by additional rainfall the next day in the Cumberland River basin. Major highways, such as Interstate-24, closed after being inundated by up to six feet of floodwaters, stranding vehicles (NOAA, 2011). Damage in the mountainous areas of western Kentucky included road washouts, damaged or destroyed culverts, erosion, and landslides. Five fatalities were attributed to the storm and statewide storm damage totaled $30M. (NOAA, 2015c).

Source: (NOAA, 2010)

Figure 7.1.15-6: Flooding in New Haven, Kentucky

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, Kentucky had 8 fatalities (1 due to cold, 3 due to flooding, 3 due to winter weather, and 1 due to unknown causes) and 25 weather-related injuries (NWS, 2015b).

7.2. 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. The categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with BMPs and mitigation measures 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 Affected 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.

7.2.1. Infrastructure

7.2.1.1. Introduction

This section describes potential impacts to infrastructure in Kentucky associated with construction, deployment, and operation of the Proposed Action and alternatives, and discusses best management practices (BMPs) and mitigation measures that could avoid or minimize those potential impacts. 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.

7.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 7.2.1-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with BMPs and mitigation measures 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.

7.2.1.3. 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 deployment phases of specific projects. 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 7.2.1-1, such impacts would be *less than significant*, at the programmatic level, due to the temporary nature of the construction 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 at the programmatic level during deployment or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare, 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 7.2.1-1, potential negative impacts would be *less than significant* at the programmatic level. Substantial beneficial impacts are likely to result from implementation.

Table 7.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is *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 that is *potentially significant,* but with mitigation is *less than significant*.	Minor delays to access to care and emergency services that do not impact health outcomes.	*No impacts* on access to care or emergency services.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

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

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

NA = Not Applicable

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

The Proposed Action and alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 7.2.1-1, any potential impacts would be *less than significant* at the programmatic level. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be *less than significant*, at the programmatic level, given the short-term nature of the deployment activities.

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

Commercial assets would be using a different spectrum for communications; as such, commercial telecommunication systems, communications, or level of service would experience *no impacts* at the programmatic level. 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.[134] Anticipated impacts would be *less than significant* , at the programmatic level, due to the limited extent and temporary nature of the deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The activities proposed by FirstNet, at the programmatic level, 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

[134] 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.

temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

7.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to infrastructure resources at the programmatic level 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 at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes 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 at the programmatic level. If required, and if done in existing huts with no ground disturbance or development of new infrastructure, installation of new associated equipment would also have *no impacts* at the programmatic level.
  - New Build – Submarine Fiber Optic Plant: At the programmatic level, the installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. Impacts to infrastructure resources associated with the construction of landings and/or facilities on

shore or the banks of water bodies that accept the submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
 - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to infrastructure at the programmatic level. The section below addresses potential impacts to infrastructure if construction of new boxes, huts, or other equipment is required near or adjacent to local infrastructure assets.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have *no impact* on infrastructure resources at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the development phase, however, it is anticipated that at the programmatic level this tie-in would cause *less than significant* impacts as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing telecommunications poles.

  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, installation of transmission equipment that would occur in existing boxes or huts and require no ground disturbance, would have *no impact* on infrastructure at the programmatic level. However, if installation of transmission equipment such as small boxes or huts, or access roads, required ground disturbing activities, then those activities 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 constitutes beneficial impacts and 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 tower site 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 composed 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 utilized but launched from existing paved surfaces, it is anticipated that there would be *no impacts* to infrastructure resources at the programmatic level 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 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 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[135]

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 infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies at the programmatic level could result, at the programmatic level, in *less than significant* impacts to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure build to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs

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

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, at the programmatic level, there would be *no impacts* to infrastructure resources associated with routine inspections of the deployable assets, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, *less than significant* impacts at the programmatic level 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 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 deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to infrastructure, at the programmatic level, as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.1, Infrastructure. The state also would not realize beneficial impacts to infrastructure resources described above.

7.2.2. Soils

7.2.2.1. Introduction

This section describes potential impacts to soil resources in Kentucky associated with deployment and operation of the Proposed Action and alternatives. 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.

7.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 7.2.2-1. As described in Section 7.1.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with BMPs and mitigation measures 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.

7.2.2.3. 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 Kentucky 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). About 57 percent[136] of Kentucky contains soil types that occur on steep slopes and, therefore, have a medium to high potential for erosion. Those soil types include: Aqualfs, Aquents, Aquepts, Aquerts, Fluvents, Humults, Orthents, Rendolls, Udalfs, Udepts, and Udults (see Section 7.1.2.4, Soil Suborders and Figure 7.1.2-2).

Based on the impact significance criteria presented in Table 7.2.2-1, building 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* at the programmatic level given the short-term and temporary duration of the construction activities.

To the extent practicable, FirstNet would likely 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.

[136] 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.

Table 7.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level

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
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is *potentially significant,* but with mitigation is *less than significant*.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is *potentially significant,* but with mitigation is *less than significant*.	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is *potentially significant,* but with mitigation is *less than significant*.	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 7.2.2-1, and due to the relatively small-scale (less than 1 acre) of most FirstNet project sites, *less than significant* impacts from topsoil mixing is anticipated at the programmatic level. BMPs and mitigation measures could be implemented to further reduce potential impacts.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Heavy equipment could cause perceptible compaction and rutting of susceptible soils.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 7.1.2.4, Soil Suborders). The most compaction susceptible soils in Kentucky are Aqualfs, Aquents, Aquepts, Aquerts, Fluvents, and Udepts , hydric soils and with poor drainage conditions. These soils constitute approximately 43 percent of Kentucky's land area,[137] mostly locatedin the southwestern and northeastern portions of the state (see Figure 7.1.1-1). 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 7.2.2-1, the risk of soil compaction and rutting resulting from construction of the Preferred Alternative in Kentucky would be *less than significant* at the programmatic level,, due to the extent of susceptible soils in the state and the relatively small-scale (less than one acre) of most FirstNet projects. and could be further reduced with as implementation of BMPs and mitigation measures (see Chapter 16).

7.2.2.4. 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, at the

[137] 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.

programmatic level, in a range of *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to soil resources at the programmatic level 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, and therefore would have *no impact* on soil resources at the programmatic level because it would not require any ground disturbing activity.
  - 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 ground disturbing activity, and therefore *no impacts* to soil resources at the programmatic level. 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 and would not require any ground disturbing activity. Impacts to soil resources associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would have *no impact* on soil resources at the programmatic level because there would be no ground disturbance associated with this activity (see Section 7.2.4, Water Resources, for a discussion of potential impacts to water resources). Impacts to soil resources associated with the construction of landings or facilities on shore to accept submarine cable are addressed below.
  - 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 soils at the programmatic level. The section below addresses potential impacts to soils if construction of new boxes, huts, or other equipment is required.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have *no impact* on soils at the programmatic level because there would be no ground disturbance for pole/structure installation, and heavy equipment use would be typically limited to bucket trucks operated from existing paved, gravel, or dirt roads. Impacts to soils associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below.
- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation is the mounting or installing of new equipment on existing structures (such as antennas on an existing tower). This activity would have *no impact* on soils resources at the

programmatic level because there would be no ground disturbance. Potential impacts to soil resources from structural hardening, addition of power units, or security measures are addressed below.

- o Deployable Technologies: Where technologies such as Cell on Wheels (COW), Cell on Light Trucks (COLT), or System on Wheels (SOW) are deployed on existing paved surfaces or dirt or gravel areas, there would be *no impacts* to soil resources at the programmatic level because there would be no ground disturbance. Potential impacts associated with paving of previously unpaved surfaces or other ground disturbing activities are addressed below.

- Satellites and Other Technologies
  - o Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, or adding equipment to satellites launched for other purposes, would have *no impact* on soil resources because those activities would not require ground disturbance.
  - o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have *no impact* on soil resources at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

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

- Wired Projects
  - o New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - o New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel, or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, lighting up of dark fiber in existing conduits or cables would have *no impact* on soil resources. However, if installation of new huts or equipment were necessary, the activity could result in soil erosion and topsoil mixing during grading or excavation activities. This activity could also require the short-term use of heavy equipment for grading or other purposes, which could result in soil compaction and rutting.
- New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in or near bodies of water would have *no impact* on soil resources because there would be no soils to impact. However, impacts to soil resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure. 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: As stated above, if installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to soils at the programmatic level. However, 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 and then the activity could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are; however, 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: As stated above, collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in *no 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.

- o Deployable Technologies: As stated above, if deployment occurred on paved surfaces or previously disturbed land, there would be *no impact* on soil resources; however, implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas.

In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads, and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be *less than significant* at the programmatic level as the activity would likely be short term, localized to the deployment locations, and those locations would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities whenever feasible. 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 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, at the programmatic level, there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.2.5. 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. 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

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 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* to soil resources associated with routine inspections of deployable assets at the programmatic level, 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, *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 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 soil resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.2, Soils.

7.2.3. Geology

7.2.3.1. Introduction

This section describes potential impacts to Kentucky geology resources associated with deployment and operation of the Proposed Action and alternatives. 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.

7.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 7.2.3-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

Table 7.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level

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
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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
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.
	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

<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">Potential Paleontological Resources Impacts</td><td>Magnitude or Intensity</td><td>Severe, widespread, observable impacts to paleontological resources.</td><td rowspan="3">Effect that is potentially significant, but with mitigation is less than significant.</td><td>Limited impacts to paleontological and/or fossil resources.</td><td>No perceptible change in paleontological resources.</td></tr>
<tr><td>Geographic Extent</td><td>Areas with known paleontological resources are highly prevalent within the state/territory.</td><td>Areas with known paleontological resources occur within the state/territory, but may be avoidable.</td><td>Areas with known paleontological resources do not occur within the state/territory.</td></tr>
<tr><td>Duration or Frequency</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td rowspan="3">Surface Geology, Bedrock, Topography, Physiography, and Geomorphology</td><td>Magnitude or Intensity</td><td>Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.</td><td rowspan="3">Effect that is potentially significant, but with mitigation is less than significant.</td><td>Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.</td><td>No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.</td></tr>
<tr><td>Geographic Extent</td><td>State/territory.</td><td>State/territory.</td><td>NA</td></tr>
<tr><td>Duration or Frequency</td><td>Permanent or long-term changes to characteristics and processes.</td><td>Temporary degradation or alteration of resources that is limited to the construction and deployment phase.</td><td>NA</td></tr>
</table>

NA = Not Applicable

7.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology could be viewed as two distinct types, those that would potentially provide impacts on the project, such as seismic hazards, and landslides, and volcanic activity (as appropriate), and those that would have 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

As discussed in Section 7.1.3.8 (Figure 7.1.3-4), the majority of Kentucky is not at risk to significant earthquake events. Based on the impact significance criteria presented in Table 7.2.3-1, seismic impacts from deployment or operation of the Proposed Action would *have no impact* on seismic activity at the programmatic level; 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 moderate to significant earthquakes in or near Kentucky, 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 Kentucky, as they do not occur in Kentucky; 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 7.1.3.8 (Figure 7.1.3-5), the majority of Kentucky is at low to moderate risk of experiencing landslide events. Based on the impact significance criteria presented in Table 7.2.3-1, potential impacts to landslide potential from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level; 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. To the extent practicable, FirstNet would likely avoid deployment in areas that are susceptible to landslide 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.

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 7.1.3.8 and shown in Figure 7.1.3-6, portions of Kentucky are vulnerable to land subsidence due to karst topography and mine collapse. Based on the impact significance criteria presented in Table 7.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level. 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 inundation from long-term land subsidence; however, where infrastructure is subject to land subsidence hazards, BMPs and mitigation measures, as discussed in Chapter 16, could 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 Mineral and Fossil Fuel Resource Impacts

As discussed in Section 7.1.3.8, portions of Kentucky contain mineral resources. Equipment deployment near mineral and fossil fuel resources would have *less than significant* effects on these resources at the programmatic level. Rather the new construction is only likely to limit access to extraction of these resources. To the extent practicable, FirstNet would likely 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

As discussed in Section 7.1.3.7, fossils are abundant throughout parts of Kentucky. Based on the impact significance criteria presented in Table 7.2.3-1, impacts to paleontological resources could be *potentially significant* if FirstNet's buildout/deployment locations were to cause impacts to paleontological resources. Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. It is anticipated that potential impacts to specific areas known to contain paleontological resources would be avoided, minimized, or mitigated, and any potential impacts would be limited and localized thus potential impacts would be *less than significant* at the programmatic level. Site- specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. BMPs and mitigation measures could further 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 require modification or removal of the surrounding terrain could cause irreparable damage to that area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 7.2.3-1, impacts would, at the programmatic level, be *less than significant* if FirstNet's deployment is unlikely to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be *less than significant* at the programmatic level, because they are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures (see Chapter 16) could be implemented to help avoid or minimize the potential impacts.

7.2.3.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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 have the potential to be impacted by geologic hazards, some activities could result in potential impacts to geologic resources, and other activities would have *no impacts*. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to geologic resources at the programmatic level 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. There would be *no impacts* to geologic resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes. The section below addresses potential impacts if entry/exit points are installed in coastal locations that are susceptible to land subsidence.

- Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have *no impact* on geologic resources at the programmatic level because there would be no ground disturbance for pole/structure installation, and heavy equipment use would be typically limited to bucket trucks operated from existing paved, gravel, or dirt roads. Impacts to geologic resources associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below.
- 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 at the programmatic level because there would be no ground disturbing activity. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would have *no impacts* to/from geologic resources at the programmatic level. The section below addresses potential impacts if ground disturbing activities associated with new huts or structures were to occur in locations that are susceptible to specific geologic hazards.
- 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 geologic resources at the programmatic level. The section below addresses potential impacts if the boxes/huts are installed in locations that are susceptible to specific geologic hazards (e.g., land subsidence, landslides, or earthquakes).

- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in *no impacts* to geologic resources at the programmatic level if no ground disturbance were associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact geologic resources if this activity did not require ground disturbance. The section below addresses potential impacts if ground disturbing activities occur in locations that are susceptible to specific geologic hazards.
  - Deployable Technologies: Where deployable technologies would be implemented on existing paved surfaces, there would be *no impacts* to/from geologic resources at the programmatic level because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts associated with site preparation for staging or landing areas is discussed below.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures, adding equipment to satellites being launched for other purposes, and the use of portable devices that use satellite technology would have *no impact* on geologic resources at the programmatic level because those activities would not require ground disturbance. The section below addresses potential impacts if ground disturbance activities occur in locations that are susceptible to specific geologic hazards.

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

Activities with the Potential to Have Impacts at the Programmatic Level

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

- Wired Projects
  - o New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of 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.
  - o New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - o Collocation on Existing Aerial Fiber Optic Plant: As stated above, if collocation does not require new utility poles or ground disturbance, there would be *no impacts* to geologic resources. However, replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to specific geologic hazards, it is possible that equipment could be affected by that hazard.
  - o Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, although lighting up of dark fiber would have *no impacts* to geologic resources at the programmatic level, installation of new associated huts or equipment, if required, could result in ground disturbance during grading or excavation activities. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - o Use of Existing Conduit – New Buried Fiber Optic Plant: As stated above, disturbance associated with the installation of fiber optic cable in existing conduit have *no impacts* to geologic resources at the programmatic level. However, if fiber were installed in

locations susceptible to landslides, earthquakes, or other geologic hazards, it is possible that the equipment could be affected by that hazard.

- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water is not expected to impact geologic resources 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: As stated above, if installation of equipment were to take place in existing facilties, there would be *no impact* to/from geologic resources. However, if installation of transmission equipment would require ground disturbance in areas 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: As stated above, collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance and, therefore, would have *no impact* on geologic resources. 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: As stated above, 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. However, 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.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: As mentioned above, 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 have *no impact* on 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.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could result in incidental removal of bedrock or mineral and fuel resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects are likely to be small-scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small-scale as a result, these potential 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, at the programmatic level, there would be *no impacts* to geological resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by geologic hazards, including minor seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. 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.

7.2.3.5. Alternatives Impact Assessment

The following section assesses potential impacts to geologic resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to 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, and COLTs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be *less than significant* at the programmatic level due to the minor amount of paving or new infrastructure needed to accommodate the deployables. 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, at the programmatic level, there would be *no impacts* 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, 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 was subject to increased seismic activity, landslides, and land subsidence. 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*, at the programmatic level, to geologic resources (or from geologic hazards) as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.3, Geology.

7.2.4. Water Resources

7.2.4.1. Introduction

This section describes potential impacts to water resources in Kentucky associated with deployment and operation of the Proposed Action. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to water resources. Implementation of BMPs, as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

7.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 7.2.4-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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 7.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity; violation of various regulations including: CWA, SDWA.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant* at the programmatic level..	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Floodplain degradation[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 BMPs and mitigation measures is less than significant* at the programmatic level..	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant* at the programmatic level..	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant* at the programmatic level..	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant* at the programmatic level..	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

NA = Not Applicable
[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).

7.2.4.3. 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 or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Approximately 41 percent of Kentucky's lakes, reservoirs, and ponds are impaired, with mercury and polychlorinated biphenyls as the most common causes of impairments (see Table 7.1.4-2 and Figure 7.1.4-2). Additionally, approximately 67 percent of the assessed Kentucky rivers, and streams are impaired due to various pollutants, such as nutrients (e.g., phosphorus) and sediments. Approximately 41 percent of the assessed Kentucky lakes, reservoirs, and ponds are impaired due to pollutants from various sources, such as agriculture, municipal point source discharges, and urban runoff (USEPA, 2012c). Groundwater quality within the state is generally good.

Construction 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.

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 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 could help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs and mitigation measures, where practicable and feasible, would 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 7.2.4-1, water quality impacts would likely be *less than significant* at the programmatic level and could be further reduced if BMPs and mitigation measures were incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. Groundwater contamination may exist in areas directly within or near the project area. If trenching[138] or tower constructive 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 Kentucky dewatering requirements. Any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be t treated prior to discharge or disposed of at a wastewater treatment facility.

Trenching would not likely introduce new contamination in the state's aquifers. The Proposed Action and Alternatives are unlikely to cause new drinking water violations, or otherwise substantially degrade groundwater quality. Based on the impact significance criteria presented in Table 7.2.4-1, there would likely be *less than significant* impacts at the programmatic level on groundwater quality within most of the state. In areas where groundwater is close to the surface, such as where the aquifers consist of limestone and are karst (see Geology, Section 7.1.3, for more information on the state's karst geology), site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Furthermore, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on humans 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 7.2.4-1, floodplain degradation impacts would be *less than significant* at the programmatic level since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would use minimal fill,

[138] 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).

would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would be temporary, lasting no more than one season or water year,[139] or occur only during an emergency.

Examples of activities that, at the programmatic level, would have *less than significant* impacts include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that include pervious surfaces such as gravel parking lots.
- Land uses that do not change the flow of water or drainage patterns.
- Limited clearing or grading activities.

See Chapter 16, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts to floodplain degradation.

Drainage Pattern Alteration

Flooding and erosion from land disturbance could change drainage patterns. Storm water runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to 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 7.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered *less than significant* at the programmatic level.

Example of activities that could have minor changes, at the programmatic level, 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.

[139] 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, 2016)

Since the proposed activities would not substantially alter drainage patterns in the following possible ways: alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to drainage patterns would be *less than significant* at the programmatic level. BMPs and mitigation measures could be implemented to further reduce potential 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 7.2.4-1. Projects that include minor consumptive use of surface water with negligible impacts on discharge (do not direct large volumes of water into different locations) on a temporary basis (no more than six months) are likely to have *less than significant* impacts at the programmatic level on flow alteration, on a watershed or subwatershed level. Example projects 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 waterbodies 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 to flow would be *less than significant* at the programmatic level. BMPs, mitigation measures, and avoidance would further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 7.1.4.7, approximately 5 percent of Kentucky residents (1.5 million residents) rely on groundwater as a source of potable water (UKY, 2014). Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. Generally, the water quality of Kentucky's aquifers is suitable for drinking and daily water needs (KDEP, 2004b). 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 or dredging during or after construction;
- Any liquid waste, including but not limited to wastewater, generation;
- Bulk storage of petroleum or chemical products;
- Use of pesticides, herbicides, or insecticides during or after construction of a commercial, industrial, or recreational use; and
- Commercial generation, treatment, storage, or disposal of hazardous wastes.

Deployment activities should be *less than* significant at the programmatic level since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. It is likely that areas that utilize groundwater for potable water purposes, would be avoided. According to Table 7.2.4-1, *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.

7.2.4.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

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

Potential 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 could result in potential impacts to water resources and others would not. In addition, and as explained in this section, the various types of Preferred Alternative Infrastructure could result, at the programmatic level, in a range of *no impacts* to *less than 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 at the Programmatic Level

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 at the programmatic level under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to water resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - 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 at the programmatic level 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, attached to satellites launched for other purposes, or the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance, construction in floodplains, or use of motorized equipment near streams.
  - 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 at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential construction/deployment-related impacts to water resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities, including in-stream construction work, resulting primarily in sediments entering streams, but also potentially to near-shore or inland waters, as well as the potential for other impacts to water quality and floodplains. The types of infrastructure development scenarios or 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. Ground 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 stream sedimentation, construction of impervious surfaces and

structures in floodplains, stream channel alteration, and accidental spills of fuels or lubricants to waterbodies.

- New Build – Buried Fiber Optic Plant projects could present a higher risk to water resources because of their relatively high degree of soil disturbance compared to the other types of projects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could potentially impact water quality due to disruption of sediments on the floor of the waterbody. Impacts to water resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Sediments entering limited near-shore or inland waterbodies could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Construction of facilities in floodplains could potentially impact floodplain functionality and drainage patterns.
- New Build – Aerial Fiber Optic Plant: Soil exposure from installation of new poles or construction of new roads, POPs, huts, or other facilities near waterbodies could result in ground disturbance, potentially resulting in sediment deposition and increased turbidity in nearby waterbodies. The use of heavy equipment during the installation of new poles and cables could result in potential soil disturbance and the resulting potential sedimentation impacts to streams, disturbance of riparian vegetation, leaching of PCPs, and accidental spills of fuels or lubricants to waterbodies.
- Collocation on Existing Aerial Fiber Optic Plant: Ground disturbance during the replacement of poles and structural hardening could result in potential soil erosion and sedimentation impacts to streams, particularly where this work would be done in proximity to waterbodies. Collocation on Existing Aerial Fiber Optic Plant projects could present a lower risk to water resources because of their relatively low degree of soil disturbance compared to the other types of projects.
- 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. 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. If a new roadway were built, any additional impervious surface could impact water resources by increasing the overall amount of runoff and nonpoint pollution.
- o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to water resources because there would be no ground disturbance or in-water construction associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact water resources if this activity would not require ground disturbance or in-water construction. However, if the on-site delivery of additional power units, structural hardening, and physical security measures required travel through streams or ground disturbance, such as grading or excavation activities near streams, potential impacts to water resources could occur including stream sedimentation and physical disturbance associated with heavy equipment use.

- Deployable Technologies
  - o Implementation of deployable technologies could result in potential impacts to water 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 direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could 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 at the programmatic level because there would be no ground disturbance.
  - o Deployment of drones, balloons, blimps, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters. In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure could include water quality impacts, but are expected to be *less than significant* at the programmatic level due to the small scale of individual 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.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure would likely be *less than significant* at the programmatic level due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 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.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to water 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, and assuming that all refueling and vehicle maintenance BMPs and mitigation measures are followed. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. 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.

7.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.[140]

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 water resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to water resources if those activities occurred on

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

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.

Potential 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 deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be *no impacts* to water resources at the programmatic level associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be *less than significant* at the programmatic level. Site maintenance, including mowing or herbicides, is anticipated to result in *less than significant* effects to water quality at the programmatic level, depending on the 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 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 water resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.4, Water Resources.

7.2.5. Wetlands

7.2.5.1. Introduction

This section describes potential impacts to wetlands in Kentucky associated with deployment and operation of the Proposed Action and alternatives. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to wetland resources. Implementation of BMPs, as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

7.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 7.2.5-1. The categories of impacts are defined at the programmatic level as *potentially significant, less than significant with BMPs and mitigation measures 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 7.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct wetland loss (fill or conversion to non-wetland)	Magnitude[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 704 of the CWA.	Effect that is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	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	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent loss, degradation, or conversion to non-wetland.		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* at the programmatic level.	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	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
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* at the programmatic level.	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	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent change in function or type that is not restored within two growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

NA = Not Applicable
[a] "Magnitude" is defined based on the type of wetland impacted, using USACE wetland categories. 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.

7.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, vibrations, light, and other human disturbance. To the extent practicable or feasible, FirstNet, and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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.

There are approximately 452,000 acres of palustrine, riverine, and lacustrine wetlands throughout Kentucky (USFWS, 2017). Palustrine (freshwater) wetlands are found on river and lake floodplains across the state; riverine wetlands are found in natural or artificial channels periodically throughout the state; and lacustrine wetlands are generally found in central Kentucky; as shown in Section 7.1.5, Table 7.1.5-2 and Figure 7.1.5-1.

Based on the impact significance criteria presented in Table 7.2.5-1, deployment activities at the programmatic level would most likely have *less than significant* direct impacts on wetlands at the programmatic level. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and locally required regulations.

In Kentucky, as discussed in Wetlands, the state does not have any wetlands of special concern (regulated high quality wetlands). Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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.

Construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) could cause *potentially significant* impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds could be *potentially significant*. Based on the impact significance criteria presented in Table 7.2.5-1, other direct effects to high- and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and locally required wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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 Kentucky 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 bogs and alkaline conditions of fens.

- *Water Quality Degradation (spills or sedimentation):* The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[141] Changes in Function(s)[142] 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* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and locally required wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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.

Examples of functions related to wetlands in Kentucky that could potentially be impacted from construction-related deployment activities include:

- *Flood Attenuation:* Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they could lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.
- *Bank Stabilization:* By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- *Water Quality:* Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.

[141] 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.
[142] 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.

- *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 7.2.5-1, 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 *less than significant* at the programmatic level. Since none of Kentucky's 420,000 acres of wetlands are considered high quality, deployment activities could have *less than significant* indirect impacts at the programmatic level on wetlands in the state. If avoidance were not possible, potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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.

7.2.5.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

Potential 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 Preferred Alternative Infrastructure could result in a range of *no impacts* to *potentially significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to wetlands at the programmatic level 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 at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to wetlands at the programmatic level 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 at the programmatic level since there would be no ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would not impact wetlands at the programmatic level, it is anticipated that this activity would have *no impact* on wetlands.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
    - 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 or near bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.
    - New Build – Aerial Fiber Optic Plant: Potential impacts could be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.

  - Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Deployable Technologies
  - Implementation of deployable technologies could result in potential impacts to wetlands if 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. Based on the analysis of proposed activities described above, direct and indirect impacts to wetlands would be expected to be *less than significant* at the programmatic level due to the small amount of land disturbance (generally less than one acre) and the short timeframe of deployment activities. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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.

Potential 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 potential deployment impacts. Depending on the proximity to wetlands, it is anticipated that there could be ongoing other potential direct impacts to wetlands if heavy equipment is used for routine operations or maintenance or if application of herbicides occurs to control vegetation along ROWs and near structures. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are not expected to be *less than significant* at the programmatic level due to the limited nature of deployment activities. It is anticipated that there would be *no impacts* at the programmatic level to wetland resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all federal, state, and local requirements associated with refueling and vehicle maintenance are followed. 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.

7.2.5.5. 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.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be *less than significant* at the programmatic level due to the small-scale and temporary duration of expected FirstNet deployable activities is any one location. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. 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 Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Tec would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland’s quality and function.

It is anticipated that there would be *less than significant* impacts at the programmatic level to wetlands associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility rights-of-way would be utilized for maintenance and inspection activities. Site maintenance, including mowing or herbicides, is anticipated to result in *less than significant* impacts to wetlands at the programmatic level due to the limited nature of site maintenance activities, including mowing and application of herbicides. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on wetlands, as explained above. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 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 at the programmatic level from the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.5, Wetlands.

7.2.6. Biological Resources

7.2.6.1. Introduction

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Kentucky associated with deployment and operation of the Proposed Action and its Alternatives. 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.

7.2.6.2. 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 7.2.6-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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 7.2.6.3, 7.2.6.4, and 7.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 7.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Kentucky.

Table 7.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury /mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: Marine Mammal Protection Act (MMPA), Magnuson Stevens Fishery Conservation And Management Act (MSFCMA), Migratory Bird Treaty Act (MBTA), and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant.*	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Kentucky for at least one species. Anthropogenic[a] disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant*.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Kentucky for at least one species. Anthropogenic[a] disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant.*	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Kentucky for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant.*	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Kentucky for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant.*	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Kentucky for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is *potentially significant, but with BMPs and mitigation measures is less than significant.*	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Kentucky.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

NA = Not Applicable
[a]Anthropogenic: “Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities” (USEPA, 2016g).

7.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Kentucky 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 7.2.6-1, direct injury or mortality impacts could be significant at the programmatic level 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, 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.

Comments received on other regional Draft PEIS documents for the Proposed Action expressed concerns related to the potential impacts to vegetation from RF emissions. Some studies have indicated the potential for *adverse effects* to vegetation from RF emissions. As explained in Section 2.4, Radio Frequency Emissions, as well as the Wildlife portion of this Biological Resources Section, additional, targeted research needs to be conducted to more fully document the nature and effects of RF exposure, including the potential impacts to vegetation.

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. About 40 percent of Kentucky has experienced extensive land use change due to cropland and pastureland creation and about 8 percent of the state has experienced extensive land use change due to urbanization. However, a large portion of the state, about 41 percent, remains as relatively unfragmented forest areas, particularly the Daniel Boone National Forest and Mammoth Cave National Park (USGS, 2011).

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.

Comments received on other regional Draft PEIS documents for the Proposed Action expressed concerns related to the potential impacts to vegetation from RF emissions. Some studies have indicated the potential for *adverse effects* to vegetation from RF emissions. As explained in Section 2.4, Radio Frequency Emissions, as well as the Wildlife portion of this Biological Resources Section, additional, targeted research needs to be conducted to more fully document the nature and effects of RF exposure, including the potential impacts to vegetation.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. 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 adramatic effect on natural resources and biodiversity.

As described in Section 7.1.6.4, when non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. In the state of Kentucky, the KDT and KDA are both responsible for eliminating certain listed weeds according to KCA 176.051 and 249.180 – 249.195. A total of 10 weeds are regulated in Kentucky.

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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to vegetation as a result of the introduction of invasive species.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section the same type of Proposed Action infrastructure could result, at the programmatic level, in a range impacts, from *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology,[143] 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.

<u>Activities Likely to Have No Impacts at the Programmatic Level</u>

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, at the programmatic level, under the conditions described below:

[143] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

- 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 at the programmatic level because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have *no impact* on terrestrial vegetation at the programmatic level.

<u>Activities with the Potential to Have Impacts at the Programmatic Level</u>

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. BMPs and mitigation measures could help avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or 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. BMPs and mitigation measures could help avoid or minimize potential impacts.

- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near 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 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. BMPs and mitigation measures could help avoid or minimize potential impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, vegetation loss, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: 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.

- o Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recover 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 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 terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be no 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 the 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 at the programmatic level from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. 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.

<u>Operational Impacts</u>

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 at the programmatic level to terrestrial vegetation 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 at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.6.3, Terrestrial Vegetation.

7.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Kentucky 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 7.2.6-1, *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* at the programmatic level, as discussed further below (except for birds, which would be *less than significant 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Terrestrial Mammals</u>

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Kentucky. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, foraging, and migration (FHWA, 2009). 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-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 man-made cables and wires are environmental concerns for avian species and violate MBTA and BGEPA. Generally, collision events occur to night-migrating birds, "poor" fliers (e.g., ducks), night-migrating birds, heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans. (Gehring, Kerlinger, & Manville, 2011)

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997). Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small-scale of likely FirstNet actions.

Direct mortality and injury to birds of Kentucky are not likely to be widespread or affect populations of species as a whole due to the small size of the likely FirstNet actions; however, DOI comments dated October 11, 2016[144] state that communication towers are "currently estimated to kill between four and five million birds per year" (Regulations.gov, 2016). Although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights (FAA, 2016c) (FAA, 2016d) (FCC, 2017). Additionally, on Jan. 6, 2017, the FCC issued a notice titled Opportunities to Reduce Bird Collisions with Communications Towers While Reducing Tower Lighting Costs (FCC, 2017). See Chapter 16, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to birds from tower lighting. Site-specific analysis and/or consultation with FWS may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If siting considerations, BMPs, and mitigation measures are implemented (Chapter 16), potential impacts could be minimized. Applicable BMPs and

[144] See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts (including possible “take”). Environmental consequences pertaining to federally listed species will be discussed in Section 7.2.6.6, Threatened and Endangered Species.

Reptiles and Amphibians

In Kentucky, reptiles and amphibians occur in a wide variety of habitats throughout the state (KDFWR, 2013a). 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.

Invertebrates

Ground disturbance or land clearing activities as well as use of heavy equipment could result in direct injury or mortality to invertebrates. However, deployment activities are expected to be temporary and isolated, thereby limiting the potential for direct mortality and likely affecting only a small number of invertebrates. The invertebrate populations of Kentucky are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat, and impeding access to resources and mates. About 40 percent of Kentucky has experienced extensive land use change due to cropland and pastureland creation and about 8 percent of the state has experienced extensive land use change due to urbanization. However, a large portion of the state, about 41 percent, remains as relatively unfragmented forest areas, particularly the Daniel Boone National Forest and Mammoth Cave National Park (USGS, 2011).

As described in Section 7.2.6.3, 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* at the programmatic level because of the small-scale nature and limited geographic scope of expected deployment activities. Additionally, FirstNet would attempt to avoid these areas. These potential impacts are described for Kentucky’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 Kentucky 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 Kentucky Department of Fish and Wildlife Resources (KDFWR) can 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 and vibration disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources.

These impacts could be particularly pronounced if birds temporarily avoid IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[145] species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stop overs (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, would help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Kentucky's amphibians and reptiles typically consist of wetlands and the surrounding upland forest. Impacts are expected to be *less than significant* at the programmatic level 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.

[145] 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.

Filling or draining of wetland breeding habitat (see Section 7.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Kentucky's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[146]

Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected at the programmatic level. Impacts to sensitive invertebrate species are discussed below in Section 7.2.6.6, 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, potential impacts are expected to remain *less than significant* at the programmatic level (except for birds and bats due to potential exposure to RF emissions, see below), due to the short-term nature and limited geographic scope of expected activities. Additionally, FirstNet would attempt to avoid these areas, 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, vibrations, light, or other 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. Depending on the project type and location, individual species may be disturbed resulting in *less than significant* impacts at the programmatic level (except for bats, see below).

There are no published studies that document physiological or other *adverse effects* to bats from radio frequency (RF) exposure. However, because bats are similar ecologically and physiologically to birds, they have the potential to be affected by RF exposure in similar ways to birds (see the birds subsection below). One study demonstrated that foraging bats avoided areas exposed to varying levels of electromagnetic radiation compared with control sites, and attributed this behavior to the increased risk of overheating and echolocation interference caused by electromagnetic field exposure (Nicholls & Racey, 2009). As stated below, experts emphasize that targeted field research needs to be conducted to more fully document the nature

[146] See Section 7.2.5, Wetlands, for a discussion of BMPs for wetlands.

and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, 2015) (Manville, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

<u>Birds</u>

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. Depending on the project type and location, individual species may be disturbed resulting in *less than significant* impacts at the programmatic level.

Research indicates that RF exposure may *adversely affect* birds. A comment letter on the Draft Programmatic Environmental Impact Statement for this region, presented by Dr. Albert Manville, former USFWS agency lead on avian-structural impacts, summarizes the state of scientific knowledge of the potential effects of RF exposure on wildlife, particularly migratory birds; the comment letter is presented in its entirety in Appendix G. RF exposure may result in adverse impacts on wildlife, although a distinct causal relationship between RF exposure and responses in wild animal populations has not been established. Further, important scientific questions regarding the mechanisms of impact, the exposure levels that trigger *adverse effects*, and the importance of confounding factors in the manifestation of effects, among other questions, remain unanswered (Manville, 2016b) (Appendix G).

Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian and mammalian subjects, including embryonic mortality in bird eggs, genetic abnormalities, cellular defects, tumor growth, and reproductive and other behavioral changes in adult birds and rodents (Wyde, 2016) (Levitt & Lai, 2010) (DiCarlo, White, Guo, & Litovitz, 2002) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008).

Few studies of the effects of RF exposure on wild animal populations have been conducted due to the difficulty of performing controlled studies on wild subjects. Those that have been conducted are observational in nature (i.e., documenting of reproductive success and behavior in birds near RF-emitting facilities). These studies lack controls on exposure levels or other potentially confounding factors. Nevertheless, findings from these studies indicate reduced survivorship at all life stages; physiological problems related to locomotion and foraging success; and behavioral changes that resulted in delayed or unsuccessful mating in several species of nesting birds (Balmori, 2005) (Balmori, 2009) (Balmori & Hallberg, 2007) (Manville, 2016b) (Appendix G). Balmori (2005) documented effects as far as 1,000 feet from an RF source consisting of multiple cellular phone towers. Another study of wild birds conducted by Engels et al. (2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise,[147] which can disrupt migration or send birds off course, potentially resulting in reduced survivorship.

Experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on birds and other wildlife and the implications of those effects on wildlife populations over the long term (Manville, 2015) (Manville, 2016b) Appendix G). Such studies should be conducted over multiple generations and include controls to more clearly establish causal relationships, identify potential chronic effects, and determine threshold exposure levels. FirstNet recognizes that RF exposure may adversely impact wildlife, particularly birds that nest, roost, forage, or otherwise spend considerable time in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in *less than significant* impacts at the programmatic level.

Invertebrates

Invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be *less than significant* at the programmatic level.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Additionally, FirstNet would attempt to avoid areas of known migratory pathways. Potential effects to migration patterns of Kentucky's amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below. Chapter 16, BMPs and

[147] Urban electromagnetic noise is a term used to describe an area with a concentration of cell phone towers and users, which by sheer volume and level of use, creates a zone of electromagnetic noise.

Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Terrestrial Mammals

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.[148]

Any clearance, drilling, and construction activities needed for network deployment, including noise and vibrations associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to 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 Kentucky undertake some of the longest-distance migrations of all animals. Kentucky's IBAs are currently under review. To date a total of 5 IBAs have been identified in Kentucky; however, it is anticipated that the review committee will list between 35 and 50 IBAs in the state when the review concludes. These areas would include breeding, migratory stopover, feeding, and wintering areas in a variety of habitats such as native grasslands, forests, and wetland/riparian areas (The National Audubon Society, 2015). Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be *less than significant* at the programmatic level. Additionally, there is some evidence in the scientific literature that RF emissions could affect bird migration. Engels et al. (2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise, which can disrupt migration or send birds off course, potentially resulting in reduced survivorship. It is unlikely that the limited amount of infrastructure, the amount of RF emissions generated by Project infrastructure, and the temporary nature of the deployment activities would result in impacts to large populations of migratory birds, but more likely that individual birds could be impacted. Chapter 16, BMPs and Mitigation Measures, provides a list of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential effects to migratory pathways.

[148] A location chosen by an animal for hibernation.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. For example, wood frogs (*Rana sylvatica*) use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, Atwood, Dunkle, & Karr, 2010) (KDFWR, 2013b). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be *less than significant* at the programmatic level. BMPs could help to further avoid or minimize the potential impacts.

Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. *No effects* to migratory patterns of Kentucky's invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the short-term and limited nature of expected activities (except for birds and bats which are anticipated to *be less than significant with BMPs and mitigation measures incorporated,* see below), as FirstNet would attempt to avoid these areas. 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. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Kentucky. For example, pregnant black bears select denning habitats that allow for more effective defense of their cubs from predators (USFWS, 2014f). There are no published studies that document *adverse effects* to bats from RF exposure. As stated above, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, 2015) (Manville, 2016b) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and

Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small-scale and impacts are expected to be *less than significant* at the programmatic level. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual, vibrations, and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian subjects, including embryonic mortality in bird eggs and reproductive changes in adult birds (Wyde, 2016) (Levitt & Lai, 2010) (DiCarlo, White, Guo, & Litovitz, 2002) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008). Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in embryonic mortality (DiCarlo, White, Guo, & Litovitz, 2002) (Manville, 2007). These studies suggest that RF emissions at low levels (far below the existing exposure guidelines for humans) (see Section 2.4.2, RF Emissions and Humans) may be harmful to wild birds; however, given the controlled nature of the studies and potential exposure differences in the wild, it is unclear how this exposure would affect organisms in the wild.

As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures) to help reduce bird mortalities associated with both RF emissions and tower collisions. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

The majority of FirstNet deployment or operation activities are likely to be small scale in nature. BMPs and mitigation measures as defined through consultation with USFWS for compliance with MBTA or BGEPA, or another appropriate regulatory agency, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 7.2.6.6, 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, 2015j).

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though BMPs would help to avoid or minimize the potential impacts. Overall, impacts to reptiles and amphibians are expected to be *less than significant* at the programmatic level due to the limited extent and temporary nature of the deployment.

<u>Invertebrates</u>

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; therefore, no reproductive effects to 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. Kentucky has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select terrestrial wildlife species. KAR 301 2:082 regulates transportation and holding of live exotic wildlife. This regulation includes an extensive list of species that are prohibited in the state of Kentucky.

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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities.

Potential invasive species effects to Kentucky's wildlife are described below.

<u>Terrestrial Mammals</u>

In Kentucky, feral hogs adversely impact several native wildlife large and small mammals, including turkey, squirrels, and deer. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (KDFWR, 2014m). FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites, as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to mammals as a result of the introduction of invasive species.

Birds

FirstNet deployment activities could result in short-term or temporary changes to specific project sites; these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities. FirstNet deployment activities could result in short-term or temporary changes to specific project sites; these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to birds as a result of the introduction of invasive species.

Reptiles and Amphibians

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 deployment activities. Invasive terrestrial reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to reptiles and amphibians as a result of the introduction of invasive species.

Invertebrates

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 forest and agricultural resources (USFS, 2015d). Species such as the gypsy moth,hemlock woolly adelgid,emerald ash borer,and Asian longhorn beetle are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to invertebrates as a result of the introduction of invasive species.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result, at the programmatic level, in a range of impacts, from *no impacts* to *less than significant impacts with BMPs and mitigation measures incorporated*, 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.

<u>Activities Likely to Have No Impacts at the Programmatic Level</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to wildlife resources, at the programmatic level, under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibrations generated by equipment required to install fiber would be infrequent and of short duration, and 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 at the programmatic level 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 if those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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 at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise and vibrations, associated with the above activities 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 individual species as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
    - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife (see Section 7.2.4, 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 and vibration disturbance could potentially impact migratory patterns of wildlife. For a discussion of radio frequency emissions, refer to Section 2.4, Radio frequency Emissions.
    - Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise and vibrations. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the 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 projects with the exception of impacts to birds and bats, which are expected to be *less than significant with BMPs and mitigation measures incorporated*; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and are therefore expected to remain *less than significant* at the programmatic level. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Chapter 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 would be infrequent, including mowing or limited application of herbicides, may result in *less than significant* effects at the programmatic level to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. 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. In particular, collisions with new cell towers that may be installed as part of the Preferred Alternative could increase avian mortality. As stated above, these impacts would likely be limited to individual wildlife species. DOI comments dated October 11, 2016[149] state communication towers are "currently estimated to kill between four and five million birds per year" (Regulations.gov, 2016). Although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Therefore, impacts to birds may be *less than significant with BMPs and mitigation measures incorporated.*

[149] See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

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 than *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 the 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.

<u>Deployment Impacts</u>

As described above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Operational Impacts</u>

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts 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 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.

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 at the programmatic level as a result the No Action Alterantive. Environmental conditions would therefore be the same as those described in Section 7.1.6.4, Terrestrial Wildlife.

7.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Kentucky 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, 2012a).

Based on the impact significance criteria presented in Table 7.2.6-1, *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.

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.

Depending on the location, the construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location depending on the nature of the deployment activity. Therefore, potential impacts are expected to be *less than significant* at the programmatic level. 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* at the programmatic level due to the short-term nature and limited geographic scope of deployment activities. BMPs and mitigation measures to protect water resources (see Section 7.2.4, 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. 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* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are those considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are not anticipated, and therefore impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize any potential impacts.

Invasive Species Effects

FirstNet deployment activities could result in *less than significant* impacts to aquatic populations at the programmatic level due to introduction of invasive species. The potential to introduce invasive plant (and plant seeds) and pest species (e.g., invasive insects) within construction zones could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet deployment activities could result in short-term or temporary changes to specific project sites however, 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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to fisheries and aquatic habitats as a result of the introduction of invasive species. Should invasive species be found on a site, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented to minimize invasive species effects to fisheries and aquatic species.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result, at the programmatic level, 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to fisheries and aquatic habitats at the programmatic level under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibrations, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. 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 at the programmatic level because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have *no impact* on the aquatic environment at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential /deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could, if conducted near water resources that support fish, result in habitat loss, alteration, and fragmentation; indirect injury/mortality; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shores or the banks of water bodies that accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g., mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites (some fish). Disturbance, including noise and vibrations, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
- 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, 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions.

- o Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- o Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the 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 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 at the programmatic level 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 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 the 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.

<u>Deployment Impacts</u>

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 programmagic level 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.

Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. At the programmatic level, as with the Preferred Alternative, the impacts could vary greatly among species and geographic region but they are expected to remain *less than significant* despite this potential variability. Nonetheless, it is anticipated that there would be *less than significant* impacts at the programmatic level to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. 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 at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.6.5, Fisheries and Aquatic Habitats.

7.2.6.6. Threatened and Endangered Species

This section describes potential impacts to threatened and endangered species in Kentucky 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 7.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as *may affect*, *likely to adversely affect*; *may affect, not likely to adversely affect*; and *no effect*. These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* and are described in general terms below (USFWS, 1998):

- *No effect* means that no listed resources would be exposed to the action and its environmental consequences.
- *May affect, not likely to adversely affect* means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any *adverse effects* to the species or habitat. Insignificant effects relate to the size of the impact and include those effects that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those extremely unlikely to occur.

- *May affect, likely to adversely affect* means that listed resources are likely to be exposed to the action or its environmental consequences and would respond in a negative manner to the exposure.

At the programmatic level, 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 7.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under *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 Table 7.2.6-2, 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 to adversely affect* a listed species. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, fish, invertebrates, and plants with known occurrence in Kentucky 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 Kentucky; they are the gray bat, Indiana bat, northern long-eared bat, and Virginia 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, 2012a) (USFWS, 2015i). Direct mortality or injury to the federally listed gray bat or Virginia big-eared bat could occur if caves were flooded or blocked off while bats were present (USFWS, 1984a) (USFWS, 1997a). While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could lead to *adverse effects* to these species; when disturbed by noise, vibrations, 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*, listed bat 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>

One endangered bird species is federally listed and known to occur in the state of Kentucky, the least tern. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with man-made 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 bird species as FirstNet would attempt, as practicable and feasible, 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.

Reptiles and Amphibians

No federally listed reptiles or amphibians are known to occur in Kentucky. Therefore, no injury or mortality effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Fish

There are five endangered and one threatened fish species federally listed and known to occur in the state of Kentucky; they include the blackside dace, Cumberland darter, duskytail darter, palezone shiner, pallid sturgeon,, and relict darter. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action. Potential impacts *may affect, but are not likely to adversely affect*, listed fish 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

Twenty-one endangered and two threatened invertebrate species are federally listed and known to occur in the state of Kentucky as summarized in Table 7.1.6-6. There are 22 federally listed mollusk species and one federally listed cave shrimp species. FirstNet would attempt, as practical and feasible, to avoid areas where these species may occur.

The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to the mollusk species and cave shrimp species are unlikely but could occur from changes in water quality from ground disturbing activities resulting from the Proposed Action. Direct mortality or injury could occur to the terrestrial invertebrate species if land clearing or excavation activities associated with the Proposed Action occurs. Potential impacts *may affect, but are not likely to adversely affect*, the listed invertebrate 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

Five endangered, five threatened, and one proposed threatened plant species are federally listed and known to occur in the state of Kentucky as summarized in Table 7.1.6-7. Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt, as practicable and feasible, to avoid areas where these species may occur; therefore, potential impacts *may affect, but are not likely to adversely affect*, listed plant 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, terrestrial reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Kentucky are described below.

<u>Terrestrial Mammals</u>

Noise, vibrations, light, and other human disturbances associated with the Proposed Action could *adversely affect* federally listed terrestrial mammals within or in the vicinity of Project activities. For example, activities could cause the gray bat to abandon breeding locations. 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, as practicable and feasible, to avoid these areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed bat 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, vibrations, light, or other human disturbance within nesting areas could cause federally listed birds to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. 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). FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, the listed bird 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>Reptiles and Amphibians</u>

No federally listed reptiles or amphibians are known to occur in Kentucky. Therefore, no reproductive effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Fish

Deployment activities resulting in increased disturbance (e.g., humans, noise, vibrations), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 7.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to federally listed fish species in Kentucky are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt, as practicable and feasible, to avoid these areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed fish 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 could cause stress resulting in lower productivity for federally listed mollusks known to occur in Kentucky. In addition, introduction of invasive aquatic species could potentially affect mollusks as a result of fish populations that they rely on for their reproductive cycle being altered (Vaughn, 1997). Deployment activities are not expected to cause changes to water quality that could result in impacts. Potential impacts to federally listed invertebrate species *may affect, but are not likely to adversely affect*, those invertebrate species, as FirstNet would attempt, as practicable and feasible, 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 listed plant species as a result of the Proposed Action. However, FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, these plant species. No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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* at the programmatic level. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Kentucky are described below.

Terrestrial Mammals

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect breeding and foraging sites of the federally listed terrestrial mammals, resulting in reduced survival and productivity. However, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed terrestrial mammals. Ground disturbing activities could impact food sources for the federally listed terrestrial mammals in Kentucky. Further, increased human disturbance, noise, vibrations, and vehicle 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, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these mammal 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 least tern is a summer resident in Kentucky. Disturbance in stopover, foraging, or breeding areas (visual, vibrations, 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. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these bird 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.

Reptiles and Amphibians

No federally listed reptiles or amphibians are known to occur in Kentucky. Therefore, no behavioral effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Fish

Changes in water quality as a result of ground disturbing activities could impact food sources for the federally listed fish species in Kentucky. Further, increased human disturbance, noise and vibrations, 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 listed fish 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 mollusks and cave shrimp resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial invertebrate species, especially during the breeding season, foraging behavior. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these invertebrate 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 federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an *adverse effect* and could be *potentially significant*. Depending on the species or habitat, the *adverse effect* threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to *potentially significant adverse effects*, 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 Kentucky are described below.

Terrestrial Mammals

One federally listed mammal in Kentucky has a federally designated critical habitat. Critical habitat in Kentucky for the Indiana bat includes the Bat Cave, Carter County, and the Coach Cave, Edmonson County (42 FR 47840, September, 22, 1977). Seventy-five percent of this species hibernates in caves, therefore "loss or subjection to excessivet disturbance or modification [of their cave habitat] would lead to the near or total extinction of the species" (USFWS, 1976). FirstNet would attempt to avoid caves where the Indiana Bat is known to occur; therefore, at the programmatic level, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for the listed bat 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.

No critical habitat has been designated for other federally listed mammal species in Kentucky.

Birds

No designated critical habitat is designated for birds in Kentucky. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles and Amphibians

No designated critical habitat is designed for reptiles or amphibians in Kentucky. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Fish

One of the federally listed fish in Kentucky has federally designated critical habitat. Critical habitat for the Cumberland darter includes segments of Bunches Creek, Calf Pen Fork, Youngs Creek, Barren Fork, Indian Creek, Cogur Fork, Kilburn Fork, Laurel Fork, Laurel Creek, Elisha Branch, Jenneys Branch, Wolf Creek, Jellico Creek, Rock Creek, and Capuchin Creek.

The Cumberland darter is endemic to Kentucky and Tennessee, and all extant occurrences of the Cumberland darter are restricted to short stream reaches (typically less than one mile of stream) (76 FR 48722 48741, August 9, 2011). 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, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for the Cumberland darter. 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 three other federally listed fish species in Kentucky.

Invertebrates

Seven of the federally listed invertebrate species in Kentucky have federally designated critical habitat; however, only six of the seven species have critical habitat designated in the state. Critical habitat for the Cumberland elktoe has been designated in Rock Creek, Big South Fork and tributaries, Sinking Creek, Marsh Creek, and Laurel Fork. Critical habitat for the Cumberlandian combshell includes Big South Fork and Buck Creek. Critical habitat for the fluted kidneyshell consists of segments of Horse Link Creek, Middle Fork Rockcastle River, Rockcastle River, Buck Creek, Rock Creek, Little South Fork Cumberland River, and Big South Fork Cumberland River. Critical habitat for the Kentucky cave shrimp consists for this species consists of a segment of the Roaring River within Mammoth Cave National Park. Critical habitat for the oyster mussel consists of segments of Big South Fork and Buck Creek. Critical habitat for the rabbitsfoot is located along three rivers, including the Tennessee River in McCracken and Livingston Counties; the Ohio River in McCracken and Ballard Counties; and the Green River in Edmonson, Green, Hart, and Taylor Counties. Critical habitat for the slabside pearlymussel is in Virginia, Tennessee, Alabama, and Mississippi per (78 FR 59555 59620, September 26, 2013); no critical habitat is designated for this species in Kentucky.

Land clearing, excavation activities, and other ground disturbing activities in these regions of Kentucky 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, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for the listed invertebrate 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.

No critical habitat has been designated for the 17 other federally listed invertebrate species in Kentucky.

<u>Plants</u>

Three of the federally listed plant species in Kentucky have federally designated critical habitat. Critical habitat for the Braun's rock-cress was designated at seventeen locations in Franklin County and Owen County. Critical habitat for the Kentucky glade cress was designated as six units in Jefferson and Bullitt Counties were designated as critical habitat for this species. Critical habitat for the Short's bladderpod was designated in Franklin, Clark, and Woodford Counties.

Land clearing, excavation activities, and other ground disturbing activities in this region of Kentucky could lead to habitat loss or degradation, which could affect these plants depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for the listed plant 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.

No critical habitat has been designated for other federally listed plant species in Kentucky.

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, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. 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>Activities Likely to Have No Effect at the Programmatic Level</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no effect* on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibrations, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to threatened and endangered species or their habitat at the programmatic level because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, and the use of portable devices that use satellite technology would have *no effect* on threatened and endangered if those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to affect protected species, it is anticipated that this activity would have *no effect* on protected species.

<u>Activities with the Potential to Affect Listed Species at the Programmatic Level</u>

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., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise and vibrations, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - 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 and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shores or the banks of water bodies that accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 7.2.4, 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 at the programmatic level. 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, effects would be similar to new wireless construction. Hazards related to security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. 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 generations are used, noise and vibration disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but are not likely adversely affect* protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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 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, as practicable and feasible, to avoid areas where these species are known to occur. Therefore, listed species may be affected, but are *not likely to be adversely affected*. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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* 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, as practicable and feasible, to avoid 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. 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, as practicable and feasible, to avoid 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 as a result of routine operations, management, and monitoring. FirstNet would attempt, as practicable and feasible, to avoid 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 effects* to threatened and endangered species at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.6.6, Threatened and Endangered Species and Species of Concern.

7.2.7. Land Use, Recreation, and Airspace

7.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Kentucky 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.

7.2.7.2. 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 7.2.7-1. As described in Section 7.2.1, Environmental Consequences Infrastructure, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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.

7.2.7.3. 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 7.2.7-1, *less than significant* impacts at the programmatic level 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.

Table 7.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is *potentially significant,* but with mitigation is *less than significant*.	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is *potentially significant,* but with mitigation is *less than significant*.	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation 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, vibration, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is *potentially significant,* but with mitigation is *less than significant*.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation 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

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 7.2.7-1, *less than significant* impacts at the programmatic level 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 above ground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 7.2.7-1*, less than significant* impacts at the programmatic level 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 above ground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise and vibration impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 7.2.7-1, *less than significant* impacts at the programmatic level 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 7.2.7-1, 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, FirstNet is expected o have a *less than significant* impact on airspace resources at the programmatic level.

7.2.7.4. 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, at the programmatic level, 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* at the programmatic level 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.

- Airspace: *No impacts* at the programmatic level to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace.

- Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
  - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
  - Recreation: See *Activities with the Potential to Have Impacts* below.
  - Airspace: It is anticipated that there would be *no impacts* at the programmatic level to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (see Section 7.1.7.5 Obstructions to Airspace Considerations).
- New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
  - Land Use: See *Activities with the Potential to Have Impacts* below.
  - Recreation: See *Activities with the Potential to Have Impacts* below.
  - Airspace: Installation of new poles would have *no impact* at the programmatic level 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* at the programmatic level 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* at the programmatic level 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* at the programmatic level 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* at the programmatic level 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* at the programmatic level recreation because it would not impede access to recreation resources
  - Airspace: Lighting of dark fiber would have *no impacts* at the programmatic level to airspace.

- New Build – Submarine Fiber Optic Plant: Installing cables in or near bodies of water and the constructing landings and/or facilities on shores or the banks of water bodies that accept 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* at the programmatic level flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace (see Section 7.1.7.5 Obstructions to Airspace Considerations).
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
  - Land Use: If installation of transmission equipment would occur in existing boxes or huts there would be *no impacts* at the programmatic level to existing and surrounding land uses. If installation of transmission equipment in new boxes or huts, see *Activities with the Potential to Have Impacts* below.
  - Recreation: If installation of transmission equipment would occur in existing boxes or shelters there would be *no impacts* at the programmatic level to recreation. If installation of transmission equipment in new boxes or huts, see *Activities with the Potential to Have Impacts* below.
  - Airspace: *No impacts* at the programmatic level 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
    - Land Use: There would be *no impacts* at the programmatic level 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* at the programmatic level to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.

        - Recreation: *No impacts* at the programmatic level to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
        - Airspace: See *Activities with the Potential to Have Impacts* below.
- 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* at the programmatic level 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* at the programmatic level 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 have *no impact* at the programmatic level 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 at the programmatic level 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 at the Programmatic Level

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
    - 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* at the programmatic level 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* at the programmatic level are anticipated- see previous section.
- New Build – Submarine Fiber Optic Plant: Installing cables in or near bodies of water and the constructing landings and/or facilities on 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* at the programmatic level 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* at the programmatic level 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 Kentucky'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* at the programmatic level 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* at the programmatic level are anticipated – see previous section.
    - Recreation: *No impacts* at the programmatic level are anticipated – see previous section.
    - Airspace: Implementation of Deployable Aerial Communications Architecture 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 Kentucky 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* at the programmatic level would are anticipated.
    - 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 obstruction. 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 partners), 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 temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands.

The degree of change in the visual environment (see Section 7.2.8, 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.

7.2.7.5. 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 at the programmatic level to land use. While a single deployable technology may imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be *less than significant* at the programmatic level due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 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 impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 7.1.7, Land Use, Recreation, and Airspace.

7.2.8. Visual Resources

7.2.8.1. Introduction

This section describes potential impacts to visual resources in Kentucky 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.

7.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 7.2.8-1. As described in Section 7.2.1 Environmental Consequences Infrastructure, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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 7.2.8-1: Impact Significance Rating Criteria for Visual Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is *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.

7.2.8.3. 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 Kentucky, residents and visitors travel to many national monuments, historic sites, and state parks, such as Fire Island to view its scenic coast and beaches. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. 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 7.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered *potentially significant* if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. The majority of FirstNet deployment activities would not cause negative impacts to the aesthetic character to a noticeable degree. However, some projects, such a towers, facilities, or infrastructure could cause a negative impact on the aesthetic character of local viewsheds depending on their size and location. However, given the small scale of likely FirstNet activities, impacts are expected to be *less than significant* at the programmatic level.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects could be considered *potentially significant* at the programmatic level.

Based on the impact significance criteria presented in Table 7.2.8-1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term could be considered *potentially significant* at the programmatic level. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience *potentially significant* impacts to night skies, although, at the programmatic level, 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.

7.2.8.4. 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, at the programmatic level, in a range of *no impacts* to *less than significant impacts with BMPs and mitigation measures incorporated* 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* at the programmatic level 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 and would result in *no impacts* to visual resources at the programmatic level.
    - 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* at the programmatic level 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* at the programmatic level on visual resources because there would be no ground disturbance, and 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 have *no impact* at the programmatic level to visual resources as long as 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 could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have *no impact* at the programmatic level on visual resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - 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* at the programmatic level to visual resources. The degree of impact would depend on the timing and location of the project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact at the programmatic level 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* at the programmatic level to visual resources could occur but effects would be highly 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 at the programmatic level 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* at the programmatic level to visual resources. However, if additional power units, structural hardening, and physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in *potential impacts* at the programmatic level to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal or areas of surface disturbance or additional nighttime lighting.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. 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.

7.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.[150]

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* at the programmatic level 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

[150] 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* at the programmatic level to visual resources as a result of the No Action Alterantive. Environmental conditions would therefore be the same as those described in Section 7.1.8, Visual Resources.

7.2.9. Socioeconomics

7.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Kentucky 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.

7.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 7.2.9-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

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 7.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level

<table>
<tr><th rowspan="2">Type of Effect</th><th rowspan="2">Effect Characteristics</th><th colspan="4">Impact at the Programmatic 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">Impacts to real estate (could be positive or negative)</td><td>Magnitude or Intensity</td><td>Changes in property values and/or rental fees, constituting a significant market shift.</td><td rowspan="3">Effect that is potentially significant, but with mitigation is less than significant.</td><td>Indiscernible impact to property values and/or rental fees.</td><td>No impacts to real estate in the form of changes to property values or rental fees.</td></tr>
<tr><td>Geographic Extent</td><td>Regional impacts observed throughout the state/territory.</td><td>Effects realized at one or multiple isolated locations as opposed to throughout the state or territory.</td><td>NA</td></tr>
<tr><td>Duration or Frequency</td><td>Persists during the life of the project.</td><td>Persists for as long as the entire construction phase or a portion of the operations phase.</td><td>NA</td></tr>
<tr><td rowspan="3">Changes to spending, income, industries, and public revenues</td><td>Magnitude or Intensity</td><td>Economic change that constitutes a market shift.</td><td rowspan="3">Effect that is potentially significant, but with mitigation is less than significant.</td><td>Indiscernible economic change.</td><td>No change to tax revenues, wages, major industries, or direct spending.</td></tr>
<tr><td>Geographic Extent</td><td>Regional impacts observed throughout the state/ territory.</td><td>Effects realized at one or multiple isolated cities/towns as opposed to throughout the state or territory..</td><td>NA</td></tr>
<tr><td>Duration or Frequency</td><td>Persists during or beyond the life of the project.</td><td>Persists for as long as the entire construction phase or a portion of the operations phase.</td><td>NA</td></tr>
</table>

Type of Effect	Effect Characteristics	Impact at the Programmatic Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
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 as opposed to throughout the state or 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
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 as opposed to throughout the state or 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

NA = Not Applicable

7.2.9.3. 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 Section 7.1.9, Socioeconomics, property values vary across Kentucky. Median values of owner-occupied housing units in the 2009–2013 period ranged from nearly $164,000 in the greater Lexington-Fayette area, to just over $90,000 in the Kentucky portion of the Huntington area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, *may adversely affect* property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing *no effect* beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, *may affect* property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and partners make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and *less than significant* at the programmatic level. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment could be a minor, is a direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage-earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and *less than significant* at the programmatic level. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary considerably across Kentucky. The average unemployment rate in 2014 was 6.5 percent, slightly higher than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were concentrated in the north-central portion of the state, but also distributed through the western portion of the state. The lowest unemployment rates were in the eastern third 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 7.2.9-1 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.

7.2.9.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because they represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 7.2.9-1. 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 at the Programmatic Level

- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have *no impact* on socioeconomic resources at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below 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* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be

small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- o Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- o New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- o Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- o New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- o New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- Wireless Projects
  - o New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, 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* at the programmatic level.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, 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* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - o Deployable Technologies: COWs, COLTs, and SOWs, aerial deployable technologies and piloted aircraft require storage, staging, and (for aerial deployables or piloted aircraft) 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 vibrations, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be *less than significant* at the programmatic level.
- Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- 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* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

In general, the abovementioned activities would have *less than significant* beneficial socioeconomic impacts 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* at the programmatic level.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a *less than significant* number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be *less than significant* at the programmatic level as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and Kentucky. These impacts, if they occur, would be *less than significant* at the programmatic level as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and Kentucky. 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.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.

7.2.9.5. 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, vibrations, and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be *less than significant* at the programmatic level as they would be limited to a relatively small number of sites within the region and Kentucky. 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 at the programmatic level from the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 7.1.9, Socioeconomics.

7.2.10. Environmental Justice

7.2.10.1. Introduction

This section describes potential impacts to environmental justice in Kentucky 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.

7.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 7.2.10-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

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 7.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level

Type of Effect	Effect Characteristics	Impact at the Programmatic 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 as opposed to throughout the state or territory.	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

7.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment" (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise and Vibrations, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, vibrations, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, 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 Indians 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 7.2.9).

Environmental justice populations are often highly localized. 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 7.1.10.4) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 7.1.10.3, Environmental Setting: Minority and Low-Income Populations, Kentucky's population has considerably lower percentages of minorities than the region or the nation. The state's poverty rate is similar to that of the South region and considerably higher than that of the nation. Kentucky has many areas with high potential for environmental justice populations. The distribution of these high potential areas is particularly prevalent in the eastern third of the state and fairly even across the remainder of the state. These areas occur both within and outside of the 10 largest population concentrations. This includes some of the state's most sparsely populated areas, such as southeastern parts of the state. Further analysis using the data developed for the screening analysis in Section 7.1.10.4, 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, 2015e; USEPA, 2016e).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "*Activities with the Potential to Have Impacts*" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

7.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result, at the programmatic level, 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to environmental justice communities, at the programmatic level, 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 communities, at the programmatic level. 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 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 environmental justice, it is anticipated that this activity would have *no impact* on environmental justice communities, at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, vibrations, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise, vibrations, and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
    - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise, viobrations, 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, vibrations, 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, vibrations, 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, vibrations, 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, aerial deployable technologies and piloted aircraft require storage, staging, and (for aerial deployables or piloted aircraft) launch and landing areas. To the extent such areas require new construction, noise, vibrations, and dust could be temporarily generated, and traffic could be disrupted. If

these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, vibrations, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be *less than significant* at the programmatic level, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. Furthermore, site-specific analysis could evaluate site conditions and the impacts of the type of deployment, and could satisfy requirements associated with any other permits or permissions necessary to perform the work. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. Chapter 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. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise,vibrations, and dust) and their duration would be very short. Routine maintenance and inspection would *not adversely affect* property values, for the same reasons.

Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be *less than significant* at the programmatic level 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.

7.2.10.5. 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 and piloted aircraft, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, vibrations, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level because they would be temporary in nature. Chapter 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 vibrations, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level as operations are expected to be temporary in nature. Chapter 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 communities, at the programmatic level, as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.10, Environmental Justice.

7.2.11. Cultural Resources

7.2.11.1. Introduction

This section describes potential impacts to cultural resources in Kentucky 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.

7.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 7.2.11-1. The categories of impacts are defined at the programmatic level as an *adverse effect; mitigated adverse effect; effect, but not adverse;* and *no effect*. These impact categories are comparable to those defined in *36 CFR § 800*, Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (NPS, 1983) and the United States (U.S.) National Park Service's *National Register Bulletin: How to Apply the National Register Criteria for Evaluation* (NPS, 2002). Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

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

7.2.11.3. 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 7.2.11-1, at the programmatic level, direct deployment impacts could have potentially *adverse effects* if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout Kentucky, some deployment activities may be in these areas, in which case BMPs (see Chapter 16) would help avoid or minimize the potential impacts.

Table 7.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	**Mitigated Adverse Effect[a]**	**Effect, but not Adverse**	**No Effect**
Physical damage to and/or destruction of historic properties[b]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	*Adverse effect* that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	*No direct effects* to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	*No direct effects* to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	*Adverse effect* that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	*No indirect effects* to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	*No indirect effects* to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	*Adverse effect* that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	*No direct or indirect effects* to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.
	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.

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect[a]	Effect, but not Adverse	No Effect
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	*Adverse effect* that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[a] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Measures Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including American Indian 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 and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially *adverse effects* from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. *Adverse effects* such as these could be avoided or minimized through BMPs (see Chapter 16).

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 minimize deployment activities that would cause such loss of access.

7.2.11.4. Potential Effects of the Preferred Alternative

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

Deployment Effects

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result, at the programmatic level, in a range of *no effects* to potentially *adverse effects* 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 Effect at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no effect* on cultural resources, at the programmatic level, 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 effects* on cultural resources at the programmatic level 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 effects* on cultural resources at the programmatic level. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have *no impacts* to cultural resources because there would be no ground disturbance and no perceptible visual changes. The section below addresses potential effects on cultural resources at the programmatic level if deployment of new 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 have *no effect* on cultural resources at the programmatic level because those activities would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have *no effect* on cultural resources at the programmatic level.

Activities with the Potential to Have Effects at the Programmatic Level

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects on cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential effects on cultural resources at the programmatic level. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities,

and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.

- New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could effect cultural resources at the programmatic level, as areas of Kentucky where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Effects to cultural resources could also potentially occur at the programmatic level as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept submarine cable, which 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 would occur in existing boxes or huts and require no ground disturbance, there would be *no effect* on cultural resources. However, there could be potentially *adverse effects* on cultural resources if installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
- Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could have effects on historic properties at the programmatic level. 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 Lexington and Louisville—that have larger numbers of historic public buildings.

- o Deployable Technologies: Implementation of deployable technologies could result in potential effects on cultural resources at the programmatic level if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, effects on historic properties could occur at the programmatic level if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect effects.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. At the programmatic level, potential effects on cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect effects including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could *affect, but not adversely affect*, cultural resources as the potential *adverse effects* would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. 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 Effects

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in effects similar to the abovementioned deployment effects. It is anticipated that there would be *no effects* to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential effects would be associated with ground disturbance or modifications of properties, however, due to the small-scale of expected activities, these actions could affect but would *not likely adversely affect*, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 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.

7.2.11.5. Alternatives Effect Assessment

The following section assesses potential effects on cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

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

Deployment Effects at the Programmatic Level

As explained above, implementation of deployable technologies could have an effect on cultural resources at the programmatic level if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could *affect, but not adversely affect*, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. 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 Effects at the Programmatic Level

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but *no adverse effects* to historic properties associated with implementation/running of the deployable technology. *No adverse effects* would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be *no effects* on 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effects* on cultural resources at the programmatic level as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 7.1.11, Cultural Resources.

7.2.12. Air Quality

7.2.12.1. Introduction

This section describes potential impacts to Kentucky's air quality from deployment and operation of the Proposed Action and Alternatives. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to air quality. Implementation of best management practices (BMPs), as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

7.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Kentucky's air quality were evaluated using the significance criteria presented in Table 7.2.12-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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 Kentucky's air quality addressed in this section are presented as a range of possible impacts.

Table 7.2.12-1: Impact Significance Rating Criteria for Air Quality at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased air emissions	Magnitude or Intensity	Emissions would prevent progress toward meeting one or more NAAQS in nonattainment areas. Emissions in attainment or maintenance areas would cause an exceedance for any NAAQS. Emissions exceed one or more major source permitting thresholds. Projects do not conform to SIP.	Effect that is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Negligible emissions would occur for any pollutant within an attainment area, but would not cause a NAAQS exceedance and would not trigger major source permitting.	Emission increases would be infrequent or absent, mostly immeasurable; projects conform to SIP.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = Not Applicable

7.2.12.3. Description of Environmental Concerns

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be above and beyond what is typically generated in a given area and may alter ambient air quality. Deployment activities may involve the use of vehicles, heavy equipment, and other equipment that could emit exhaust and create fugitive dust in localized areas. During operations, routine maintenance and other use of generators at tower facilities may emit exhaust for specific durations (maintenance) or unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be *less than significant* at the programmatic level due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Kentucky that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 7.1.12, Air Quality, and Table 7.1.12-3). The majority of the counties in Kentucky are not designated as maintenance areas for pollutants. Ten counties are designated for one or more of the following pollutants: PM, SO_2, and ozone (Table 7.1.12-6); six counties located in the northern portion of the state are designated nonattainment or maintenance for two or more NAAQS pollutants (Figure 7.1.12-1).

Based on the significance criteria presented in Table 7.2.12-1, air emission impacts would likely be *less than significant* at the programmatic level given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. *Less than significant* emissions could occur at the programmatic level for any of the criteria pollutants within attainment areas in Kentucky; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Kentucky (Table 7.1.12-6), and because infrastructure could be deployed in these areas, BMPs and mitigation measures (see Chapter 16, BMPs and Mitigation Measures) could help avoid or minimize potential air quality impacts. In addition, it is anticipated that any air pollution increase due to deployment would likely be short-term with pre-existing air quality levels generally achieved after some months (typically less than a year, and could be as short as a few hours or days for some activities such as pole construction).

7.2.12.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

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

Potential Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to air quality at the programmatic level 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* at the programmatic level on ambient air quality concentrations.
    - 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 air quality, it is anticipated that this activity would have *no impact* on air quality at the programmatic level.

Activities with Potential Impacts at the Programmatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be *less than significant* at the programmatic level due to the shorter duration and localized nature of the activities. The types of infrastructure 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 or near bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of water bodies that accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.

- Deployable Technologies
  - The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be *less than significant* 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.

Potential 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 at the programmatic level to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, 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.

7.2.12.5. 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 or piloted aircraft. 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:

Potential 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 at the programmatic level. 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.

7.2.13. Noise and Vibration

7.2.13.1. Introduction

This section describes potential noise and vibration impacts from construction, deployment, and operation of the Proposed Action and alternatives in Kentucky. 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.

7.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise and vibration impacts of the Proposed Action were evaluated using the significance criteria presented in Table 7.2.13-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential noise and vibration impacts to Kentucky addressed in this section are presented as a range of possible impacts.

7.2.13.3. Description of Environmental Concerns

Increased Noise and Vibration Levels

The Proposed Action has the potential to generate noise and vibrations during construction and operation of various equipment used for deployment. These noise and vibration levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise and vibrations could cause impacts on residential areas, or other facilities that are sensitive to noise and vibrations, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 7.1.13, Noise and Vibrations).

Based on the significance criteria presented in Table 7.2.13-1, noise and vibration impacts would likely be *less than significant* at the programmatic level given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise and vibration sources be deployed/operated long-term in the same area. Noise and vibration levels from deployment activities are not expected to exceed typical noise and vibration levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise and vibration effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise and vibration -sensitive receptors. However, given that much of the construction and operation of the Proposed Action would often occur in populated areas, FirstNet may not be able to completely avoid noise or vibration impacts.

Table 7.2.13-1: Impact Significance Rating Criteria for Noise and Vibrations at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise and vibration levels	Magnitude or Intensity	Noise and vibration levels would exceed typical noise and vibration 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 and vibration levels from construction equipment or generators.	Natural sounds would prevail. Noise and vibrations generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

dBA = A-weighted decibel(s); VdB = vibration decibel(s)

7.2.13.4. 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, at the programmatic level, in potential noise and vibration impacts and while others would not.

In addition, the same type of Proposed Action Infrastructure could result, at the programmatic level, 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 at the Programmatic Level

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibrations generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise or vibration impacts at the programmatic level.
- Wireless Projects
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise and vibrations generated. For example, balloons are expected to have minimal to *no impact* on the noise environment at the programmatic level.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise and vibrations would be emitted during installment of this equipment. Noise and vibrations caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. At the programmatic level, deployment and operation of satellite-enabled devices and

equipment are expected to have minimal to *no impact* on the noise or vibration-sensitive resources at the programmatic level.

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

Activities with the Potential for Noise and Vibration Impacts at the Programmatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could create noise and vibration impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to noise and vibration include the following:

- Wired Projects
  - o New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise and vibrations levels from the use of heavy equipment and machinery.
  - o New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise and vibrations levels from the use of vehicles and machinery.
  - o Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise and vibrations levels from the use of heavy equipment and machinery.
  - o Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels, and vibrations, if the activity required the use of heavy equipment for grading or other purposes.
  - o New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate noise and vibrations if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in short-term and temporarily increased noise and vibration levels to local residents and other noise- and vibration-sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - o Installation of Optical Transmission or Centralized Transmission Equipment: Noise and vibration 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 from optical networks is relatively low, and vibration impacts would not occur. Heavy equipment used to grade and construct access roads could generate increased levels of noise and vibrations 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 and vibrations. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise and vibrations 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 onsites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact local noise sensitive resources temporarily. Vibration impacts are expected to be negligible.
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise and vibrations generated. For example, mobile equipment deployed via heavy trucks could generate noise and vibrations from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise and vibrations during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise and vibration-sensitive resources.

In general, noise and vibrations from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. These impacts are expected to be *less than significant* at the programmatic level due to the temporary duration of deployment activities. Additionally, pre-existing noise and vibrations levels would be achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 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 and vibrations. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise and vibration impacts could result as explained above. Chapter 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.

7.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise and vibration impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment and piloted aircraft. 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 and vibration impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise and vibrations from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise and vibration levels. Several vehicles traveling together could also create short-term noise and vibration impacts on residences or other noise- and vibration-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 and vibration impact if they are required to fly above residential areas, areas with a high concentration of noise- and vibration-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 and vibrations in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise and vibration impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise and vibration impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate *less than significant* short-term impacts at the programmatic level on any residential areas or other noise and vibration-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise and vibration levels would quickly return to baseline levels. 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 or vibrations at the programmatic level. By not deploying the NPSBN, FirstNet would avoid generating noise and vibrations from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

7.2.14. Climate Change

7.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable FirstNet installations and infrastructure in Kentucky 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.

7.2.14.2. 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 7.2.14-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with BMPs and mitigation measures 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, 2016).

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, 2016). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

Table 7.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	See discussion below in Section 7.2.14.5, Potential Impacts of the Preferred Alternative	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.	NA
	Duration or Frequency			Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is *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

7.2.14.3. Projected Future Climate

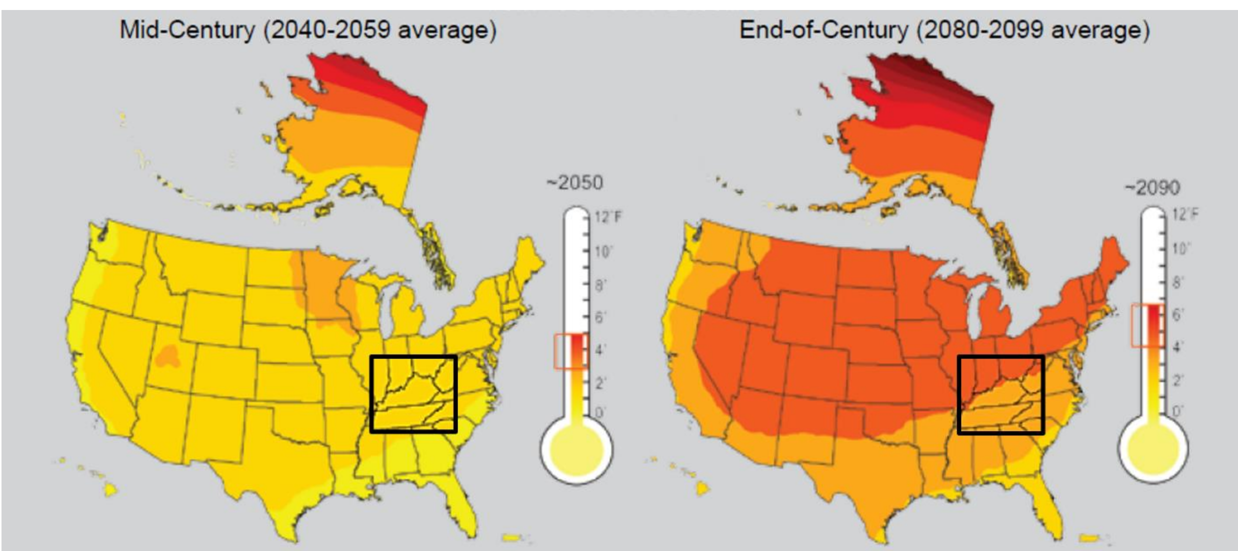
There have been increasing numbers of days above 95°F and nights above 75°F, and decreasing numbers of extremely cold days since 1970 in the southeast. Temperatures across this section of the United States are expected to increase during this century. Major consequences of warming include significant increases in the number of hot days, defined as 95°F or above, and decreases in freezing events. (USGCRP, 2014a)

Air Temperature

Figure 7.2.14-1 and Figure 7.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Kentucky from a 1969 to 1971 baseline.

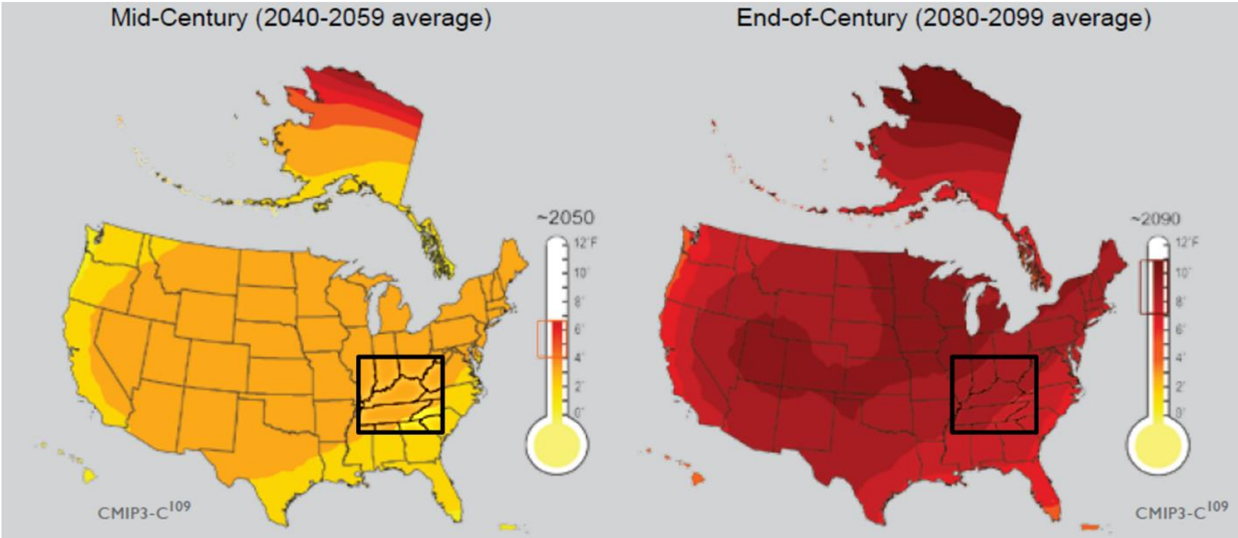
Cfa – Figure 7.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Kentucky under a low emissions scenario would increase by approximately 4°F. By the end of the century (2080 to 2099) under a low emissions scenario temperatures in the majority of Kentucky temperatures are projected to increase by approximately 5°F while a small portion along the northern border of the states is expected to increase by 6°F. (USGCRP, 2009)

Figure 7.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5°F. Under a high emissions scenario for the period (2080 to 2099) in the Cfa region of Kentucky, temperatures would increase by approximately 9°F in the majority of the state while the southeastern corner is expected to have an 8°F temperature increase. (USGCRP, 2009)



Source: (USGCRP, 2009)

Figure 7.2.14-1: Kentucky Low Emission Scenario Projected Temperature Change



Source: (USGCRP, 2009)

Figure 7.2.14-2: Kentucky High Emission Scenario Projected Temperature Change

Precipitation

Predicting future precipitation patterns in the southeast are much less certain that projections for temperature. The southeast is located in the transition zone between projected wetter conditions to the north and drier conditions to the southwest, therefore, many of the model projections show only small changes relative to natural variations. However, many models do project drier conditions in the far southwest portion of the region and wetter conditions in the far northeast portion of the region. (USGCRP, 2014a)

Total seasonal snowfall has generally decreased in southern and some western areas although snow is melting earlier in the year and more precipitation is falling as rain versus snow. Overall snow cover has decreased in the Northern Hemisphere, due in part to higher temperatures that shorten the time snow spends on the ground. (USGCRP, 2014b)

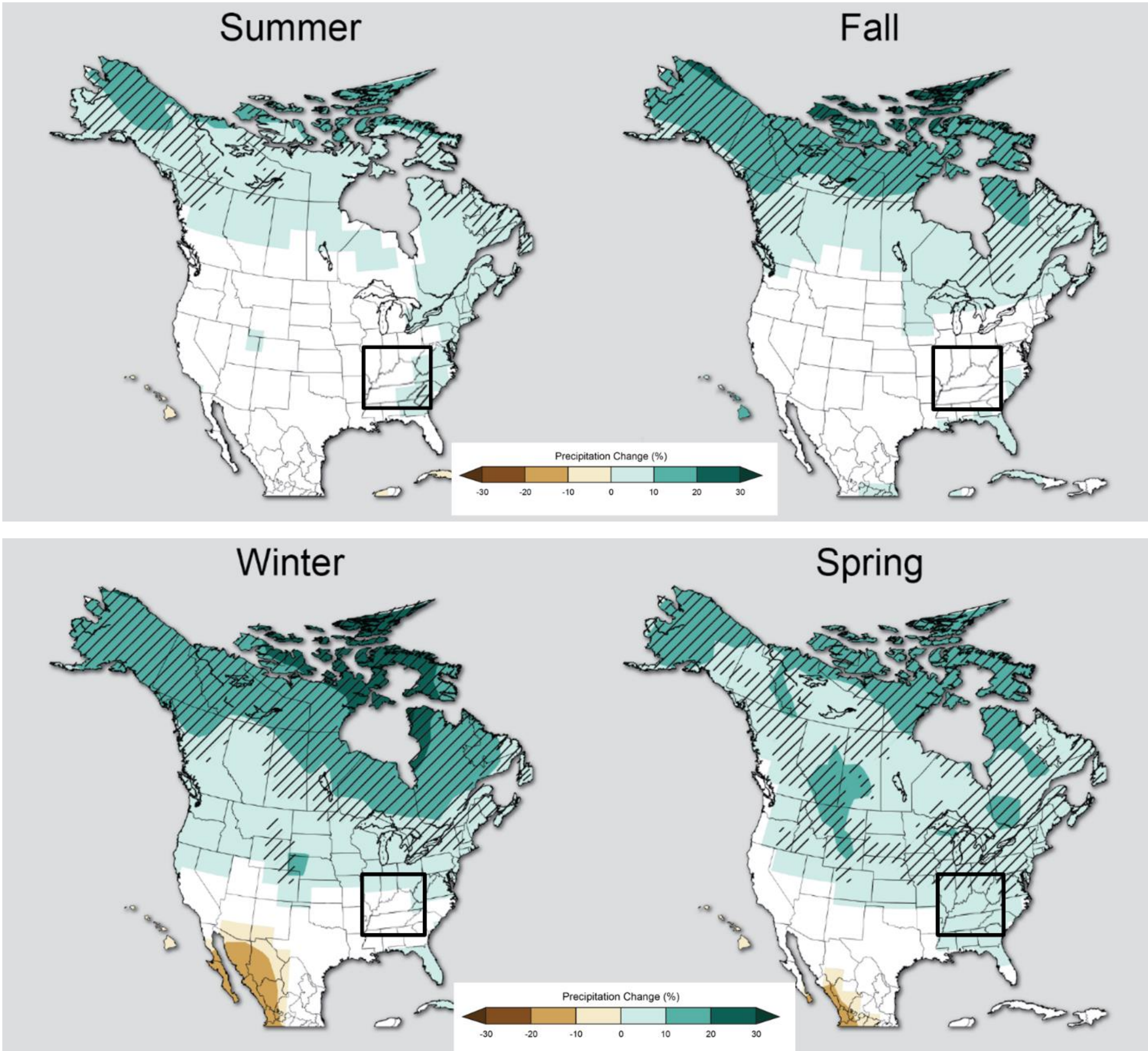
In the majority of Kentucky, there is an expected increase of about 10 percent in the number of consecutive dry days under a low emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario in the majority of the state there is a projected increase of about 20 percent in the number of consecutive dry days. An increase in consecutive dry days could lead to drought. (USGCRP, 2014c)

Figure 7.2.14-3 and Figure 7.2.14-4 show predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline. Figure 7.2.14-3 show seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions means more than 70 percent cuts from current levels by 2050. (USGCRP, 2014c)

Figure 7.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014c)

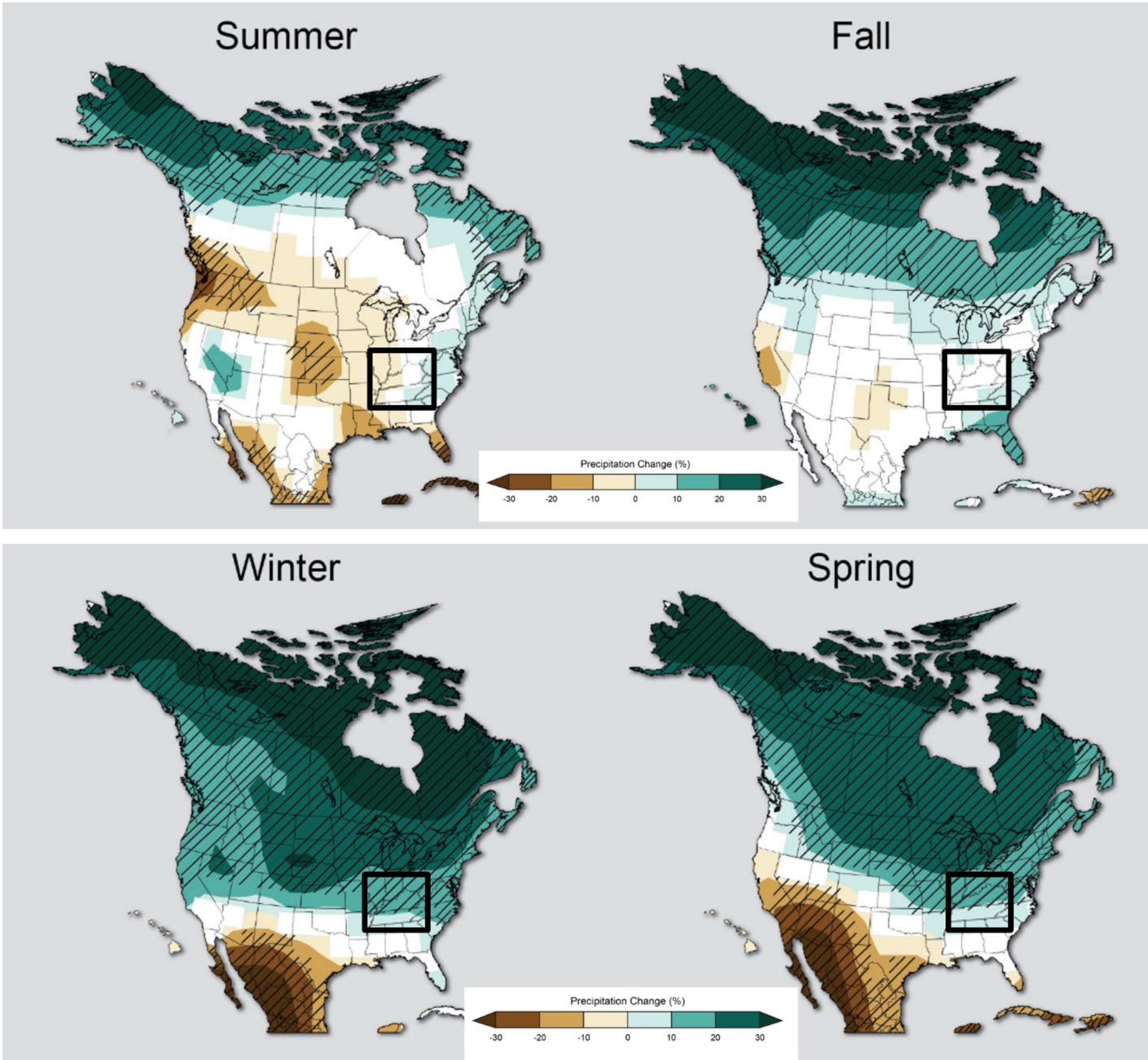
Cfa - Figure 7.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation in winter and summer would increase by 10 percent in the eastern corner of the state while the remainder of this region is not expected to have any changes to precipitation during these two seasons. Spring precipitation is expected to increase 10 percent. However, there are no expected changes in precipitation in fall other than fluctuations due to natural variability. (USGCRP, 2014c)

Figure 7.2.14-4 shows that if emissions continue to increase, winter precipitation could increase as much as 20 percent over the period 2071 to 2099. In spring, precipitation in this scenario is expected to increase as much as 20 percent in the majority of the state while a small portion of the southern border is expected to increase 10 percent. Summer precipitation is expected to decrease 10 percent, remain constant, and increase 10 percent, which changes moving west to east respectively. No significant change to fall precipitation is anticipated over the same period. (USGCRP, 2014c)



Source: (USGCRP, 2014c)

Figure 7.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario



Source: (USGCRP, 2014c)

Figure 7.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as winter storms and thunderstorms. Trends in thunderstorms are subject to greater uncertainties than trends in temperature and associated variables directly related to temperature such as sea level rise. Climate scientists are studying the influences of climate change on severe storms. Recent research has yielded insights into the connections between warming and factors that cause severe storms. For example, atmospheric instability and increases in wind speed with altitude link warming with tornadoes and thunderstorms. Additionally, research has found a link between warming and conditions favorable for severe thunderstorms. However, more research is required to make definitive links between severe weather events and climate change. (USGCRP, 2014d)

7.2.14.4. 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 7.2.14-1, climate change impacts as a result of GHG emissions could be significant at the programmatic level and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

Climate Change

Climate change may increase project-related impacts by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. Because parts of Kentucky are expected to experience increases in extreme heat during the summer (USGCRP, 2014c), there may be observed impacts to public health during these periods, including increased morbidity and mortality in urban areas such as Louisville, which has already measured a 0.5°F increase in average temperature per decade, and has one of the fastest-growing urban heat islands in the U.S. (City of Louisville, 2016). Forested areas of the Southeast, including Kentucky, may be at a higher risk of wildland fires, particularly during the periods of extended heat and drought that are forecasted under warming scenarios (Mitchell, 2014).

Climate change impacts on FirstNet installations and infrastructure will vary from state to state, depending on the placement and vulnerability of the installations and infrastructure, and the impacts that climate change is anticipated to have in that particular location. Based on the impact significance criteria presented in Table 7.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities. Winter and spring precipitation is projected to increase in Kentucky, and the frequency of heavy downpours is projected to continue to increase as the century progresses, which in turn may increase the potential for flash floods (USGCRP, 2014c). A large portion of Kentucky is expected to experience increases in extreme heat during the summer (USGCRP, 2014c), extended periods of extreme heat may impede the operation of the grid and overwhelm the equipment needed to keep microwave and other transmitters cool (DOE, 2015a).

7.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

Given this assessment is programmatic and does not include any site-specific locations or deployment technology, it is impossible to determine the actual GHG emissions associated with any of the action alternatives. This information could only be captured once the site-specific information is determined. However, an assessment of potential impacts is provided in this section based on the potential emissions associated with the various activities that could occur as a result of the implementation of the Preferred in Kentucky, 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, at the programmatic level, in a range of *no impacts to less than significant impacts with BMPs and mitigation measures incorporated* depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* at the programmatic level 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 these activities.

Activities with the Potential to Have Impacts at the Programmatic Level

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wired Projects
  - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
  - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
  - Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
  - New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
  - Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and 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 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 if operated in large numbers over the long-term. However this would be highly dependent on their size, number, and the frequency and duration of their use.
  - Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of piloted or unmanned aircraft were used for a sustained period (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. These emissions would arise from the combustion of fuel used by equipment during construction and operation. The total potential level of GHG emissions would be *less than significant*; although geographically large (all 50 states and five territories, and the District of Columbia) any one site would be limited in extent and emit minor levels of GHG emissions as explained in the analysis. Land use related 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.

7.2.14.6. 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 a *less than significant* impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be *less than significant* at the programmatic level 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.

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. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to *no impact* at the programmatic level on the deployed technology due to the temporary nature of deployment. 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, at the programmatic level, there would be *no impacts* to GHG emissions or climate as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.14, Climate Change.

7.2.15. Human Health and Safety

7.2.15.1. Introduction

This section describes potential impacts to human health and safety in Kentucky 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.

7.2.15.2. 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 7.2.15-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, *as potentially significant, less than significant with BMPs and mitigation measures 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. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

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 7.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level

Type of Effect	Effect Characteristics	Impact at the Programmatic Level: Potentially Significant	Impact at the Programmatic Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact at the Programmatic Level: Less than Significant	Impact at the Programmatic Level: No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect that 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 as opposed to throughout the state or territory..	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact at the Programmatic 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 that 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 as opposed to throughout the state or territory..	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	**Effect Characteristics**	**Impact at the Programmatic Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Man-Made Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect that 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 as opposed to throughout the state or territory..	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

7.2.15.3. 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 7.2.15-1, 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 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, 2016d).

1. Engineering controls;
2. Work practice controls;
3. Administrative controls; and
4. Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes[151], 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.

[151] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents (OSHA, 2016e).

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of employer specific workplace rules and operational practices (OSHA, 2016d). 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, 2016d). 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>State Plan (private, state, and local)</u> - The Kentucky Occupational Safety and Health (Kentucky OSH) is authorized by OSHA to administer the state program which oversees employee safety in all state and local government and private sector workplaces. The FirstNet proposed action and site work will not be performed by state or local employees. The involvement of state and local employees will be limited to emergency responders (e.g., police, fire, emergency medical transporters, etc.) and local government permitting authorities.

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 7.2.15-1, 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 KDEP, 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, Superfund, and applicable Kentucky 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 Kentucky 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 Affected 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 7.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a *less than significant* beneficial impact at the programmatic level, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. 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.

7.2.15.4. 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, at the programmatic level, 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 at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to human health and safety at the programmatic level under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators, although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary and intermittent. It is anticipated that there would be *no impacts* to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to human health and safety at the programmatic level 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 at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise, vibrations, 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 right-of-ways, 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 ROW. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in or near bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or the banks of water bodies that 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. 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 and vibrations 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, noise, and vibrations. 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. 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 and vibration 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *less than significant* impacts at the programmatic level to human health and safety associated with routine inspections of the Preferred Alternative. 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 and vibration 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.

7.2.15.5. 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 at the programmatic level to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source is an electrical generator, then there would also likely be a need to manage hazardous materials (fuel) onsite. These activities could result in *less than significant* impacts at the programmatic level to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise and vibration 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. At the programmatic level, as with the Preferred Alternative, it is anticipated that there would be *no impacts* to human health and safety 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 at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.2.15, Health and Human Safety.

KY APPENDIX A – BIOLOGICAL RESOURCES

Table A-1: S1-Ranked Terrestrial Communities in Kentucky

Vegetative Community Type	Distribution by County
Appalachian seep/bog	Bath, Bell, Edmonson, Harlan, Jackson, Laurel, Letcher, McCreary, Pulaski, and Whitley
Bottomland marsh	Calloway, Fulton, Graves, Henderson, McCracken, and Muhlenberg,
Bottomland ridge/terrace forest	Ballard and McCracken
Bluegrass woodland	Harrison and Mercer
Bluegrass mesophytic cane forest	Madison
Calcareous seep/bog	Clinton
Coastal Plain forested acid seep	Calloway
Cumberland highlands forest	Harlan
Cumberland Mountains pitch pine woodland	Harlan
Cumberland Plateau gravel/cobble bar	Jackson, Laurel, McCreary, Pulaski, Rockcastle, and Whitley
Cumberland Plateau sandstone glade	Jackson and McCreary
Cypress (tupelo) swamp	Ballard, Carlisle, Fulton, Graves, Hickman, Marshall, and Muhlenberg
Dolomite glade	Bullitt
Limestone/dolomite prairie	Bullitt, Caldwell, Christian, Garrard, Grayson, Hardin, Hart, Larue, Lincoln, Logan, Madison, Nelson, Todd, and Warren
Limestone flat rock glade	Hardin, Simpson, and Warren
Sandstone barrens (open woodland)	Christian, Crittenden, Hardin, Livingston, and Warren
Sandstone prairie	Hardin, Hart, Laurel, McCreary, and Warren
Sinkhole/depression marsh	Clinton, Edmonson, McCreary, and Wayne
Shawnee Hills sandstone glade	Christian, Edmonson, Hancock, Hardin, Hart, Livingston, and Warren
Tallgrass prairie	Christian, Crittenden, Grayson, Hardin, Hart, Logan, and Trigg
Wet depression/sinkhole forest	Barren, Clinton, Edmonson, Logan, Pulaski, and Wayne
Wet meadow	Lincoln and Pulaski
Wet prairie	McCracken and Russell
Xerohydric flatwoods	Marshall, McLean, Union, Webster, and Whitley

ACRONYMS

Acronym	Definition
AAF	Army Airfield
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AFB	Air Force Base
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AIRFA	American Indian Religious Freedom Act
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
BMP	Best Management Practice
CAA	Clean Air Act
CCC	Civilian Conservation Corps
CCD	Common Core of Data
CCMP	Comprehensive Conservation and Management Plan
CCR	Consumer Confidence Report
CCS	Center for Climate Strategies
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
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
CWS	Community Water Systems
DAHP	Department of Archaeology and Historic Preservation

Acronym	Definition
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
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
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FLM	Federal Land Manager
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAO	Government Accountability Office
GAP	Gap Analysis Program
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GMA	Growth Management Act
GNIS	Geographic Names Information System
HAP	Hazardous Air Pollutant
HAPC	Habitat Areas of Particular Concern
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
HF	Gaseous Fluorides
IBA	Important Bird Areas
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
IWIN	Integrated Wireless Network
KCVG	Kentucky International Airport

Acronym	Definition
KDA	Kentucky Department of Agriculture
KDEP	Kentucky Department for Environmental Protection
KDFW	Kentucky Department of Fish and Wildlife
KDNR	Kentucky Department for Natural Resources
KDPH	Kentucky Department for Public Health
KDT	Kentucky Department for Transportation
KERC	Kentucky Emergency Response Commission
KEWS	Kentucky Emergency Warning System
KOSH	Kentucky Occupational Safety and Health
KPDES	Kentucky Pollutant Discharge Elimination System
KSDF	(KCVG) and Louisville International Airport
KSNPC	Kentucky State Nature Preserve Commission
KSR	Kentucky Revised Statutes
KWIEC	Kentucky Wireless Interoperability Executive Committee
KY	Kentucky
KY-EPHRS	Kentucky-Electronic Public Health Record System
KYTC	Kentucky Transportation Cabinet
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LMAPCD	Louisville Metro Air Pollution Control District
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
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
NEPA	National Environmental Policy Act

Acronym	Definition
NERR	National Estuarine Research Reserve
NESCA	Nongame and Endangered Species Conservation Act
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NMFS	National Marine Fisheries Service
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
NWI	National Wetlands Inventory
NWP	Nationwide Permit
NWR	National Wildlife Refuges
NWS	National Weather Service
OCIO	Office of the CIO
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
ONRW	Outstanding National Resource Water
OSHA	Occupational Safety and Health Administration
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

Acronym	Definition
PGA	Peak Ground Acceleration
PHS	Priority Habitats and Species
POP	Points of Presence
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
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

Acronym	Definition
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
TVA	Tennessee Valley Authority
TWA	Time Weighted Average
UA	Unmanned Aircraft
USACE	United States Army Corps of Engineers
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
VERP	Voluntary Environmental Cleanup Program
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
WQC	Water Quality Certification
WWI	World War I
WWII	World War II

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