

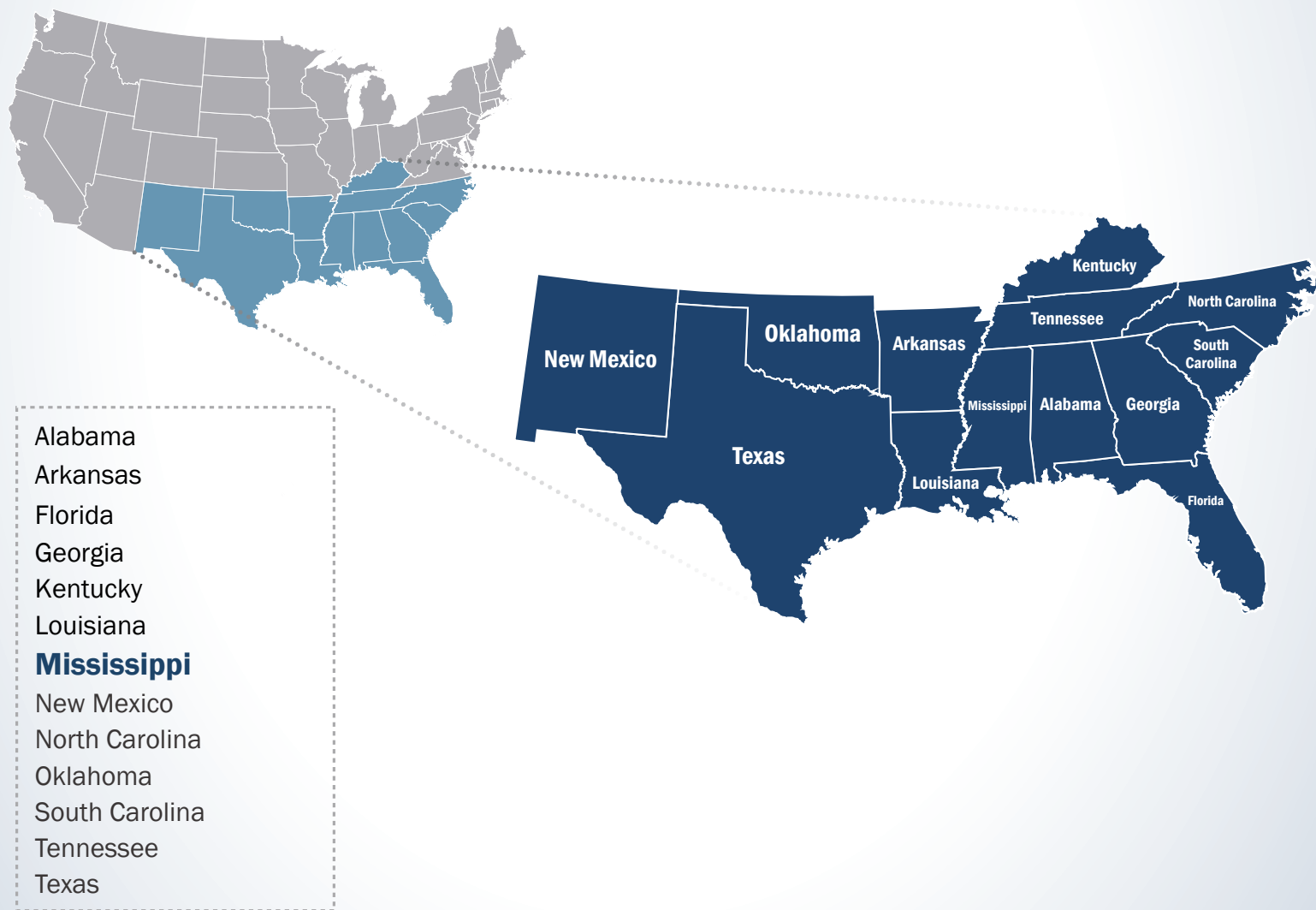


FirstNet[®]

Nationwide Public Safety Broadband Network

Final Programmatic Environmental Impact Statement for the Southern United States

VOLUME 7 - CHAPTER 9



First Responder Network Authority



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

VOLUME 7 - CHAPTER 9

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

Cooperating Agencies

Federal Communications Commission
General Services Administration
U.S. Department of Agriculture—Rural Utilities Service
U.S. Department of Agriculture—U.S. Forest Service
U.S. Department of Agriculture—Natural Resource Conservation Service
U.S. Department of Commerce—National Telecommunications and Information Administration
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

August 2017

Page Intentionally Left Blank.

Contents

9. Mississippi.....	9-7
9.1. Affected Environment	9-8
9.1.1. Infrastructure.....	9-8
9.1.2. Soils.....	9-37
9.1.3. Geology.....	9-48
9.1.4. Water Resources	9-63
9.1.5. Wetlands	9-76
9.1.6. Biological Resources	9-83
9.1.7. Land Use, Recreation, and Airspace.....	9-128
9.1.8. Visual Resources.....	9-153
9.1.9. Socioeconomics	9-165
9.1.10. Environmental Justice.....	9-182
9.1.11. Cultural Resources	9-187
9.1.12. Air Quality	9-205
9.1.13. Noise and Vibrations.....	9-215
9.1.14. Climate Change.....	9-220
9.1.15. Human Health and Safety	9-228
9.2. Environmental Consequences	9-242
9.2.1. Infrastructure.....	9-242
9.2.2. Soils.....	9-254
9.2.3. Geology.....	9-264
9.2.4. Water Resources	9-277
9.2.5. Wetlands	9-292
9.2.6. Biological Resources	9-303
9.2.7. Land Use, Recreation, and Airspace.....	9-361
9.2.8. Visual Resources.....	9-375
9.2.9. Socioeconomics	9-383
9.2.10. Environmental Justice.....	9-396
9.2.11. Cultural Resources	9-404
9.2.12. Air Quality	9-412
9.2.13. Noise and Vibrations.....	9-419
9.2.14. Climate Change.....	9-427
9.2.15. Human Health and Safety	9-442
MS Appendix A – Air Quality.....	9-457
MS Appendix B – Biological Resources	9-461
Acronyms.....	9-464
References.....	9-468
GIS References	9-511

List of Tables

Table 9.1.1-1: Relevant Mississippi Infrastructure Laws and Regulations	9-8
Table 9.1.1-2: Mississippi Interstates	9-10
Table 9.1.1-3: Amtrak Train Routes Serving Mississippi	9-13
Table 9.1.1-4: Key Mississippi Indicators	9-14
Table 9.1.1-5: Public Safety Infrastructure in Mississippi by Type	9-15
Table 9.1.1-6: First Responder Personnel in Mississippi by Type	9-15
Table 9.1.1-7: Mississippi Public Safety P25 Networks.....	9-20
Table 9.1.1-8: Telecommunications Access Providers and Coverage in Mississippi as of December 31, 2013	9-21
Table 9.1.1-9: Wireless Telecommunications Coverage by Providers in Mississippi	9-22
Table 9.1.1-10: Number of Commercial Towers in Mississippi by Type	9-28
Table 9.1.1-11: Fiber Provider Coverage	9-31
Table 9.1.2-1: Relevant Mississippi Soil Laws and Regulations.....	9-38
Table 9.1.2-2: Characteristics of Major Land Resource Areas in Mississippi	9-41
Table 9.1.2-3: Major Characteristics of Soil Suborders ^a Found in Mississippi, as depicted in Figure 9.1.2-2.....	9-45
Table 9.1.3-1: Relevant Mississippi Geology Laws and Regulations	9-49
Table 9.1.4-1: Relevant Mississippi Water Resources Laws and Regulations.....	9-63
Table 9.1.4-2: Section 303(d) Impaired Waters of Mississippi, 2014.....	9-69
Table 9.1.4-3: Description of Mississippi's Principal Aquifers	9-74
Table 9.1.5-1: Relevant Mississippi Wetlands Laws and Regulations	9-76
Table 9.1.5-2: Mississippi Wetland Types, Descriptions, Location, and Amount, 2014	9-78
Table 9.1.6-1: Relevant Mississippi Biological Resources Laws and Regulations	9-84
Table 9.1.6-2: USEPA Level III Ecoregions of Mississippi.....	9-87
Table 9.1.6-3: Mississippi Freshwater Fish	9-93
Table 9.1.6-4: Mississippi Saltwater Fish.....	9-95
Table 9.1.6-5: Mississippi Sharks.....	9-97
Table 9.1.6-6: Gulf of Mexico EFH Habitat Areas of Particular Concern	9-98
Table 9.1.6-7: Federally Listed Mammal Species of Mississippi.....	9-101
Table 9.1.6-8: Federally Listed Bird Species of Mississippi	9-105
Table 9.1.6-9: Federally Listed Reptile Species of Mississippi.....	9-109
Table 9.1.6-10: Federally Listed Fish Species of Mississippi	9-115
Table 9.1.6-11: Federally Listed Amphibian Species of Mississippi	9-118
Table 9.1.6-12: Federally Listed Invertebrate Species of Mississippi.....	9-119
Table 9.1.6-13: Federally Listed Plant Species of Mississippi.....	9-127
Table 9.1.7-1: Major Land Use in Mississippi by Coverage Type.....	9-130
Table 9.1.7-2: Top Five Developed Metropolitan Areas	9-132
Table 9.1.7-3: Major Federal Land Ownership in Mississippi	9-134
Table 9.1.7-4: State Land in Mississippi ^a	9-135
Table 9.1.7-5: Indian Reservations of Mississippi.....	9-135
Table 9.1.7-6: SUA Designations	9-142
Table 9.1.7-7: Other Airspace Designations.....	9-143
Table 9.1.7-8: Type and Number of Mississippi Airports/Facilities	9-145
Table 9.1.8-1: Relevant Mississippi Visual Resources Laws and Regulations	9-153
Table 9.1.8-2: State Historic Sites	9-157

Table 9.1.8-3: Mississippi NPS Unites and Affiliated Areas	9-160
Table 9.1.8-4: Mississippi National Wildlife Refuges.....	9-163
Table 9.1.9-1: Land Area, Population, and Population Density of Mississippi.....	9-167
Table 9.1.9-2: Recent Population Growth of Mississippi.....	9-167
Table 9.1.9-3: Projected Population Growth of Mississippi.....	9-168
Table 9.1.9-4: Population of the 10 Largest Population Concentrations in Mississippi.....	9-169
Table 9.1.9-5: Selected Economic Indicators for Mississippi	9-172
Table 9.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Mississippi, 2009–2013	9-176
Table 9.1.9-7: Employment by Class of Worker and by Industry, 2013	9-176
Table 9.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Mississippi, 2009–2013	9-177
Table 9.1.9-9: Selected Housing Indicators for Mississippi, 2013	9-178
Table 9.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Mississippi, 2009–2013	9-178
Table 9.1.9-11: Residential Property Values in Mississippi, 2013.....	9-179
Table 9.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Mississippi, 2009–2013	9-179
Table 9.1.9-13: State and Local Government Revenues, Selected Sources, 2012	9-181
Table 9.1.10-1: Population by Race and Hispanic Status, 2013	9-184
Table 9.1.10-2: Percentage of Population (Individuals) in Poverty, 2013.....	9-184
Table 9.1.11-1: Relevant Mississippi Cultural Resources Laws and Regulations	9-188
Table 9.1.11-2: NRHP Listed Archaeological Sites in Mississippi.....	9-195
Table 9.1.12-1: Major Air Pollutant Source Thresholds.....	9-207
Table 9.1.12-2: De Minimis Levels	9-208
Table 9.1.12-3: Mississippi Nonattainment and Maintenance Areas by Pollutant Standard and County	9-210
Table 9.1.12-4: Relevant Federal Class I Areas	9-213
Table 9.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)	9-217
Table 9.1.14-1 Mississippi CO ₂ Emissions by Fuel Type and Sector, 2014	9-222
Table 9.1.15-1: Relevant Mississippi Human Health and Safety Laws and Regulations.....	9-229
Table 9.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level	9-244
Table 9.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level.....	9-256
Table 9.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level	9-265
Table 9.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level.....	9-279
Table 9.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level	9-293
Table 9.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level.....	9-304
Table 9.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level.....	9-344
Table 9.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level.....	9-362

Table 9.2.8-1: Impact Significance Rating Criteria for Visual Resources at Programmatic Level	9-377
Table 9.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level.....	9-384
Table 9.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level.....	9-397
Table 9.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level.....	9-405
Table 9.2.12-1: Impact Significance Rating Criteria for Air Quality at the Programmatic Level	9-414
Table 9.2.13-1: Impact Significance Rating Criteria for Noise and Vibrations at the Programmatic Level.....	9-421
Table 9.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level.....	9-428
Table 9.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level.....	9-444
Table A-1: National Ambient Air Quality Standards (NAAQS).....	9-457
Table A-2: Federally Regulated Hazardous Air Pollutants (HAPs)	9-458
Table B-1: S1-Ranked Terrestrial Communities in Mississippi	9-461

List of Figures

Figure 9.1.1-1: Mississippi Transportation Networks	9-11
Figure 9.1.1-2: Wireless Network Configuration	9-16
Figure 9.1.1-3: MSWIN 700 MHz County Coverage Map	9-19
Figure 9.1.1-4: AT&T and Verizon Wireless Availability in Mississippi.....	9-23
Figure 9.1.1-5: Sprint and T-Mobile Wireless Availability in Mississippi	9-24
Figure 9.1.1-6: C Spire Wireless and Teletec Communications Wireless Availability in Mississippi	9-25
Figure 9.1.1-7: Other Providers Wireless Availability in Mississippi.....	9-26
Figure 9.1.1-8: Types of Towers.....	9-27
Figure 9.1.1-9: FCC Tower Structure Locations in Mississippi.....	9-29
Figure 9.1.1-10: Typical Fiber Optic Network in Mississippi.....	9-30
Figure 9.1.1-11: Fiber Availability in Mississippi for AT&T Mississippi	9-32
Figure 9.1.1-12: TEC of Jackson Inc.'s Fiber Availability in Mississippi	9-33
Figure 9.1.1-13: Other Providers' Fiber Availability in Mississippi	9-34
Figure 9.1.2-1: Locations of Major Land Resource Areas in Mississippi	9-40
Figure 9.1.2-2: Mississippi Soil Taxonomy Suborders	9-43
Figure 9.1.3-1: Physiographic Regions and Provinces of Mississippi.....	9-50
Figure 9.1.3-2: Generalized Surface Geology for Mississippi	9-53
Figure 9.1.3-3: Generalized Bedrock Geology for Mississippi	9-54
Figure 9.1.3-4: Mississippi 2014 Seismic Hazard Map.....	9-58
Figure 9.1.3-5: Mississippi Landslide Incidence and Susceptibility Hazard Map	9-60
Figure 9.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Mississippi	9-62
Figure 9.1.4-1: Major Mississippi Watersheds and Surface Waterbodies.....	9-66

Figure 9.1.4-2: Mississippi’s Estuaries and Critical Resource Waters	9-67
Figure 9.1.4-3: Section 303(d) Impaired Waters of Mississippi.....	9-70
Figure 9.1.4-4: Principal and Sole Source Aquifers of Mississippi.....	9-75
Figure 9.1.5-1: Wetlands by Type, in Mississippi, 2014	9-80
Figure 9.1.5-2: Mississippi estuarine wetland	9-81
Figure 9.1.6-1 USEPA Level III Ecoregions in Mississippi.....	9-86
Figure 9.1.6-2: Important Bird Areas in Mississippi	9-92
Figure 9.1.6-3: ESA Designated Critical Habitat in Mississippi	9-100
Figure 9.1.7-1: Major Land Use Distribution by Coverage Type.....	9-133
Figure 9.1.7-2: Land Ownership Distribution.....	9-136
Figure 9.1.7-3: Mississippi Recreation Resources.....	9-138
Figure 9.1.7-4: National Air Space Classification Profile	9-140
Figure 9.1.7-5: Composite of Mississippi Airports/Facilities.....	9-146
Figure 9.1.7-6: Public Mississippi Airports/Facilities	9-147
Figure 9.1.7-7: Private Mississippi Airports/Facilities	9-148
Figure 9.1.7-8: SUAs in Mississippi.....	9-151
Figure 9.1.7-9: MTRs in Mississippi	9-152
Figure 9.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive.....	9-156
Figure 9.1.8-2: Chimney Bluffs State Park.....	9-158
Figure 9.1.8-3: Natural Areas that May be Visually Sensitive	9-159
Figure 9.1.8-4: Gulf Islands National Seashore.....	9-160
Figure 9.1.8-5: Black Creek Wild and Scenic River	9-162
Figure 9.1.8-6: Chestnut Oak Disjunct NNL	9-164
Figure 9.1.9-1: Population Distribution in Mississippi, 2009–2013.....	9-170
Figure 9.1.9-2: Median Household Income in Mississippi, by County, 2013	9-174
Figure 9.1.9-3: Unemployment Rates in Mississippi, by County, 2014.....	9-175
Figure 9.1.10-1: Potential for Environmental Justice Populations in Mississippi, 2009– 2013.....	9-186
Figure 9.1.11-1: Timeline of Prehistoric Human Occupation	9-189
Figure 9.1.11-2: Federally Recognized Tribes in Mississippi	9-194
Figure 9.1.11-3: National Heritage Area (NHA) and National Register of Historic Places (NRHP) Sites in Mississippi	9-202
Figure 9.1.11-4: Representative Architectural Styles of Mississippi	9-205
Figure 9.1.12-1: Nonattainment and Maintenance Counties in Mississippi.....	9-212
Figure 9.1.12-2: Federal Class I Areas with Implications for Mississippi	9-214
Figure 9.1.13-1: Sound Levels of Typical Sounds	9-216
Figure 9.1.14-1: Mississippi CO ₂ Emissions by Fuel Type 1980-2013	9-223
Figure 9.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties	9-224
Figure 9.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014	9-232
Figure 9.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Mississippi (2013).....	9-235
Figure 9.1.15-3: Aerial View of the Southeastern Wood Preserving Site, Batchelor Creek, and Residential Areas, Canton, MS.....	9-237
Figure 9.1.15-4: High Priority Abandoned Mine Lands in Mississippi (2015).....	9-238
Figure 9.1.15-5: Map of Tornado Tracks Through Central Mississippi.....	9-241

Figure 9.2.14-1: Mississippi Low Emission Scenario Projected Temperature Change	9-429
Figure 9.2.14-2: Mississippi High Emission Scenario Projected Temperature Change.....	9-430
Figure 9.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario	9-432
Figure 9.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario	9-433
Figure 9.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050	9-435
Figure 9.2.14-6: 1.24-foot Sea Level Rise Above 1992 Levels by 2050.....	9-436

9. MISSISSIPPI

American Indian tribes with a rich cultural history lived in what is now the state of Mississippi for centuries before the 1600s. The French founded the first permanent settlement in Mississippi in 1699. The Mississippi Territory was organized in 1798, and in 1817, Mississippi became the 20th state to enter the Union (State of Mississippi, 2015a) (Mississippi Secretary of State, 2015). Mississippi is bordered by Louisiana and Arkansas to the west, the Gulf of Mexico and Florida to the south, Alabama to the east, and Tennessee to the north. This chapter provides details about the existing environment of Mississippi as it relates to the Proposed Action.



General facts about Mississippi are provided below:

- **State Nickname:** The Magnolia State
- **Land Area:** 46,923.27 square miles; **U.S. Rank:** 32 (U.S. Census Bureau, 2010a)
- **Capital:** Jackson
- **Counties:** 82 (U.S. Census Bureau, 2015a)
- **2014 Estimated Population:** Over 2.9 million people; **U.S. Rank:** 31 (U.S. Census Bureau, 2009)
- **Most Populated Cities:** Jackson and Gulfport (U.S. Census Bureau, 2015a)
- **Main Rivers:** Coldwater River, Mississippi River, Tombigbee River, Yazoo River, Big Black River, Pearl River, Chickasawhay River, Pascagoula River
- **Bordering Waterbodies:** Mississippi River
- **Mountain Ranges:** None
- **Highest Point:** Woodall Mountain (806 ft.) (USGS, 2015a)

9.1. AFFECTED ENVIRONMENT

9.1.1. Infrastructure

9.1.1.1. *Specific Regulatory Considerations*

Multiple Mississippi laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 9.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state’s applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

Table 9.1.1-1: Relevant Mississippi Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Mississippi Code Unannotated (MCU): Title 49 Conservation and Ecology; Title 53 Oil, Gas, and Other Minerals: Mississippi Administrative Code (MAC): Title 11 Mississippi Department of Environmental Quality (MDEQ)	MDEQ	Manages the natural resources of the state and oversees programs related to environmental protection.
MCU: Title 39 Libraries, Arts, Archives, and History: MAC: Title 16 Archives and History	Mississippi Department of Archives and History	Oversees programs in the state related to historic preservation.
MCU: Title 33 Military Affairs: Title 33-15-7 Mississippi Emergency Management Agency	Mississippi Emergency Management Agency	Coordinates the emergency management functions of the state.
MCU: Title 77 Public Utilities and Carriers: MAC: Title 77 Public Service Commission	Public Service Commission	Regulates gas, water, electricity, sewage, pipeline, and common carrier companies.
MCU: Title 61 Aviation; Title 65 Highways, Bridges, and Ferries: MAC: Title 65-1-2 Mississippi Department of Transportation (MDOT)	MDOT	Oversees the development and operation of the state’s highway, mass transit, railroad, and aviation facilities and services.

Sources: (State of Mississippi, 2013a) (MDEQ, 2013c) (State of Mississippi, 2013b) (State of Mississippi, 2013c) (State of Mississippi, 2013d) (State of Mississippi, 2010a) (State of Mississippi, 2010b) (State of Mississippi, 2010c) (State of Mississippi, 2013e) (State of Mississippi, 2013f) (State of Mississippi, 2013g)

9.1.1.2. *Definition of the Resource*

This section provides information on key Mississippi infrastructure resources that could potentially be affected by FirstNet projects. Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure is entirely manmade with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as “developed.” Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, ports,

usace harbors and other manmade facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Section 9.1.1.3 provides an overview of Mississippi's traffic and transportation infrastructure, including road and rail networks and waterway facilities. Mississippi's public safety infrastructure could include any infrastructure utilized by a public safety entity¹ as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et. seq.) (the Act), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in Mississippi are presented in more detail in Section 9.1.1.4. Section 0 describes Mississippi's public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Mississippi's utilities, such as power, water, and sewer, is presented in Section 0.

9.1.1.3. Transportation

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

The Mississippi Department of Transportation (MDOT) has jurisdiction over freeways and major roads, airports, railroads, mass transit, and ports in the state; local counties have jurisdiction for smaller streets and roads.

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

- 75,116 miles of public roads (FHWA, 2014) and 17,091 bridges (FHWA, 2015a);
- 2,600 miles of rail network that includes passenger rail and freight (MDOT, 2011);
- 237 aviation facilities, including airstrips and heliports (FAA, 2015a); and
- 2 major ports and 14 smaller ports in the state (MDOT, 2016).

Road Networks

As identified in Figure 9.1.1-1, the major urban centers of the state from north to south are Memphis-Forrest City, Cleveland-Indianola, Jackson-Vicksburg-Brookhaven, and New Orleans-Metairie-Hammond (U.S. Department of Commerce, 2013a). Mississippi has five major interstates connecting its major metropolitan areas to one another, as well as to other states.

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

Travel outside the major metropolitan areas is conducted on interstates, and state and county roads. Table 9.1.1-2 lists the interstates and their start/end points in Mississippi. 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 9.1.1-2: Mississippi Interstates

Interstate	Southern or western terminus in MS	Northern or eastern terminus in MS
I-10	LA line near Pearlinton	AL line near Orange Grove
I-20	LA line in Vicksburg	AL line near Toomsuba
I-55	LA line near Osyka	TN line in Southaven
I-59	LA line near Nicholson	AL line near Toomsuba
I-69	Rt-304 in Hernando	I-55 in Hernando

Source: (FHWA, 2015b)

In addition to the Interstate System, Mississippi has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 9.1.1-1 illustrates the major transportation networks, including roadways, in Mississippi. Section 9.1.8, Visual Resources, describes the National and State Scenic Byways found in Mississippi from an aesthetic perspective.

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

- Great River Road: 2,069 miles through Arkansas, Illinois, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Tennessee, and Wisconsin. "Throughout history, the Mississippi River influenced many lives: the Dakota, Chippewa, and Hopewell cultures; early French voyagers; African-Americans seeking freedom on the Underground Railroad; and many more. Through its charming river towns and metropolitan cities, historic sites and cultural artifacts, today's Great River Road still links resources, people, and history" (FHWA, 2015c).
- Natchez Trace Parkway: 444 miles in Alabama, Mississippi, and Tennessee. "Native Americans, Kaintuck boatmen, post riders, government officials, and soldiers all moved across this trail, creating a vital link between the Mississippi Territory and the fledgling United States. Pass through forests, cypress swamps, and farmland to meander through the rock-studded hills of Tennessee, cotton fields in Alabama, and Mississippi's rural countryside" (FHWA, 2015c).

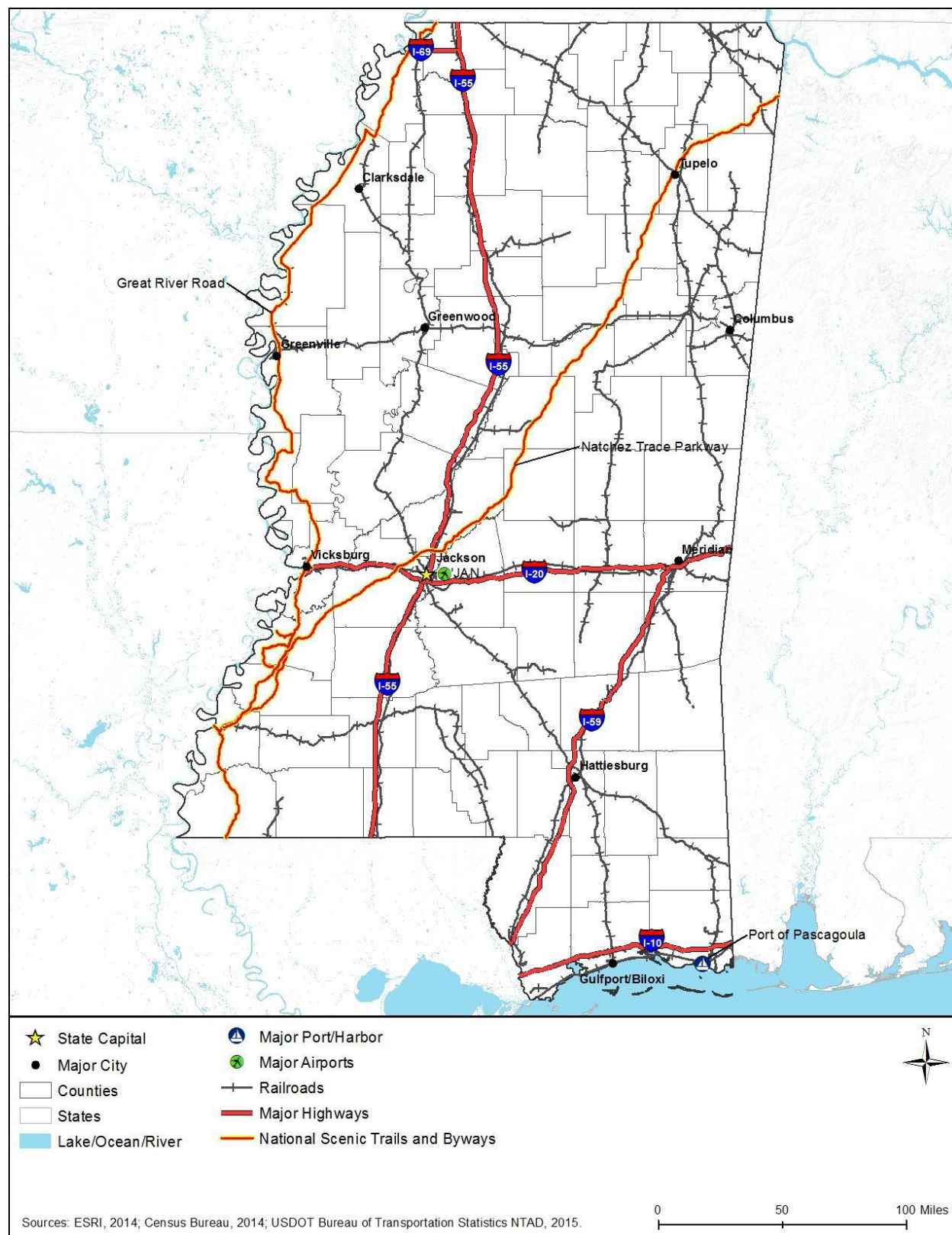


Figure 9.1.1-1: Mississippi Transportation Networks

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by MDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Mississippi has six State Scenic Byways that crisscross the entire state (MDOT, 2012):²

- Beach Boulevard Scenic Byway;
- Brice's Crossroads Battlefield – Chief Tishomingo Scenic Byway;
- Byways to Space Scenic Byway;
- Grand Gulf Raymond Scenic Byway;
- Highway 67 Scenic Byway; and
- Highway 605 Scenic Byway.

Airports

Air service to the state is provided by Jackson-Medgar Wiley Evers International Airport (JAN), which is operated by the Jackson Municipal Airport Authority (Jackson Municipal Airport Authority, 2015a). In 2014, JAN served 1,075,608 passengers (Jackson Municipal Airport Authority, 2015b), facilitated 42,296 aircraft operations (Jackson Municipal Airport Authority, 2015c), and moved 1,374,459 pounds of cargo (Jackson Municipal Airport Authority, 2015d). Figure 9.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 9.1.7, Land Use, Recreation, and Airspace, provides greater detail on airports and airspace in Mississippi.

Rail Networks

Mississippi is connected to a network of passenger rail (Amtrak) and freight rail. Figure 9.1.1-1 illustrates the major transportation networks, including rail lines, in Mississippi. Amtrak runs two lines through Mississippi: City of New Orleans and Crescent. The City of New Orleans runs daily between Chicago and New Orleans, with six stops in Mississippi. “Based on FY 2009 Amtrak ridership reports, about 6 percent of Mississippi riders on the City of New Orleans are traveling locally (in both directions) between stations in Mississippi. Another 34 percent of the Mississippi riders are traveling (in both directions) between stations in Mississippi and New Orleans or Hammond, LA. The majority of Magnolia State riders (60 percent) are traveling (in both directions) between Mississippi and stations north of Mississippi” (MDOT, 2011). The Crescent runs every day between New York and New Orleans, making four stops in Mississippi. “Based on FY 2009 Amtrak ridership reports, about 15 percent of Mississippi riders on the Crescent are traveling locally (in both directions) between stations in Mississippi. Another 24 percent of the Mississippi riders are traveling (in both directions) between stations in Mississippi and New Orleans or Slidell, LA. The majority of Magnolia State riders (61 percent) are traveling (in both directions) from Mississippi to stations north and east of Mississippi” (MDOT, 2011). Table 9.1.1-3 provides a complete list of Amtrak lines that run through Mississippi.

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

Table 9.1.1-3: Amtrak Train Routes Serving Mississippi

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Mississippi
City of New Orleans	Chicago, IL	New Orleans, LA	19 hours	Greenwood, Yazoo City, Jackson, Hazelhurst, Brookhaven, McComb
Crescent	New York, NY	New Orleans, LA	30 hours	Meridian, Laurel, Hattiesburg, Picayune

Sources: (Amtrak, 2015) (Amtrak, 2016)

All 2,600 miles of railroad track in Mississippi are owned and operated by freight rail companies (MDOT, 2011). Five Class I railroads operate in the state: BNSF Railway, CSX Transportation, Canadian National Railway, Kansas City Southern Railway Company, and Norfolk Southern Railway Company (MDOT, 2011). In addition, 27 local or regional railroad companies operate in Mississippi (MDOT, 2011). Approximately two-thirds of Mississippi's rail tracks are owned by the five Class I railroads, equating to about 1,700 miles of track (MDOT, 2011). In 2006, freight rail moved 130 million tons of freight in Mississippi; of those tons, 78.6% passed through the state, 12.6% was inbound, 7.5% was outbound, and 1.3% traveled within Mississippi (MDOT, 2011).

Harbors and Ports

Mississippi is a state bound by its bodies of water. Its southern border is shared with the Gulf of Mexico, while the Mississippi River defines its western border. Both of these bodies of water are important for recreational or industrial purposes, with the Mississippi River playing an important role and giving access to the country's interior, with the river lined with shipping facilities for just this purpose. Additionally, a handful of harbors dot the coastline of the Gulf Coast in southern Mississippi, offering options such as Bay St. Louis and its recreational marinas (Bay Saint Louis Harbor, 2015). The Ports of Pascagoula and Gulfport provide large scale shipping options into the Gulf, allowing participation in international trade. The Port of Pascagoula operates in southeastern Mississippi, on the Bayou Casotte and Pascagoula River. The Port of Gulfport is in southern Mississippi, directly on the Gulf of Mexico. Both of these can be seen in Figure 9.1.1-1.

The Port of Pascagoula operates terminals on two harbors to better accommodate their cargo (Port of Pascagoula, 2015a). The Port of Pascagoula is the largest seaport in the state, and "the Port's two harbors include a combination of public and private terminals," which helps put it in the top 20 United States ports by foreign cargo volume. The eastern harbor offers a 42 ft. channel and the western harbor a 38 ft. channel (Port of Pascagoula, 2015b). The western harbor on the Pascagoula River offers both cold and open storage, while the eastern harbor on the Bayou Casotte offers open storage and a transit shed. Rail service at the terminals is provided by CSXT and Mississippi Export Railroad, which connects to the Canadian National Railroad (Port of Pascagoula, 2015c). Both harbors can be reached via State Route 90, which connects to I-10 north of the port. In general terms, the port's imported cargo includes crude oil, aggregate, forest products, and phosphate rock; while exports include paper products, frozen poultry, fertilizer,

and petroleum products (Port of Pascagoula, 2015d). In 2013, the Port of Pascagoula was responsible for importing \$9.4 billion worth of cargo, which weighed 16.4 million tons, and exporting \$4.7 billion weighing 5.2 million tons (U.S. Census Bureau, 2015b).

The Port of Gulfport’s location on the Gulf of Mexico gives it “easy access to open ocean waters via a short 18-mile ship channel that is maintained at 11 meters of depth” (MSPA, 2015a). It sees service from freighters traveling from Mexico, the Caribbean, Central America, and South America (MSPA, 2015a). Its facilities include 10 vessel berths with 6,000 feet of berthing space, 110 acres of open storage, and 400,000 square feet of covered storage in warehouses. These facilities have helped make the Port of Gulfport “the second largest importer of green fruit in the United States and the third busiest container port located directly on the U.S. Gulf of Mexico” (MSPA, 2015b). It handles bananas, pineapples, frozen poultry, crushed limestone, and patrol boats (MSPA, 2015c). Rail service is provided by Kansas City Southern Railway Company, which also provides connections to CSX rails. The port can be reached overland via I-10, with connections from Route 49 (MSPA, 2015d). In 2013, the port imported \$1.4 billion in cargo weighing about 1 billion kg, and exported \$1 billion in cargo weighing 688 million kg (U.S. Census Bureau, 2015b).

9.1.1.4. Public Safety Services

Mississippi public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 9.1.1-4 presents Mississippi’s key demographics including population; land area; population density; and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 9.1.9, Socioeconomics.

Table 9.1.1-4: Key Mississippi Indicators

Mississippi Indicators	
Estimated Population (2014)	2,994,079
Land Area (square miles) (2010)	46,923.27
Population Density (persons per sq. mile) (2010)	63.2
Municipal Governments (2013)	296

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

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

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

Infrastructure Type	Number
Fire and Rescue Stations ^a	762
Law Enforcement Agencies ^b	342
Fire Departments ^c	417

Sources: (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 9.1.1-6: First Responder Personnel in Mississippi by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers ^a	1,470
Fire and Rescue Personnel ^b	11,968
Law Enforcement Personnel ^c	12,408
Emergency Medical Technicians and Paramedics ^{d e}	2,120

Sources: (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.

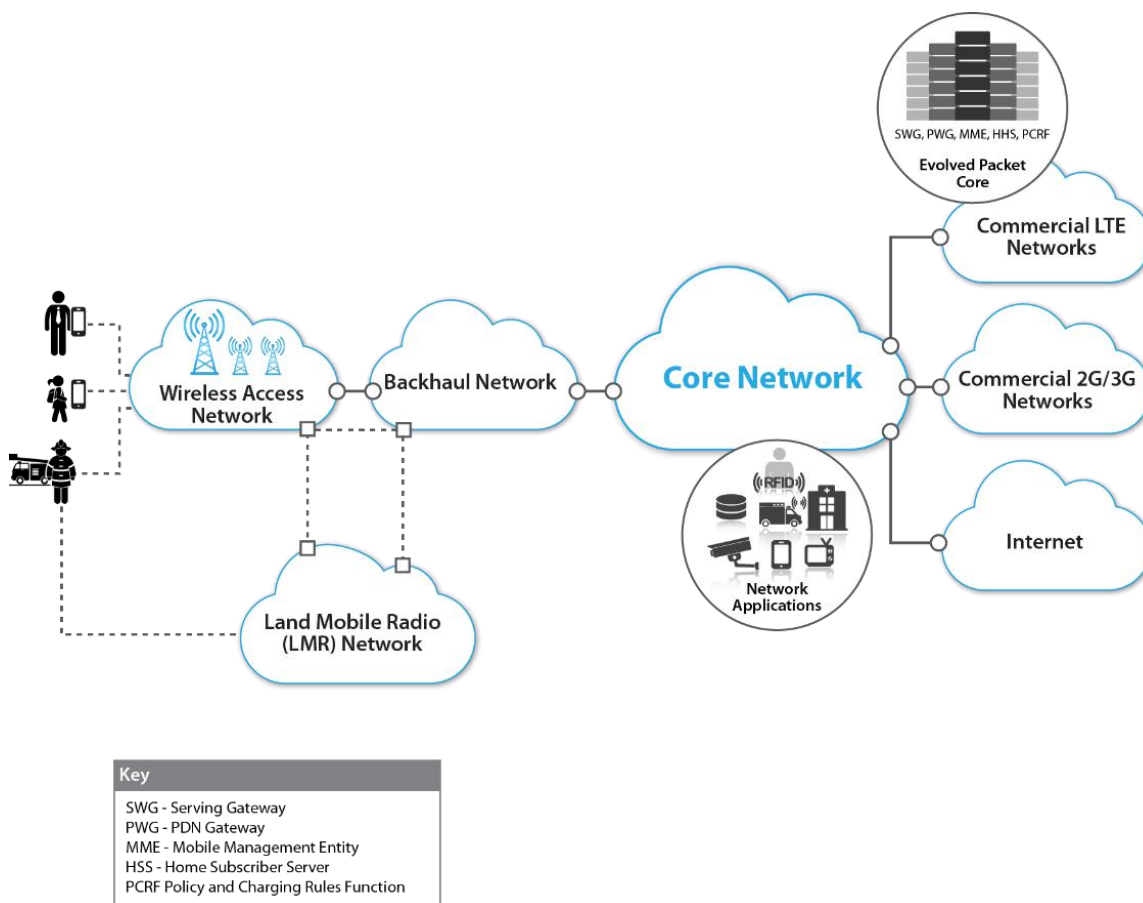
^d BLS Occupation Code: 29-2041

^e All BLS data collected in 2015.

9.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Mississippi; 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 9.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a Long Term Evolution (LTE) (see Section 9.1.1) 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 9.1.1-2: Wireless Network Configuration

Public Safety Communications

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

Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and specifically in Mississippi. 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 enable the public safety community to incorporate disparate Land Mobile Radio (LMR) networks with a nationwide public safety LTE broadband network, the U.S. Department of Commerce Public Safety Communications Research Program (PSCR) – Boulder Laboratories, in 2015, prepared a locations-based services (LBS) research and development roadmap to examine the current state of location-based technologies, forecast the evolution of LBS capabilities and gaps, and identify potential research and development opportunities that would improve the public safety community's use of LBS within operational settings. This is the first of several technology roadmaps that PSCR plans to develop over the next few years to better inform investment decisions (PSCR, 2015).

Like most states, Mississippi's public safety LMR network environment is facing transition and reflects the challenges of the need for greater system capabilities. These increasing capabilities require continued investment in the state's 700 MHz statewide system, ongoing LMR maintenance and upgrades, and ongoing expansion of the state's commitment to improving the interoperability of its public safety LMR infrastructure.

Mississippi's statewide public safety communication needs are supported by the Mississippi Wireless Integrated Network (MSWIN) which is a 144 tower site digital P25 700 MHz network supported by a microwave backhaul network (Mississippi Wireless Communications Commission, 2015a). The system services support both state public safety agencies and users, as well as county and local departments and users who elect to subscribe to this digital 700 MHz system (Mississippi Wireless Communications Commission, 2015a).

Responsibility for the implementing the state's public safety wireless interoperability strategy, as well as oversight and maintenance of the MSWIN network, resides with Mississippi's Wireless Communications Commission which was formed in 1972 by state legislative action (Mississippi Wireless Communications Commission, 2015b).

In 2010 The Executive Office of Mississippi's MESHNet (Mississippi Education, Safety, and Health Network) project was awarded. MESHNet was one of seven grant recipients of a National Telecommunication Information Administration's (NTIA) Broadband Technology Opportunities Program (BTOP) federal grant for the MESHNet project which centered on building out a public safety LTE 700 MHz and microwave network in the state (NTIA, 2010a).

Mississippi's MESHNet infrastructure project was one of seven BTOP initial infrastructure grant projects that was intended to represent predecessor 700 MHz public safety initial deployment broadband networks (NTIA, 2010b).

Statewide/Multi-County Public Safety Networks

The statewide 700 MHz digital P25 network, MSWIN, provides coverage to the majority of the state's counties, as Figure 9.1.1-3 illustrates (Mississippi Wireless Communications Commission, 2015a).

The MSWIN statewide system provides wireless communications to the majority of the state's agencies.³ In addition, MSWIN provides public safety communications to the county/local public safety agencies and departments, and to state public safety talkgroups including the Mississippi State Highway Patrol, Mississippi State Department of Health, and Statewide Interoperability Talkgroups (Mississippi Wireless Integrated Network, 2015).

³ With Mississippi's Department of Corrections being the primary agency not currently on MSWIN (Mississippi Secretary of State, 2015)



Source: (Mississippi Wireless Communications Commission, 2015a)

Figure 9.1.1-3: MSWIN 700 MHz County Coverage Map

County/City Public Safety Networks

In Mississippi, county and local public safety communications have been supported by a diverse set of systems and frequencies; including Very High Frequency (VHF),⁴ Ultra High Frequency (UHF),⁵ 700 MHz, and 800 MHz. There continues to be high diversity in the types and

⁴ VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA 2005).

⁵ UHF band covers frequencies ranging from 300 MHz to 3000 MHz (NTIA 2005).

frequencies of LMR systems adopted by county and local public safety departments in spite of the increased adoption of MSWIN (RadioReference.com, 2015a).

There are four public safety digital P25 systems operational in Mississippi with the majority of these systems on 800 MHz; the statewide MSWIN system operates on 700 MHz and Table 9.1.1-7 below lists the public safety digital P25 system currently operational in the state (Project 25.org, 2015a) (Project 25.org, 2015b).

Table 9.1.1-7: Mississippi Public Safety P25 Networks

Mississippi P25 Public Safety Systems	Frequency Band
Mississippi Wireless Integrated Network (MSWIN)	700 MHz
Hancock County Public Safety	800 MHz
Oktibbeha County	800 MHz
Mississippi Band of Choctaw Indians (P25)	800 MHz

Sources: (Project 25.org, 2015a) (Project 25.org, 2015b)

The Hancock County Public Safety digital P25 network operates on 800 MHz and is served by three tower sites in the county; located in the cities of Kiln, St. Louis, and Diamondhead (RadioReference.com, 2015b). The network supports countywide law enforcement talk groups for the sheriff's department and police operations, fire and EMS dispatch, as well as county operations (RadioReference.com, 2015b).

In Oktibbeha Count, the digital P25 network operates on 800 MHz which was an upgrade from the previous Enhanced Digital Access System (EDACS) technology. The system is a four tower site system serving county sheriff department and fire/EMS dispatch (RadioReference.com, 2015c).

The Mississippi Band of Choctaw Indians' digital P25 system also operates on 800 MHz and provides public safety communications coverage in five counties in the state: Neshoba, Lake, Winston, Jones, and Newton (RadioReference.com, 2015d).

Public Safety Answering Points

According to the Federal Communication Commission's (FCC) Master PSAP registry there are 153 PSAPs in Mississippi serving Mississippi's 82 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Mississippi'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 Mississippi'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

Mississippi's commercial telecommunications industry provides the full spectrum of telecommunications technologies and networks, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems. Table 9.1.1-8 Table 9.1.1-8 presents the number of providers of switched access⁶ lines, Internet access,⁷ and mobile wireless services including coverage.

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

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines ^a	118	96.8% of households ^b
Internet access ^c	45	31.0% of households
Mobile Wireless ^d	7	90.0% of population

Sources: (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; 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 9.1.1-9 shows the wireless providers in Mississippi along with their geographic coverage. The following four maps: Table 9.1.1-4 to Table 9.1.1-7 show: AT&T Mobility LLC and Verizon Wireless' coverage; Sprint and T-Mobile's coverage; C Spire Wireless and Teletec Communications' coverage; and the coverage of all other providers with less than 5% coverage area, respectively.

⁶ "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)" (FCC, 2014b).

⁷ Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

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

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	97.63%
C Spire Wireless	95.63%
Verizon Wireless	94.66%
Sprint	32.52%
T-Mobile	13.75%
Teletec Communications	5.42%
Other ^a	13.21%

Source: (NTIA, 2014)

^a Other: Provider with less than 5% coverage area.
Providers include: Tri State Internet, LLC; Magnolia Wireless; NetWireless Solutions LLC; Delta Link Inc.; Cricket Communications, Inc.; Dixie-Net; Vance Wireless; Firenet1.com; TEC of Jackson, Inc.; GulfPines Communications; Mobile Communications, LLC.

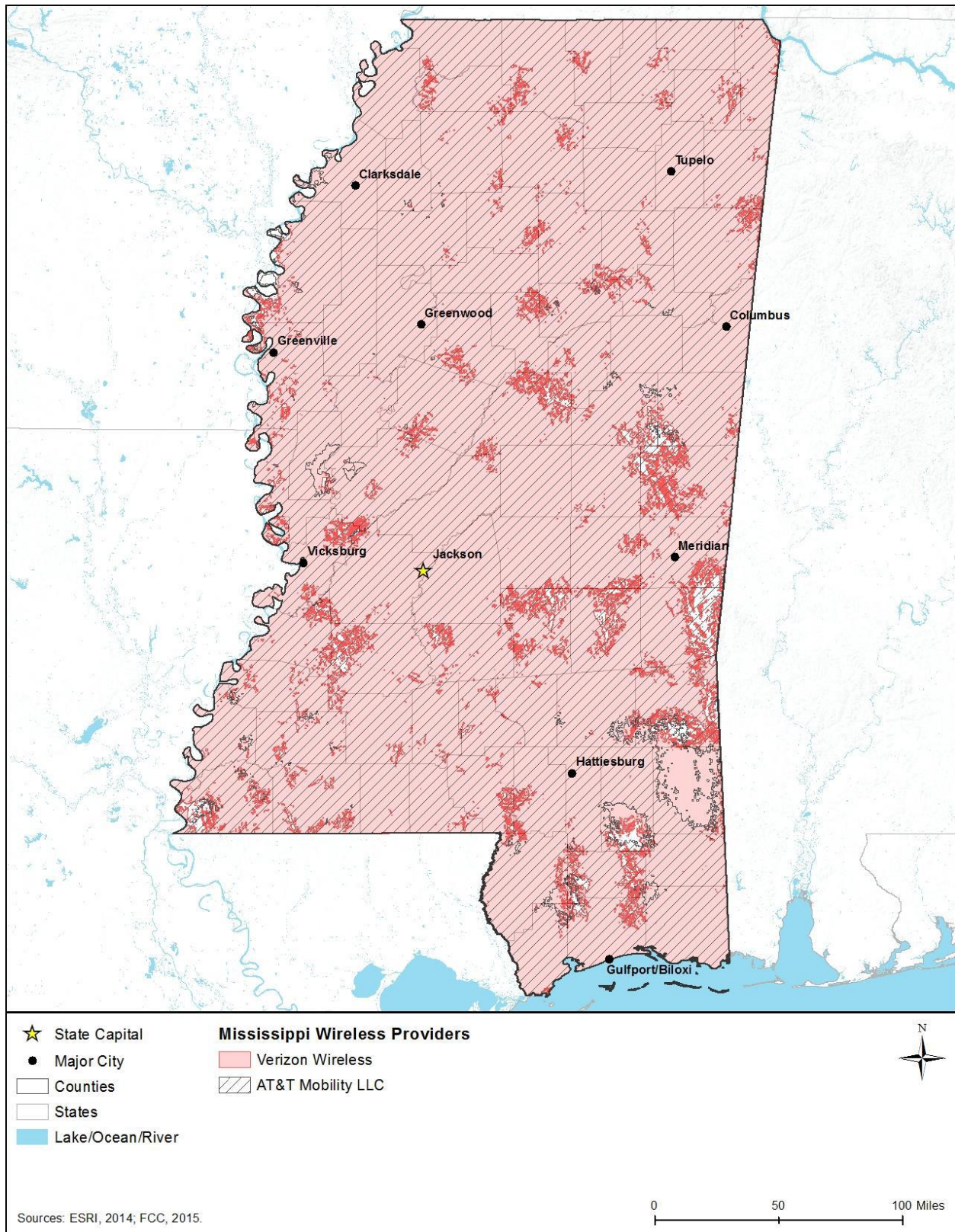


Figure 9.1.1-4: AT&T and Verizon Wireless Availability in Mississippi

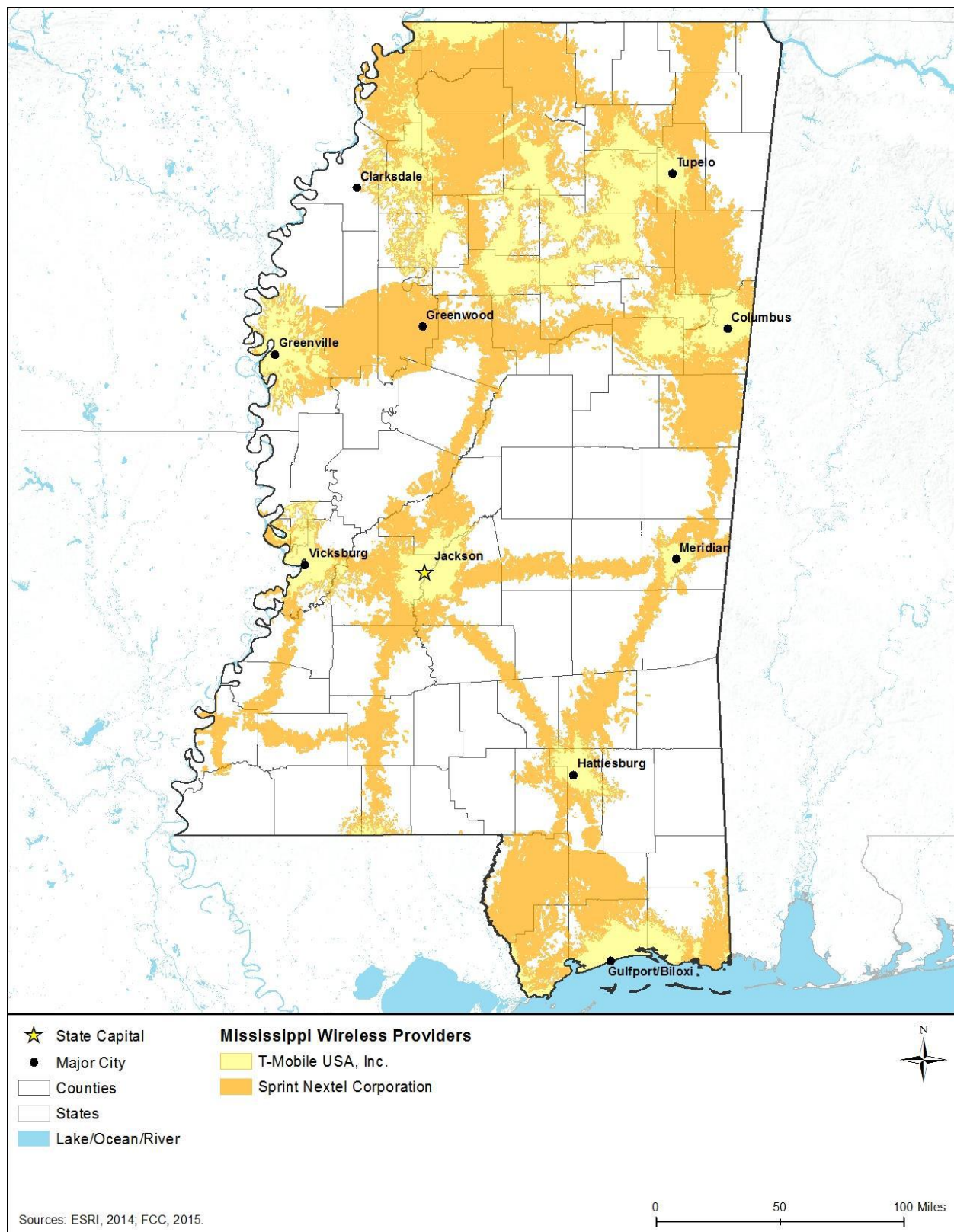


Figure 9.1.1-5: Sprint and T-Mobile Wireless Availability in Mississippi

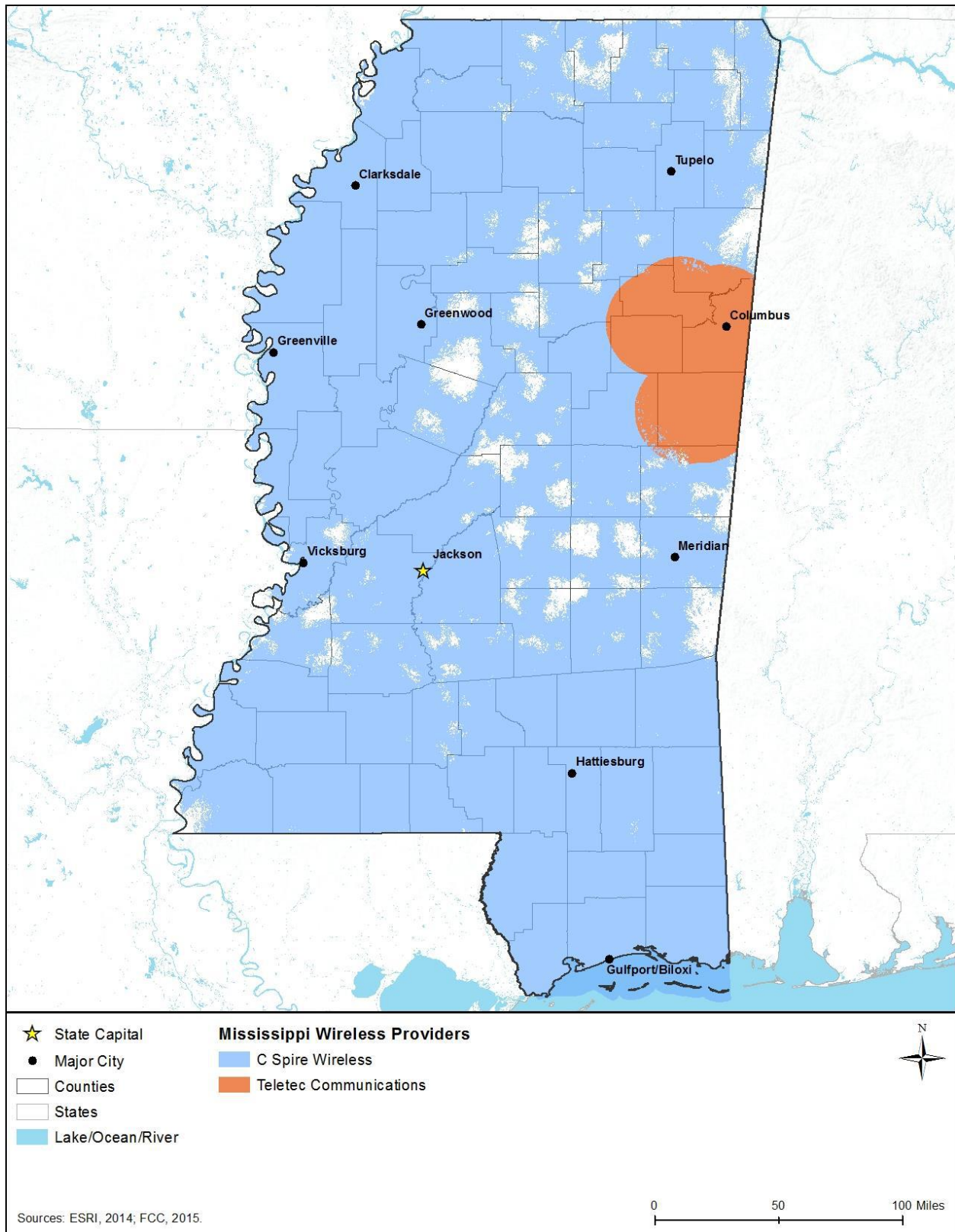


Figure 9.1.1-6: C Spire Wireless and Teletec Communications Wireless Availability in Mississippi

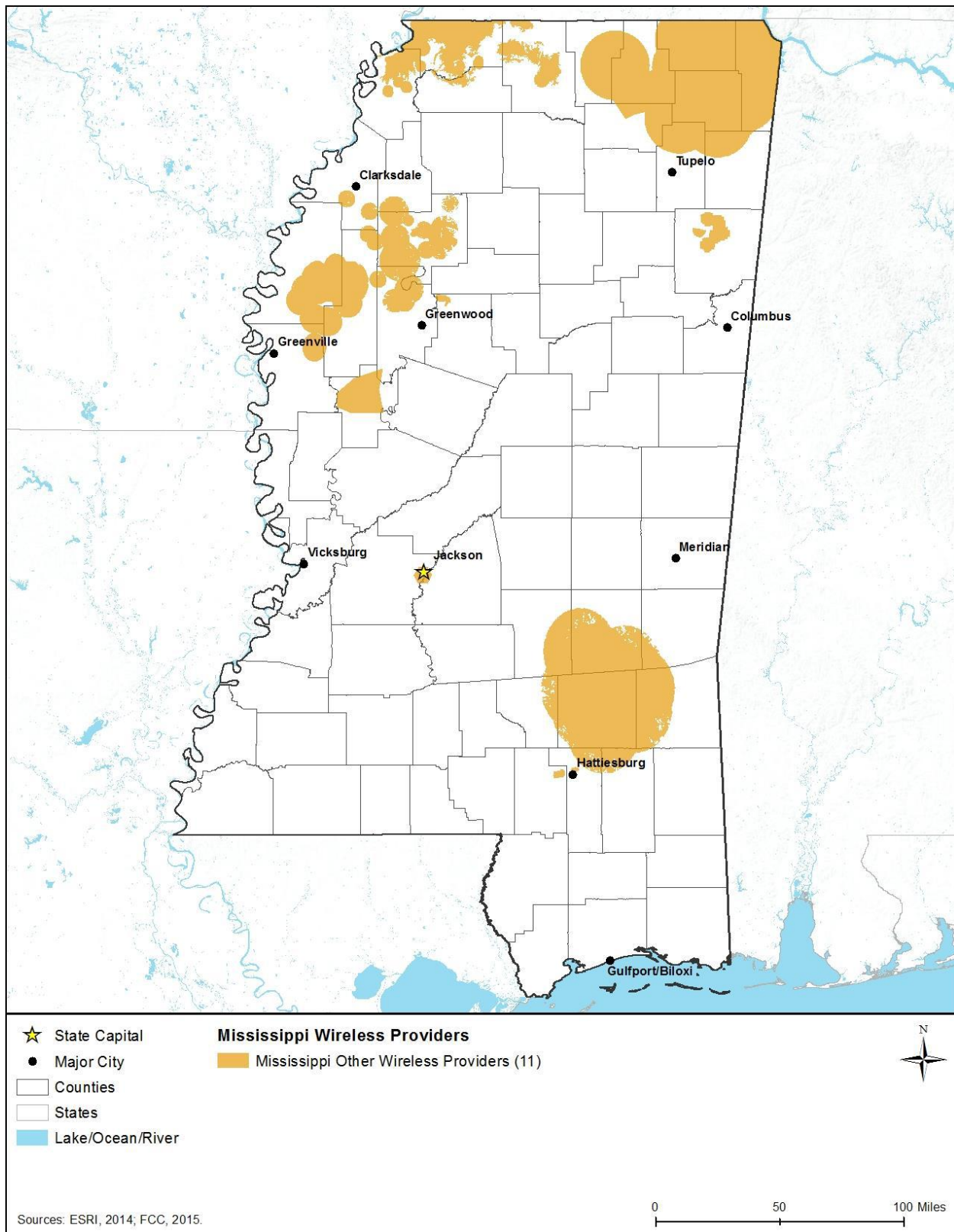


Figure 9.1.1-7: Other Providers Wireless Availability in Mississippi

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 9.1.1-8 presents representative examples of each of these categories or types of towers.



Monopole
100–200 feet

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



Lattice
200–400 feet

Source: Personal Picture



Guyed
200–2,000 feet

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

Figure 9.1.1-8: Types of Towers

Telecommunications tower infrastructure proliferates throughout Mississippi, although tower infrastructure is concentrated in the higher and more densely populated areas of Mississippi; Clarksdale, Tupelo, Greenville, Greenwood, Columbus, Vicksburg, Jackson, Meridian, and Hattiesburg. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).⁸ Table 9.1.1-10 presents the number of towers

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

(including broadcast towers) registered with the FCC in Mississippi, by tower type, and Figure 9.1.1-9 presents the location of those 3,056 structures, as of June 2016.

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

Constructed^a Towers^b		Constructed Monopole Towers	
100 ft. and over	869	100 ft. and over	0
75 ft. – 100 ft.	1,064	75 ft. – 100 ft.	2
50 ft. – 75 ft.	419	50 ft. – 75 ft.	29
25 ft. – 50 ft.	134	25 ft. – 50 ft.	32
25 ft. and below	24	25 ft. and below	4
Subtotal	2,510	Subtotal	67
Constructed Guyed Towers		Buildings with Constructed Towers	
100 ft. and over	111	100 ft. and over	0
75 ft. – 100 ft.	121	75 ft. – 100 ft.	3
50 ft. – 75 ft.	11	50 ft. – 75 ft.	3
25 ft. – 50 ft.	5	25 ft. – 50 ft.	2
25 ft. and below	0	25 ft. and below	0
Subtotal	248	Subtotal	8
Constructed Lattice Towers		Multiple Constructed Structures^c	
100 ft. and over	32	100 ft. and over	0
75 ft. – 100 ft.	145	75 ft. – 100 ft.	0
50 ft. – 75 ft.	32	50 ft. – 75 ft.	0
25 ft. – 50 ft.	7	25 ft. – 50 ft.	0
25 ft. and below	2	25 ft. and below	0
Subtotal	218	Subtotal	0
Constructed Tanks^d			
Tanks	5		
Subtotal	5		
Total All Tower Structures		3,056	

Source: (FCC, 2015b)

^a Planned construction or modification has been completed. Results will return only those antenna structures that the FCC has been notified are physically built or planned modifications/alterations to a structure have been completed (FCC, 2015b).

^b Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).

^c Multiple constructed structures per antenna registration (FCC, 2016c).

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

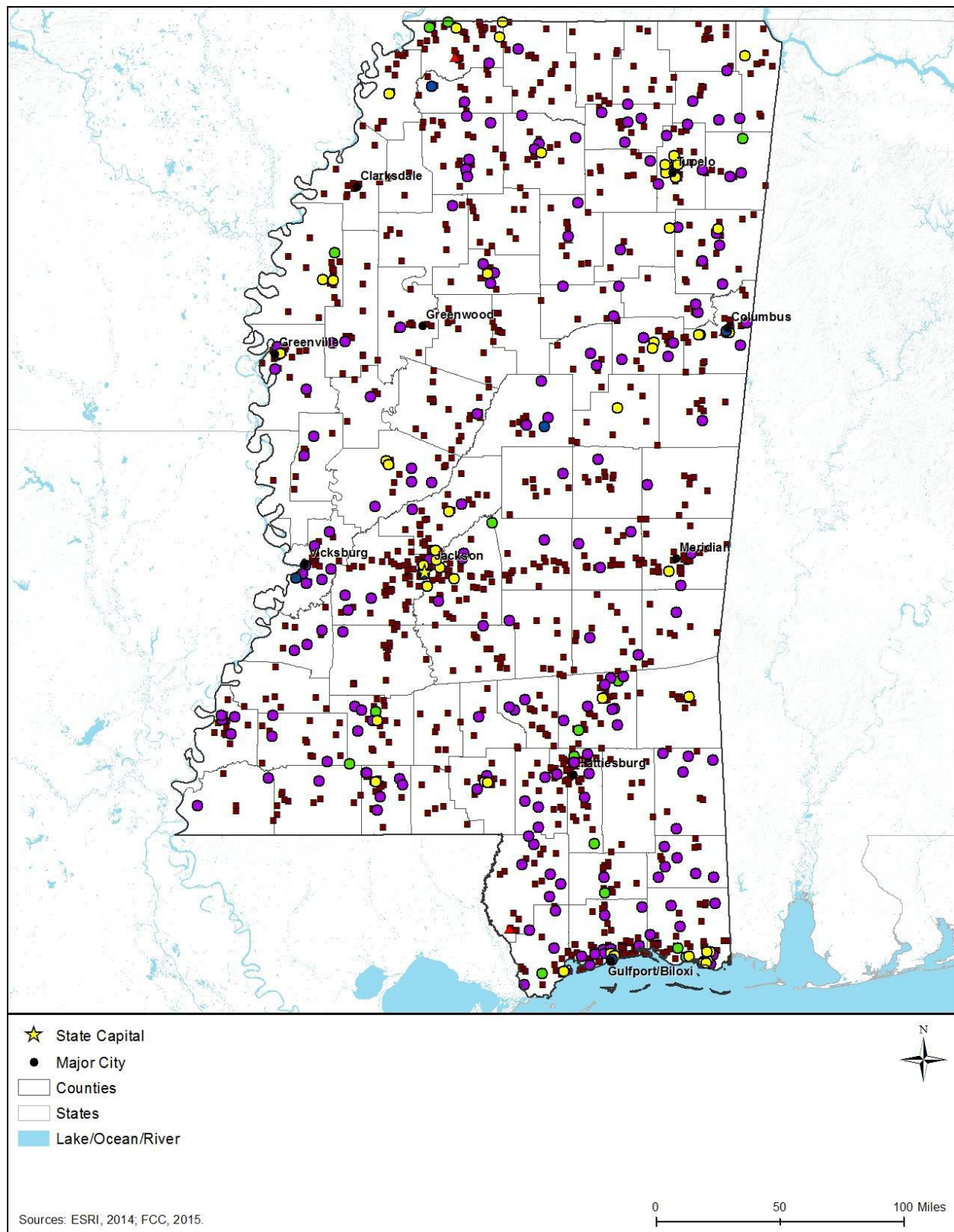
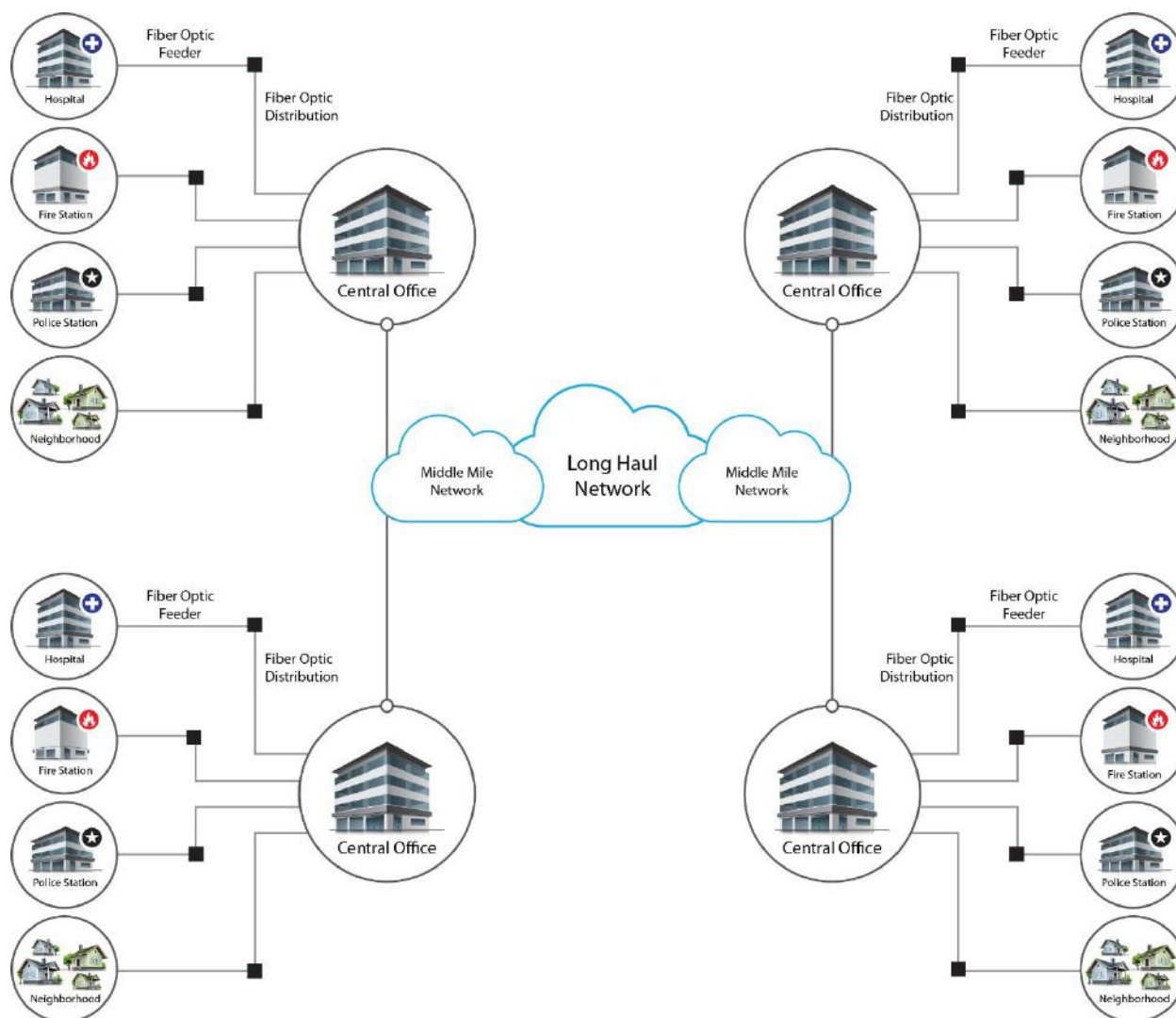


Figure 9.1.1-9: FCC Tower Structure Locations in Mississippi

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 9.1.1-10. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions) (FCC 2000).



Source: (ITU-T, 2012)

Prepared by: Booz Allen Hamilton

Figure 9.1.1-10: Typical Fiber Optic Network in Mississippi

Last Mile Fiber Assets

In Mississippi, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Mississippi there are 42 fiber providers that offer service in the state, as listed in Table 9.1.1-11. Figure 9.1.1-11 show coverage for AT&T Mississippi, Figure 9.1.1-12 shows coverage for TEC of Jackson Inc., and Figure 9.1.1-13 shows coverage for all other providers with less than 5 percent coverage area, respectively.⁹

Table 9.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
AT&T Mississippi	27.44%
TEC of Jackson, Inc.	5.43%
Other ^a	25.88%

Source: (NTIA, 2014)

^a Other: Provider with less than 5% coverage area. Providers include: Comcast; Dixie-Net; Cable One; MetroCast Communications of Mississippi, LLC; InLine; Franklin Telephone Co. Inc.; TEC; Megagate Broadband; TDS TELECOM; Frontier Communications of Mississippi, LLC; Southern Light LLC; Fulton Telephone Company, Inc.; Zayo Group LLC; Delta Telephone Co. Inc.; Windstream Mississippi LLC; Ripley Video Cable; Level 3 Communications, LLC; CenturyLink; Charter Communications Inc.; Bruce Telephone Company, Inc.; Mediacom; Decatur Telephone Co. Inc.; Suddenlink Communications; Noxapater Telephone Company; C Spire Fiber; Sledge Telephone Co. Inc.; Lakeside Telephone Company Inc.; MegaPath Corporation; Smithville Telephone Company, Inc.; Network Telephone Corporation/Cavalier Telephone; Georgetown Telephone Company Inc.; Mound Bayou Telephone and Communications, Inc.; Bailey Cable TV; Vicksburg Video, Inc.; TW Telecom of Mississippi LLC; Telepak Networks, Inc.; GulfPines Communications; Xfone USA, Inc.; Cable TV Of Belzoni, Inc.; Cogent Communications.

⁹ The broadband map utilized data collected as part of the broadband American Recovery and Reinvestment Act initiative. The data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). Each state's broadband data was downloaded accordingly. The data pertaining to broadband data/coverage for census blocks, streets, addresses, and wireless were used. Census blocks, roads, and addresses were merged into one file and dissolved by similar business and provider names. Square miles were calculated for each provider. The maps show all providers over 5% on separate maps; providers with areas under 5% were merged and mapped as "Mississippi Other Fiber Providers". All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "Mississippi Other Wireless Providers". Providers under 5% were denoted in their respective tables.

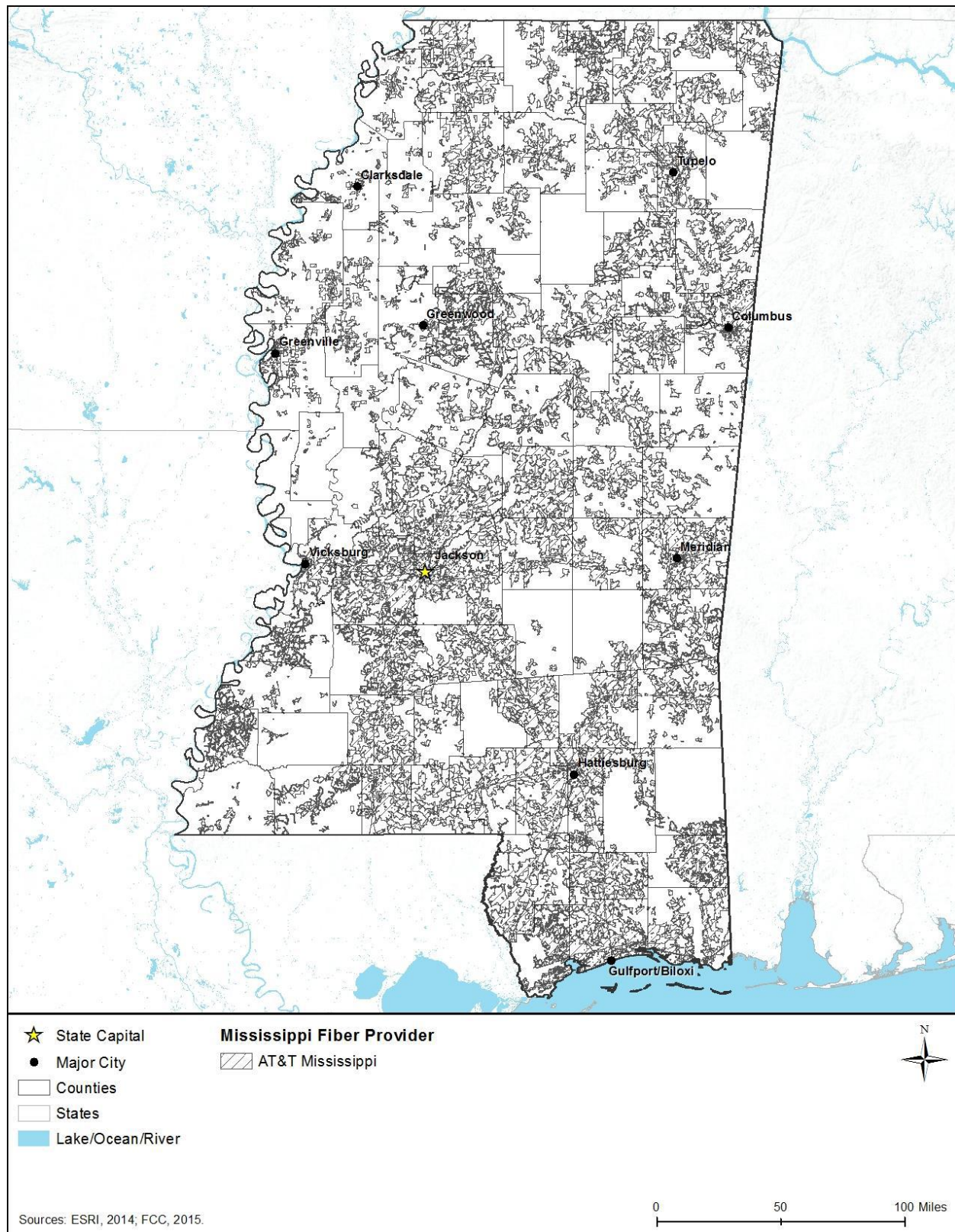


Figure 9.1.1-11: Fiber Availability in Mississippi for AT&T Mississippi

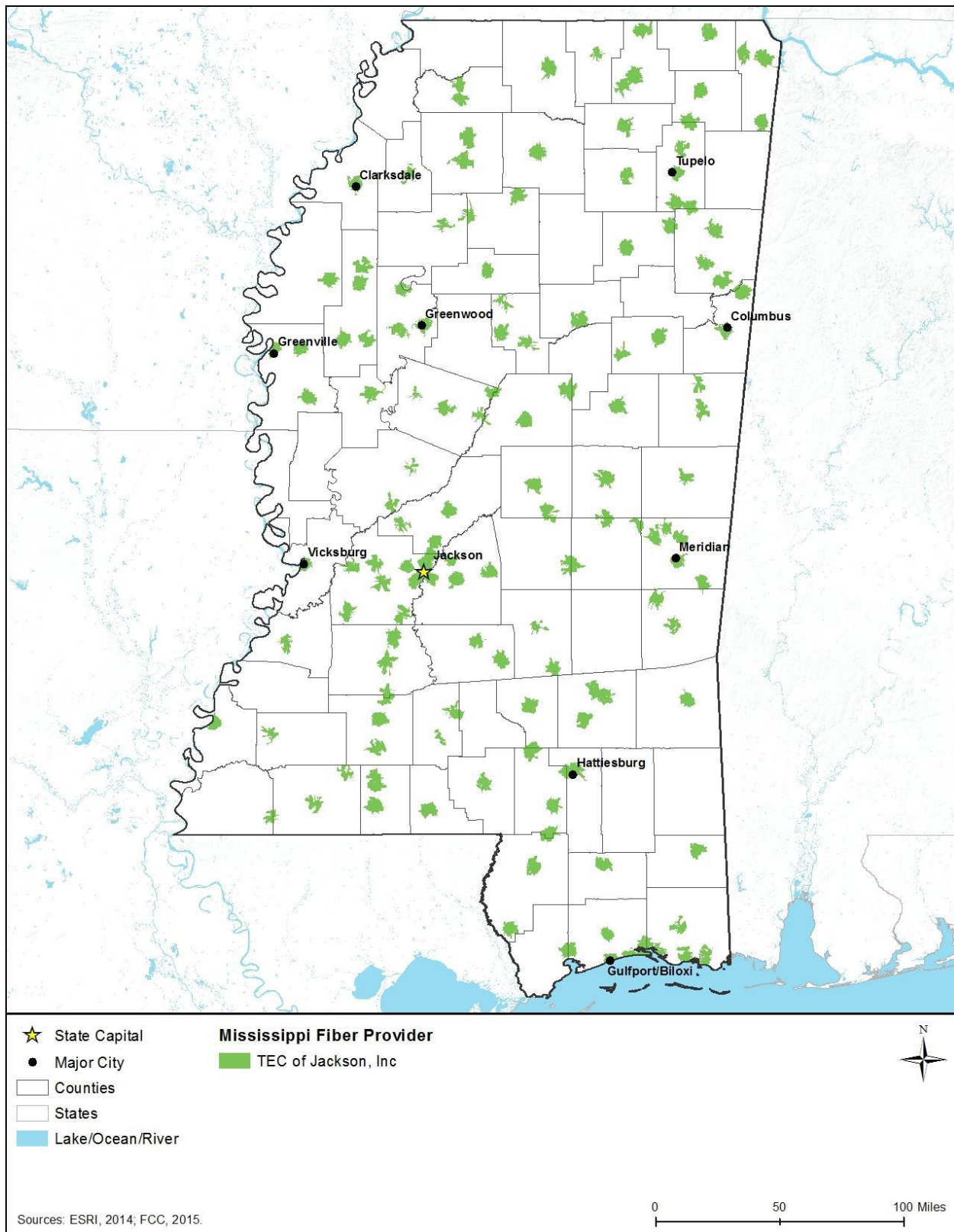


Figure 9.1.1-12: TEC of Jackson Inc.’s Fiber Availability in Mississippi

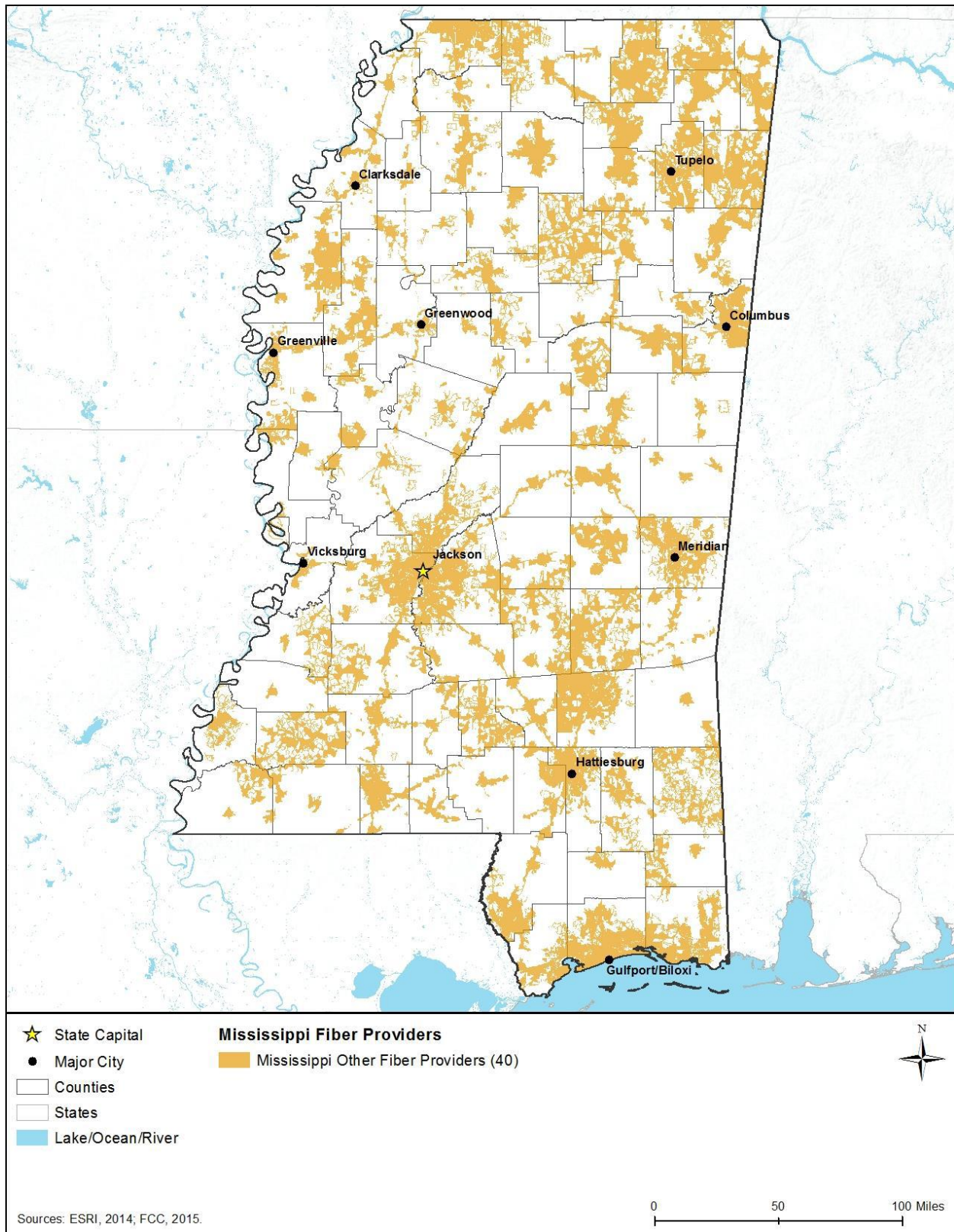


Figure 9.1.1-13: Other Providers' Fiber Availability in Mississippi

Data Centers

Data centers (also known as network access points, collocation facilities, hosting centers, carrier hotels, and Internet exchanges) are large telecommunications facilities that house routers, switches, servers, storage, and other telecommunications equipment. These data centers facilitate efficient network connectivity among and between telecommunications carriers and between carriers and their largest customers. These facilities also provide racks and cages for equipment, power, and cooling, cabling, physical security, and 24x7 monitoring (CIO Council, 2015; GAO, 2013). Ownership of data centers may be public or private; comprehensive information regarding data centers may not be publicly available as some are related to secure facilities.

9.1.1.6. 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 9.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Mississippi's electric utilities are all regulated or monitored to some degree by the Mississippi Public Service Commission (PSC). The PSC regulates and assures fair rates for services provided to customers and that the service provided is of adequate quality (PSC, 2015a). Its authority extends mainly to investor owned utilities, and though the PSC has "limited regulatory authority over the electric systems of municipalities, electric cooperatives, and wholesale power generators, the Electric Division also monitors these areas in order to provide information to policy makers in the state" (PSC, 2015b). There are six investor owned utilities in the state: Chickasaw Solar, Mississippi Power Company, SR Houston, LLC, SR Walker East, LLC, Entergy Mississippi, and Silicon Ranch Investment (PSC, 2015c). Additionally, there are twenty electric associations and fifteen municipal electric providers in the state (PSC, 2015d) (PSC, 2015e).

Nearly all of the electricity produced in Mississippi comes from facilities using natural gas, coal, or nuclear power as a fuel source (EIA, 2015a). In 2016, 50,152 thousand megawatthours¹⁰ of electricity came from natural gas fueled facilities, which represented 79.7 percent of the total 62,906 thousand megawatthours generated that year. Coal provided 5,342 thousand megawatthours (8.5 percent), while nuclear power provided 5,897 thousand megawatthours (9.4 percent) (EIA, 2017a). The state's nuclear power comes from the 1,251 megawatt Grand Gulf nuclear power facility on the Mississippi River (EIA, 2015b). Biomass from wood or wood-based fuels provided 2.4 percent, or 1,494 thousand megawatthours (EIA, 2015a) (EIA, 2017a). In 2014, 34.5 percent of the state's energy went to Mississippi's industrial sector, while 32.8

¹⁰ 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, 2016a)

percent went to the transportation sector, 18.8 percent to the residential sector, and 14 percent to the commercial sector (EIA, 2015b).

Water

Ensuring the quality of Mississippi's drinking water is the responsibility of the Mississippi State Department of Health (MSDH), and its' Bureau of Public Water Supply (BPWS). The BPWS's main responsibilities include the enforcement of the "Federal and State Safe Drinking Water Acts (SDWAs)." In doing this, the MSDH operates programs for the testing of water for contaminants, working with engineers on the design of new water supplies or engineering facilities, issuing annual surveys of community public water supplies for operational or maintenance issues, enforcement of all SWDA standards, and licensing water facility operators to ensure their competency, education, and experience (MSDH, 2015a). Public water systems overseen by MSDH are broken into three categories: community, non-transient non-community, and transient non-community. Community systems would include towns or neighborhoods, while non-transient non-community systems regularly would include schools or workplaces. Transient non-community systems like parks or truck stops serve an ever changing group of people. There are more than one thousand community systems, while the state has about 70 non-transient non-community supplies and 70 transient non-community supplies (MSDH, 2015b). The SWDA mandates that each community system issue a Consumer Confidence Report (CCR) to its consumers, detailing the quality, source, and possible contaminants (MSDH, 2015c). The MSDH 2014 Water Systems Compliance Report noted a total of 115 violations for contaminant levels in its water systems, among 58 systems. There were an additional 295 violations of monitoring or reporting standards, across 56 systems (MSDH, 2015d).

Wastewater

The management and regulation of Mississippi's wastewater disposal processes is the responsibility of the Mississippi Department of Environmental Quality (MDEQ). Their main means of regulation are the issuing of permits to allow and set limits on the discharge of wastewater, and the certification of wastewater facility operators. MDEQ offers general permits for the discharge of wastewater that authorize a large category of facilities within a geographical area. For example, the statewide Baseline Stormwater General Permit for Industrial Activities "authorizes the discharge of stormwater runoff into waters of the State from regulated industrial activities in accordance with the provisions of the Mississippi Air and Water Pollution Control Law" (MDEQ, 2015a). The MDEQ also offers general permits for construction and municipal stormwater operations, among several others. Mississippi's general wastewater discharge permits cover operations across the state (MDEQ, 2015a).

The MDEQ also certifies its wastewater facility operators, and has offered training since 1969. They published an operations and training manual in 1984, "which provided a single reference as a basis of instruction and certification. The Manual is now in its fifth edition" (MDEQ, 2015b). Certification has been mandatory since 1987 and since then over 1000 operators have been certified. "Certification is offered in four (4) classes of treatment and two (2) classes of collection based on size and type of facility" (MDEQ, 2015b).

Solid Waste Management

The management of Mississippi's solid waste is handled by the MDEQ as well. In their 2013 Status Report on Solid Waste Management Facilities and Activities, the MDEQ noted that 6,730,940 tons of solid waste were received or collected for disposal; and of this total, "Commercial landfills disposed of 3,315,144 tons (49.25%), non-commercial landfills disposed of 2,307,002 tons (34.27%), commercial rubbish sites disposed of 1,094,801 tons (16.27%), and non-commercial rubbish sites disposed of 13,993 tons (0.21%) of waste" (MDEQ, 2013a). Municipal landfills disposed of 3,313,434 tons, in nineteen facilities. It should be noted that Mississippi brought in 804,237 tons of solid waste from outside the state, making up 11.95 percent of the total solid waste that was sent to landfills. The report also notes 22 permitted industrial or institutional landfills that accepted waste in 2013. The 15 active landfills disposed of a total of 2,307,002 tons of solid waste (6 landfills were inactive and 1 active landfill reported the total disposal tonnage as confidential business information) (MDEQ, 2013a).

Additionally, there were 716,665 tons of waste sent to transfer stations, 508,015 used for land application, 126,433 tons sent to processing facilities, 22,258 tons sent to composting facilities, and 852,894 tons "distributed by Beneficial Use Determination (BUD) holders for legitimate end uses in the State of Mississippi during Calendar Year 2013" (MDEQ, 2013a).

9.1.2. Soils

9.1.2.1. Definition of the Resource

The Soil Science Society of America defines soil as:

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

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

- *Parent Material*: The original geologic source material from the soil formed affects soil aspects, including color, texture, and ability to hold water.
- *Climate*: Chemical changes in parent material occur slowly in low temperatures. However, hot temperatures evaporate moisture, which also facilitates chemical reactions within soils. The highest degree of reaction within soils occurs in temperate, moist climates.

- *Topography*: Steeper slopes produce increased runoff, and, therefore, downslope movement of soils. Slope orientation also dictates the microclimate to which soils are exposed, because different slope faces receive more sunlight than others.
- *Biology*: The presence/absence of vegetation in soils affects the quantity of organic content of the soil.
- *Time*: Soil properties are dependent on the period over which other processes act on them.

9.1.2.2. *Specific Regulatory Considerations*

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 9.1.2-1 below.

Table 9.1.2-1: Relevant Mississippi Soil Laws and Regulations

State Law/Regulation	Agency	Applicability
Mississippi National Pollutant Discharge Elimination System (NPDES)	MDEQ	Soil erosion and sediment controls are to be incorporated in the Stormwater Pollution Prevention Plan, as part of the NPDES construction general permit

Source: (MDEQ, 2005) (MDEQ, 2010)

9.1.2.3. *Environmental Setting*

Mississippi is composed of three Land Resource Region (LRR),¹¹ as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Atlantic and Gulf Coast Lowland Forest and Crop Region;
- Mississippi Delta Cotton and Feed Grains Region; and
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

Within and among Mississippi's three LRRs are six Major Land Resource Areas (MLRA),¹² which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Mississippi's MLRAs are presented in Figure 9.1.2-1 and Table 9.1.2-2.

¹¹ Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).

¹² 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)

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, biota¹³ such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils¹⁴ 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 rutting¹⁵ (discussed further in the subsections below).

¹³ The flora and fauna of a region

¹⁴ 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)

¹⁵ Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009b).

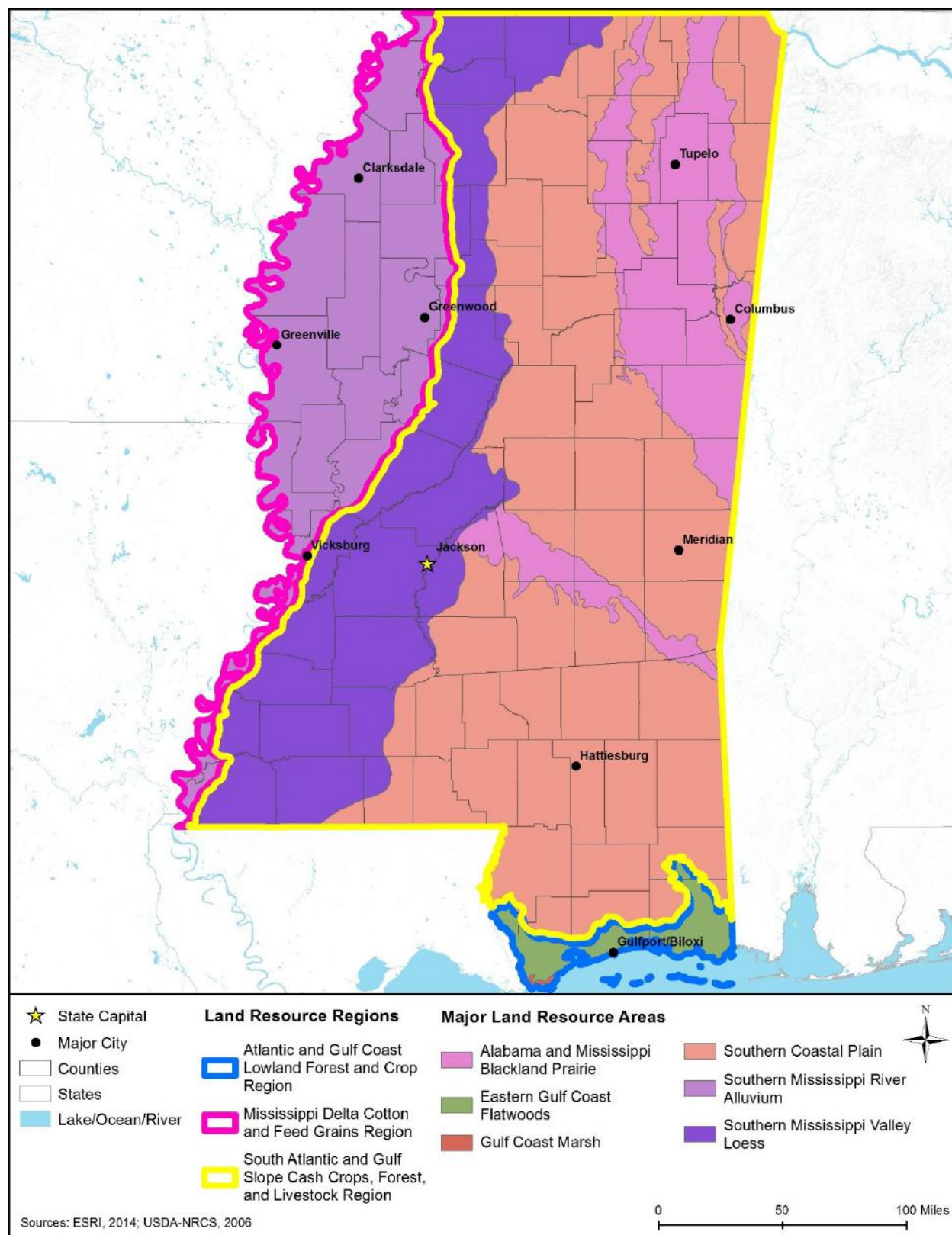


Figure 9.1.2-1: Locations of Major Land Resource Areas in Mississippi

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

MLRA Name	Region of State	Soil Characteristics
Alabama and Mississippi Blackland Prairie	Central and Northeastern Mississippi	Inceptisols ^a and Vertisols ^b are the dominant soil orders. These clayey or loamy ^c soils are typically somewhat poorly drained to well drained, and range from shallow to very deep.
Eastern Gulf Coast Flatwoods	Southern Mississippi	Alfisols, ^d Entisols, ^e Histosols, ^f Spodosols, ^g and Ultisols ^h are the dominant soil orders. These sandy, mucky, or loamy soils typically range from somewhat poorly drained to very poorly drained, and are deep or very deep.
Gulf Coast Marsh	Southern Mississippi	Entisols and Histosols are the dominant soil orders. These clayey and very poorly drained soils are typically very deep.
Southern Coastal Plain	Eastern and Central Mississippi	Entisols, Inceptisols, and Ultisols are the dominant soil orders. These loamy soils range from poorly drained to somewhat excessively drained, and are typically very deep.
Southern Mississippi River Alluvium	Western Mississippi	Alfisols, Entisols, Inceptisols, and Vertisols 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	Western Mississippi	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.

Source: (NRCS, 2006)

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

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

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

^d Alfisols: “Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10% of the world’s ice-free land surface.” (NRCS, 2015b)

^e Entisols: “Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world’s ice-free land surface.” (NRCS, 2015b)

^f Histosols: “Histosols have a high content of organic matter and no permafrost. Most are saturated year round, but a few are freely drained. They form in decomposed plant remains that accumulate in water, forest litter, or moss faster than they decay. Histosols make up about 1% of the world’s ice-free land surface.” (NRCS, 2015b)

^g Spodosols: “Spodosols formed from weathering processes that strip organic matter combined with aluminum from the surface layer and deposit them in the subsoil. They commonly occur in areas of coarse-textured deposits under coniferous forests of humid regions, tend to be acid and infertile, and make up about 4% of the world’s ice-free land surface.” (NRCS, 2015b)

^h Ultisols: “Soils found in humid environments that are formed from fairly intense weathering and leaching processes. This results in a clay-enriched subsoil dominated by minerals. They have nutrients concentrated in the upper few inches and make up 8% of the world’s ice-free land surface.” (NRCS, 2015b)

9.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy,¹⁶ there are 12 soil orders in the world and they are characterized by both observed and inferred¹⁷ 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, 2015d). 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 STATSGO2¹⁸ soil database identifies 15 different soil suborders in Mississippi (NRCS, 2015e). Figure 9.1.2-2 depicts the distribution of the soil suborders, and Table 9.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

¹⁶ Science of naming and classifying organisms or specimens.

¹⁷ “Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)” (NRCS, 2015c).

¹⁸ STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset.

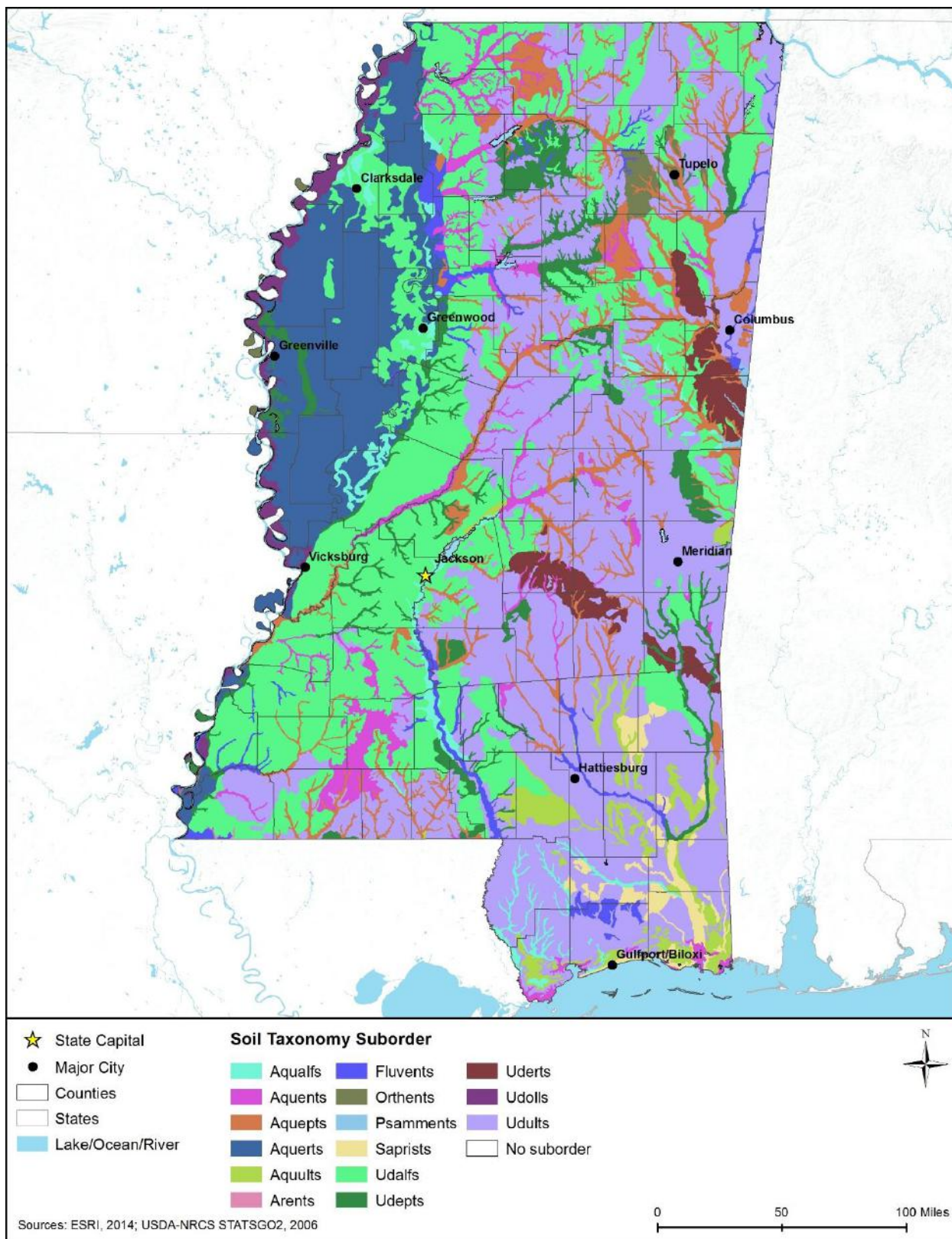


Figure 9.1.2-2: Mississippi Soil Taxonomy Suborders

Page Intentionally Left Blank.

Table 9.1.2-3: Major Characteristics of Soil Suborders^a Found in Mississippi, as depicted in Figure 9.1.2-2

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.	Loam, Silt loam, 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
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Loam, Silt loam, Silty clay loam, Variable	0-2	Very 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
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, groundwater is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Clay, Clay loam, Fine sandy loam, Loam, Mucky loam, Sandy clay loam, Silt loam, Silty clay, Silty clay loam	0-2	Very poorly drained to somewhat poorly drained	No, Yes	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Vertisols	Aquerts	Aquerts are wet soils, with prolonged moisture at or near the soil surface. Their natural vegetation includes savanna, grass, and forest. They are used as forest, rangeland, and cropland, although drainage for cropland can be difficult due to poor drainage.	Clay, Silty clay loam	0-5	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Ultisols	Aquults	Aquults are found in wet areas where groundwater is very close to the surface during part of each year, usually in winter and spring. Their slopes are gentle, with many soils formerly and currently supporting forest vegetation.	Clay loam, Fine sandy loam, Loam, Loamy sand, Sandy loam, Silt loam	0-2	Poorly drained	Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Entisols	Arents	Arents are predominantly used for pasture, crops, wildlife habitat, and urban land. Since they have been subject to various means of mixing, they lack diagnostic horizons.	Variable	1-5	NA ^d	No	C	Medium	Low	Medium	Low
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Fine sandy loam, Loamy sand, Sand, Silt loam, Stratified loamy fine sand to fine sandy loam, Stratified loamy sand to fine sandy loam, Very fine sandy loam	0-5	Moderately well drained to excessively drained	No, Yes	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	High, due to hydric soil and poor drainage conditions
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Channery loam, Variable	0-15	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, Sand	0-5	Excessively drained	No	A	Low	High	Low	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Histosols	Saprist	Saprist have organic materials are well decomposed, and many support natural vegetation and are used as woodland, rangeland, or wildlife habitat. Some Saprist, particularly those with a mesic or warmer temperature regime, have been cleared, drained, and used as cropland.	Clay, Loamy sand, Muck, Peat, Sandy clay loam	0-1	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Alfisols	Udalf	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Loam, Loamy sand, Sandy loam, Silt loam, Silty clay, Silty clay loam, Very fine sandy loam	0-25	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.	Fine sandy loam, Loam, Silt, Silt loam, Silty clay loam	0-3	Somewhat poorly drained to somewhat excessively drained	No, Yes	B, C	Medium	Moderate, Low	Medium	High, due to hydric soil and poor drainage conditions
Vertisols	Uderts	Uderts are found in humid areas, and primarily used as cropland, forest, or pasture. They have low permeability, and water usually must be drained from the surface of cropland.	Silty clay, Silty clay loam	0-5	Somewhat poorly drained to moderately well drained	No	D	High	Very Low	High	Low
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay, Silt loam, Silty clay	0-2	Somewhat poorly drained	No, Yes	C	Medium	Low	Medium	High, due to hydric soil and poor drainage conditions
Ultisols	Udult	Udults are more or less freely drained, relatively humus poor, and have an udic moisture regime. Most of these soils currently support or formerly supported mixed forest vegetation, and many have been cleared and used as cropland (mostly with the use of soil amendments).	Clay loam, Fine sandy loam, Loam, Loamy sand, Sand, Sandy clay loam, Sandy loam, Silt loam, Stratified loamy sand to sandy clay loam, Stratified weathered bedrock to fine sandy loam	0-45	Moderately well drained to somewhat excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low

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

^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, 2015f). 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 9.1.2.5.

^d The dataset from NRCS is missing the attributes to populate this information.

9.1.2.5. *Runoff Potential*

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

Group A. Sand, loamy sand or sandy loam soils. This group of soils has “low runoff potential and high infiltration rates²⁰ even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission” (Purdue University, 2015). Fluvents, Psamments, and Udults fall into this category in Mississippi.

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

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, Arenets, Fluvents, Orthents, Udalfs, Udepts, Udolls, and Udults fall into this category in Mississippi.

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, Aquults, Saprists, Udalfs, Uderts, and Udults fall into this category in Mississippi.

9.1.2.6. *Soil Erosion*

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

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

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

public safety hazard (NRCS, 1996a). Table 9.1.2-3 provides a summary of the erosion potential for each soil suborder in Mississippi. Soils with medium to high erosion potential in Mississippi include those in the Aqualfs, Aquents, Aquepts, Aquerts, Aquults, Arens, Fluvents, Orthents, Sapristis, Udalfs, Udepts, Uderts, Udolls, and Udupts suborders, which are found throughout most of the state (Figure 9.1.2-2).

9.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (USFWS, 2009a). 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 9.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Mississippi. Soils with the highest potential for compaction and rutting in Mississippi include those in the Aqualfs, Aquents, Aquepts, Aquerts, Aquults, Fluvents, Sapristis, Udepts, and Udolls suborders, which are found throughout the state, but particularly in western areas of the state (Figure 9.1.2-2).

9.1.3. Geology

9.1.3.1. Definition of the Resource

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

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

- Section 9.1.3.3, Environmental Setting Physiographic Regions and Provinces;^{21,22}
- Section 9.1.3.4, Surface Geology;
- Section 9.1.3.5, Bedrock Geology;²³
- Section 9.1.3.6, Paleontological Resources;²⁴
- Section 9.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 9.1.3.8, Geologic Hazards.²⁵

9.1.3.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 9.1.3-1.

Table 9.1.3-1: Relevant Mississippi Geology Laws and Regulations

State Law/Regulation	Agency	Applicability
Mississippi Building Codes	Local Agencies	Check county, city, and other local agencies for seismic guidelines in building codes.

Sources: (The City of Oxford Mississippi, 2015) (The City of Gulfport, 2014) (International Code Council, 2014)

9.1.3.3. Environmental Setting: Physiographic Regions and Provinces

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

Mississippi has one major physiographic region: Atlantic Plain (Coastal Plain Province). The locations of these physiographic divisions are shown in Figure 9.1.3-1 and their general characteristics summarized in the following subsections.

²¹ Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, N., 1916).

²² Physiographic provinces: Subsets within physiographic regions (Fenneman, N., 1916).

²³ Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015b).

²⁴ Paleontology: “Study of life in past geologic time based on fossil plants and animals” (USGS, 2015c).

²⁵ Geologic Hazards: Any geological or hydrological process that poses a threat to people and/or their property, which includes but is not limited to volcanic eruptions, earthquakes, landslides, sinkholes, mudflows, flooding, and shoreline movements (NPS, 2013).

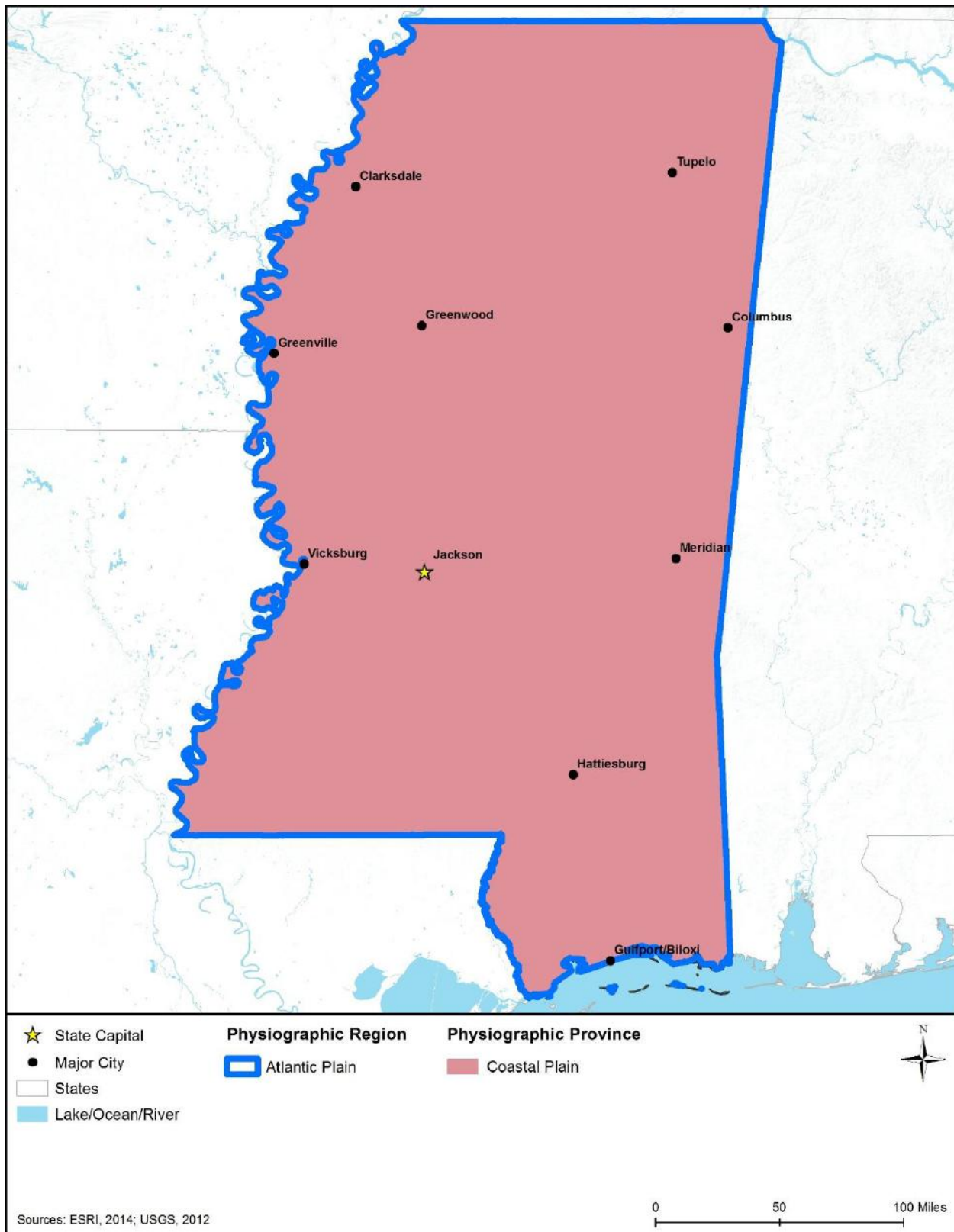


Figure 9.1.3-1: Physiographic Regions and Provinces of Mississippi

Atlantic Plain Region

The Atlantic Plain Region includes the Continental Shelf and the Gulf and Atlantic Coast plains stretching from New York south to Florida and west to Texas. The Atlantic Plain Region formed through the repetitive rise and fall of the oceans over the last 150 million years. Sedimentary strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the Appalachian Mountains, which began to form 480 to 440 million years ago (MYA), dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain.²⁶ (NPS, 2015a)

Coastal Plain Province – As reported above, the Atlantic Plain Region within Mississippi is composed of one physiographic province the Coastal Plain Province (USGS, 2003a). Locally, the physiography varies throughout the state.

In northeastern Mississippi, the Tennessee River Hills generally are roughly 650 feet above sea level (ASL), and are noted for their rugged and steep topography (Mississippi State Geological Survey, 1920). The highest elevation in the state, Woodall Mountain (806 feet ASL), is within Tishomingo County in northeastern Mississippi (MDEQ, 2014a). Elevations decrease to the west and south, in an area referred to as the Black Prairie Belt, and reach 179 feet ASL at Macon, Mississippi. The North-Central Plateau includes parts of 16 counties throughout north-central Mississippi. “As the name suggests, the surface was originally that of a plateau sloping gently southward and westward. The highest railroad point is on the Illinois Central Railroad near Holly Springs, the altitude being 625 feet, though neighboring points reach considerably higher.” (Mississippi State Geological Survey, 1920)

In northwestern and west-central Mississippi, the Yazoo Delta includes the area along the Mississippi River between Memphis (Tennessee) and Vicksburg. “It is a low-lying featureless expanse, sloping gently southward. Its altitude at the Tennessee line is 217 feet [ASL], and at Vicksburg it is 94 [feet ASL].” (Mississippi State Geological Survey, 1920)

The Long Leaf Pine Hills comprise much of southern Mississippi to within 10 to 15 miles of the state’s coastline along the Gulf of Mexico. “It slopes gently from an altitude of more than 400 feet at its northern border to about 150 feet at its southern border.” Furthest south within the state, the Coastal Pine Meadows extends “from the Gulf border inland for a distance of 5 to 25 miles”. The Long Leaf Pine Hills are noted for their minimal relief and elevations that are close to sea level. (Mississippi State Geological Survey, 1920)

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)

9.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,²⁷ 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,²⁸ subsidence,²⁹ and erosion (Thompson, 2015).

Surface geology in Mississippi generally is attributable to marine and fluvial activities. Surface exposures from the Devonian (359 to 318 MYA) and Mississippian (318 to 299 MYA) Periods are found in northeastern Mississippi, while the state's youngest surface deposits are along the Mississippi River and Gulf Coast floodplains. (Dockery III, 1997)

²⁷ 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, 2013a).

²⁸ 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).

²⁹ Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000).

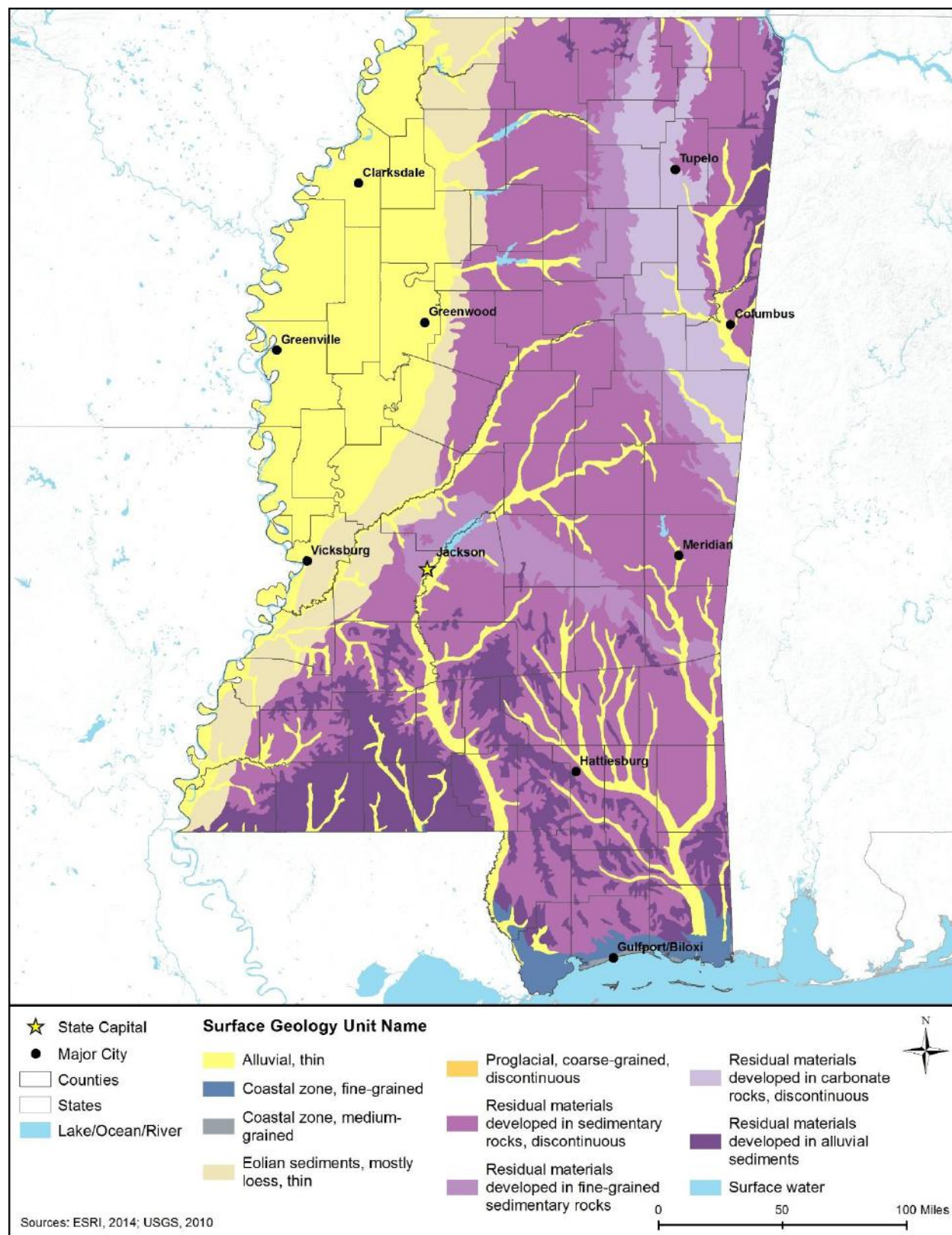
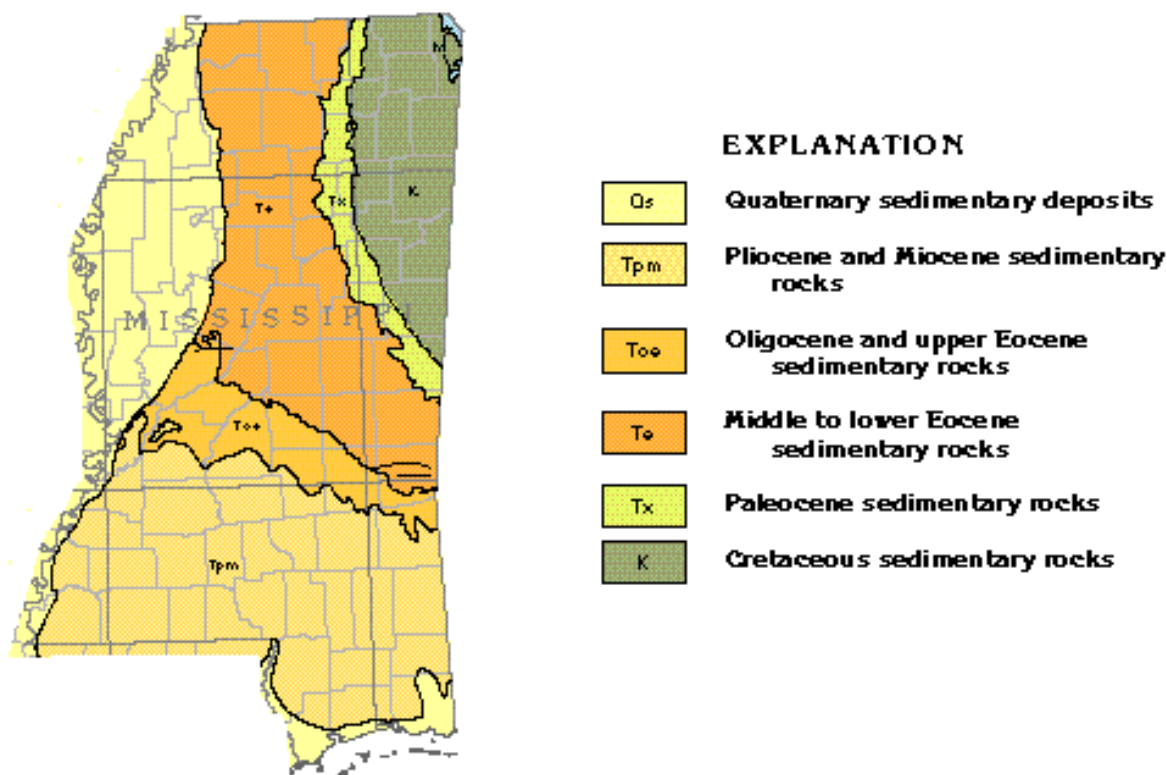


Figure 9.1.3-2: Generalized Surface Geology for Mississippi

9.1.3.5. *Bedrock Geology*

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015e) reveals important information about a region’s surface and subsurface characteristics (i.e., three dimensional geometry), including dip (slope of the formation),³⁰ rock composition, and regional tectonism.³¹ 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 (NDES, 2014).

Mesozoic (251 to 66 MYA) sedimentary rocks underlie Mississippi, and are typically poorly consolidated or unconsolidated clastic³² rocks. Within the Gulf Coast basin, an extensive salt layer from the Jurassic Period (200 to 146 MYA) comprises the lower part of the bedrock, with Cretaceous (146 to 66 MYA) and Tertiary (66 to 2.6 MYA) sedimentary rocks overlying these layers throughout much of the state. A salt-dome basin underlies southern Mississippi, and penetrates most, if not all, of the Tertiary rocks in these locations. These domes range between one and three miles in diameter. (USGS, 1998) Figure 9.1.3-3 displays the generalized bedrock geology for Mississippi.



Source: (USGS, 1998)

Figure 9.1.3-3: Generalized Bedrock Geology for Mississippi

³⁰ 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).

³¹ Tectonism: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust” (USGS, 2015f).

³² Clastic: “A sedimentary rock composed of fragments (clasts) of pre-existing rock or fossils” (USGS, 2015g).

9.1.3.6. *Paleontological Resources*

A deep, oxygen-poor sea covered northeastern Mississippi during the Devonian Period. ” Few organisms could have tolerated these conditions. As a result, fossils from these rocks are limited primarily to plant fragments and the remains of animals that swam above the deeper, oxygen-starved waters” (PP, 2017a). Shallow seas continued into the Carboniferous Period (359 to 299 MYA), as evidenced by the preservation of mollusk, crinoid,³³ brachiopod,³⁴ and trilobite³⁵ fossils from this timeframe. In the late Carboniferous, tectonic activity led to mountain-building events, forming the Southern Appalachian Mountains) and the sea retreated. During the Cretaceous Period (146 to 66 MYA), northeastern Mississippi was again under a shallow sea. This time produced marine fossils such as clams, oysters, snails, crinoids, turtle bones, mosasaurs, shark and fish teeth, crocodiles, hadrosaurs, and theropods . During the Tertiary Period (66 to 2.6 MYA), “warm, tropical seas flooded southern Mississippi”, preserving whale, shark, fish, mollusk, and other invertebrate fossils. Fossilized wood has also been recovered in Mississippi, indicating the presence of forests and swamps (PP, 2017b). The *Basilosaurus*, one of Mississippi’s state fossils, was present in the Eocene Epoch (56 to 34 MYA). Additionally, the *Zygorhiza*, another Mississippi state fossil, was a stout-bodied species that resembled a whale and grew up to 20 feet that also lived during the Eocene Epoch (MDEQ, 1991). During the Quaternary Period (2.6 MYA to present), loess³⁶ deposits preserve manatee, hippo, and short-faced bear fossils (PP, 2017b).



Source: (PP, 2017b)

Mississippi State Fossils
Basilosaurus and *Zygorhiza*

9.1.3.7. *Fossil Fuel and Mineral Resources*

Oil and Gas

In 2016, Mississippi produced 21,075 thousand barrels of oil, which accounted for less than 1 percent of total nationwide production. In December 2016, , Mississippi ranked 13th among oil producing states. Most production occurs in the southern portions of the state (EIA, 2017b) (EIA, 2017c) (EIA, 2017d). Mississippi has three basins from which oil and gas are produced: the Black Warrior Basin, the Mississippi Interior Salt Basin, and the Wilcox Trend (DOE, 2005).

In 2015, Mississippi produced 58,207 million cubic feet, which accounted for 0.2 percent of total nationwide production. This level of production ranked 20th nationwide among natural gas producing states (EIA, 2017b) (EIA, 2017e).

³³ 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).

³⁴ 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).

³⁵ 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).

³⁶ Loess: “A wind-blown deposit of sediment made mostly of silt-sized grains” (USGS, 2015g).

Minerals

As of 2015, Mississippi's nonfuel mineral production was valued at \$220M, ranking 43th in the nation. Mississippi's leading nonfuel mineral commodities were sand and gravel (construction), stone (crushed), clays (fuller's earth), clays (ball), sand and gravel (industrial) (USGS, 2017a). Other minerals produced in the state as of 2013 (the most recent year data was readily available), natural gemstones, bentonite, common clay, sulfur, agricultural lime, salt, concrete, limestone, kaolin, dimension stone, calcareous marl, fuller's earth, steel, and titanium dioxide pigment plant (USGS, 2016a).

In 2015, Mississippi produced 3,143 thousand short tons of coal, which accounted for 0.4 percent of the total nationwide production. This level of production ranked 18th nationwide among coal producing states. Mississippi's Red Hills surface coalmine is one of the largest lignite³⁷ coalmines in the country. (EIA, 2015c) (EIA, 2017f) (EIA, 2017g)

9.1.3.8. Geologic Hazards

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

Earthquakes

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

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale.³⁸ Subduction zone earthquakes occur where Earth's tectonic plates collide. "When tectonic plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth" (ODG, 2015). Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014b). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale (ODG, 2015).

³⁷ Lignite Coal: "A class of brownish-black, low-rank coal defined by the American Society for Testing and Materials as having less than 8,300 Btu on a moist, mineral-matter-free basis" (USGS, 1981).

³⁸ 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, 2014a)

Figure 9.1.3-4 depicts the seismic risk throughout Mississippi; 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 (PGA)) 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)

Between 1973 and March 2012, there were four earthquakes of a magnitude 3.5 (on the Richter scale) or greater in Mississippi although numerous earthquakes that originated in nearby states were often felt in Mississippi (USGS, 2014c). The New Madrid Seismic Zone³⁹ (NMSZ) presents the greatest risk of producing damaging earthquakes within the state. “The earthquakes of 1811-1812, which originated along the New Madrid fault zone, shook many areas in Mississippi, reaching as far south as the Gulf Coast.” It is estimated that 25 counties within Mississippi are at risk of incurring damage from potential future earthquakes within the NMSZ. Another area of relatively frequent earthquake activity is in east-central Mississippi within Lauderdale and Clarke Counties. The White River Fault Zone, within Tallahatchie County,⁴⁰ also has produced earthquakes within the state (MEMA, 2012), including the largest earthquake ever recorded in Mississippi – a magnitude 4.6 earthquake in 1931 (MEMA, 2012).

³⁹ The New Madrid Seismic Zone is a “linear area of seismic activity extending from the southern portion of Illinois to Marked Tree, Arkansas” (about 45 miles from the state’s border with Mississippi) (MEMA, 2012).

⁴⁰ Tallahatchie County is in northwestern Mississippi.

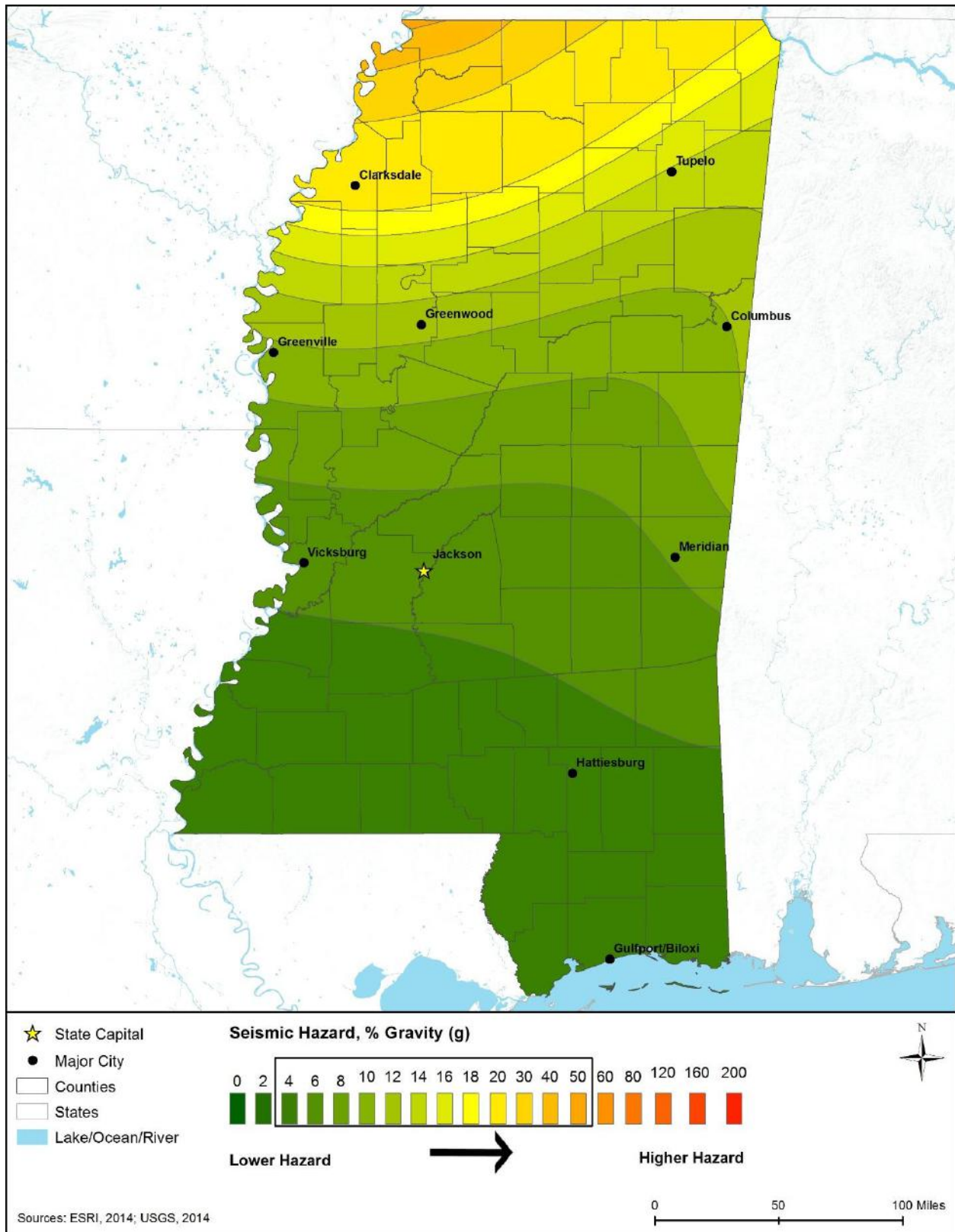


Figure 9.1.3-4: Mississippi 2014 Seismic Hazard Map

Landslides

As shown in Figure 9.1.3-5, portions of Mississippi are at high risk of experiencing landslide events. “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, 2003b). 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, 2003b).

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, 2003b).

According to the USGS’s Landslide Overview Map of the United States, portions of Mississippi are moderately to highly susceptible to experiencing landslides. In particular, areas of southeastern Mississippi that are underlain by Cretaceous (146 to 66 MYA) clays are prone to slump⁴¹ landslides. Within eastern portions of the Mississippi River Valley, loess deposits also are at risk of failure, particularly along steep riverbanks and road cuts. “[The] Lower Mississippi Alluvial Plain within the meander belt of the Mississippi River is susceptible to landsliding; practically all slumps and flows are riverbank failures because of erosion by the river and its tributaries. The upper alluvial valley [is] more susceptible to failure than the lower delta area because fine-grained deposits in the upper valley are underlain by coarse, easily eroded sand at depths to which the river can scour... In the lower delta area, the fine-grained deposits are thicker, [and] bank failures are much less frequent” (Radbruch-Hall, et al., 1982). Figure 9.1.3-5 shows landslide incidence and susceptibility throughout Mississippi.

⁴¹ Slump: “A type of landslide in which a mass of rock breaks away along a curved surface and rotates more or less intact downslope. The sliding mass of rock is called a slump block” (USGS, 2015g).

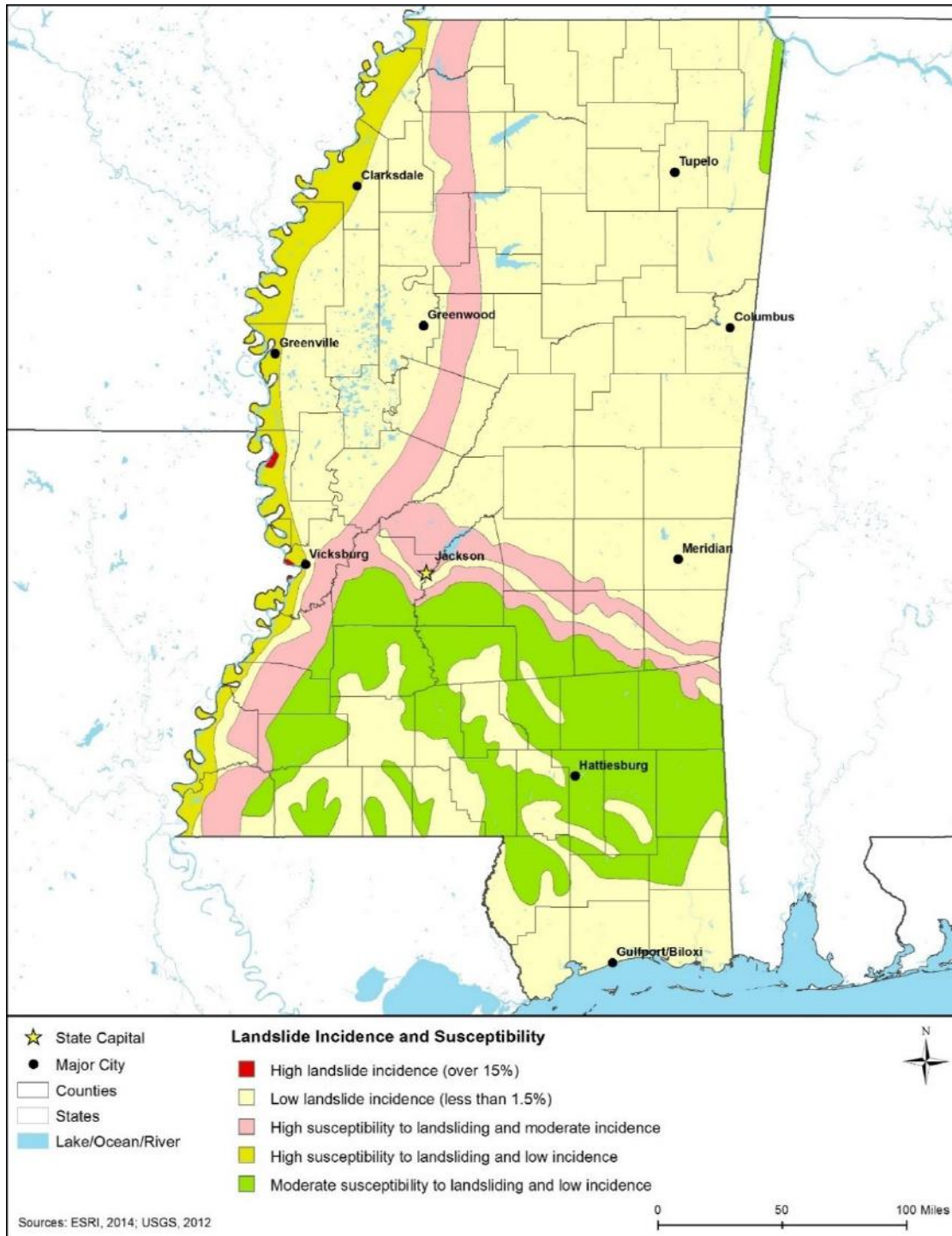


Figure 9.1.3-5: Mississippi Landslide Incidence and Susceptibility Hazard Map⁴²

⁴² Susceptibility hazards not indicated in Figure 9.1.3-5 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014d)

Subsidence

Land subsidence is a “gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials” (USGS, 2000). 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 Mississippi). 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, 2013b)

Although land subsidence is not considered to be a major problem within Mississippi,⁴³ portions of the state are susceptible to land subsidence due to karst⁴⁴ topography. As indicated in Figure 9.1.3-6, a band of carbonate⁴⁵ rocks stretches throughout portions of northeastern Mississippi. There are 44 known karst caves in Mississippi, particularly along the Natchez Trace Parkway within the Pride Mountain Formation, Tuscomb Limestone,⁴⁶ and Fort Payne Chert.⁴⁷ “In southern Mississippi, the Vicksburg Group also is known to have caves; the farthest west caves are located in Rankin County...Karst terrain in the vicinity of Natchez Trace is subtle and consists of minor doline⁴⁸ (hollows in limestone) and internal drainage features. Karst is primarily expressed as springs at Natchez Trace Parkway, for example, in the Colbert Creek area” (NPS, 2010).

⁴³ Land subsidence in Mississippi is excluded from analysis within the Mississippi State Hazard Mitigation Plan (2013). “It was determined hazards initially ranked and identified by 45 percent or fewer of local jurisdictions as hazards of concern do not pose a significant state-level threat to Mississippi.” Land subsidence was included in 6 percent of local plans. (MEMA, 2012)

⁴⁴ Karst Topography: “A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater” (USGS, 2015g).

⁴⁵ Carbonate: “A sedimentary rock made mainly of calcium carbonate (CaCO₃). Limestone and dolomite are common carbonate sedimentary rocks” (USGS, 2015g).

⁴⁶ 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).

⁴⁷ Chert: “A very fine-grained sedimentary rock made of quartz. Usually made of millions of globular siliceous skeletons of tiny marine plankton called radiolarians. Black chert is called flint” (USGS, 2015g).

⁴⁸ Doline: “A depression in the surface commonly found in in karst landscapes” (USGS, 2015g).

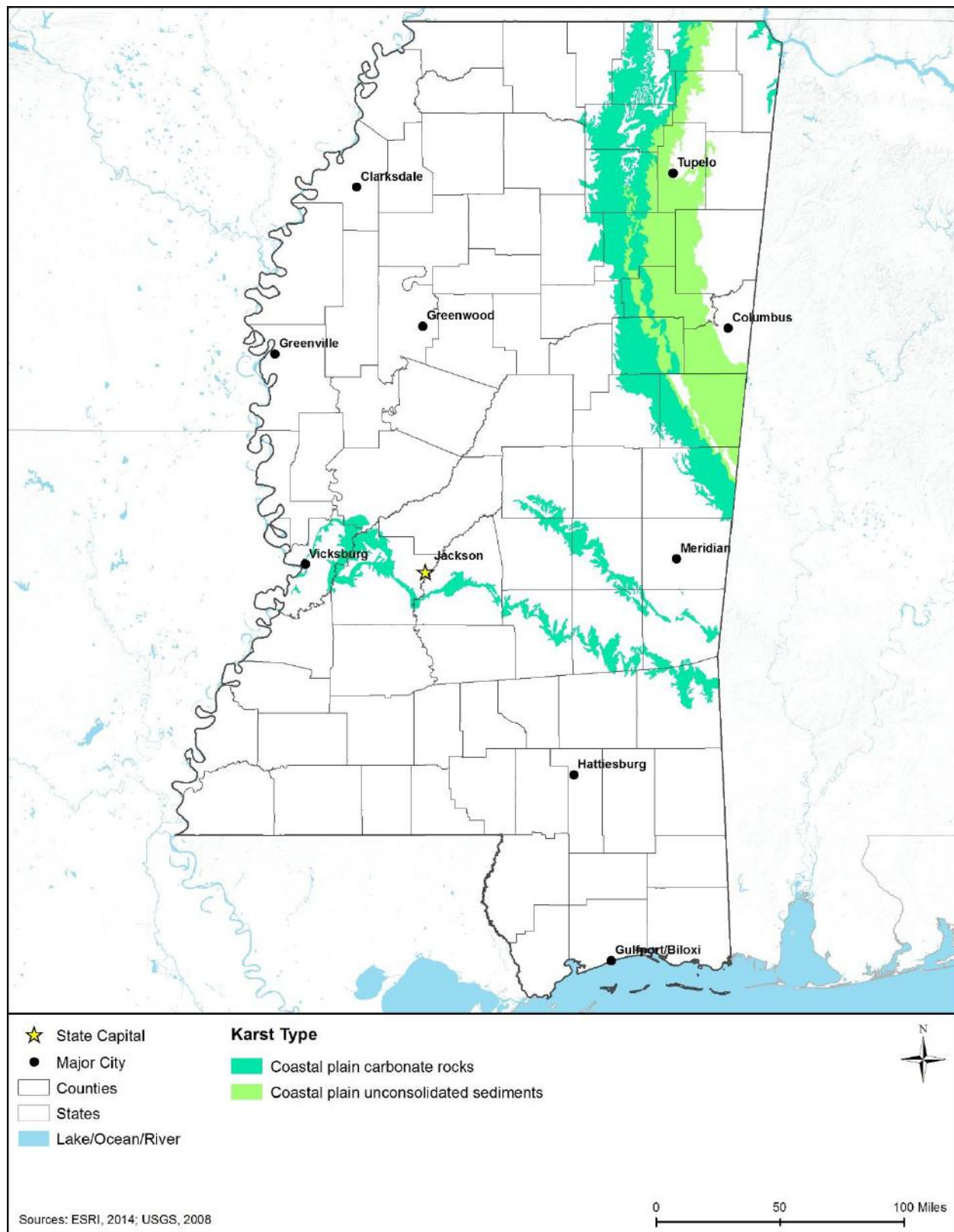


Figure 9.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Mississippi

9.1.4. Water Resources

9.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 9.1.5). These resources can be grouped into watersheds, which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological services health. (USGS, 2014e)

9.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 9.1.4-1 summarizes the major Mississippi laws and permitting requirements relevant to the state's water resources.

Table 9.1.4-1: Relevant Mississippi Water Resources Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
Clean Water Act (CWA) Section 404 Nationwide Permits (NWP), Mississippi regional requirements	U.S. Army Corps of Engineers (USACE) Vicksburg/Mobile Districts	Regional conditions apply to activities authorized by USACE NWPs in Mississippi.
Coastal Wetlands Protection Act	Mississippi Department of Marine Resources (MDMR)	Regulates most activities occurring within wetlands at or below the watermark of ordinary high tide in the state's defined coastal zone boundary.
National Pollutant Discharge Elimination System (NPDES) Program	MDEQ	Regulates the discharge of pollutants in stormwater discharges associated with small and large construction activities that disturb one or more acres.
CWA Section 401 Water Quality Certification	MDEQ	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from MDEQ indicating that the proposed activity will not violate water quality standards.
Regulations for Water Quality Criteria for Intrastate, Interstate, and Coastal Waters (11 Miss. Admin. Code Pt. 6, Ch. 2)	MDEQ	"The policy inherent in the standards shall be to protect water quality existing at the time these water quality standards were adopted and to upgrade or enhance water quality within the State of Mississippi."

Source: (USACE, 2017) (MDMR, 2017) (MDEQ, 2010) (MDEQ, 2017) (USACE Vicksburg District, 2015) (MDMR, 2015a) (MDEQ, 2015a) (MDEQ, 2007a) (MDEQ, 2014b)

9.1.4.3. *Environmental Setting: Surface Water*

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine⁴⁹ and coastal waters. According to the MDEQ, Mississippi has more than 82,000 miles of rivers and streams, approximately 260,000 acres of publicly owned lakes, reservoirs, and ponds, and 758 square miles of estuarine waters. These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, tourism, agriculture, fishing, power generation, and manufacturing across the state. (MDEQ, 2014c)

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). Mississippi's waters (lakes, rivers, and streams) are divided into 9 major watersheds, or drainage basins (Figure 9.1.4-1). Visit www.deq.state.ms.us/mdeq.nsf/page/WMB_Basin for information and additional maps about each MDEQ watershed's location, size, and water quality (MDEQ, 2015a).

North Independent Streams and the Tennessee River Basin drain the area along the northern Mississippi border. The Yazoo River Basin is the state's largest basin and drains an approximate area 13,355 square miles in northern and central Mississippi (MDEQ, 2015c). The Big Black River is south of the Yazoo River Basin, extending from central Mississippi to the western border. The South Independent Streams Basin is located in southwest Mississippi and drains into the Mississippi River. The Pearl River Basin extends from east central to southwest Mississippi, draining an approximate area of 8,000 square miles (MDEQ, 2015c). The Tombigbee River Basin covers northeastern Mississippi, and the Pascagoula River Basin encompasses the southeastern portion of the state. The Coastal Streams Basin is adjacent to south Mississippi's coastline and empties into the Gulf of Mexico (MDEQ, 2015d).

Freshwater

As shown in Figure 9.1.4-1, there are eight major rivers in Mississippi: Mississippi, Yazoo, Big Black, Pearl, Coldwater, Chickasawhay, Pascagoula, and Tombigbee. The Mississippi River and the Pearl River have a combined length of approximately 480 miles, and form Mississippi's western border with Arkansas and Louisiana. The Tombigbee River originates in northeast Mississippi and flows in southward direction toward western Alabama. The Big Black River begins in central Mississippi and flows southwesterly for approximately 300 miles to meet the Mississippi River. The Chickasawhay River, in southeastern Mississippi, is a tributary of the Pascagoula River, which empties into the Gulf of Mexico.

Mississippi also contains hundreds of publicly owned lakes, reservoirs, and ponds covering an approximate area of 260,000 acres. Manmade reservoirs are the largest lakes in Mississippi. These reservoirs provide flood control and drinking water, and support many recreational activities (MDEQ, 2014c).

⁴⁹ 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).

Major reservoirs in Mississippi include (Figure 9.1.4-1): Grenada Reservoir, Enid Reservoir, Sardis Reservoir, Arkabutla Reservoir, and Ross Barnett Reservoir. The Grenada, Enid, Sardis, and Arkabutla reservoirs are located in the central and northern portion of the Yazoo River Basin. (MDEQ, 2014c) Grenada Reservoir covers an approximate surface area of 9,800 acres, and was originally constructed for flood control. In addition, the reservoir provides a critical habitat for wildlife in the surrounding area (USACE, 2015a). Sardis Reservoir is located north of Grenada Reservoir and encompasses approximately 32,500 acres. This reservoir is used for flood control and is a popular site for recreational activities (USACE, 2015b). Ross Barnett Reservoir is located in the Pearl River Basin and is a drinking water source for residents in Jackson, Mississippi (MDEQ, 2014c).

Estuarine and Coastal Waters

Estuaries (including bays and tidal rivers) are bodies of water that provide transition zones between fresh river water and saline ocean water. Barrier islands, sand bars, and other landmasses protect estuaries, including those in Mississippi, from ocean waves and storms. Mississippi's estuarine environments support a variety of habitats, including tidal wetlands, mudflats, rocky shores, oyster reefs, freshwater wetlands, sandy beaches, and eelgrass beds, and are a critical part of the lifecycle of many different plant and animal species. (USEPA, 2012a)

There are approximately 758 square miles of estuarine waters (MDEQ, 2014c). Minor bays that drain into the Mississippi Sound include (Figure 9.1.4-2): Back Bay of Biloxi, Mississippi Sound, and Pascagoula Bay. In addition, the Grand Bay National Estuarine Research Reserve (NERR) is located in far southeastern Mississippi, and covers approximately 18,400 acres. Established in 1999, waters within the reserve are designated as Critical Resource Waters.⁵⁰ The Grand Bay NERR is managed through a partnership between local, state, and federal agencies to “promote estuarine research and education within Mississippi’s Coastal Zone and its adjacent ecosystems” (MDMR, 2015b).

⁵⁰ “Critical resource waters include marine sanctuaries and marine monuments managed by the National Oceanic and Atmospheric Administration, and National Estuarine Research Reserves. District Engineers may designate additional critical resource waters, after notice and an opportunity for public comment” (ILDNR, 2015).

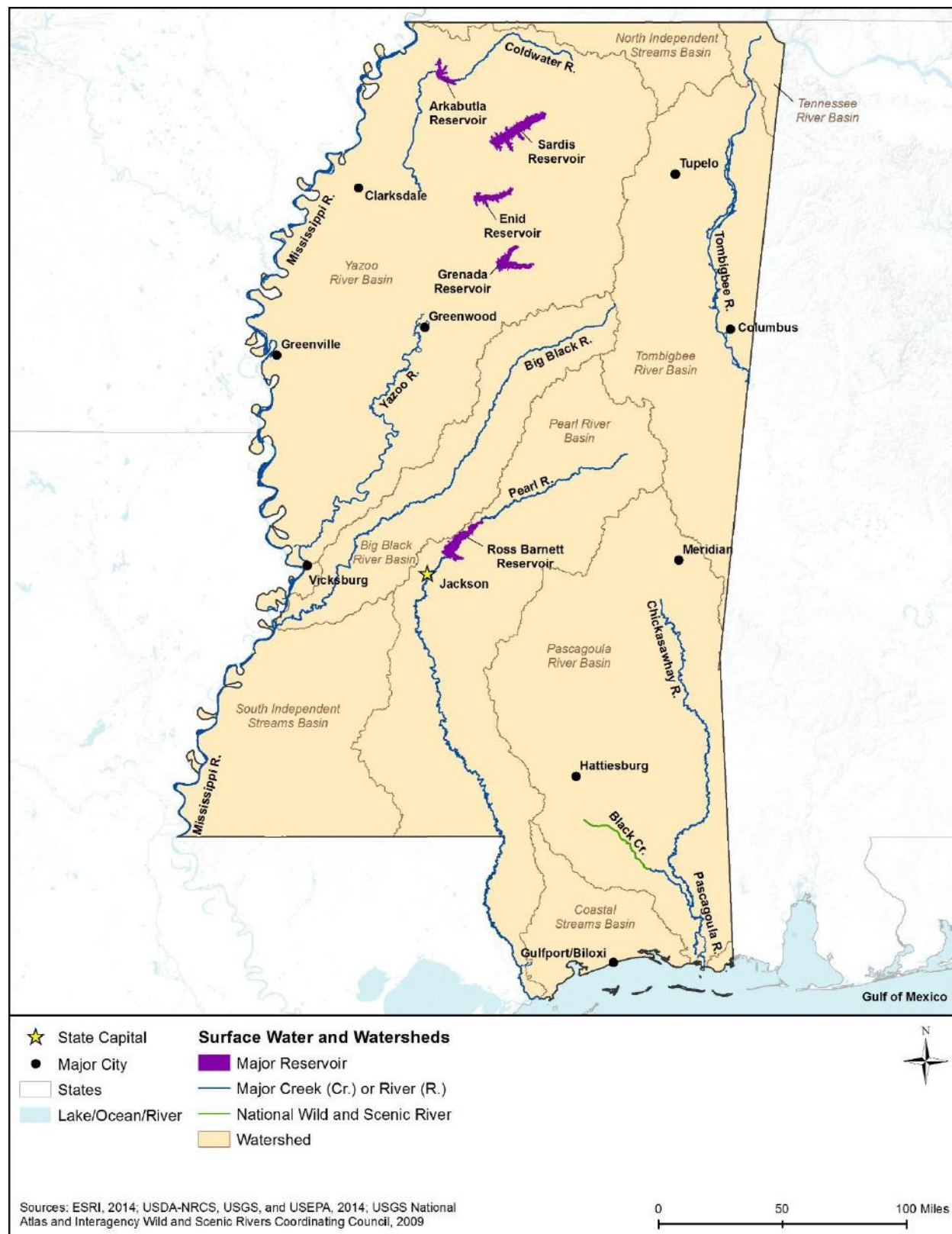


Figure 9.1.4-1: Major Mississippi Watersheds and Surface Waterbodies

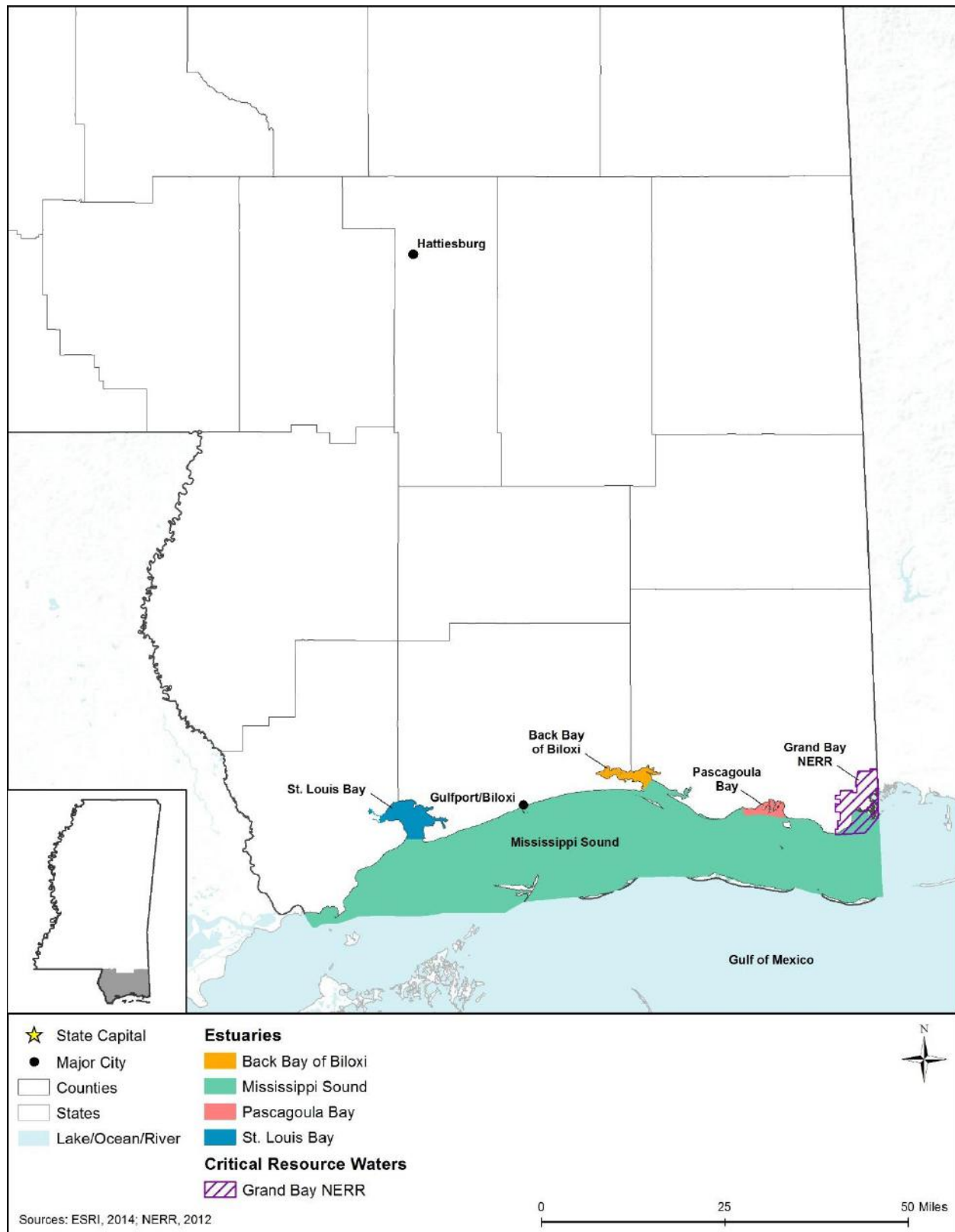


Figure 9.1.4-2: Mississippi's Estuaries and Critical Resource Waters

9.1.4.4. *Environmental Setting: Sensitive or Protected Waterbodies*

Wild and Scenic Rivers

The Black Creek (Figure 9.1.4-1) is a federally designated National Wild and Scenic River in Mississippi. The segment of river includes 21 miles designated as scenic. The river is characterized by “deep, black water, colorful vertical bluffs and contrasting white sand bars” as it travels through the coastal plain of Mississippi. The river provides a habitat for many plants and wildlife, and often has trees and flowering shrubs overhanging its banks. Black Creek also supports a variety of recreational opportunities, such as backpacking, fishing, and camping. (National Wild and Scenic Rivers, 2015a)

9.1.4.5. *Impaired Waterbodies*

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue, are used to evaluate water quality. Under Section 303(d) of the Clean Water Act, states are required to assess water quality and report a listing of impaired waters,⁵¹ the causes of impairment, and probable sources. Table 9.1.4-2 summarizes the water quality of Alabama’s assessed major waterbodies by category, percent impaired, designated use,⁵² cause, and probable sources. Figure 9.1.4-3 shows the Section 303(d) waters in Mississippi as of 2014.

As shown in Table 9.1.4-2, various sources affect Mississippi’s waterbodies, causing impairments. For example, a main cause of impairment for major rivers in Mississippi, such as the Big Black, Pearl, and Tombigbee, is biological impairment (MDEQ, 2014d). Designated uses for impaired rivers include aquatic life, fishing, and recreation. In addition, Mississippi lakes are threatened by elevated levels of mercury and pesticides. MDEQ monitors pesticide levels in the Yazoo River Basin, and maintains a fish tissue monitoring program to determine extent of mercury contamination in the state’s waters. MDEQ issues fish consumption advisories for various waterbodies throughout the state including the Gulf of Mexico. (MDEQ, 2014c)

⁵¹ Impaired waters: waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters. (USEPA, 2015a)

⁵² Designated Use: an appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply. (USEPA, 2015a)

Table 9.1.4-2: Section 303(d) Impaired Waters of Mississippi, 2014

Water Type^a	Amount of Waters Assessed^b (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	7%	68%	aquatic life, fishing, and primary and secondary contact recreation	biological impairment, sediment, nutrients, mercury, and pathogens ^c	unknown sources and industry
Lakes, Reservoirs, and Ponds	22%	43%	aquatic life and fishing	mercury, nutrients organic enrichment, and pesticides	unknown sources
Gulf coastal shoreline	11%	3%	aquatic life and primary contact recreation	pathogens and nutrients	unknown sources

Source: (USEPA, 2014a)

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

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

^c Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015a).

Pathogen and nutrients have affected waters along Mississippi's Gulf coastal shoreline, causing impairments. MDEQ has established the Mississippi Coastal Assessment Program to monitor water quality in Mississippi estuarine waters. Further, the MDEQ Coastal Beach Monitoring Program assesses recreation use support in waters along the state's coastal shoreline. According to the Mississippi 2014 Section 305(b) Water Quality Assessment Report, approximately 25 miles of Mississippi's 42 miles of public beaches were assessed. Of these assessed beaches, approximately 59 percent attained primary contact recreation. Mississippi beaches are continually monitored to ensure safe swimming conditions for residents and visitors. (MDEQ, 2014c)

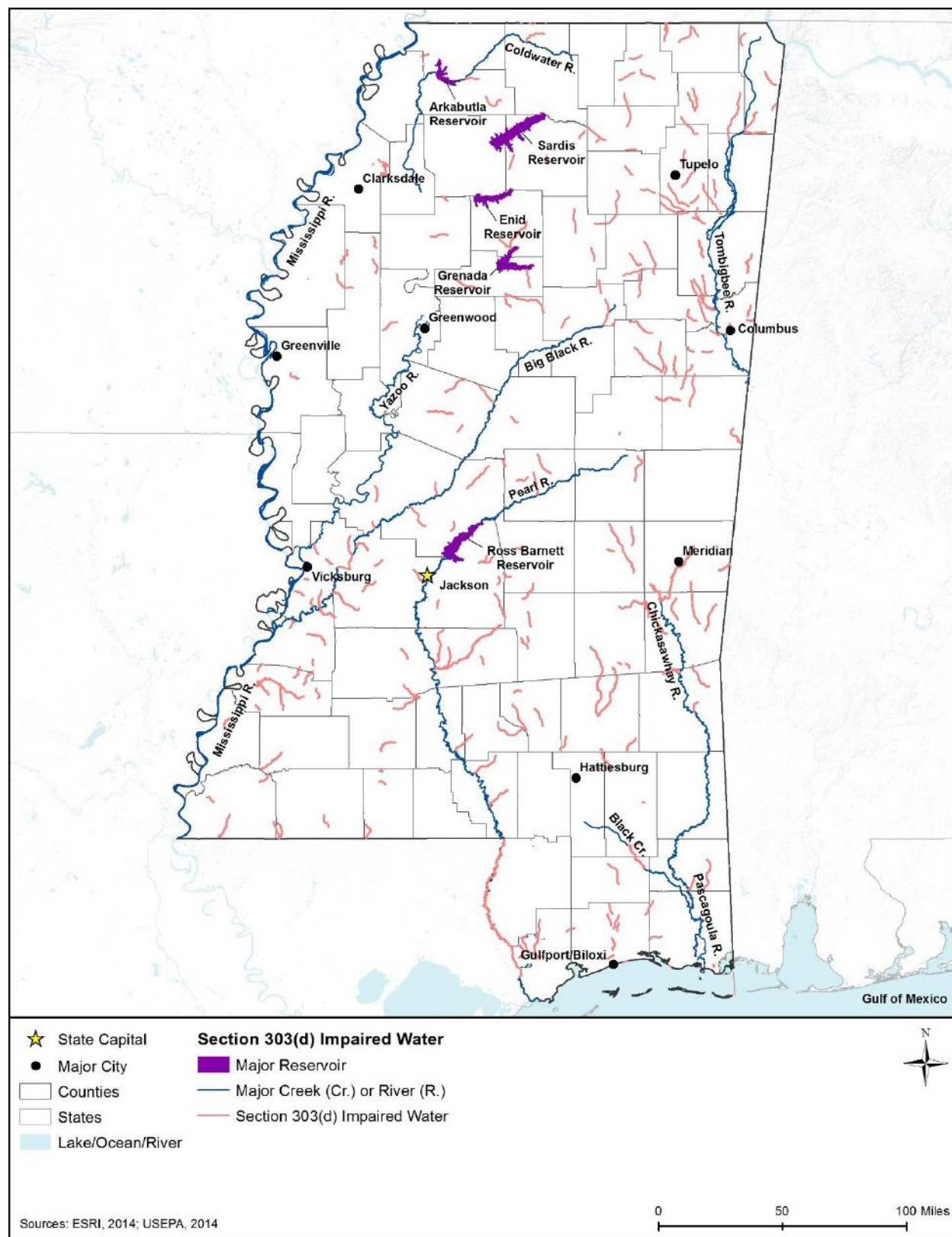


Figure 9.1.4-3: Section 303(d) Impaired Waters of Mississippi, 2014

9.1.4.6. Floodplains

The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as “any land area susceptible to being inundated by water from any source” (44 Code of Federal Regulations [CFR] 59.1) (FEMA, 2000).⁵³ 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).

There are two primary types of floodplains in Mississippi.

- **Riverine and lake floodplains** occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In steep river valleys 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).
- **Coastal floodplains** in Mississippi occur in lands bordering the Mississippi Sound. Coastal flooding can occur when strong wind and storms, usually nor’easters and hurricanes, increase water levels on the adjacent shorelines (FEMA, 2013). In addition, a storm surge event that takes place during high tide can cause floodwaters to exceed normal tide levels, resulting from strong winds preventing tidal waters to recede in conjunction with additional water pushed toward the shore, as was the case during Hurricane Katrina (NOAA, 2015a).

⁵³ 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, 2015b). There are several causes of flooding in Mississippi, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, hurricanes or tropical storms, over-development/impervious⁵⁴ surfaces, and dam failure (Mississippi Emergency Management Agency, 2013).

Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. Based on historical flooding and flood disaster declarations, tidal flood problems are most severe in the Pearl River, Gulf Coast, and Pascagoula River basins (see Figure 9.1.4-1). From 1984-2013, 18 flood events have resulted in federally declared major disasters. Every county in the state has experienced at least one flood disaster declaration since 1993. (Mississippi Emergency Management Agency, 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 330 communities in Mississippi through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities “to adopt and enforce floodplain management regulations and to implement broader floodplain management programs” and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Mississippi had 31 communities participating in the CRS (FEMA, 2014d).⁵⁵

Hurricane Katrina

In 2005, Hurricane Katrina made landfall at the mouth of the Pearl River in Mississippi. The hurricane produced widespread flooding across the state, affecting 26 counties. Approximately five to eight inches of rain was produced over a six to ten hour period, flooding many county and secondary roads for a long period. (Mississippi Emergency Management Agency, 2013) The heaviest rain fell in southeast, central, and northeast Mississippi. Total estimated damage within the state is approximately \$7.4 billion, including \$1.5 billion in agricultural losses. (NOAA, 2015a)



Source: (FEMA, 2006)

⁵⁴ Impervious: a hardened surface or area that does not allow water to pass through. For example, roads, rooftops, driveways, sidewalks, pools, patios, and parking lots are all impervious surfaces (USEPA, 2015a).

⁵⁵ A list of the 31 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014e) and additional program information is available from FEMA’s NFIP CRS website: www.fema.gov/national-flood-insurance-program-community-rating-system.

9.1.4.7. Groundwater

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface, and includes underground water that occupies pore spaces between sand, clay, or rock particles. An aquifer is a permeable geological formation that stores or transmits water to wells and springs. Groundwater is contained in either confined (bound by clays or nonporous bedrock) or unconfined (no layer to restrict the vertical movement of groundwater) aquifers. 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).

Mississippi's principal aquifers consist of carbonate-rock⁵⁶ and sandstone aquifers.⁵⁷ Groundwater resources provide more than 90 percent of Mississippi's drinking water supply. Generally, the water quality of Mississippi's aquifers is suitable for drinking and daily water needs. Statewide, the most serious threats to groundwater quality include leaking underground storage tanks containing petroleum-based products and faulty septic systems, discharge from hazardous waste landfills and industrial contamination, chemical spills, pesticide application, and saltwater intrusion (saltwater moving into freshwater aquifers). (MDEQ, 2015e)

Table 9.1.4-3 provides details on aquifer characteristics in the state. Figure 9.1.4-4 shows Mississippi's principal and sole source aquifer.

⁵⁶ 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).

⁵⁷ 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)

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

Aquifer Type and Name	Location in State	Groundwater Quality
Coastal Plain aquifer system in semi-consolidated sand (Coastal lowlands aquifer system) consists of sand, silt, and clay.	Southern half of the state	Small concentration of dissolved solids but salinity increases as it moves toward the coast. In addition, as the water approaches the coastline, it becomes more mineralized. Water is used primarily for public supply purposes. Industrial uses are mainly for mining and thermoelectric power.
Coastal Plain aquifer system in semi-consolidated sand (Mississippi Embayment aquifer system) consists of sand, silt, and clay.	Central part of the state stretching west from Meridian to the center of the state, then north to the border with Tennessee	Generally, the water is suitable for most uses. In the north, contains low amount of dissolved solids. Water concentration is of moderate salinity closer to the coast. Main use is for domestic and commercial use. Other uses include agriculture and industry for mining, and thermoelectric power.
Coastal Plain aquifer system in semi-consolidated sand (Southeastern Coastal Plain aquifer system) consists of gravel, sand, clay, and limestone.	Northeast corner of the state	Water is generally suitable for most uses. Contain median levels of dissolved-solids concentrations and is hard. Primary use is agricultural while other uses include public supply, domestic and commercial use.
Mississippi River Valley alluvial aquifer consists of gravel, coarse sand, silt, and clay.	Western central to northwestern part of the state	Majority of water is calcium bicarbonate type with lower level of dissolved solids. Quality of water is generally suitable for most uses though primary use is industrial and agricultural.

Sources: (Moody, Carr, Chase, & Paulson, 1986) (Renken, 1998)

Sole Source Aquifers

The U.S. Environmental Protection Agency (USEPA) defines sole source aquifers (SSAs) as “an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer” and are areas with no other drinking water sources (USEPA, 2015b). Mississippi has one designated SSA within the state (as shown in Figure 9.1.4-4). The Southern Hills Regional SSA is located in southwest Mississippi between the Mississippi and Pearl rivers and south to the Louisiana state line. Designating a groundwater resource as an SSA helps to protect the drinking water supply in that area and requires reviews for all federally funded proposed projects to ensure that the water source is not jeopardized. (USEPA, 2015b)

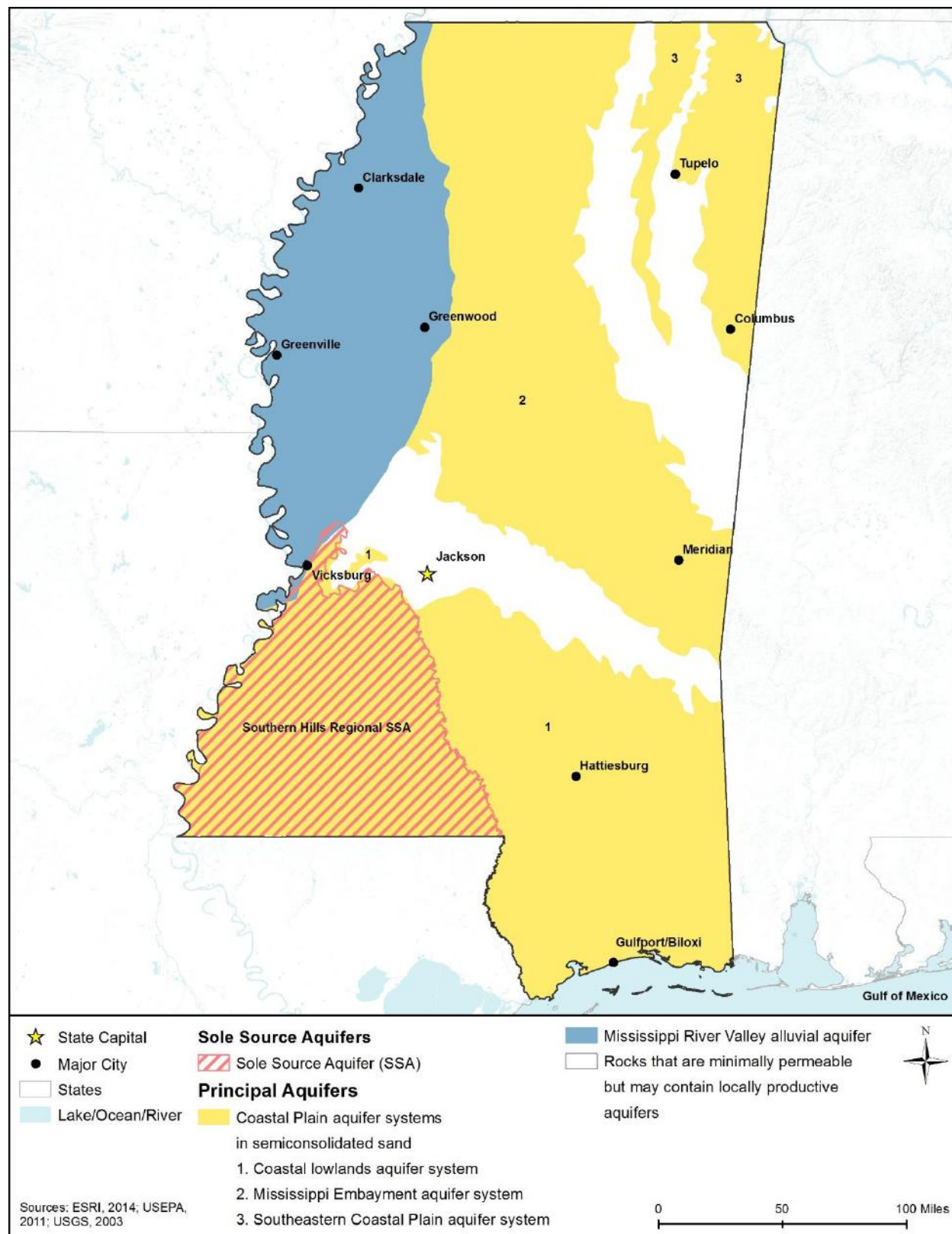


Figure 9.1.4-4: Principal and Sole Source Aquifers of Mississippi

9.1.5. Wetlands

9.1.5.1. Definition of the Resource

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

The USEPA estimates that “more than one-third of the United States threatened and endangered species live only in wetlands, and nearly half of such species use wetlands at some point in their lives” (USEPA, 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, 1995)

9.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 9.1.6-1 summarizes the major Mississippi state laws and permitting requirements relevant to the state’s wetlands.

Table 9.1.5-1: Relevant Mississippi Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
Clean Water Act (CWA) Section 404 Nationwide Permits (NWP), Mississippi regional requirements	USACE Vicksburg/Mobile Districts	Regional conditions to all NWPs authorized by USACE in the Coastal Zone of Mississippi, which includes Hancock, Harrison, and Jackson Counties, and for activities in the Grand Bay National Estuarine Research Reserve.
Coastal Wetlands Protection Act	Mississippi Department of Marine Resources (MDMR)	Regulates most activities occurring within wetlands at or below the watermark of ordinary high tide in the state’s defined coastal zone boundary.
National Pollutant Discharge Elimination System (NPDES) Program	MDEQ	Regulates the discharge of pollutants in stormwater discharges associated with small and large construction activities that disturb one or more acres
CWA Section 401 Water Quality Certification	MDEQ	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from MDEQ indicating that the proposed activity will not violate water quality standards

Sources: (USACE, 2017) (MDMR, 2017) (MDEQ, 2010) (USACE Vicksburg District, 2015) (MDMR, 2015a) (MDEQ, 2015a) (MDEQ, 2007a)

9.1.5.3. *Environmental Setting: Wetland Types and Functions*

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 9.1.5-2:). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats (USFWS, 2015a).

- “The Marine System consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the Water Regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except outside the mouths of estuaries.” Where wave energy is low, mangroves, or mudflats may be present.
- “The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and the ocean water is at least occasionally diluted by freshwater runoff from the land.”
- “Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt.”
- 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 the salinity due to ocean-derived salts is below 0.5 percent.” The System is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013)

Historically, Mississippi had approximately 10 million acres of wetlands, and “today almost 60 percent of these wetlands have been lost” (MDEQ, 2007a). In Mississippi, palustrine (freshwater) wetlands found on river and lake floodplains along the western and eastern half of the state, as shown in (Chapman et. al., 2004) Figure 9.1.5-1, while estuarine/marine wetlands are found in the southern portion of the state. There are approximately 57,000 acres of estuarine wetlands in Mississippi (USFWS, 2014a). Riverine and lacustrine wetlands, as defined in Table 9.1.5-2, comprise less than one percent of the wetlands in the state, and are therefore, they are not discussed in this PEIS.

Table 9.1.5-2 uses 2014 NWI data to characterize and map Mississippi wetlands on a broad-scale.⁵⁸ 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. The map codes and colorings in Table 9.1.5-2: correspond to the wetland types in the figures.

Table 9.1.5-2: Mississippi 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, often on forested lowlands within the state	3,830,013
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Throughout the state, often on river and lake floodplains	
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.	Eastern part of the state and along the coast	136,831
Palustrine unconsolidated bottom	PUB	PUB and PAB wetlands are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Southern part of the state along the coast	171,444
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	2,214
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	14,714

⁵⁸ 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.

Wetland Type	Map Code and Color	Description ^a	Occurrence	Amount (acres) ^b
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.	Western part of the state	18,332
Estuarine and Marine intertidal wetland	E2/M2	These intertidal wetlands include the areas between the highest tide level and the lowest tide level. Semidiurnal tides (two high tides and two low tides per day) periodically expose and flood the substrate. Wetland examples include vegetated and non-vegetated brackish (mix of fresh and saltwater), and saltwater marshes, shrubs, beaches, sandbars, or flats.	Southern part of the state along the coast	57,617
TOTAL				4,231,165

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

^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)

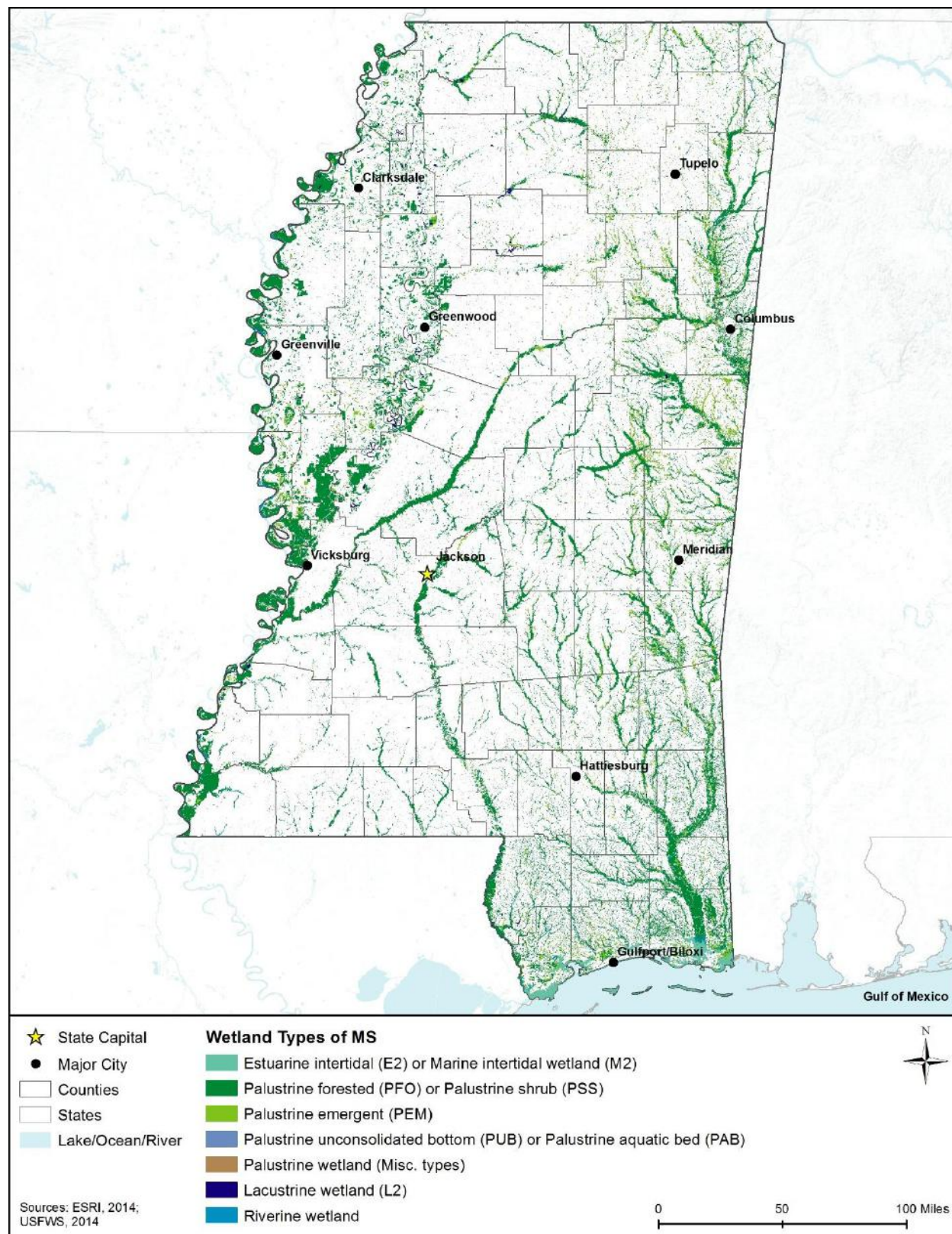


Figure 9.1.5-1: Wetlands by Type, in Mississippi, 2014

Palustrine Wetlands

In Mississippi, palustrine wetlands include the majority of vegetated freshwater wetlands (forested wetlands, freshwater marshes, swamps, and ponds). Palustrine forested wetlands (PFO) are found throughout the state and are the most common type of palustrine wetlands within Mississippi. Common types of PFO in Mississippi include cypress swamps, hardwood swamps, and bayhead swamps. Palustrine scrub-shrub wetlands (PSS) occur throughout Mississippi, usually found in previously disturbed areas. Common vegetative species in Mississippi PSS are willow (*Salix* spp.), wax myrtle (*Morella cerifera*), buttonbush (*Cephalanthus occidentalis*), and silver maple saplings (*Acer saccharinum*). Mississippi marshes occur in shallow water along the northern boundary of coastal marshes, and along coastal bays, and support diverse plant and animal species. Common marsh plants in Mississippi include cattail (*Typha latifolia*), sedges (*Eleocharis* spp.), prairie cordgrass (*Spartina pectinata*), and duckweed (*Lemna minor*) (NPS, 2015b). PEM are common in the eastern part of the state and along the coastline (USFWS, 2014a).

Based on the USFWS NWI 2014 analysis, there are currently approximately 4.1 million acres of palustrine (freshwater) wetlands in the state. Of those, PFO/PSS wetlands are the dominant wetland type (93 percent), followed by PUB/PAB (ponds) (4 percent), PEM wetlands (3 percent), and other palustrine wetlands (less than 1 percent) (USFWS, 2017a).

Estuarine and Marine Wetlands

In Mississippi, estuarine, or tidal fringe wetlands, can be vegetated (salt marshes) or unvegetated (mud and sand flats), and are found between the open saltwater of the bays or the Gulf of Mexico and the uplands of the coastal plain and barrier islands. These wetlands are found along Mississippi's shoreline, as shown in Figure 9.1.5-1. Salt marshes are the primary coastal habitat along the Gulf of Mexico. Mississippi's coastal wetlands provide valuable habitat for shrimp, blue crab, oysters, and various fish species. (Fluery, 2000)

Since 1973, regulation under the Mississippi Coastal Wetlands Protection Law and the establishment of the Mississippi Coastal Program has proactively protected estuarine wetlands and curbed substantial loss from construction and development in the state.

For example, between 1930 and 1973 approximately 8,170 acres of estuarine wetlands were lost from development. In 1973, there were approximately 66,000 acres of coastal wetlands. However, under the state's "No net loss" policy enacted by the Mississippi Coastal Wetlands



Source: (USDA, 2015a)

Figure 9.1.5-2: Mississippi Estuarine Wetland

Protection Law, in 1999 the state contained approximately 64,000 acres of coastal wetlands. (MDMR, 1999a)

Coastal development and urban expansion has historically caused great losses to estuarine wetlands in Mississippi. Although these ecosystems are now protected by state and local regulations, such as the Mississippi Coastal Wetlands Protection Law and Coastal Preserves Program, habitat loss still occurs due to natural processes and adverse human influences (e.g., coastal development, inputs of excess sediments and nutrients). (MDMR, 1999b)

9.1.5.4. Wetlands of Special Concern or Value

In addition to protections under state's regulations and national CWA, Mississippi considers certain wetland communities, specifically estuarine wetlands along the Gulf coast, as areas of special value due to their global or regional scarcity, local/national importance, or habitat they support.

Protected Wetland Areas

Because of the ongoing significant coastal wetland losses along the Gulf Coast, the USEPA has been working with the Gulf of Mexico Program to “improve water quality in the region, improve coastal community resilience, increase environmental education about the importance of the Gulf of Mexico, and restore critical habitat in the Gulf of Mexico” (USEPA, 2015c). As part of this collaboration, the USEPA and Gulf of Mexico Program developed the Gulf Ecological Management Site (GEMS) Program in order to acquire information about coastal wetland sites and make them accessible to the public through the Internet. Mississippi has 21 coastal preserve sites included in the GEMS program. More information on the Mississippi GEMSs is available at www.dmr.ms.gov/index.php/mississippi-gems#sthash.7tZKNvx9.dpuf.

Mississippi's coastal zone serves as habitat for numerous fish and wildlife species. In 1999, Grand Bay was designated as part of the National Estuarine Research Reserve System (NERRS), which is administered by NOAA. The Grand Bay Reserve includes approximately 18,000 acres and was selected because of the biological diversity of the region's ecosystems. The reserve supports “rare and endangered plant and animal species, important marine fisheries, and archeological sites.” It is comprised of a variety of habitats, including coastal bays, saltwater marshes, maritime pine forests, pine savanna, and pitcher plant bogs. As part of the NERR System, “the site is protected for long-term research, water-quality monitoring, education, and coastal stewardship.” More information on the Grand Bay NERR is available at <http://nerrs.noaa.gov/reserves/grand-bay.html>. (NOAA, 2015c)

Other Important Wetland Sites in Mississippi

- Wildlife Management Areas are designated for outdoor recreation; these public lands include over 665,000 acres, including wetlands (MDWFP, 2015a). To learn more about state Wildlife Management Areas, visit www.mdwfp.com/wildlife-hunting/wmas.aspx.
- National Natural Landmarks in Mississippi range in size from 13 acres to over 260 acres, and are owned by a variety of landowners including the U.S. Forest Service (USFS) and private

individuals (NPS, 2012a). Section 9.1.8, Visual Resources, describes Mississippi'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 Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, and easements managed by national and local nonprofit natural resource conservation groups such as The Nature Conservancy, Grand Bay National Estuarine Research Reserve, and Land Trust for the Mississippi Coastal Plain (USGS, 2015h). According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (<http://conservationeasement.us/>), the NRCS holds approximately 176,000 acres in conservation easements in Mississippi (NCED, 2015).

9.1.6. Biological Resources

9.1.6.1. *Definition of the Resources*

This section describes the biological resources of Mississippi. Biological resources include terrestrial⁵⁹ vegetation, wildlife, fisheries and aquatic⁶⁰ habitats, and threatened⁶¹ and endangered⁶² species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources.

Mississippi has a high range of biological diversity⁶³ within the state. It contains barrier islands and coastal lowlands, large river floodplain forests, rolling and hilly coastal plains with evergreen and deciduous forests, and a variety of aquatic habitats. Each of these topics is discussed in more detail below. (Chapman et. al., 2004)

9.1.6.2. *Specific Regulatory Considerations*

The federal laws relevant to the protection and management of biological resources in Mississippi are summarized in detail in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 9.1.6-1 summarizes major state laws relevant to Mississippi's biological resources.

⁵⁹ Terrestrial: "Pertaining to land" (USEPA, 2016a).

⁶⁰ Aquatic: "Pertaining to water" (USEPA, 2016a).

⁶¹ 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)) (USEPA, 2016a).

⁶² 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)) (USEPA, 2016a).

⁶³ Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2016a).

Table 9.1.6-1: Relevant Mississippi Biological Resources Laws and Regulations

Law/Regulation	Regulatory Agency	Summary
Plant Act 2014 Sections 69-25-1 to 69-25-47	Mississippi Department of Agriculture and Commerce	Protection of the agricultural and horticultural interests of the state from the introduction and spread of injurious insects and plant diseases within the state.
Nongame and Endangered Species Conservation Act Sections 49-5-101 to 49-5-119	Mississippi Department of Wildlife, Fisheries and Parks (MDWFP)	Outlines management and protection of non-game and endangered species in Mississippi.
Fisheries and Wildlife Management Law of 1970 Sections 49-3-1 to 49-3-17	Mississippi Department of Marine Resources	Establishes a program for the discovery and dissemination of knowledge concerning the management and proper utilization of fish and game resources in Mississippi.
Mississippi Natural Heritage Law of 1978 Sections 49-5-141 to 49-5-157	MDWFP	Provides a registration and dedication procedure by which owners of natural areas may voluntarily agree to manage and protect their areas as natural resources.
Coastal Wetlands Protection Act Sections 49-27-1 to 49-27-71	MDWFP	Provides for the preservation of the natural state of the coastal wetlands and their ecosystems and to prevent the despoliation and destruction of them.

Sources: (MDMR, 2017) (Mississippi Department of Agriculture and Commerce, 2014) (Michigan State University, 2016) (State of Mississippi, 2013h) (State of Mississippi, 2012)

9.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology,⁶⁴ soils, climate,⁶⁵ and water of a given geographic area and correlates with distinct areas identified as ecoregions.⁶⁶ Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (NWR, 2015) (USDA, 2015b) (WWF, 2015). Ecoregion boundaries often coincide with physiographic⁶⁷ regions of a state. One main physiographic region makes up Mississippi, the Atlantic Plain (Fenneman, N., 1916). 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

⁶⁴ USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and groundwater availability.

⁶⁵ Climate: “The average weather conditions in a particular location or region at a particular time of the year. Climate is usually measured over a period of 30 years or more” (USEPA, 2015d).

⁶⁶ Ecoregion: “A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables” (USEPA, 2015d).

⁶⁷ Physiographic: “The natural, physical form of the landscape” (USEPA, 2015d).

by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions (USEPA, 2016b). This Section provides an overview of the terrestrial vegetation resources for Mississippi at USEPA Level III. (USEPA, 2016b)

As shown in Figure 9.1.6-1, USEPA Level III Ecoregions in Mississippi, the USEPA divides Mississippi into four Level III ecoregions. The entire western ecoregion is generally aligned with the Mississippi River area and makes up the Mississippi Alluvial Plain. The central part of the state from the north to the south is the Mississippi Valley Loess Plain. The entire eastern border and southern half of the state is within the lower-lying Southeastern Plains ecoregion and Mississippi's relatively small coastline in the southeastern part of the state is part of the Southern Coastal Plain ecoregion. These two plains ecoregions are part of the Atlantic Plain physiographic region. The changes in elevation and latitude from the higher elevations in the northern areas of the state to the Gulf Coast provide for a diverse array of abiotic⁶⁸ conditions and vegetative communities. (Chapman et. al., 2004)

⁶⁸ 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, 2016c).

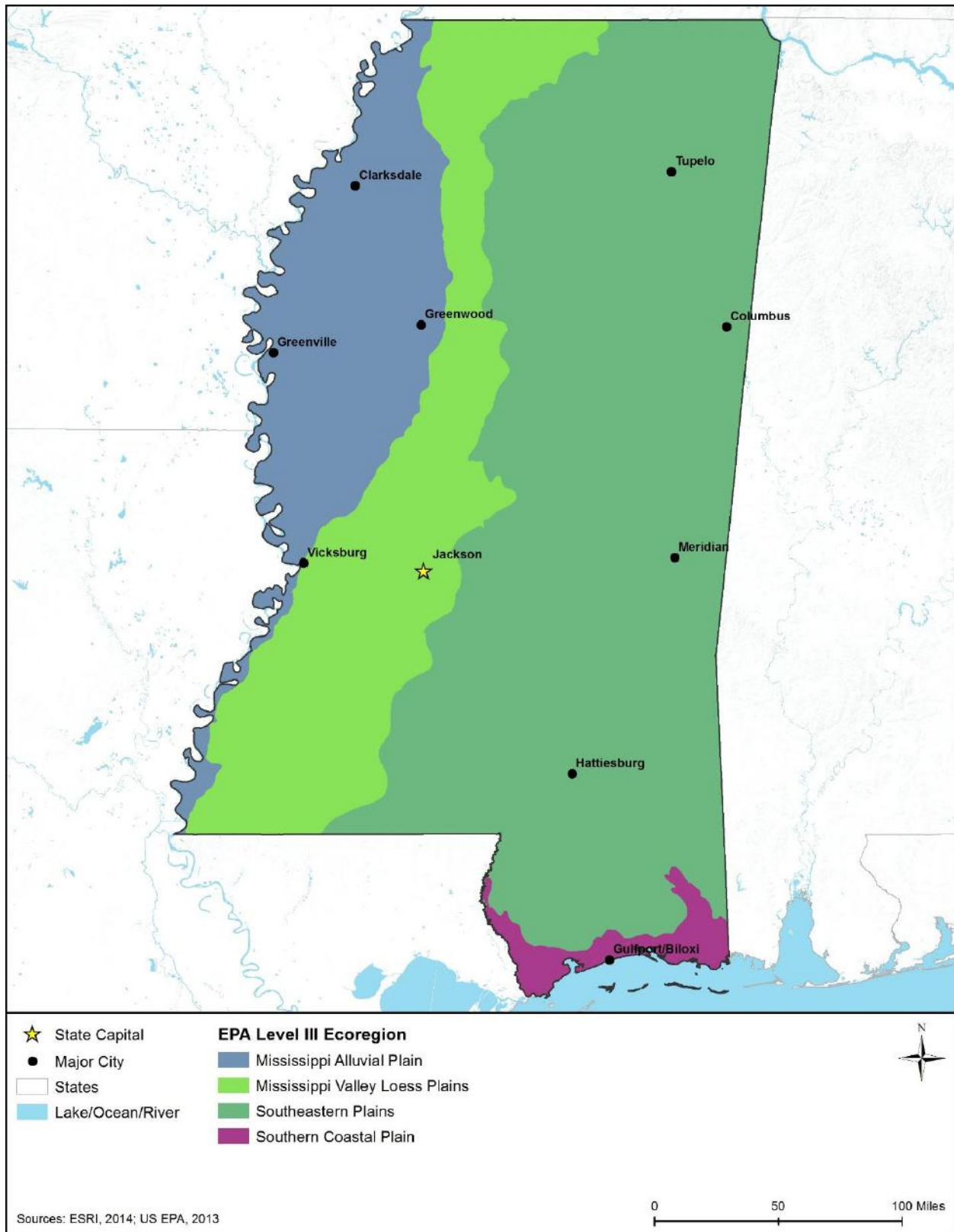


Figure 9.1.6-1 USEPA Level III Ecoregions in Mississippi

Table 9.1.6-2: USEPA Level III Ecoregions of Mississippi

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region				
65	Southeastern Plains	Less elevation and relief than in Piedmont. Soils composed of sands, silts, and clays, unlike the metamorphic and igneous rocks found ecoregions to the north.	Mixed forest and oak-hickory-pine.	Hardwood Trees – turkey oak (<i>Quercus laevis</i>), red oak (<i>Quercus rubra</i>), water oak (<i>Quercus nigra</i>), and hickory (<i>Carya</i> spp.) Conifer Trees - Longleaf pine (<i>Pinus palustris</i>), loblolly pine (<i>Pinus taeda</i>), shortleaf pine (<i>Pinus echinata</i>)
73	Mississippi Alluvial Plain	Broad, flat alluvial plain with river terraces, swales, and levees providing the main elements of relief. Contains deep fertile soils which typically poorly drained.	Bottomland deciduous forests.	Hardwood trees – black willows (<i>Salix nigra</i>), cottonwoods (<i>Populus</i> spp.), cypress (<i>Cupressaceae</i> spp.), oak (<i>Quercus</i> spp.) and hickory (<i>Carya</i> spp.)
74	Mississippi Valley Loess Plain	Irregular plains with gently rolling hills. Soils are deep, steep, silty, and erosive.	Contains some mixed forests and oak hickory, and oak-hickory-pine	Hardwood Trees – sweetgum (<i>Liquidambar styraciflua</i>), basswood (<i>Tilia</i> spp.), eastern hophornbeam (<i>Ostrya virginiana</i>), tulip poplar (<i>Liriodendron tulipifera</i>), southern magnolia (<i>Magnolia grandiflora</i>), water oak (<i>Quercus nigra</i>), and Spanish moss (<i>Tillandsia usneoides</i>) Conifer Trees –loblolly (<i>Pinus taeda</i>) and shortleaf pine (<i>Pinus echinata</i>)
75	Southern Coastal Plain	This Ecoregion is composed primarily of flat plains, but also contains barrier islands, lagoons, marshes, and swamps. Soils are wetter and elevation is lower than in the Southeastern Plains to the north.	Native vegetation is a variety of forest communities, including pine flatwoods, and savannas.	Conifer Trees – longleaf pine (<i>Pinus palustris</i>), pond pine (<i>Pinus serotina</i>), slash pine (<i>Pinus elliottii</i>), and loblolly pine (<i>Pinus taeda</i>) Hardwood Trees – pond cypress, beech (<i>Fagus</i> spp.), sweetgum (<i>Liquidambar styraciflua</i>), southern magnolia (<i>Magnolia grandiflora</i>), and oaks

Sources: (Fenneman, N., 1916) (Chapman et. al., 2004) (CEC, 2011)

Communities of Concern

The state of Mississippi 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 community⁶⁹ that could result from implementation of an action. (MDWFP, 2005)

The Mississippi Natural Heritage Program (MNHP) 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 MNHP ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Mississippi. Communities ranked as an S1 by the MNHP are of the greatest concern. This rank is typically based on the range of the community, the number of occurrences, the viability of the occurrences, recent trends, and the vulnerability of the community. (MDWFP, 2005)

There are 25 vegetative communities that are ranked as S1 communities in Mississippi, some of which may not be considered rare within the U.S. but have been ranked as rare by MDWFP (MDWFP, 2005). These communities occur throughout the state and are found in all USEPA Level III ecoregions in Mississippi. Mississippi Appendix B provides a description of the communities of conservation concern in Mississippi along with their description, distribution, and the associated USEPA Level III ecoregions.

Nuisance and Invasive Plants

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

In Mississippi, noxious weeds are regulated by the Mississippi Department of Agriculture and Commerce and addressed in Chapter 69-25-7 of the Mississippi Administrative Code. The Plant Act was amended in 2014 to include a list of noxious plants. All the plants also appear on the Federal Noxious Weed List These species are listed below:

⁶⁹ 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, 2015d).

Benghal dayflower (*Commelina benghalensis*), Brazilian Satintail (*Imperata braziliensis*), Chinese Tallow Tree/Popcorn Tree (*Sapium sebiferum*), Cogongrass (*Imperata cylindrica*), Giant Salvinia (*Salvinia molesta*), Hydrilla (*Hydrilla verticillata*), Itchgrass (*Rottboellia cochinchinensis*), Kudzu (*Pueraria montana* var. *lobata*), Tropical soda apple (*Solanum viarum*).

9.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Mississippi, divided among mammals,⁷⁰ birds,⁷¹ reptiles and amphibians,⁷² and invertebrates.⁷³ Terrestrial wildlife consist of those species, and their habitats, that live predominantly on land. Terrestrial wildlife include common game and nongame mammals, birds, including wading birds and migratory birds, and reptiles and amphibians. 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. Currently, the state is home to 63 mammal species, 78 reptile species, 61 amphibian species, and 400 regularly occurring bird species, and a diverse array of invertebrate species (Jones & Carter, 1989) (MDWFP, 2012).

Mammals

Common and widespread mammalian species in Mississippi include white tailed deer (*Odocoileus virginianus*), armadillo, several bat species, mole (*Scalopus aquaticus*) and coyote (*Canis latrans*). Mississippi is also home to more specialized mammals and mammals whose range has diminished in recent times. These less common mammals include gray, northern and Indiana bat that are only found in Tishomingo County. Black bears (*Ursus americanus*) were once found statewide but now only occur in isolated areas (MDWFP, 2005) (Shropshire, 2015).

According to the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) the following species comprise Mississippi's designated game species: bear, beaver, coyote, white-tail deer, fox, wild rabbit, raccoon (*Procyon lotor*), squirrel, and bobcat (*Lynx rufus*). However, there is no open season for bear or mountain lion, which are protect species. Furbearers⁷⁴ that may be trapped include bobcat, fox, mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), nutria, opossum, otter (*Lontra canadensis*), raccoon, and striped skunk (*Mephitis mephitis*) (MDWFP, 2015b).

Mississippi has identified 17 mammals as Species of Greatest Conservation Need (SGCN). This list includes three extirpated species: Florida panther (*Puma concolor coryi*), silver-haired bat (*Lasionycteris noctiva-Gans*), and Indiana bat (*Myotis sodalis*). The remaining SGCN mammal

⁷⁰ Mammals: "Warm-blooded vertebrates that give birth to and nurse live young; have highly evolved skeletal structures; are covered with hair, either at maturity or at some stage of their embryonic development; and generally have two pairs of limbs, although some aquatic mammals have evolved without hind limbs" (USEPA, 2015d).

⁷¹ Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves" (USEPA, 2015d).

⁷² Amphibian: "A cold-blooded vertebrate that lives in water and on land. Amphibians' aquatic, gill-breathing larval stage is typically followed by a terrestrial, lung-breathing adult stage" (USEPA, 2015d).

⁷³ Invertebrates: "Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc." (USEPA, 2015d).

⁷⁴ Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

species are divided into three categories with two Tier 1⁷⁵ species, 11 Tier 2⁷⁶ species and one Tier 3⁷⁷ species (MDWFP, 2005).

The threatened and endangered mammals found in Mississippi are discussed in Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Birds

The number of native bird species documented in Mississippi varies according to the timing of the data collection effort, changes in bird taxonomy,⁷⁸ and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., mountains, large rivers and lakes, sandy beaches, coastal islands, etc.) found in Mississippi support a large variety of bird species.

According to the Mississippi Ornithological Society there are over 400 species of birds who are either permanent residents, summer residents or winter residents in Mississippi, such as the White-eyed vireo (*Vireo griseus*), European starling (*Sturnus vulgaris*), and Rusty blackbird (*Euphagus carolinus*) (Mississippi Ornithological Society, 2004). MDWFP has identified 70 SGCN in Mississippi, including two extirpated species (Buchmans's warbler [*Vermivora bachmani*] and ivory-billed woodpecker [*Campephilus principalis*]), eight Tier 1 species, 31 Tier 2 species, and 29 Tier 3 species (MDWFP, 2005).

Mississippi is located within the Mississippi Flyway, which includes two other Gulf of Mexico coastal states (Mississippi and Louisiana) and extends northward into the Canadian provinces of Saskatchewan, Manitoba, and Ontario. More 325 bird species migrate along the Mississippi Flyway while traveling between breeding grounds to the north and wintering grounds to the south (NAS, 2015a). "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations" (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in Northern Alabama and the Gulf Coast (eBird, 2015a). Golden eagles are found in a variety of habitat types; and not known within Mississippi. Consequently, golden eagles observed within the state are generally transients (eBird, 2015b).

⁷⁵Tier 1 – "in need of immediate conservation action and/or research because of extreme rarity, restricted distribution, unknown or decreasing population trends, specialized habitat needs and/or habitat vulnerability. Some species may be considered critically imperiled and at risk of extinction/extirpation" (MDWFP, 2005).

⁷⁶Tier 2 – "in need of timely conservation action and/or research because of rarity, restricted distribution, unknown or decreasing population trend, specialized habitat needs or habitat vulnerability or significant threats"(MDWFP 2005).

⁷⁷Tier 3 – "less immediate conservation concern, but are in need of planning and effective management due to unknown or decreasing population trends, specialized habitat needs or habitat vulnerability"(MDWFP 2005).

⁷⁸Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2013a).

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. Thirty-three IBAs have been identified in Mississippi (5 global⁷⁹ IBAs and 28 state⁸⁰ IBAs) (NAS, 2015b). The majority of the IBAs in Mississippi occur along the Gulf coast and the coast of the Mississippi River as displayed in Figure 9.1.6-2.

MDWFP has identified 70 birds as SGNC in Mississippi (Mississippi Department of Wildlife, Fisheries, and Parks, 2015a). Information on Mississippi's threatened and endangered birds is included in Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Reptiles and Amphibians

There are 142 reptiles and amphibians in Mississippi, with 31 frogs, 30 salamanders, 1 alligator, 13 lizards, 41 snakes, and 26 turtles (MDWFP, 2012). Some of Mississippi's herpetofauna are widespread throughout the state, while some species are found only in specific environments (MDWFP, 2005). The American alligator (*Alligator mississippiensis*) is also found in Mississippi, primarily in the coastal and inland waters in the southern portion of the state. Alligators may be hunted in Mississippi, as regulated by the MDWFP (MDWFP, 2015b).

Eighteen of Mississippi's amphibians and 35 reptiles are SGCN (MDWFP, 2005). This list includes 3 extirpated species including the southern hognose snake (*Heterodon simus*), Tiger Salamander (*Ambystoma tigrinum*), and the Bay springs salamander (*Plethodon ainsworthi*). The threatened and endangered herpetofauna found in Mississippi are discussed in Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Invertebrates

Mississippi's diverse invertebrate groups include beetles and other insects, terrestrial snails, dragonflies, butterflies, and millipedes. However, most of Mississippi's invertebrates are not well documented. According to MDWFP, future effort may be placed on the study of Mississippi's pollinator species (Mississippi Department of Wildlife, Fisheries, and Parks, 2015a). In the U.S., one third of all agricultural output depends on pollinators⁸¹. 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).

⁷⁹ Global IBAs include sites that meet at least one Global criteria (i.e., Sites with significant numbers of globally threatened species, sites supporting 1% or greater population of a waterbird simultaneously).

⁸⁰ State IBAs include areas important to species only according to state-specific criteria (e.g., state-listed species) (NAS, 2015a).

⁸¹ Pollinators: "Animals or insects that transfer pollen from plant to plant" (USEPA, 2015d).

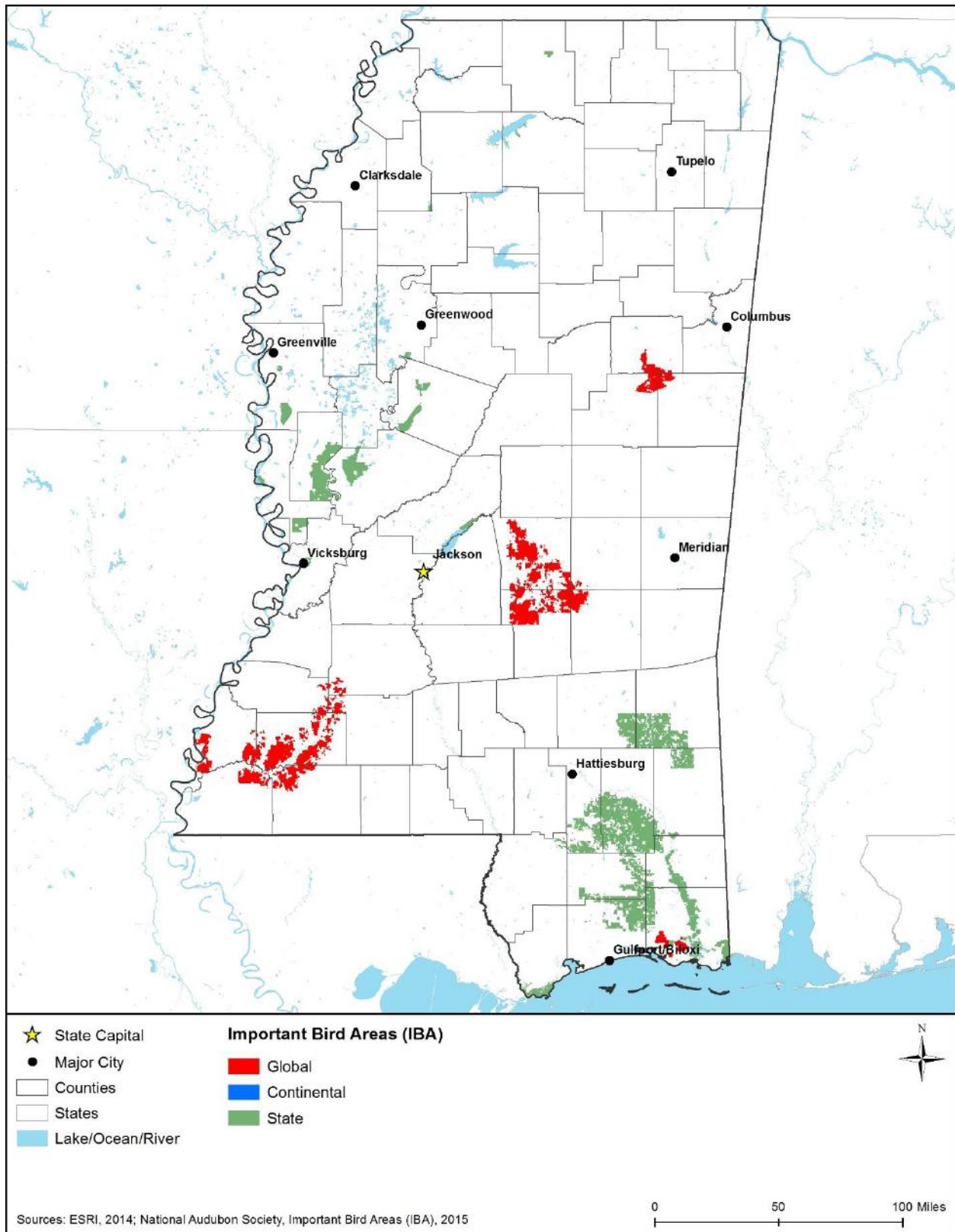


Figure 9.1.6-2: Important Bird Areas in Mississippi

Invasive Wildlife Species

Exotic wildlife species are regulated by MDWFP. A permit must be obtained from MDWFP prior to importing, possessing, purchasing, transferring or selling a wildlife species that is not normally domesticated in Mississippi (MDWFP, 2015c). Wild hogs are a non-native species that pose a threat to native resources in Mississippi. The importation, transportation or release of wild hogs into the state is prohibited (MDWFP, 2015d). Invasive wildlife species are important to consider when proposing a project since project activities may result in conditions that favor the growth and spread of invasive wildlife populations. These situations may result from directly altering the landscape or habitat to a condition that is more favorable for an invasive species, or by altering the landscape or habitat to a condition that is less favorable for a native species.

9.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Mississippi, including sea turtles, saltwater and freshwater fish, and invertebrates. The summary of non-native and/or invasive aquatic species is also presented. No Essential Fish Habitat (EFH) Habitat Areas of Particular Concern (HAPC) designated under the Magnuson-Stevens Fishery Conservation and Management Act are in Mississippi waters.

Freshwater Fish

Interior Mississippi waterbodies support a diverse assemblage of fish, from endemic cavefish and small darters to large sturgeon and sharks. Mississippi is home to three species that are only found within the state of Mississippi: Bayou darter (*Etheostoma rubrum*), Yazoo shiner (*Notropis rafinesquei*), and the Yazoo darter (*Etheostoma raneyi*). Some of the more commonly caught Mississippi freshwater game fish are black bass (including largemouth [*Micropterus salmoides*] and smallmouth bass [*Micropterus dolomieu*]), crappie (*Pomoxis* sp.), blue gills (*Lepomis macrochirus*), catfish species, and various sunfish species. Many of these taxa are found throughout the southeastern states.

Three fish that inhabit coastal and inland waters of the state are designated as threatened, and one inland fish is designated as endangered. Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Table 9.1.6-3 lists the 14 major families of freshwater fish in Mississippi.

Table 9.1.6-3: Mississippi Freshwater Fish

Mississippi Freshwater Fish	
Acipenseridae, sturgeon <ul style="list-style-type: none"> Gulf Sturgeon (<i>Acipenser oxyrinchus desotoi</i>) Pallid Sturgeon (<i>Scaphirhynchus albus</i>) 	Ictaluridae, catfish <ul style="list-style-type: none"> Bullhead (<i>Ameiurus</i> spp.) Frecklebelly Madtom (<i>Noturus munitus</i>) Channel catfish (<i>Ictalurus punctatus</i>) Blue catfish (<i>Ictalurus furcatus</i>) Flathead catfish (<i>Pylodictis olivaris</i>)
Amiidae, primitive ray-finned fish <ul style="list-style-type: none"> Bowfin (<i>Amia calva</i>) 	
Anguillidae, freshwater eels <ul style="list-style-type: none"> American eel (<i>Anguilla rostrata</i>) 	

Mississippi Freshwater Fish	
Catastomidae, suckers <ul style="list-style-type: none"> • Bigmouth Buffalo (<i>Ictiobus cyprinellus</i>) • Black Buffalo (<i>Ictiobus niger</i>) • Carpsucker (<i>Carpionodes carpio</i>) • Highfin (<i>Carpionodes velifer</i>) • Redhorse (<i>Moxostoma</i>) • Smallmouth Buffalo (<i>Ictiobus bubalus</i>) • Quillback (<i>Carpionodes cyprinus</i>) 	Lepisosteidae, gars <ul style="list-style-type: none"> • Alligator Gar (<i>Atractosteus spatula</i>) • Spotted Gar (<i>Lepisosteus oculatus</i>) • Longnose Gar (<i>Lepisosteus osseus</i>) • Shortnose Gar (<i>Lepisosteus platostomus</i>)
Clupeidae, ray-finned fishes <ul style="list-style-type: none"> • Gizzard Shad (<i>Dorosoma cepedianum</i>) • Threadfin Shad (<i>Dorosoma petenense</i>) 	Loricariidae, catfish <ul style="list-style-type: none"> • Vermiculated sailfin catfish (<i>Pterygoplichthys disjunctivus</i>)^{IS}
Centrarchidae, ray-finned fish <ul style="list-style-type: none"> • Shadow Bass (<i>Ambloplites ariommus</i>) • Warmouth (<i>Lepomis gulosus</i>) • Rock bass (<i>Ambloplites rupestris</i>)^{IS} • Smallmouth Bass (<i>Micropterus dolomieu</i>)^{IS} 	Moronidae, “temperate” bass <ul style="list-style-type: none"> • White bass (<i>Morone chrysops</i>)
Cyprinidae, carps and true minnows <ul style="list-style-type: none"> • Bighead carp (<i>Hypophthalmichthys nobilis</i>) 	Percidae, darters and perches <ul style="list-style-type: none"> • Brichteye Darters (<i>Etheostoma lynceum</i>)
Esocidae, pike and pickerel family <ul style="list-style-type: none"> • Chain Pickerel (<i>Esox niger</i>) 	Petromyzontidae, lampreys <ul style="list-style-type: none"> • Southern Brook lamprey (<i>Ichthyomyzon gagei</i>)
	Poeciliidae, tooth-carps <ul style="list-style-type: none"> • Sailfin Molly (<i>Poecilia latipinna</i>)
	Polyodontidae, paddlefish <ul style="list-style-type: none"> • Paddlefish (<i>Polyodon spathula</i>)
	Sciaenidae, drums <ul style="list-style-type: none"> • Freshwater drum (<i>Aplodinotus grunniens</i>)
	Syngnathidae, pipefishes <ul style="list-style-type: none"> • Gulf pipefish (<i>Syngnathus scovelli</i>)

Sources: (Mississippi State University, 2016) (MDWFP, 2015e)

IS: Invasive Species

Saltwater Fish

Numerous saltwater fish species frequent Mississippi’s Gulf of Mexico coast. Saltwater game fish regulated in the state by the Mississippi Department of Marine Resources and includes a select species of shark, snapper, mullet, red drum (*Sciaenops ocellatus*), king mackerel (*Scomberomorus cavalla*), gag (*Mycteroperca microlepis*), cobin, tilefish, flounder, and greater Amberjack (*Seriola dumerili*) (MDMR, 2015c) .

The endangered smalltooth sawfish (*Pristis pectinate*) and the threatened Gulf of Mexico subspecies of the Atlantic sturgeon (*Acipenser oxyrinchus*) are known to inhabit the coastal marine waters of Mississippi. Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Table 9.1.6-4 lists the 28 major families of saltwater fish in Mississippi waters, and Table 9.1.6-5 lists sharks.

Shellfish and Other Invertebrates

With its range of inland and coastal water environments, Mississippi has a diverse range of shellfish and other invertebrate populations. Currently, there are approximately 84 mussel and clams species (49 SGCN) and 50 crawfish species (34 SGCN species) in Mississippi's freshwater environments. There a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.). (MDWFP, 2005) (MDWFP, 2008) (MDWFP, 2015f) (MMNS, 2016)

Mussels are one of the most imperiled groups in the United States (Galbraith, Maloney, Hamilton, & Puckett, 2013), and there are 16 federally protected species in Mississippi. Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species

Other invertebrate groups in Mississippi's waters include clams, oysters, and shrimp, some of which are part of states commercially and recreationally valuable fisheries (MDMR, 2015c).

Table 9.1.6-4: Mississippi Saltwater Fish

Mississippi Saltwater Fish	
Acipenseridae, sturgeon <ul style="list-style-type: none"> Atlantic sturgeon (<i>Acipenser oxyrhynchus</i>) Pallid sturgeon (<i>Scaphirhynchus albus</i>) 	Scombridae <ul style="list-style-type: none"> Little tunny (<i>Euthynnus alletteratus</i>) Spanish mackerel (<i>Scomberomorus maculatus</i>) Wahoo (<i>Acanthocybium solandri</i>)
Albulidae, bonefishes <ul style="list-style-type: none"> Bonefish (<i>Albula vulpes</i>) 	Scorpaenidae, scorpionfish <ul style="list-style-type: none"> Red lionfish (<i>Pterois volitans</i>)^{1S}
Anguillidae, freshwater eels <ul style="list-style-type: none"> American eel (<i>Anguilla rostrate</i>) 	Serranidae <ul style="list-style-type: none"> Goliath grouper (<i>Epinephelus itajara</i>) Gag (<i>Mycteroperca micolepis</i>) Nassau grouper (<i>Epinephelus striatus</i>) Warsaw grouper (<i>Epinephelus nigritus</i>) Red grouper (<i>Epinephelus morio</i>) Yellowfin grouper (<i>Mycteroperca venenosa</i>) Black grouper (<i>Mycteroperca bonaci</i>) Gag grouper (<i>Mycteroperca microlepis</i>) Calico grouper/speckled hind (<i>Epinephelus drummondhayi</i>) Scamp grouper (<i>Mycteroperca phenax</i>)
Ariidae, sea catfishes <ul style="list-style-type: none"> Hardhead catfish (<i>Arius felis</i>) Gafftopsail catfish (<i>Bagre marinus</i>) 	Scorpaenidae, scorpionfish <ul style="list-style-type: none"> Red lionfish (<i>Pterois volitans</i>)^{1S}
Balistidae, leatherjackets <ul style="list-style-type: none"> Ocean triggerfish (<i>Canthidermis sufflamen</i>) Queen triggerfish (<i>Balistes vetula</i>) 	Sparidae, porgies <ul style="list-style-type: none"> Pinfish (<i>Lagdon rhombides</i>) Sheepshead (<i>Archosargus probatocephalus</i>)
Carangidae, jacks, pompanos, runners, and scads <ul style="list-style-type: none"> Almaco jack (<i>Seriola rivoliana</i>) Greater amberjack (<i>Seriola dumerili</i>) Crevalle jack (<i>Caronx hippos</i>) Florida pompano (<i>Trachinotus Carolinus</i>) 	Sphyraenidae, barracudas <ul style="list-style-type: none"> Southern sennet (<i>Sphyraena picudilla</i>)
Elopidae, tenpounders <ul style="list-style-type: none"> Ladyfish (skipjack) (<i>Elops saurus</i>) 	
Ephippidae <ul style="list-style-type: none"> Atlantic spadefish (<i>Chaetodipterus faber</i>) 	
Fundulidae, topminnows and killifish <ul style="list-style-type: none"> Gulf killifish (<i>Fundulus grandis</i>) 	

Mississippi Saltwater Fish	
Lobotidae, tripletails <ul style="list-style-type: none"> Atlantic trippletail (<i>Lobotes surinamensis</i>) 	Sciaenidae, drums and croakers <ul style="list-style-type: none"> Atlantic croaker (<i>Micropogonias undulatus</i>) Black drum (<i>Pogonias cranis</i>) Red drum (<i>Sciaenops ocellatus</i>) Sand seatrout, sand weakfish (<i>Cynoscion arenarius</i>) Southern kingfish (<i>Menticirrhus americanus</i>) Spotted seatrout (<i>Cynoscion nebulosus</i>)
Lutjanidae, snappers <ul style="list-style-type: none"> Mutton snapper (<i>Lutjanus analis</i>) Red snapper (<i>Lutjanus campechanus</i>) Vermillion snapper (<i>Rhomboplites aurorubens</i>) Queen snapper (<i>Etelis oculatus</i>) Silk snapper (<i>Lutjanus vivanus</i>) Wenchman (<i>Pristopomoides aquilonaris</i>) 	Stromateidae, butterfishes <ul style="list-style-type: none"> Black driftfish (<i>Hyperoglyphe bythites</i>)
Lutjanidae, snappers (cont.) <ul style="list-style-type: none"> Schoolmaster (<i>Lutjanus apodus</i>) Blackfin snapper (<i>Lutjanus buccanella</i>) Dog snapper (<i>Lutjanus jocu</i>) Gray snapper (<i>Lutjanus griseus</i>) Mahogany snapper (<i>Lutjanus mahogoni</i>) Lane Snapper (<i>Lutjanus synagris</i>) 	Syngnathidae, seahorses, pipefishes, and sea dragons <ul style="list-style-type: none"> Gulf Pipefish (<i>Syngnathus scovelli</i>)
Malacanthidae, tilefish <ul style="list-style-type: none"> Goldface Tilefish (<i>Caulolatilus chrysops</i>) Anchor Tilefish (<i>Caulolatilus intermedius</i>) Blackline Tilefish (<i>Caulolatilus cyanops</i>) Blueline Tilefish (<i>Caulolatilus microps</i>) 	Synodontidae, lizardfishes <ul style="list-style-type: none"> Inshore lizardfish (<i>Synodus foetens</i>)
Megalopidae, tarpons <ul style="list-style-type: none"> Atlantic tarpon (<i>Megalops atlanticus</i>) 	Tetraodontidae, puffers <ul style="list-style-type: none"> Southern puffer (<i>Spheroidea nephelus</i>) Smooth pouffer (<i>Lagocephalus laevis</i>) Stripped burrfish (<i>Chilomycterus schoepfi</i>) Porcupine fish (<i>Diodon hystrix</i>)
Moronidae, temperate basses <ul style="list-style-type: none"> Striped bass (<i>Morone saxatilis</i>) 	Trichiuridae, mackerels <ul style="list-style-type: none"> Atlantic cutlassfish (<i>Trichiurus lepturus</i>) Escolar (<i>Lepidocybium flavobrunneum</i>) Oilfish (<i>Ruvettus pretiosus</i>) King mackerel (<i>Scomberomorus cavalla</i>) Spanish mackerel (<i>Scomberomorus maculatus</i>)
Mugilidae <ul style="list-style-type: none"> Striped mullet (<i>Mugil cephalus</i>) 	Tetraodontidae, puffers <ul style="list-style-type: none"> Southern puffer (<i>Spheroidea nephelus</i>) Smooth pouffer (<i>Lagocephalus laevis</i>) Stripped burrfish (<i>Chilomycterus schoepfi</i>) Porcupine fish (<i>Diodon hystrix</i>)
Pleuronectidae, flounder <ul style="list-style-type: none"> Southern flounder, (<i>Paralichthys lethostigma</i>) Gulf flounder (<i>Paralichthys albigutta</i>) 	Trichiuridae, mackerels <ul style="list-style-type: none"> Atlantic cutlassfish (<i>Trichiurus lepturus</i>) Escolar (<i>Lepidocybium flavobrunneum</i>) Oilfish (<i>Ruvettus pretiosus</i>) King mackerel (<i>Scomberomorus cavalla</i>) Spanish mackerel (<i>Scomberomorus maculatus</i>)
Pomatomidae <ul style="list-style-type: none"> Bluesfish (<i>Pomatomus saltatrix</i>) 	Triglidae, searobins <ul style="list-style-type: none"> Bighead searobin (<i>Prionotus tribulus</i>)
Pristidae, sawfish	Xiphiidae, swordfishes <ul style="list-style-type: none"> Swordfish (<i>Xiphias gladius</i>)
Ephippidae <ul style="list-style-type: none"> Smalltooth sawfish (<i>Pristis pectinate</i>) 	
Rachycentridae, cobia <ul style="list-style-type: none"> Cobia (<i>Rachycentron canadum</i>) 	

Sources: (MDMR, 2015c) (MDWFP, 2015e) (DMR, 2016)

IS: Invasive Species

Table 9.1.6-5: Mississippi Sharks

Mississippi Sharks	
Large Coastal Sharks ^a <ul style="list-style-type: none"> Sandbar (<i>Carcharhinus plumbeus</i>) Blacktip (<i>Carcharhinus limbatus</i>) Dusky (<i>Carcharhinus obscurus</i>) Spinner (<i>Carcharhinus brevipinna</i>) Silky (<i>Carcharhinus falciformis</i>) Bull (<i>Carcharhinus leucas</i>) Bignose (<i>Carcharhinus altimus</i>) Narrowtooth (<i>Carcharhinus brachyurus</i>) Galapagos (<i>Carcharhinus galapagensis</i>) Night (<i>Carcharhinus signatus</i>) Caribbean reef (<i>Carcharhinus perezii</i>) Tiger (<i>Galeocerdo cuvier</i>) Lemon (<i>Negaprion brevirostris</i>) Sand tiger (<i>Odontaspis taurus</i>) Bigeye sand tiger (<i>Odontaspis noronhai</i>) Nurse (<i>Ginglymostoma cirratum</i>) Scalloped hammerhead (<i>Sphyrna lewini</i>) Great hammerhead (<i>Sphyrna mokarran</i>) Smooth hammerhead (<i>Sphyrna zygaena</i>) Whale (<i>Rhincodon typus</i>) Basking (<i>Cetorhinus maximus</i>) White (<i>Carcharodon carcharias</i>) 	Small Coastal Sharks <ul style="list-style-type: none"> Atlantic sharpnose (<i>Rhizoprionodon terraenovae</i>) Caribbean sharpnose (<i>Rhizoprionodon porosus</i>) Finetooth (<i>Carcharhinus isodon</i>) Blacknose (<i>Carcharhinus acronotus</i>) Smalltail (<i>Carcharhinus porosus</i>) Bonnethead (<i>Sphyrna tiburo</i>) Atlantic angel (<i>Squatina dumeril</i>) Pelagic Sharks <ul style="list-style-type: none"> Shortfin mako (<i>Isurus paucus</i>) Longfin mako (<i>Isurus paucus</i>) Porbeagle (<i>Lamna nasus</i>) Thresher (<i>Alopias vulpinus</i>) Bigeye thresher (<i>Alopias superciliosus</i>) Blue (<i>Prionace glauca</i>) Oceanic whitetip (<i>Carcharhinus longimanus</i>) Sevengill (<i>Hepranchias perlo</i>) Sixgill (<i>Hexanchus griseus</i>) Bigeye sixgill (<i>Hexanchus vitulus</i>)

Source: (MDMR, 2015c)

^a This table is organized by federal and state shark management groups.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act identifies and protects aquatic habitats necessary for spawning, breeding, feeding, or growth to maturity. These areas are designed as Essential Fish Habitat (EFH). The National Oceanic and Atmospheric Administration (NOAA) operates a website and mapping tool,⁸² which provides the public a means to obtain illustrative representations of EFH area (NOAA, 2015d) (NOAA, 2015e). This EFH Mapper is used to identify the existing conditions for a project location to identify sensitive resources.⁸³

Also under the Magnuson-Stevens Act, NOAA Fisheries considers a second, more limited habitat designation for each species in addition to EFH. Habitat Areas of Particular Concern (HAPC) are described as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or in an environmentally stressed area.

⁸² NOAA National Marine Fisheries Service EFH Mapper v3.0 (<http://www.habitat.noaa.gov/protection/efh/habitatmapper.html>).

⁸³ NOAA's Essential Fish Habitat Mapper v 3.0 was used to identify "EFH areas of particular concern" and "EFH areas protected from fishing." As of July 2016, the procedure to use this interactive tool is as follows: 1) Visit <http://www.habitat.noaa.gov/protection/efh/habitatmapper.html>. 2) Select "EFH Mapper" under Useful Links. 3) After closing the opening tutorial, select the "Region" of interest from the drop-down menu. 4) Select the species under "Essential Fish Habitat" to view the areas in the selected region protected for the various life states (i.e., eggs, larvae, juvenile, adult, or all).

In general, HAPCs include high value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish. HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations (NOAA, 2010). Table 9.1.6-6 lists HPACs in the Gulf of Mexico.

Table 9.1.6-6: Gulf of Mexico EFH Habitat Areas of Particular Concern

Species	Gulf of Mexico HAPCs
Various ecologically and economically important fish species in the Gulf of Mexico	Alderice Bank, Bouma Bank, East Flower Garden Bank, West Flower Garden Bank, Florida Middle Grounds, Geyser Bank, Jakkula Bank, MacNeil, Madison-Swanson Marine Reserve, McGrail Bank, Pulley Ridge, Rankin Bight Bank, Rezak Sidner Bank, Stetson Bank, Sonnier Bank, Tortugas North, Tortugas South. The HPAC nearest Mississippi is the Madison-Swanson Marine Reserve, which is about 60 miles south of Panama City, FL, and 200 miles southeast of Pascagoula, MS

Source: (NOAA, 2005) (NOAA, 2009) (NOAA, 2015e)

Marine Mammals

Mississippi's two regularly occurring marine mammals are the bottle-nosed dolphin (*Tursiops* sp.) and West Indian manatee (*Trichechus manatus*). Two species of whales, the finback (*Balaenoptera physalus*) and humpback (*Megaptera novaeangliae*), are federally protected in Mississippi's waters. These two species, as well as the manatee, are discussed in Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Marine Reptiles

There are seven species of sea turtles in the world, five of which are known and protected in Mississippi: loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), Kemp's Ridley (*Lepidochelys kempii*), and hawksbill (*Eretmochelys imbricata*) (MDWFP, 2014):

- The leatherhead is observed sporadically in Mississippi;
- Observations of green turtle and hawksbill are rare in Mississippi;
- The loggerhead is the most frequent sea turtle to Mississippi beaches; and
- Kemp's Ridley is the most frequently seen sea turtle in the coastal waters off Mississippi however they do not nest on Mississippi beaches.

These species are discussed in Section 9.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Invasive Aquatic Species

As previously discussed, Mississippi has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase and introduction of select invasive species, both plants and animals. Noxious weeds are regulated by the Mississippi Department of Agriculture and Commerce and addressed in Chapter 69-25-7 of the Mississippi Administrative Code. Furthermore, Mississippi State Law 49-7-80 states, “No person shall stock, place, release or cause to be released into any of the public waters of the state any aquatic species without first obtaining a permit from the Mississippi Department of Wildlife, Fisheries and Parks.” It is also illegal to sell game fish for any purpose other than for stocking private fish ponds. In 2013 the state of Mississippi developed a State Management Plan for Aquatic Species to describe the aquatic invasive species problem and proposed management actions (MDEQ, 2013b).

Potentially invasive aquatic plants include: alligator weed (*Alternanthera philoxeroides*), water hyacinth (*Eichhornia crassipes*), South Pacific beach vitex (*Vitex rotundifolia*), salvinia (*salvinia molesta*) and common salvinia (*Salvinia minima*). Potentially invasive aquatic animals include: nutria, Asian tiger shrimp (*Penaeus monodon*), giant applesnail (*Pomacea maculata*), Indopacific lionfish (*Pterois* sp.), Asian Carp, and zebra mussel.

9.1.6.6. Threatened and Endangered Species

The USFWS is responsible for administering the ESA (16 U.S.C §1531 et seq.) in state of Mississippi. The USFWS has identified 29 federally endangered and 17 federally threatened species known to occur in Mississippi (USFWS, 2015c) (USFWS, 2015d). Of these 46 federally listed species, 12 of them have designated critical habitat⁸⁴ in Mississippi (USFWS, 2016a). There is one candidate⁸⁵ species identified by USFWS as occurring within the state (USFWS, 2015e). Candidate species are not afforded statutory protection under the ESA; however, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2014c). The 46 federally listed species include 6 mammals, 9 reptiles, 6 birds, 5 fishes, 1 amphibian, 16 invertebrates, and 3 plants (USFWS, 2015c), and are discussed in detail under the following sections.

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

⁸⁴ 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)).

⁸⁵ 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, 2014b).

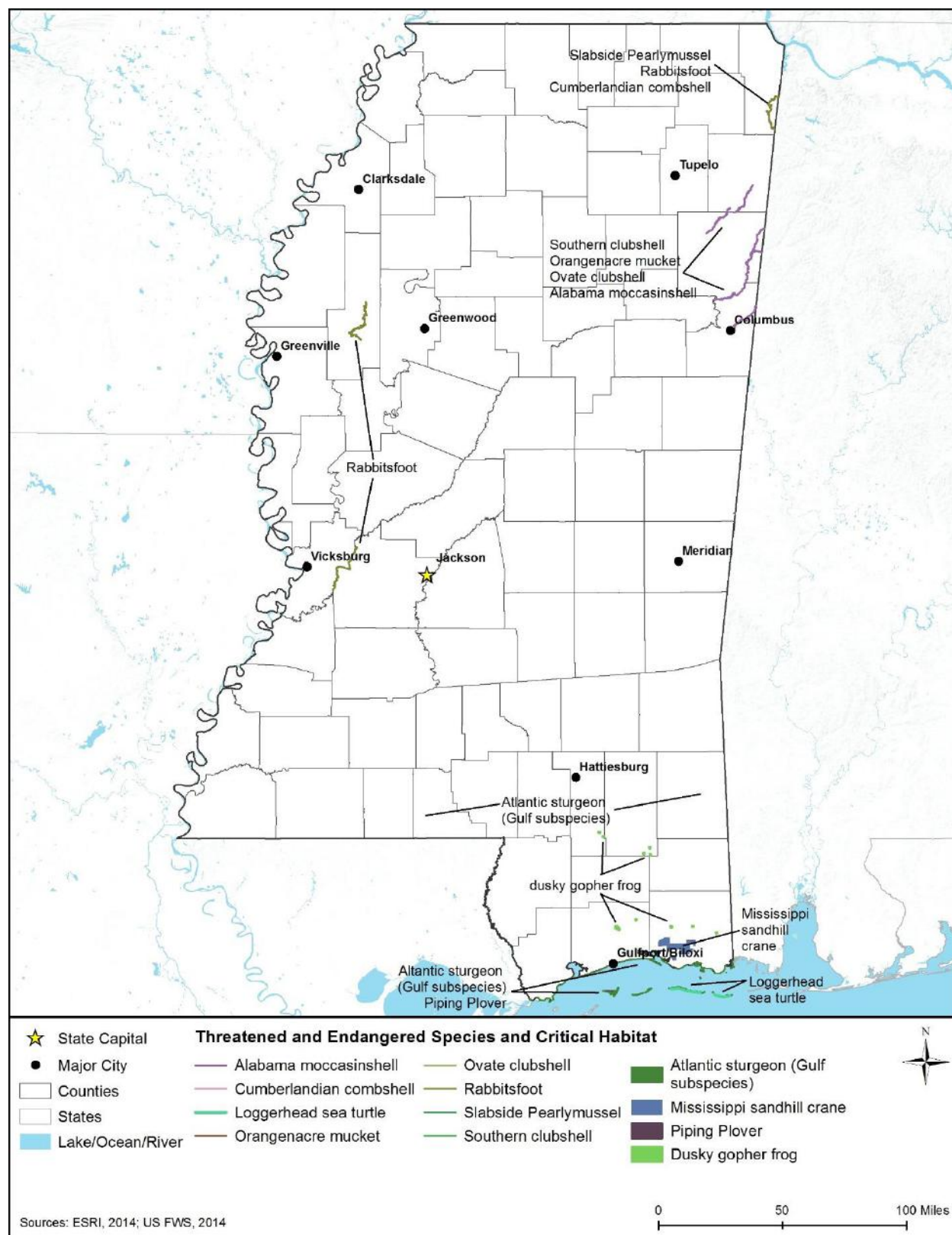


Figure 9.1.6-3: ESA Designated Critical Habitat in Mississippi

Mammals

Four endangered and two threatened mammals are federally listed for Mississippi as summarized in Table 9.1.6-7. Gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalis*) are found in the northeastern portion of the state. Northern long-eared bat (*Myotis septentrionalis*) is found in the northeastern and west-central portions of the state. The marine mammals are found along the coast of Mississippi. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Mississippi is provided below. (USFWS, 2015c)

Table 9.1.6-7: Federally Listed Mammal Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Marine Mammals				
Finback Whale	<i>Balaenoptera physalus</i>	Endangered	No	Deep offshore water in all major oceans.
Humpback Whale	<i>Megaptera novaeangliae</i>	Endangered	No	Offshore South Carolina
West Indian Manatee	<i>Trichechus manatus</i>	Threatened	No	Coastal waters, estuaries, and warm water outfalls
Terrestrial Mammals				
Gray Bat	<i>Myotis grisescens</i>	Endangered	No	Caves in limestone karst regions near rivers; known only from Tishomingo County in the NE corner of the state.
Indiana Bat	<i>Myotis sodalis</i>	Endangered	No	Trees and snags, caves, and abandoned mines; known only from Benton and Tishomingo Counties in the northeastern part of the state.
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Threatened	No	Trees and snags, caves, and abandoned mines; known from only Sharkey and Tishomingo Counties.

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

Marine Mammals

Finback Whale. The endangered finback whale (*Balaenoptera physalus*), also referred to as the fin whale, is the second largest whale in the world, reaching a length from 75 to 85 feet and weighing between 80,000 and 160,000 pounds (NOAA, 2013a). The species was first federally listed as endangered under early endangered species legislation in 1970 (35 Federal Register [FR] 8491 8498, June 2, 1970) and was grandfathered into the ESA of 1973 (USFWS, 2015f). Finback whales are found in all of the world's oceans, are highly nomadic, move in social groups of two to seven individuals, and prefer high latitudes and cold currents where food concentrations are high (NOAA, 2013a).

Finback whales primarily feed on krill, small fish, and squid, moving through the water at a fast speed averaging 15 miles per hour with bursts of speed reaching 35 miles per hour. In the North Atlantic Ocean, fin whales are often seen in large feeding groups that include humpback whales (*Megaptera novaeangliae*), minke whales, and Atlantic white-sided dolphins. In the late summer, finback whales migrate to equatorial waters where they spend the winter fasting and living off of their fat reserves. After an 11-12 month gestation period, birthing and nursing occurs (NECWA, 2007) (NOAA, 2013a).

The finback whale population had declined as a result of whaling. Commercial whaling ended in the Northern Pacific Ocean in 1976, the Southern Ocean by 1977, and Northern Atlantic Ocean by 1987; however, finback whales are still hunted in Greenland. Additional current threats to this species include vessel collisions, entanglement in fishing gear, reduced food supply, habitat degradation, and underwater noise or vibration disturbance (NOAA, 2013a).

Humpback Whale. The humpback whale reaches 30 to 60 feet in length and is distinguished from other whales by its robust, thick, and chunky body shape and very long (up to 15 feet) white flippers (NOAA, 2015f). The humpback whale was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C §1531 et seq.) (USFWS, 2015g). Humpback whales are found in all of the world's oceans. In the North Atlantic Ocean, feeding populations are found in the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland, and western Greenland during the spring, summer, and fall as they feed and build up their fat reserves to live off of all winter. These populations all combine to migrate to their winter breeding and calving grounds in tropical and subtropical waters in the West Indies. Humpbacks travel near the water surface during migrations, and prefer shallow waters during feeding and calving (NOAA, 2015f).

While humpback whales are federally listed as an endangered species with an estimated 10,400 individuals in the western North Atlantic, they have shown signs of increasing population (NOAA, 2013b). Current threats to this species include entanglement in fishing gear, ship strikes,⁸⁶ harassment from recreational whale watching, habitat degradation, and harvesting for scientific research (USFWS, 2015g).

⁸⁶ Ship strikes: Collisions between whales and vessels (IWC, 2016).

West Indian Manatee. The West Indian Manatee (*Trichechus manatus*) averages 9 feet in length and weighs about 1,000 pounds (USFWS, 2015h). The manatee was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was grandfathered into the ESA of 1973. The West Indian manatee was downlisted to threatened on March 16, 2017 (USFWS, 2017b). The West Indian manatee is also protected under the Marine Mammal Protection Act (MMPA). The manatee has a large, seal-shaped body with flippers and a large tail, and is typically gray in color (USFWS, 2015i). Manatees found in mainland U.S. waters are recognized as a separate subspecies known as the Florida manatee (*Trichechus manatus*



West Indian manatee

Photo Credit: USFWS

latirostris) (USFWS, 2001a). The species is found in the Gulf of Mexico from Texas, Louisiana, Mississippi, Alabama, and Florida; along the Atlantic coast, the species extends from Florida north along Georgia and South Carolina to North Carolina. In Mississippi, the species occurs in coastal Hancock, Harrison, and Jackson Counties (USFWS, 2015i).

West Indian manatees are found in tropical and subtropical coastal and river waters. The Florida manatee (*Trichechus manatus latirostris*) is found along the southeast U.S. coast, while the Antillean subspecies (*Trichechus manatus manatus*) is typically encountered along the Caribbean coast of Central and South America, and locally throughout the West Indies (USFWS, 2001a). Threats to West Indian manatees include death or serious injury from vessel strikes and habitat loss or fragmentation leading to decreased availability of warm-water refuges (USFWS, 2001a).

Terrestrial Mammals

Gray Bat. The gray bat is an insectivorous⁸⁷ bat that weighs approximately 7 to 16 grams and is longer than any other species in the genus *Myotis*. Gray bats have dark gray fur after molting in July or August and then the fur transitions to a chestnut brown. This species was federally listed as endangered in 1976 (41 FR 17736 17740, April 28, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst within southeastern states from Kansas and Oklahoma east to Virginia and North Carolina (USFWS, 1997a) (USFWS, 2015j). In Mississippi, the gray bat is known from only Tishomingo County in the northeastern portion of the state (USFWS, 2015j).

Gray bats live in caves all year, hibernating in deep vertical caves in the winter and roosting in caves scattered along rivers the rest of the year. Most caves are in limestone karst regions and near rivers where these bats feed on flying aquatic and terrestrial insects. Current threats to this species include human disturbance, habitat loss and degradation from flooding, and commercialization of caves (e.g., adding gates that alter air flow, humidity, and temperature in caves) (USFWS, 1997a).

⁸⁷ Insectivorous: “An animal that feeds on insects” (USEPA, 2015k).

Indiana Bat. The Indiana bat is a small, insectivorous mammal measuring approximately 3 to 3.5 inches in length with a wingspan of 9.5 to 10.5 inches. Indiana bats have dull grayish chestnut fur and strongly resemble the more common little brown bat (*Myotis lucifugus*) (USFWS, 2015k). 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 grandfathered into the ESA of 1973 as an endangered species. In 2009, only 387,000 Indiana bats were known to exist in its range, less than half of the population of 1967 (USFWS, 2015l). Regionally, this species is currently found in the central portion of the eastern United States, from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Mississippi, the Indiana bat is known only from Benton and Tishomingo Counties in the northeastern part of the state (USFWS, 2015k). Critical habitat has been defined for several caves in the region, but none are located in Mississippi (USFWS, 2015m).

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 hibernation sites (within 10 miles) before migrating to their summer habitats where the females roost. Some of these summer habitats can be as far as 300 miles away from their hibernation sites (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 the Indiana bat include shagbark hickory (*Carya ovata*), white oak (*Quercus alba*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), and American elm (*Ulmus rubra*) (USFWS, 2012a).

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

Northern Long-eared Bat. The Northern long-eared bat is a medium-sized, brown furred, insectivorous bat. This bat is medium-sized, reaching a length of 3 to 3.7 inches, with long ears relative to other members of the genus *Myotis* (USFWS, 2015n). The Northern long-eared bat was listed as endangered in 2013 (78 FR 72058 72059, December 2, 2013) and was relisted as threatened in 2015 (80 FR 17973 18033, April 2, 2015). Its range includes most of the eastern and north central United States. In Mississippi, the northern long-eared bat is known from only Sharkey County in the west-central area of the state and Tishomingo County in the northeastern corner of the state (USFWS, 2015o).

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, 2015n).

White Nose Syndrome is the leading cause for the decline of this species. The numbers of northern long-eared bats in hibernacula has decreased by 99 percent in the northeast U.S. (USFWS, 2015o). 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, 2015n).

Birds

Four endangered and two threatened avian species are federally listed and known to occur in Mississippi as summarized in Table 9.1.6-8. Least tern (*Sterna antillarum*) is known from western Mississippi along the Mississippi River. Mississippi sandhill crane (*Grus canadensis pulla*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*) are found along or near the Mississippi coast, while the red-cockaded woodpecker (*Picoides borealis*) and wood stork (*Mycteria americana*) are found across the Mississippi coastal plain region. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Mississippi is provided below. (USFWS, 2015c) (USFWS, 2015e)

Table 9.1.6-8: Federally Listed Bird Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Least Tern	<i>Sterna antillarum</i>	Endangered	No	Unvegetated sandbars near rivers, reservoirs and other open water habitat; known from 11 counties in western Mississippi along the Mississippi River.
Mississippi Sandhill Crane	<i>Grus canadensis pulla</i>	Endangered	Yes, in Jackson County.	Wet pine savanna areas predominated by wiregrass with scattered longleaf pine, slash pine, and pond cypress; known from only Jackson County.
Piping Plover	<i>Charadrius melodus</i>	Endangered	Yes, in Hancock, Harrison, and Jackson Counties.	Open, sandy beaches and on tidal mudflats and sandflats; known from coastal Mississippi.
Red Knot	<i>Calidris canutus rufa</i>	Threatened	No	Intertidal marines, estuaries, and bays around the coast of Mississippi.
Red-cockaded Woodpecker	<i>Picoides borealis</i>	Endangered	No	Mature pine forests, found in 23 counties in southern and central Mississippi.
Wood Stork	<i>Mycteria americana</i>	Threatened	No	Primarily feed in fresh and brackish wetlands and nest in cypress or other wooded swamps. Found throughout the whole state of Mississippi.

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

Least Tern. The least tern is the smallest member of the gull and tern family. The birds are approximately 9 inches in length. Unlike gulls, terns will dive into the water for small fish. The body of least terns is predominately gray and white, with black streaking on the head. Least terns have a forked tail and narrow pointed wings. Least terns less than a year old have less distinctive black streaking on the head and less of a forked tail (USFWS, 2015p). The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). The species is known to breed along the Mississippi River in on sandbars and dike fields and is known from 11 counties along the western border of the state (along the Mississippi River) (USFWS, 1990a) (USFWS, 2015p).

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

Mississippi Sandhill Crane. The Mississippi sandhill crane resembles the great blue heron, but a major distinguishing characteristic is that cranes are completely gray. Great blue herons usually have white on their heads and dark colored underparts. When standing erect, cranes are about 4 feet tall. Male and female cranes are similar in appearance. All cranes have long necks, and adult cranes possess a bald red forehead. The species vocalizations are loud and clattering. Cranes are also unique in that they require separate nesting, foraging, and roosting habitats (USFWS, 2015q). The species was federally listed as endangered in 1973 (38 FR 14678, June 4, 1973). The species is known from only a small area of Lower Coastal Plain pine savannah in Jackson County, Mississippi (USFWS, 2015q). Critical habitat for the species has been defined in Jackson County east of Biloxi, Mississippi (USFWS, 1977).

Suitable habitat for Mississippi sandhill cranes includes savanna areas used year-round that consist of wet grasslands predominated by wiregrass with scattered longleaf pine, slash pine, and pond cypress trees. Nesting habitat includes open areas of grasses and sedges with perennial shallow water. Threats to the species include forestry practices, agriculture, and human development that have altered most of the wet savanna habitat. The small amount of pine savanna habitat remaining could also be a limiting factor (USFWS, 1991).

Piping Plover. The piping plover is a small, pale brown-colored shorebird with a short beak and black band across its forehead, measuring approximately 7.25 inches in length. The piping plover was listed as endangered in 1985 for the Great Lakes watershed of both the United States and Canada, and as threatened in the remainder of its range in the U.S., which includes the Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, and the Virgin Islands (50 FR 50726 50734, December 11, 1985). Piping plovers can be found in Hancock, Harrison, and Jackson Counties in coastal Mississippi (USFWS, 2015r). Critical habitat for the piping plover along coastal areas within Mississippi has been designated within Hancock, Harrison, and Jackson Counties (USFWS, 2001b).

Critical habitat for the piping plover has been designated within Mobile and Baldwin Counties, Alabama. Piping plover are found on open, sandy beaches and on tidal mudflats and sandflats along both the Atlantic and Gulf coasts (USFWS, 2001b). Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Nesting often occurs in wetlands in the Northern Great Plains. They feed on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates. Current threats to this species include habitat loss and habitat degradation, human disturbance, pets, predation, flooding from coastal storms, and environmental contaminants (USFWS, 2015s) (USFWS, 2015t).

Red Knot. The red knot is approximately 9 inches in length with a wing span up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005). It was federally listed as a threatened species in 2014 (79 FR 73705 73748, December 11, 2014). The red knot migrates annually from its breeding grounds above the Arctic Circle to the tip of South America where it winters. During spring and fall migration, the red knot travels in “non-stop segments of 1,500 miles and more, converging on critical stopover areas to rest and refuel along the way” Some have been documented to fly more than 9,300 miles from south to north in the spring (USFWS, 2005) (USFWS, 2014d). Red knot is known to occur in Hancock, Harrison, and Jackson Counties in coastal Mississippi (USFWS, 2015u).

The preferred habitat for the red knot is intertidal marines, estuaries, and bays. Mussel beds are important food sources for the red knot. Red knots eat mussels and other mollusks almost all year; however, during migration season red knots eat “juvenile clams and mussels and horseshoe crab eggs” (USFWS, 2005). Current threats to the red knot include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at their migration stopovers; and disturbance by humans, dogs, vehicles, and climate change (USFWS, 2014d) (USFWS, 2016b).

Red-cockaded Woodpecker. The red-cockaded woodpecker is a small black and white woodpecker that grows approximately seven inches with a wingspan of about 15 inches. It is characterized by its black cap and white cheek patches (USFWS, 2015v). The red-cockaded woodpecker was listed as endangered in 1970 under early endangered species legislation (35 FR 16047 16048, October 13, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C §1531 et seq.). Regionally, this species is known to occur in open pine forests in the southeast from Virginia south to Florida and west to Oklahoma and Texas. It can be found in 23 counties in Mississippi (USFWS, 2015w).

The preferred habitat for the red-cockaded woodpecker is mature pine forests, preferring longleaf pines (*Pinus palustris*). Red-cockaded woodpeckers forage on insects by pecking pine trunks and branches and flaking away bark. Its diet is



Photo credit: USFWS

Red-cockaded Woodpecker

primarily composed of insects, with occasional wild fruits and pine seeds. Current threats to the red-cockaded woodpecker include lack of suitable habitats (USFWS, 2003a).

Wood Stork. The wood stork is a large, long-legged wading bird, about 50 inches tall, with a wingspan of 60 to 65 inches. The plumage is white except for black primaries and secondaries and a short black tail. The head and neck are largely unfeathered and dark gray in color. The bill is black, thick at the base, and slightly decurved. Immature birds are dingy gray and have a yellowish bill (USFWS, 2015x). The bird was federally listed as a threatened species in 1984 (49 FR 7332 7335, February 28, 1984). The wood stork is the only stork regularly occurring in the United States. The breeding range of the species extends from the southeastern United States south through Mexico and Central America, Cuba and Hispaniola, and through South America to western Ecuador, eastern Peru, Bolivia, and northern Argentina (USFWS, 1997b). This species is found throughout the entire state of Mississippi (USFWS, 2015x).

The preferred habitat includes a variety of freshwater and estuarine wetlands for nesting, feeding, and roosting. Freshwater colony sites must remain inundated throughout the nesting cycle to protect against predation and abandonment. Foraging sites occur in shallow, open water where prey concentrations are high, such as freshwater marshes, roadside and agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads or swamp sloughs (USFWS, 1997b). Current threats to the wood stork include loss of feeding habitat, water level manipulations affecting drainage, predation, and/or lack of nest tree regeneration, human disturbance, and pesticides/chemical pollutants (USFWS, 1997b).

Reptiles

Four endangered and five threatened reptile species are federally listed and known to occur in Mississippi as summarized in Table 9.1.6-9. The black pine snake (*Pituophis melanoleucus lodingi*), eastern gopher tortoise (*Gopherus polyphemus*), Alabama red-belly turtle (*Pseudemys alabamensis*), and yellow-blotched turtle (*Graptemys flavimaculata*) are located in the southeastern part of the state. Ringed map turtle (*Graptemys oculifera*) is located in the central and southern portion of the state. All four sea turtles, the hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*), are found along the gulf coast of Mississippi. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Mississippi is provided below. (USFWS, 2015c)

Table 9.1.6-9: Federally Listed Reptile Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Marine Resptiles				
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered	No	Warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation; found along the coast of Mississippi.
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	Endangered	No	Muddy or sandy bottoms where prey items can be found, in waters rarely greater than 160 feet deep; found along the coast of Mississippi.
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered	No	Coastal waters and the open sea environment; found along the coast of Mississippi.
Loggerhead Sea Turtle	<i>Caretta caretta</i>	Threatened	Yes, along the beaches of Horn Island and Petit Bois Island in Jackson County.	Open sea environment and inshore area such as salt marshes, creeks, bays, and lagoons; found along the coast of Mississippi.
Terrestrial Reptiles				
Alabama Red-belly Turtle	<i>Pseudemys alabamensis</i>	Endangered	No	It inhabits streams, lakes, and sloughs in Harrison and Jackson Counties in coastal Mississippi.
Black Pine Snake	<i>Pituophis melanoleucus lodingi</i>	Threatened	Proposed for 9 counties in Mississippi.	Sandy, well-drained soils with an open-canopied overstory of longleaf pine, a reduced shrub layer, and a dense herbaceous ground cover; known from 12 counties in southeastern Mississippi
Gopher Tortoise	<i>Gopherus polyphemus</i>	Threatened	No	Longleaf pine and wiregrass community, which includes sandhills, dry flatwoods, and turkey oak scrub; in Mississippi, known from 19 counties in the southeastern portion of the state.
Ringed Map Turtle	<i>Graptemys oculifera</i>	Threatened	No	River stretches having moderate current, numerous basking logs, and sand beaches for nesting; known from 13 counties in central and southern Mississippi.
Yellow-blotched Turtle	<i>Graptmys flavimaculata</i>	Threatened	No	Rivers and large creeks; known from 10 counties in southeastern Mississippi in the Pascagoula River watershed.

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

Marine Reptiles

Hawksbill Sea Turtle. The hawksbill sea turtle is one of the smaller sea turtles. It was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970). The hawksbill sea turtle has overlapping plates that are thicker than those of other sea turtles. Its shell is dark brown with faint yellow streaks with a yellow coloring on its under shell. Adults range in size from 30 to 36 inches and weigh up to 300 pounds. The hawksbill sea turtle is found throughout all of the oceans of the world (NOAA, 2014a) (USFWS, 2015y). Even though in the Atlantic Ocean they range along the Atlantic seaboard of the United States to northern Brazil, they are more infrequently found offshore of Mid-Atlantic and New England states (USFWS, 2015z).

The waters surrounding Culebra, Mona, and Monito Islands, Puerto Rico are designated as critical habitat for the continued survival and recovery of hawksbill turtles (63 FR 46693 46701, September 2, 1998).

Hawksbill sea turtles prefer warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation. As an omnivore, hawksbill sea turtles feed primarily on sponges, algae, and invertebrates. Nesting for hawksbill sea turtles occurs on remote beaches in the Gulf of Mexico and the Caribbean Sea in two to three year cycles, where females lay between 140 to 200 eggs. (USFWS, 2015y)

Current threats to the hawksbill sea turtle include accidental capture in fishing lines, vessel strikes, contaminants and oil spills, disease, and habitat loss or destruction in coral reef communities. Outside of the U.S., an additional threat to the species is the harvest of their meat and eggs (NOAA, 2014a).

Kemp's Ridley Sea Turtle. The Kemp's Ridley sea turtle is considered the smallest sea turtle species and the most endangered. These sea turtles can grow to more than two feet long and weigh up to 100 pounds (NOAA, 2015g) (USFWS, 2015aa). The Kemp's Ridley sea turtle was first federally listed in 1970 (35 FR 18319 18322, December 2, 1970) under the Endangered Species Conservation Act and incorporated into the ESA as an endangered species (16 U.S.C §1531 et seq.) (USFWS, 2015ab). Their range includes the Gulf of Mexico and the U.S. Atlantic seaboard, from New England to Florida. They prefer nearshore habitats with muddy or sandy bottoms in waters rarely greater than 160 feet deep where their prey items—such as crabs, jellyfish, fish, and mollusks—are found (NOAA, 2015g). In Mississippi, the Kemp's Ridley sea turtle is known from coastal Hancock, Harrison, and Jackson Counties (USFWS, 2015ab).

Kemp's Ridley sea turtles gather in large groups in Tamaulipes, Mexico where approximately 95 percent of this species' breeding occurs. Nesting occurs as early as April and into July. Some males migrate yearly between breeding and feeding grounds, whereas other remain near breeding grounds throughout the year. Hatchlings drift with the currents or float with plant material rafts for approximately two years (NOAA, 2015g). Historically, the decline of this species was the harvesting of their sea turtle eggs during nesting. Current threats to this species include the direct harvest of adults and eggs, accidental capture in fishing lines, recreational activities on beaches, and pollution (USFWS, 2015aa).

Leatherback Sea Turtle. The leatherback sea turtle is the deepest-diving and most wide-ranging sea turtle, growing 4 to 8 feet long and weighing 500 to 2,000 pounds (USFWS, 2015ac). The leatherback sea turtle was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C §1531 et seq.) (USFWS, 2015ad). The leatherback sea turtle is capable of tolerating a wide range of water temperatures; hence its wide global distribution, including parts of the Atlantic, Pacific, and Indian Oceans. The occurrence in the United States is rare for the Atlantic population, with the most significant location within the East coast being in southeastern Florida (NOAA, 2015h) (USFWS, 2015ac). In Mississippi, the leatherback sea turtle is known from coastal Hancock, Harrison, and Jackson Counties (USFWS, 2015ad).

Leatherback sea turtles are found in ocean waters and nearshore coastal waters. Their main diet includes jellyfish, salps (a transparent barrel-shaped tunicate),⁸⁸ and other soft-bodied animals (NOAA, 2015h). For reproduction, female leatherback sea turtles nest at two to three year intervals during March to July. Nest-building occurs during the night. Each female leatherback sea turtle can create up to 11 nests per nesting season (USFWS, 2015ac). Current threats to the species include harvesting of turtles and their eggs, hunting, incidental capture in fishing gear, and consumption of plastics that were mistaken for jellyfish (NOAA, 2015h).

Loggerhead Sea Turtle. The loggerhead sea turtle can grow to an average length of 3 feet and weight of 250 pounds. This species has a reddish-brown carapace and flippers, with a large head (USFWS, 2015ae). The loggerhead sea turtle was initially listed as threatened throughout its range in 1978 (43 FR 32800 32811, July 28, 1978); by 2011, nine different distinct populations were listed. The northwestern Atlantic Ocean population remained listed as threatened (76 FR 58868 58952, September 22, 2011) (USFWS, 2015af). This turtle is known to occur throughout temperate and tropical regions in the Atlantic, Pacific, and Indian Oceans with most nesting areas located in the western Atlantic Ocean. Nesting by the loggerhead sea turtle occurs from Texas to Virginia along the southeastern coast of the United States. (USFWS, 2008a). In Mississippi, the loggerhead sea turtle is known from coastal Hancock, Harrison, and Jackson Counties (USFWS, 2015af). Loggerhead sea turtles nest on coastal sand beaches near the dune line, or in areas with coral reefs; they prefer to feed in rocky places (NOAA, 2014b). Hatchlings use offshore floating sargassum mats and juveniles frequent coastal bays, inlets, and lagoons. Critical habitat has been designated in Mississippi along the beaches of Horn Island and Petit Bois Island in Jackson County (NOAA, 2014d).

Loggerhead sea turtles are found in the open sea and in inshore areas such as salt marshes, creeks, bays, and lagoons. Current threats to the loggerhead sea turtle include incidental captures in fishing gear, direct harvesting of eggs, and habitat loss and degradation (NOAA, 2014c) (USFWS, 2008a).

⁸⁸ Tunicate: “Commonly known as ‘sea squirts.’ The body of an adult tunicate is quite simple, being essentially a sack with two siphons through which water enters and exits. Water is filtered inside the sack-shaped body.” (University of California Museum of Paleontology, 2006)

Terrestrial Reptiles

Alabama Red-belly Turtle. The Alabama red-belly turtle is a large, freshwater turtle that can reach a length of –8 to 10 inches. As it is named, it has an orange to reddish color on its under shell. Its arched upper shell is brown to olive color typically with yellow, orange, or reddish streaks. The Alabama red-belly turtle’s skin is olive to black color with yellow to light orange stripes. This turtle has a notch at the tip of its upper jaw with a toothlike projection surrounding it on either side. The Alabama red-belly turtle was federally listed as endangered in 1987 (52 FR 22939 22943, June 16, 1987). This species can be found in Alabama and Mississippi (USFWS, 2015ag). It inhabits streams, lakes, and sloughs⁸⁹ in Harrison and Jackson Counties in coastal Mississippi (USFWS, 2016c).

This turtle lives in large, vegetated areas of shallow water in the backwater areas of bays and river channels. It uses snags and vegetation for habitat, foraging, and to bask in the sun. Threats to the Alabama red-belly turtle include habitat disturbance due to dredged material disposal and predation (USFWS, 1990b).

Black Pine snake. The black pine snake is a large, non-venomous, egg-laying constricting snake with keeled scales, a disproportionately small head, and a pointed snout. Black pine snakes are distinguished from other pine snakes by their uniform darker brown to black coloring. There is considerable individual variation in adult black pine snakes; some adults have russet-brown snouts, white scales on their throat, or blotches on the end of its body near the tail. Adult black pine snakes range from 48 to 76 inches long. The black pine snake was federally listed as threatened in 2015. (USFWS, 2015ah). This species is currently known from Mississippi and Alabama; in Mississippi, the snake is known from 12 counties in the southeastern portion of the state (USFWS, 2015ai). A proposed rule to designate critical habitat for the species was published in 2015 for areas in Forest, Greene, George, Harrison, Jones, Marion, Perry, Stone, and Wayne Counties, Mississippi, and Clarke County, Alabama (USFWS, 2015aj).

Black pine snakes were widespread in longleaf pine forests that once covered the southeastern United States. These snakes are known to occur in sandy, well-drained soils in longleaf pine forests, a reduced shrub layer, and a dense herbaceous ground cover. Threats to the species include loss of longleaf pine habitat through conversion to densely stocked pine plantations or agriculture, habitat fragmentation, and impacts from urbanization (80 FR 60467 60489, October 6, 2015) (USFWS, 2015ak).

Gopher Tortoise.

The western gopher tortoise (*Gopherus polyphemus*) is dark-brown to grayish-black colored terrestrial turtle that digs deep borrows in dry sandy habitat. Adult tortoises have a shell length between 6 and 15-inches long. Distinctive morphology include, “elephantine hind feet, shovel-like forefeet, and a gular projection beneath the head on the yellowish, hinge less plastron or undershell.”

⁸⁹ A wetland, usually a swamp or shallow lake, often a backwater to a larger body of water.

The species is listed as threatened west of the Mobile and Tombigbee Rivers, and as a candidate species east of those rivers (USFWS, 1990c) (USFWS, 2015al), and was federally listed as threatened in 1987 (52 FR 25376 25380, July 7, 1987). Western gopher tortoises occur in the Coastal Plain in southern South Carolina, Georgia, Florida, Alabama, Mississippi, and eastern Louisiana. The species was first recommended for review as a protected species in 1982 (47 FR 58454 58460, December 30, 1982) and was listed as threatened in the western portion in 1987 (52 FR 25376 25380, July 7, 1987).



Gopher tortoise

Photo Credit: USFWS

Gopher tortoises occur in the Coastal Plain from southern South Carolina, Georgia, Florida, Alabama, Mississippi, and eastern Louisiana. In Mississippi, the species is known from 19 counties in the southeastern portion of the state (USFWS, 2015al).

Preferred habitats of the western gopher tortoise are sand ridges in longleaf pine savannas. The species is also found “ruderal⁹⁰ habitats such as fence rows, pastures, and field edges and power lines.” Breeding occurs between February and September (USFWS, 1990c).

The major threat to gopher tortoise is habitat destruction, followed by “habitat fragmentation and degradation, predation, inadequacy of regulatory mechanisms, and incompatible use of herbicides in forest management and some silvicultural activities” (USFWS, 2016d).

Ringed Map Turtle. The ringed map turtle is a small turtle with each shield of its upper shell having a yellow ring bordered inside and outside with dark olive-brown: its undershell (plastron) is yellow. The head has a large yellow spot behind the eye, two yellow stripes from the orbit backwards, and a characteristic yellow stripe covering the whole lower jaw. Males grow to 4 inches and females to 7 inches in plastron length (USFWS, 2015am). The species was listed as threatened in 1986 (51 FR 45907 45910, December 23, 1986). Ringed map turtles are known from the Pearl and Bogue Chitto Rivers in Mississippi and eastern Louisiana; in Mississippi, the species is known from occurs in 13 counties in the central and southern portion of the state. (USFWS, 2015am)

Preferred habitats include river stretches having moderate current, numerous basking logs, and sand beaches for nesting. The river exposure must be wide enough to allow for sun penetration for several hours. The species nests in unvegetated and short grass areas, with nests generally within 115 feet of the river bank. Nests are built in areas with very fine sand (USFWS, 1988).

⁹⁰ Growing where the natural vegetational cover has been disturbed by humans.

Major threats to the ringed map turtle include habitat modification and water quality degradation. Channel and floodplain modifications and reservoir construction have caused population declines. Increased channelization within the watershed, which causes increased runoff and heavy siltation, is also a threat. Sand and gravel dredging also impacts suitable habitat (USFWS, 1988).

Yellow-blotched Turtle. The yellow-blotched map turtle is a medium-sized aquatic turtle with females attaining a carapace (upper shell) length of a least 8 inches and males occasionally exceeding 4.75 inches. The carapace is olive to light brown. Each costal scute has an irregular bright yellow or orange blotch. Juveniles and adult males have a black spine on the first four vertebral scutes (USFWS, 2015an). The yellow-blotched map turtle was federally listed as threatened in 1991 (56 FR 1459 1463, January 14, 1991). This species is known only from 10 counties in southeastern Mississippi in the Pascagoula River watershed (USFWS, 1993a) (USFWS, 2015an).

Yellow-blotched map turtle habitat includes rivers and large creeks. It tends to avoid smaller streams where the surface of the water is shaded by bank vegetation for much of the day. Preferred habitat includes river stretches with moderate currents, abundant basking sites, and sand bars. Threats to the species include sedimentation and stream modification, commercial collecting, wanton shooting, and trapping, nest predation, and water quality degradation (USFWS, 1993a).

Fish

Two endangered, three threatened, and one candidate fish species are federally listed and known to occur in Mississippi, as summarized in Table 9.1.6-10. The gulf sturgeon (*Acipenser oxyrinchus desotoi*) is found in coastal plain rivers and the Mississippi coast, and the smalltooth sawfish is also found along the Gulf coast. The bayou darter is found in central Mississippi, the pallid sturgeon (*Scaphirhynchus albus*) is found in the Mississippi River, the candidate species and the snail darter (*Percina tanasi*) is found in the northeastern part of the state. The Pearl darter (*Percina aurora*) has been identified as a candidate species in Mississippi. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Mississippi is provided below. (USFWS, 2015c) (USFWS, 2015e)

Table 9.1.6-10: Federally Listed Fish Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Atlantic Sturgeon (Gulf subspecies)	<i>Acipenser oxyrinchus desotoi</i>	Threatened	Yes, portions of the Pearl River and Bogue Chitto, portions of the Pascagoula River and its tributaries, and much of the Mississippi coast.	Large rivers and oceans; known from 19 counties in southern Mississippi.
Bayou Darter	<i>Etheostoma rubrum</i>	Threatened	No	Meandering stream sections over stable gravel riffles or sandstone exposures with riffles and runs and moderate to swift flow; known from three counties in central Mississippi.
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered	No	Large rivers with strong currents; found in the Mississippi River along the western state border.
Smalltooth Sawfish	<i>Pristis pectinata</i>	Endangered	No	Shallow coastal waters of warm seas; known from coastal Mississippi.
Snail Darter	<i>Percina tanasi</i>	Threatened	No	Larger creeks and small rivers, where it occurs in areas with moderate to swift flow over mixed sand and gravel; known only from Tishomingo County in northeast Mississippi.

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

Atlantic Sturgeon (Gulf subspecies). The Gulf sturgeon (Gulf subspecies of Atlantic sturgeon) (*Acipenser oxyrinchus desotoi*) can grow up to 9 feet and weigh up to 300 pounds (USFWS, 2015ao). A bony fish with a long bladelike snout, this species is light to dark brown with a pale belly in coloring (USFWS, 1995). The Gulf sturgeon was federally listed as threatened in 1991 (56 FR 49653 49658, September 30, 1991) (USFWS, 2015ap). The Gulf sturgeon migrates in the spring from salt water to spawn in freshwater rivers in the summer. Individual Gulf sturgeons often return to the river they were born in to spawn. When not migrating, Gulf sturgeon prefer to rest near the bottom of riverbeds and oceans.

Gulf sturgeons used to be common in rivers from Tampa Bay, Florida to the Mississippi River; now they can be found only in a number of large fresh water rivers from the Suwannee River in Florida to the Pearl River in Louisiana (USFWS, 2015ao). It is known to occur in 19 counties in southern Mississippi (USFWS, 2015ap). The critical habitat for the Gulf sturgeon in Mississippi includes portions of the Pearl River and Bogue Chitto, portions of the Pascagoula River and its tributaries, and much of the Mississippi coast (NOAA, 2003). Major threats to the Gulf Sturgeon are barriers (such as dams) to historical spawning habitats, loss of habitat, poor water quality, and overfishing for sturgeon eggs and meat (USFWS, 1995).

Bayou Darter. The bayou darter is a diminutive species with a prominent double basicaudal spot and black subocular bar. The male has a narrow, terminal clear area and a subterminal black band of equal width on the caudal fin. The remainder of the caudal fin has a narrow, yellow band with fin rays that are reddish with some yellow. The female has a series of four or five russet or red wavy lines on the caudal fin (USFWS, 1990d). This species was listed as threatened in 1975 (40 FR 44149 44151, September 25, 1975). The species is endemic to the Bayou Pierre and its larger tributaries in Mississippi, known from Claiborne, Copiah, and Hinds Counties in the central portion of the state (USFWS, 2015aq).

The preferred habitats for bayou darter are shallow (less than 6 inches deep), meandering stream sections over stable gravel riffles or sandstone exposures with riffles and runs and moderate to swift flow. The major threat facing bayou darter is man-induced alteration of its habitat, including floodplain/channel modification, petroleum exploration and transportation, and farming and silviculture (USFWS, 1990d).

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 is found in the Missouri River, Yellowstone River, and some of its larger tributaries in Montana. This species range also includes the Missouri-Mississippi confluence, and the Mississippi River down to New Orleans, Louisiana (USFWS, 2014e). The pallid sturgeon was listed as endangered in 1990 (54 FR 36641 36647, September 6, 1990). In Mississippi, the species is known from 11 counties along the Mississippi River on the western border of the state (USFWS, 2015ar).



Pallid sturgeon

Photo Credit: USFWS

Pallid sturgeon prefer large rivers with strong currents; they can withstand a wide range of turbidity conditions. The key reason for this species' decline has been habitat fragmentation and alteration from the damming of major rivers and other large tributaries (USFWS, 2014e).

Smalltooth Sawfish. The endangered smalltooth sawfish is in the ray family but in some respects appears to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. Sawfish snouts are extended as a long, narrow, flattened, rostral blade with a series of transverse teeth along either edge. The rostrum has a saw-like appearance and hence the name of sawfish. This species was listed as endangered in 2005 (70 FR 69464 69466, November 16, 2005). In the western Atlantic, the smalltooth sawfish has been reported from Brazil through the Caribbean and Central America, the Gulf of Mexico, and the Atlantic coast of the United States (USFWS, 2009b). The species is known from Hancock, Harrison, and Jackson Counties in coastal Mississippi (USFWS, 2015as).

The preferred habitats for the smalltooth sawfish are shallow coastal waters of warm seas. They are found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths (USFWS, 2009b).

The primary reason for the decline of the smalltooth sawfish population has been bycatch in various commercial and recreational fisheries. The secondary reason for the decline of the smalltooth sawfish population is habitat loss and degradation. Other threats to the species include entanglement in marine debris, injury from saw removal, pollution, and disturbance of natural behavior by divers and other marine activities (USFWS, 2009b).

Snail Darter. The snail darter is approximately 3 inches long. “Background color above the lateral line is brown with occasional faint traces of green” (USFWS, 1983a). Four dark brown saddle-like marks cross the back of the fish and the lower part of its sides are lighter with dark blotches. Snail darters have a white belly, with dark brown coloring for the upper portion of their head. “The cheeks are mottled brown interspersed by traces of yellow” (USFWS, 1983a). (USFWS, 2015at). This species was originally listed as endangered in 1975 but was reclassified as threatened in 1984 (49 FR 27510 27514, July 5, 1984). This species was originally listed as endangered in 1975 (40 FR 47505 47506, October 9, 1975) but was reclassified as threatened in 1984 (49 FR 27510 27514, July 5, 1984) (USFWS, 2015au). The species occurs in Tennessee River tributaries in Alabama, Georgia, and Tennessee. In Mississippi, the species is only known from Tishomingo County in northeast Mississippi. (USFWS, 2015av)

The preferred habitat for the snail darter is cold water streams with rock shoals, small boulders, and areas of mixed sand and gravel (USFWS, 1983b).

“Extensive impoundment of the upper Tennessee River system has removed suitable habitat from most of the snail darter's native range. Isolated populations survive in larger tributaries where the principal threat is stream habitat degradation resulting from failure to employ Best Management Practices (BMPs) for forestry and agriculture, failure to control soil erosion from construction sites and bridge crossings, and increased stormwater runoff from developing urban and industrial areas” (GADNR, 2009).

Amphibians

One endangered amphibian species is federally listed and known to occur in Mississippi as summarized in Table 9.1.6-11. The dusky gopher frog (*Rana sevosia*) occurs in the southeastern coastal plain of Mississippi. Information on the habitat, distribution, and threats to the survival and recovery of this species in Mississippi is provided below. (USFWS, 2015c)

Table 9.1.6-11: Federally Listed Amphibian Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Dusky Gopher Frog	<i>Rana sevosa</i>	Endangered	Yes, in Forrest, Harrison, Jackson, and Perry Counties in Mississippi.	Uplands dominated by fire-maintained longleaf pine with a grassy understory. Larval habitat consists of grassy, acidic, isolated, ephemeral, depressional wetlands. Known from two Mississippi counties.

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

Dusky Gopher Frog. The endangered dusky gopher frog has a stubby appearance due to its short, plump body, comparatively large head, and relatively short legs. The coloration of its back varies in individual frogs. It ranges from an almost uniform black to a pattern of reddish brown or dark brown spots on a ground color of dark gray or brown. Warts densely cover the back. The belly is thickly covered with dark spots and dusky markings from chin to mid-body (USFWS, 2015aw). This species was listed as endangered in 2001 (66 FR 62993 63002, December 4, 2001). The species is listed in Harrison and Jackson Counties in southeastern Mississippi (USFWS, 2015ax). Critical habitat for the species has been defined in in Forrest, Harrison, Jackson, and Perry Counties in Mississippi (USFWS, 2012b).

Preferred post-larval dusky gopher frog habitat consists of uplands dominated by fire-maintained longleaf pine with a grassy understory. Larval habitat consists of grassy, acidic, isolated, ephemeral, depressional wetlands that lack predaceous fish. Principal threats to the dusky gopher frog include degradation and destruction of breeding and non-breeding habitat, habitat fragmentation, and alteration of hydrological patterns due to urbanization and climate change. Additional threats include the restricted range of the dusky gopher frog, its small number of populations, and disease (USFWS, 2015aw).

Invertebrates

There are 12 endangered and 4 threatened invertebrate species federally listed and known to occur in Mississippi as summarized in Table 9.1.6-12. The 16 species listed all have different ranges throughout the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Mississippi is provided below. (USFWS, 2015c)

Table 9.1.6-12: Federally Listed Invertebrate Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Alabama Heelsplitter	<i>Potamilus inflatus</i>	Threatened	No	Soft, stable substrate in slow to moderate current; known from the Pearl River and the Tombigbee watersheds in 6 counties in the southern and eastern part of the state.
Alabama Moccasinshell	<i>Medionidus acutissimus</i>	Threatened	Yes, in the East Fork Tombigbee River, Bull Mountain Creek, Buttahatchee River, and Luxapalila Creek in northeast Mississippi.	Sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers; known from Lowndes and Monroe Counties along the eastern border of the state with Alabama.
Black Clubshell	<i>Pleurobema curtum</i>	Endangered	No	Rivers and streams, inhabiting sand and gravel beds; known from Itawamba and Monroe Counties, Mississippi
Cumberlandian Combshell	<i>Epioblasma brevidens</i>	Endangered	Yes, in Bear Creek, Tishomingo County.	Rivers of swift currents with sand and gravel substrates in riffle and shoal areas; in Mississippi, found only in Tishomingo County.
Fat Pocketbook	<i>Potamilus capax</i>	Endangered	No	Streams, tributaries, and channels in western Mississippi.
Flat Pigtoe	<i>Pleurobema marshalli</i>	Endangered	No	Sand and gravel shoals in rivers and streams; found in Clay, Lowndes, and Monroe Counties in eastern Mississippi.
Mitchell's Satyr Butterfly	<i>Neonympha mitchellii</i>	Endangered	No	Wetlands that are low nutrient wetlands and receive carbonate rich groundwater; in Mississippi, found in Itawamba, Monroe, and Prentiss Counties.
Orangenacre Mucket	<i>Lampsilis perovalis</i>	Threatened	Yes, in Buttahatchee River, East Fork Tombigbee River, Bull Mountain Creek, and Luxapalila Creek in the eastern portion of Mississippi.	Stable sand, gravel, and cobble substrate in moderate to swift currents in streams and small rivers. Found in Itawamba, Lowndes, and Monroe Counties.

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Ovate Clubshell	<i>Pleurobema perovatum</i>	Endangered	Yes, in Buttahatchee River, East Fork Tombigbee River, Bull Mountain Creek, and Luxapalila Creek in the eastern portion of Mississippi.	Sand and gravel shoals and runs of small rivers and large streams. Found in Itawamba, Lowndes, and Monroe Counties.
Rabbitsfoot	<i>Quadrula cylindrical</i>	Threatened	Yes, in the Big Sunflower River in Sunflower County, Bear Creek in Tishomingo County, and the Big Black River in Hinds and Warren Counties.	Shallow area of streams and rivers with sand and gravel along the banks; known from 7 counties in Mississippi.
Sheepnose Mussel	<i>Plethobasus cyphus</i>	Endangered	No	Large rivers and streams with moderate to swift currents and shallow shoal habitats; In Mississippi, known only from Sunflower County.
Slabside Pearlymussel	<i>Pleuroaia dolabelloides</i>	Endangered	Yes, critical habitat is designated along Bear Creek in Tishomingo County.	Large creeks and rivers with sand and gravel bottoms and moderate current; in Mississippi, known only from Tishomingo County.
Snuffbox Mussel	<i>Epioblasma triquetra</i>	Endangered	No	Small to medium sized creeks, lakes, and rivers with shoal habitats and swift current; In Mississippi, known only from Tishomingo County.
Southern Clubshell	<i>Pleurobema decisum</i>	Endangered	Yes, in the East Fork Tombigbee River, Bull Mountain Creek, Buttahatchee River, and Luxapalila Creek in northeast Mississippi.	Sand/gravel/cobble substrate in shoals and runs of small rivers and large streams; known from Itawamba, Lowndes, and Monroe Counties in the northeast portion of the state.
Southern Combshell	<i>Epioblasma penita</i>	Endangered	No	Rivers and streams, inhabiting sand and gravel beds; known from Itawamba, Lowndes, and Monroe Counties in the Tombigbee River watershed.
Stirrupshell	<i>Quadrula trapes</i>	Endangered	No	Rivers and streams, inhabiting sand and gravel beds; Tombigbee River watershed.

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

Alabama Heelsplitter. The Alabama heelsplitter (*Potamilus inflatus*), or inflated heelsplitter, has an oval, thin shell and grows up to about five and a half inches in length. The shell is brown to black and young specimens sometimes have green rays. The inner shell is a pink to purple color. The Alabama heelsplitter was federally listed as threatened in 1990 (55 FR 39868 39872, September 28, 1990) (USFWS, 2015ay).

This species can be found regionally in rivers throughout Alabama, Louisiana, and Mississippi. In Mississippi, it occurs in the Pearl River and the Tombigbee watersheds in 6 counties in the southern and eastern part of the state. It inhabits sand, mud, silt, and sandy-gravel substrates. It prefers a soft, stable substrate in slow to moderate current. Threats to the Alabama heelsplitter include habitat destruction due to sand and gravel mining, and channel maintenance (dredge disposal) (USFWS, 1993b).

Alabama Moccasinshell. “The Alabama moccasinshell is a small, delicate species, approximately 30 mm (1.2 in) in length. The shell is narrowly elliptical, and thin, with a well-developed acute posterior ridge that terminates in an acute point on the posterior ventral margin. The posterior slope is finely corrugated. The periostracum is yellow to brownish yellow, with broken green rays across the entire surface of the shell. The thin nacre is translucent along the margins and salmon-colored in the umbos (beak cavity)” (USFWS, 2003b). (USFWS, 2000a). The species was federally listed as threatened in 1993 (58 FR 14330 14340, March 17, 1993). Historically, the species is known to occur in Alabama, Mississippi, Georgia, and Tennessee within the Alabama River and tributaries, the Tombigbee River and tributaries, the Black Warrior River and tributaries, the Cahaba River, and the Coosa River and tributaries. In Mississippi, the species is known from Lowndes and Monroe Counties along the eastern border of the state with Alabama (USFWS, 2015az). Critical habitat for the Alabama moccasinshell has been designated in Alabama, Mississippi, Georgia, and Tennessee; in Alabama, the critical habitat includes portions of the Buttahatchee River, Sucarnoochee River, North River, Cahaba River, and Lower Coosa River tributaries and drainages (69 FR 40084 40171, July 1, 2004) (USFWS, 2015ba).

The Alabama moccasinshell inhabits sand/gravel/cobble shoals having moderate to strong currents within streams and small rivers (USFWS, 2015ba). Sedimentation, habitat modification, eutrophication, and degraded water quality are the primary causes of the decline of the Alabama moccasinshell (USFWS, 2015bb).

Black Clubshell. The black clubshell (*Pleurobema curtum*) is a bivalve⁹¹ mollusk that attains a normal adult size of about 2 inches long, 1.4 inches high, and 1.2 inches wide. The shell varies from green in young shells to a dark greenish-black in older shells. The shell is subtriangular, inflated in front, with a bluish-white, iridescent, thin nacre. The shell has near-terminal, prominent umbos. It is elongated posteriorly, with complete heavy hinge dentition (USFWS, 1989a). The species was federally listed as endangered in 1987 (52 FR 11162 11169, April 7, 1987). Historically, the species is known from the Tombigbee River and the East Fork

⁹¹ Bivalve: “A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing” (Smithsonian Institution, 2016).

Tombigbee River in Itawamba and Monroe Counties, Mississippi (USFWS, 1989a) (USFWS, 2015bc).

The black clubshell mussel inhabits large streams and rivers, inhabiting sand and gravel beds. The primary cause of population decline for the species is habitat modification for navigation. This includes physical destruction during dredging, increasing sedimentation, reducing water flow, and suffocating juveniles with sediment. Other threats include water diversion and non-point source pollution from fertilizers and pesticides (USFWS, 1989a).

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) (USFWS, 2015bd). Historically, the species was found across the Cumberland and Tennessee River basins. In Mississippi, the Cumberlandian combshell exists only Tishomingo County in the northeastern part of the state (USFWS, 2015bd). As depicted in Figure 3.1.6-3, critical habitat for the Cumberlandian combshell is defined within Bear Creek in Tishomingo County (USFWS, 2004b).

Suitable habitats for the Cumberlandian combshell are shoals in fast moving rivers having sand and gravel substrates (USFWS, 2004b) (USFWS, 2015bd). 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).

Fat Pocketbook. The fat pocketbook (*Potamilus capax*) is a mussel with a conical shell. This species has a smooth shell that is typically yellowish brown and lacks rays (USFWS, 1989b). 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, 2015be). In Mississippi, the fat pocketbook occurs in 11 counties along the western border of the state (USFWS, 2015be). This species is typically found in streams, tributaries, and channels with sand, mud, or gravel, or substrates (USFWS, 2007).

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

Flat Pigtoe The flat pigtoe (*Pleurobema marshalli*), also known as Marshall's mussel, is a bivalve freshwater mollusk that grows to about 2.4 inches long, 2 inches high, and 1.2 inches wide. The shell has a shallow cavity, rounded egg-shaped outline, and a white interior (USFWS, 1989c). The flat pigtoe was federally listed as endangered in 1987 (52 FR 11162 11169, April 7, 1987).

This species is known to occur regionally in the Tombigbee River in Alabama and Mississippi. In Mississippi, it is believed to be found in Clay, Lowndes, and Monroe Counties in the eastern portion of the state (USFWS, 2015bf). It inhabits sand and gravel shoals in rivers and streams. Shells of the flat pigtoe were found during a 1984 survey of the Tombigbee River tributaries, but it has not been found alive since 1980, and could possibly be extinct. Threats to the flat pigtoe include sedimentation, water diversion, and runoff pollution (USFWS, 1989c).

Mitchell's Satyr Butterfly. The Mitchell's satyr butterfly has a wingspan of approximately 1.75 inches with brown wings having orange-ringed black spots and silver centers on the lower region (USFWS, 1999). The Mitchell's satyr butterfly was federally listed as endangered in 1991 (56 FR 28825 28828, June 25, 1991). It was regionally known to occur in 30 locations within the states in the Great Lakes region. It has since been extirpated from many locations but isolated populations have been documented in regions of Alabama, Indiana, Michigan, Mississippi, Ohio, and Virginia. In Mississippi, this species is known to occur in a few regions within Itawamba, Monroe, and Prentiss Counties in the northeast portion of the state (USFWS, 2015bg) (XSIC, 2015).

Suitable habitats for the Mitchell's satyr butterfly are very restricted as it inhabits fens, a rare wetland type. Fens are low nutrient wetlands that receive carbonate rich groundwater and are suitable to feed the Mitchell's satyr caterpillars as their diet consist of sedges which are grass-like plants. Current threats to the survival of this species include habitat loss, pesticides and pollutants, and collecting. The habitats that this species depend on are being removed for development or are being degraded by pollution from agriculture and runoff (USFWS, 1999).

Orangenacre Mucket. The orangenacre mucket grows up to 3.6 inches in length with a thick outer shell and a rose colored, pink, or white inner shell. The outer shell is a yellow to dark reddish brown color, sometimes with green rays (USFWS, 2000b). The orangenacre mucket was federally listed as threatened in 1993 (58 FR 14330 14340, March 17, 1993).

This species occurs regionally in Alabama and Mississippi. In Alabama, it can be found in the Alabama River and tributaries, streams of the Tombigbee and Black Warrior Rivers, and the Cahaba River and tributaries in 27 counties throughout the state (USFWS, 2015bh). Critical habitat in Mississippi was established in 2004 in the Buttahatchee River, East Fork Tombigbee River, Bull Mountain Creek, and Luxapalila Creek (USFWS, 2004c). It inhabits stable sand, gravel, and cobble substrate in moderate to swift currents in streams and small rivers. Threats to the orangenacre mucket include habitat loss and degradation due to urban and agricultural runoff, impoundment projects, and mining projects (USFWS, 2015bh) (USFWS, 2000b).

Ovate Clubshell. The ovate clubshell is a small to medium-sized mussel that grows up to 2 inches in length. The oval-shaped shell has an outer skin color of yellow to dark brown with occasional broad green rays, and a white interior (USFWS, 2000c). The ovate clubshell was federally listed as endangered in 1993 (58 FR 14330 14340, March 17, 1993).

This species is found regionally in Alabama and Mississippi. In Mississippi, it can be found in Itawamba, Lowndes, and Monroe Counties in the eastern portion of the state (USFWS, 2016e). Critical habitat in Mississippi was established in 2004 in the Buttahatchee River, East Fork

Tombigbee River, Bull Mountain Creek, and Luxapalila Creek (USFWS, 2004d). It inhabits sand and gravel shoals and runs of small rivers and large streams. Threats to the ovate clubshell include channelization, household and agricultural runoff, and channel erosion (USFWS, 2000c).

Rabbitsfoot. The rabbitsfoot can grow up to 6 inches in length. The shell of the rabbitsfoot mussel is generally yellowish, greenish, or olive in color and turns yellowish brown with age (USFWS, 2015bi). 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 (USFWS, 2011) (USFWS, 2015bj). In Mississippi, it is known from seven counties across the state (USFWS, 2015bi). A critical habitat designation was recorded in 2015 at 31 stream segments where the mussels are known to occur (80 FR 24691 24774, April 30, 2015), illustrated in Figure 3.1.6-3. In Mississippi, critical habitat for rabbitsfoot is defined for the Big Sunflower River in Sunflower County, Bear Creek in Tishomingo County, and the Big Black River in Hinds and Warren Counties (USFWS, 2015bk).

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, 2011). The current threats to the rabbitsfoot include the loss of habitat, isolation of populations, range restrictions, sedimentation, and presence of exotic non-native species (USFWS 2011).

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. In Alabama, it can be found in seven counties in the northern portion of the state (USFWS, 2012d) (USFWS, 2015bl). In Mississippi, it is known only from Sunflower County (USFWS, 2015bl).

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, 2012d).

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. In Mississippi, the species is known only from Tishomingo County, critical habitats have been designated along Bear Creek, Tishomingo County, Mississippi, as depicted in Figure 3.1.6-3 (USFWS, 2012e) (USFWS, 2015bm).

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 is 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, 2012f). 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, 2015bn). It still occurs in 14 states and in Canada (USFWS, 2012f). In Mississippi, the species is known only from Tishomingo County (USFWS, 2015bn).

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

Southern Clubshell. The southern clubshell grows to 2.8 inches long, with a thick shell, and heavy hinge plate and teeth. The shell outline is roughly rectangular. The posterior ridge ends abruptly with little development of the posterior slope at the dorsum of the shell. The outer surface color ranges from yellow to yellow-brown with occasional green rays or spots on younger specimens (USFWS, 2000a). The species was federally listed as endangered in 1993 (58 FR 14330 14340, March 17, 1993). The species' range extends through Alabama, Mississippi, and Georgia. In Mississippi, the species is known from Itawamba, Lowndes, and Monroe Counties in the northeast portion of the state (USFWS, 2015bo). Critical habitat for the

southern clubshell has been designated in Alabama, Mississippi, Georgia, and Tennessee; in Mississippi, the critical habitat is within the East Fork Tombigbee River, Bull Mountain Creek, Buttahatchee River, and Luxapalila Creek in Itawamba, Lowndes, and Monroe Counties (USFWS, 2004e).

The southern clubshell inhabits sand/gravel/cobble substrate in shoals and runs of small rivers and large streams. Habitat modification, sedimentation, and water quality degradation are the primary causes of decline of the southern clubshell. This species cannot tolerate impoundment or channelization. Surviving populations are threatened by channelization projects, household and agricultural runoff, and channel degradation caused by sand and gravel mining and/or channel maintenance projects (USFWS, 2000a).

Southern Combshell. The southern combshell, also referred to as the penitent mussel. Adult mussels are about 2.2 inches long, with yellowish, greenish-yellow, or tawny colored shells, sometimes with darker dots (USFWS, 1989a). The species was federally listed as endangered in 1987 (52 FR 11162 11169, April 7, 1987). Historically, the species is known from Alabama and Mississippi in the Tombigbee River, East Fork Tombigbee River, Alabama River, Cahaba River, and the Coosa River. In Alabama, the species is known or believed to occur in Fayette, Lamar, Winston, and Marion Counties in the northwestern portion of the state (USFWS, 1989a) (USFWS, 2015bp).

The Southern combshell mussel inhabits large streams and rivers, primarily sand and gravel beds. The primary cause of population decline for the species is habitat modification for navigation. This includes physical destruction during dredging, increasing sedimentation, reducing water flow, and suffocating juveniles with sediment. Other threats include water diversion and non-point source pollution from fertilizers and pesticides (USFWS, 1989a).

Stirrupshell. The stirrupshell is a freshwater mussel with shells that are a yellowish-green color, with green zigzag markings that become brown with age. Adult stirrupshells are about 2.2 inches long, 2 inches high, and 1.4 inches wide (USFWS, 1989a). The species was federally listed as endangered in 1987 (52 FR 11162 11169, April 7, 1987). Historically, the species is known to range from Alabama and Mississippi in the Tombigbee River, Black Warrior River, and Alabama River. In Mississippi, the species is known from the Tombigbee River watershed (USFWS, 1989a) (USFWS, 2015bq).

The stirrupshell mussel inhabits large streams and rivers, primarily sand and gravel beds. The primary cause of population decline for the species is habitat modification for navigation. This can result in physical destruction during dredging, increased sedimentation, reduced water flow, and suffocation of juveniles with sediment. Other threats include water diversion and non-point source pollution from fertilizers and pesticides (USFWS, 1989a).

Plants

Two endangered and one threatened plant species are federally listed and known to occur in Mississippi as summarized in Table 9.1.6-13. The Louisiana quillwort (*Isoetes louisianensis*) is found in the southeastern portion of the state, pondberry (*Lindera melissifolia*) is found in the west-central portion of the state, and Price’s potato-bean (*Apios priceana*) is found in the eastern part of the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Mississippi is provided below. (USFWS, 2015c)

Table 9.1.6-13: Federally Listed Plant Species of Mississippi

Common Name	Scientific Name	Federal Status	Critical Habitat in Mississippi	Habitat Description
Louisiana Quillwort	<i>Isoetes louisianensis</i>	Endangered	No	Sandy soils and gravel bars in or near shallow blackwater streams and overflow channels in riparian woodland/ bayhead forests; known from 9 counties in southeast Mississippi.
Pondberry	<i>Lindera melissifolia</i>	Endangered	No	Seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions; known from Bolivar, Sharkey, Sunflower, and Tallahatchie Counties in the west-central portion of the state.
Price’s Potato-bean	<i>Apios priceana</i>	Threatened	No	Open, wooded areas, in forest gaps and in open, low areas near streams and rivers; known from eastern Mississippi.

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

Louisiana Quillwort. The Louisiana quillwort “is a small, semi-aquatic, facultative evergreen plant with spirally arranged leaves arising from a globose, two-lobed corm. The pliant, hollow leaves are transversely septate and measure 2 to 3 millimeters (mm) (0.12 inch) wide, and up to 40 centimeters (cm) (16.0 inches) long. Spore-containing structures (sporangia) are embedded in the pale, broadened bases of the leaves” (USFWS, 1996). Louisiana quillwort was listed as endangered in 1992 (57 FR 48741 48747, October 28, 1992). The species is known or believed to occur in Alabama, Louisiana, and Mississippi; in Mississippi, the species is known from nine counties in the southeast portion of the state (USFWS, 2015br).

Habitat for the Louisiana quillwort “appears to be restricted to sandy soils and gravel bars in or near shallow blackwater streams and overflow channels in riparian woodland/bayhead forests of pine flatwoods and upland longleaf pine.” The most serious threat to the species is “[h]abitat loss through land use practices that significantly transform riparian forest communities and alter stream quality and dynamics.” “Dredging, ditching, channelization, road construction, and off-road vehicles (ORV) can alter natural processes and result in habitat loss.” In addition, timber removal, mining, feral hogs, beaver dams, and plant collection are potential threats (USFWS, 1996).

Pondberry. The pondberry “is a deciduous shrub, growing from less than 1 foot (30 cm) to, infrequently, more than 6 feet (2 m) in height. Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins. Shrubs usually are sparsely branched, with fewer branches on smaller plants. Plants are rhizomatous, frequently propagating by vegetative sprouts and forming colonies. Plants are dioecious, each plant is a male or a female, and produce clusters of small, yellow flowers in early spring prior to leaf development, from buds on branches produced from the growth during the preceding year. Immature fruits are drupes, green, and ripen to red by fall. (USFWS, 2015bs). Pondberry was listed as endangered in 1986 (51 FR 27495 27500, July 31, 1986). The species is known from Alabama, Arkansas, Georgia, Mississippi, Missouri, North Carolina, and South Carolina; in Mississippi, the species is known from Bolivar, Sharkey, Sunflower, and Tallahatchie Counties in the west-central portion of the state (USFWS, 2015bs).

Suitable habitat for this species includes seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions. Threats to the species include alteration or destruction of its habitat through land-clearing, drainage modification, timber-harvesting, and disturbance from domestic animals (USFWS, 1993c).

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 1.6-4 inches long. 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, 1993d). 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, 1993d) (USFWS, 2015bt). The species is known from Clay, Kemper, Lee, and Oktibbeha Counties in eastern Mississippi (USFWS, 2015bu).

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, 1993d) (USFWS, 2015bt).

9.1.7. Land Use, Recreation, and Airspace

9.1.7.1. Definition of the Resources

The following summarizes major land uses, recreational venues, and airspace considerations in Mississippi, 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” (Natural Resources Management and Environment Department, 2017). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover,

observed on the ground or remote sensing and mapping, on the earth's surface; land cover includes vegetation and manmade development (Anderson, Hardy, Roach, & Witmer, 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, 2003).

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, highlighting areas of recreational significance within four identified regions.

Airspace

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

9.1.7.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, summarizes numerous federal environmental laws and regulations that, to one degree or another, may affect land use in Mississippi. However, most site-specific land use controls and requirements are governed by local county, city, and village laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities. Section 17-1-1 of the Mississippi Code provides the regulatory framework for counties and municipalities to prepare comprehensive plans, including land use plans. (State of Mississippi, 2015b)

Because the Nation's airspace is governed by federal laws, there are no specific Mississippi state laws that would alter the existing conditions relating to airspace for this PEIS. Title 61 Aviation of the Mississippi Code governs aviation for the state (State of Mississippi Judiciary, 2015a).

9.1.7.3. Land Use and Ownership

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

Land Use

Forest and woodlands comprise the largest portion of land use with 52 percent of Mississippi's total land area occupied by this category (Table 9.1.7-1 and Figure 9.1.7-1). Agriculture is the second largest area of land use with 26 percent of the total land area. Developed land is the third largest area of land with approximately 6 percent of the total land area (USGS, 2011). The remaining percentage of land by coverage type includes surface water and other land cover, shown in Figure 9.1.7-1, that are not associated with specific land uses (USGS, 2011).

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

Land Use	Square Miles	Percent of Land
Forest and Woodland	25,223	52.0%
Agricultural Land	12,486	26.0%
Developed Land	2,689	6.0%
Surface Water and other Land Cover	7,761	16.0%

Source: (USGS, 2011)

Forest and Woodland

Forest and woodland areas can be found throughout the state. Most forest and woodland areas throughout Mississippi are privately owned (approximately 88 percent) (USFS, 2009c). Section 9.1.6 presents additional information about terrestrial vegetation.

State Forests

There are three state forests: the Kurtz State Forest, Camden State Forest, and Jamie L. Whitten State Forest. State Forests are under the administration of and managed by the Mississippi Forestry Commission. The state forests are managed to demonstrate sound forestry practices while maintaining game animal habitat. The Forestry Commission also provides technical assistance to the management of forestland on school trust lands administered by the local school boards. The objective of the Mississippi Forestry Commission for the school trust lands is to maximize sustainable timber production. (Mississippi Forestry Commission, 2014) (Mississippi Forestry Commission, 2010)

Private Forest and Woodland

Approximately 88 percent of Mississippi's total forestland is owned collectively by private landowners with 70 percent owned by approximately 163,000 family forest landowners. About 83 percent of the family owned forests are less than 100 acres. There are a variety of reasons for private landowners to hold forest and woodland areas including aesthetic value, protection of nature, recreation, and timber harvest (USFS, 2009c). 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 9.1.6, Biological Resources and Section 9.1.8, Visual Resources.

Agricultural Land

Agricultural land exists in every region of the state, with the largest concentrations in the area north of Vicksburg and east of the Mississippi River (Figure 9.1.7-1). About one-quarter of Mississippi's total land area is classified as agricultural land (approximately 26%, or 12,486 square miles). In 2012, there were 38,067 farms in Mississippi and 87 percent were owned and operated by small, family businesses, with the average farm size of 287 acres (USDA, 2014a). Some of the state's largest agricultural uses include soybeans, sweet potatoes, corn, cotton, rice, hay, wheat, catfish, berries, and nuts. Other agricultural uses include cattle, hogs, and poultry (USDA, 2014b). For more information by county, access the USDA Census of Agriculture website:

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

Developed Land

Developed land in Mississippi tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 9.1.7-1). Although only 6 percent of Mississippi land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 9.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 9.1.7-1 shows where these areas are located within the Developed land use category.

Table 9.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Jackson	351,478
Gulfport	208,948
Memphis (MS/AR)	128,310
Hattiesburg	80,358
Pascagoula	50,428
Total Population of Metropolitan Areas	819,522
Total State Population	2,994,079

Sources: (U.S. Census Bureau, 2010b) (U.S. Census Bureau, 2015d)

^a Mississippi's statewide population in 2016 was 2,988,726 (U.S. Census Bureau, 2015e).

9.1.7.4. Land Ownership

Land ownership within Mississippi has been classified into four main categories: private, federal, state, and tribal.⁹²

Private Land

The majority of land in Mississippi is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 9.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.⁹³

⁹² 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 dataset 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.

⁹³ Total acreage of private land could not be obtained for this state.

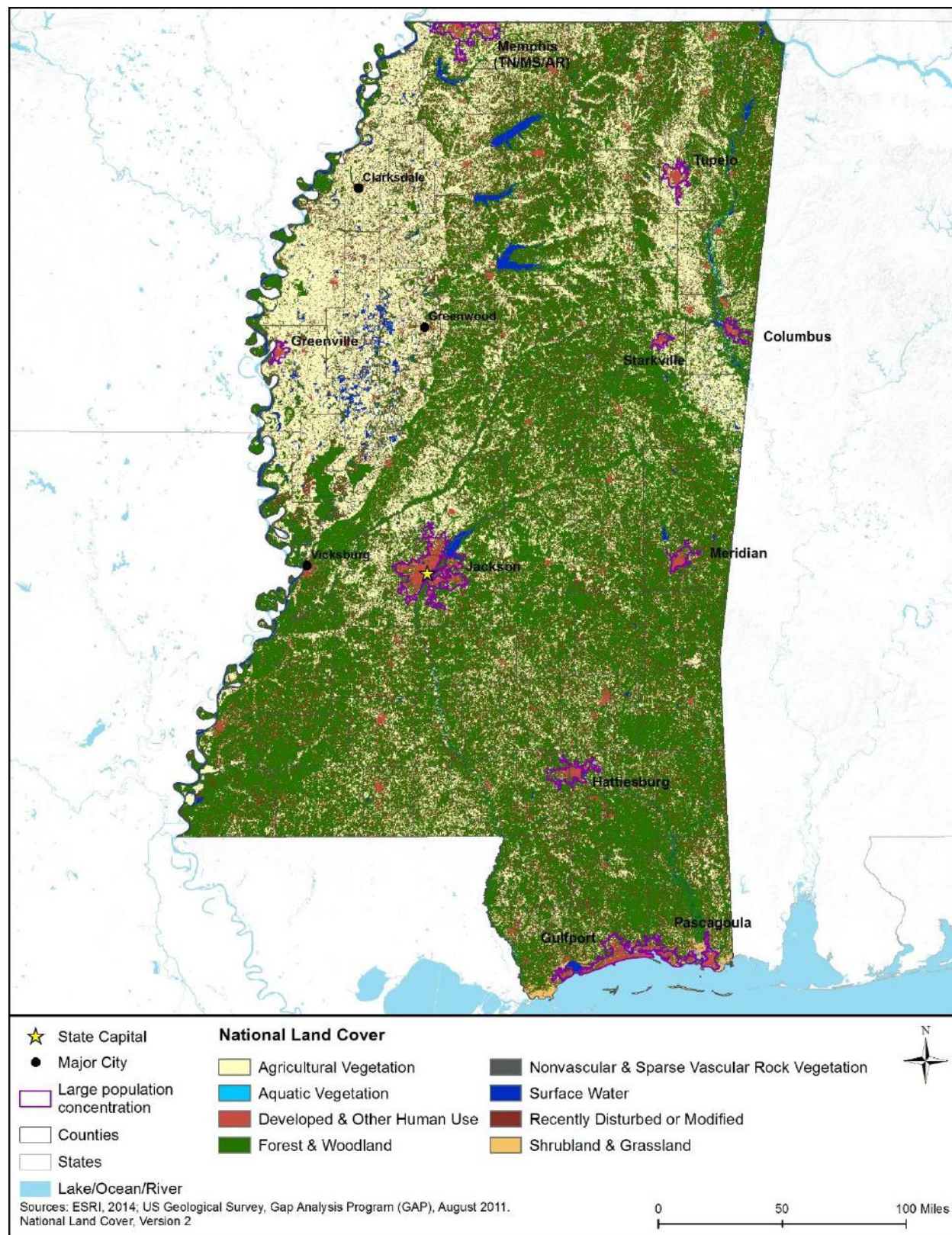


Figure 9.1.7-1: Major Land Use Distribution by Coverage Type

Federal Land

The federal government manages 2,625 square miles (5 percent) of Mississippi land with a variety of land types and uses, including military bases, training centers, national wildlife refuges, national forests, national parks, and historic sites (Figure 9.1.7-2) (USGS, 2012b) (USGS, 2014f). Five federal agencies manage the majority of federal lands throughout the state (Table 9.1.7-3 and Figure 9.1.7-2). 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 9.1.7-3: Major Federal Land Ownership in Mississippi

Agency	Square Miles	Representative Type
Department of Defense (DoD)	467	Military Bases, Camps, Training Centers, Airfields
USFWS	339	National Wildlife Refuges
USFS	1,652	National Forests
National Park Service (NPS)	162	Parks, Battlefields, National Seashore, National Heritage Areas
Tennessee Valley Authority	5	Water Projects
Total	2,625	NA

Sources: (USGS, 2012b) (USGS, 2014f)

- The DoD owns and manages 467 square miles used for military bases, camps, military training centers, and airfields;
- The USFWS owns and manages 339 square miles consisting of 12 National Wildlife Refuges in Mississippi;
- The USFS owns and manages 1,652 square miles set aside as the six national forests consisting of the Bienville, Delta, Desoto, Holly Springs, Homochitto, and Tombigbee National Forests;
- The NPS manages 162 square miles consisting of two National Battlefields, one National Seashore, one National Historical Park, one National Scenic Trail, one Parkway, two National Military Parks, and three other NPS affiliated areas, such as National Heritage Areas; and
- The Tennessee Valley Authority manages 5 square miles consisting of water projects. (USGS, 2012b) (USGS, 2014f)

State Land⁹⁴

The Mississippi state government owns approximately 303 square miles of land comprised of coastal preserves, conservation lands, wildlife management areas, state parks, and public school trust lands. The Department of Wildlife, Fisheries, and Parks manages approximately half of the state lands (Table 9.1.7-4).

⁹⁴ 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.

Table 9.1.7-4: State Land in Mississippi ^a

Agency	Square Miles	Representative Type
Department of Marine Resources	75	Coastal Preserves
Department of Environmental Quality (DEQ)	23	Conservation lands
Department of Wildlife, Fisheries, and Parks	160	54 Wildlife Management Areas, State Parks
Secretary of State	45	Public School Trust Lands

Sources: (USGS, 2012b) (USGS, 2014f)

^a Acres are not additive due to overlapping boundaries of the State Forests, State Parks and Recreation Areas, and Wildlife Management Areas.

- The Department of Marine Resources manages 75 square miles of coastal wetland habitat set within 20 coastal preserves (Mississippi Department of Marine Resources, 2015);
- The Department of Environmental Quality (DEQ) manages 23 square miles consisting of conservation lands;
- The Department of Wildlife, Fisheries, and Parks manages 160 square miles consisting of 54 wildlife management areas that provide wildlife habitat and hunting opportunities and 25 state parks the offer recreation facilities and opportunities (Mississippi Department of Wildlife, Fisheries, and Parks, 2015b); and
- The Secretary of State manages 45 square miles consisting of public school trust lands that are leased to provide funding for public education. (Mississippi Secretary of State, 2014b) (USGS, 2012b) (USGS, 2014f)

Tribal Land

The Bureau of Indian Affairs, along with individual tribes, manages 33.8 square miles, or less than 0.1 percent of the total land within Mississippi.⁹⁵ These lands are composed of one Indian Reservation currently located in the state (Table 9.1.7-5). For additional information regarding tribal land, see Section 9.1.11, Cultural Resources.

Table 9.1.7-5: Indian Reservations of Mississippi

Reservation Name	Square Miles
Choctaw Reservation	33.8
Total	33.8

Sources: (USGS, 2012c) (USGS, 2014g)

⁹⁵ Although the Bureau of Indian Affairs “manages” American Indian lands, the Bureau of Indian Affairs is different than other land management agencies as the lands are held in trust for sovereign nations.

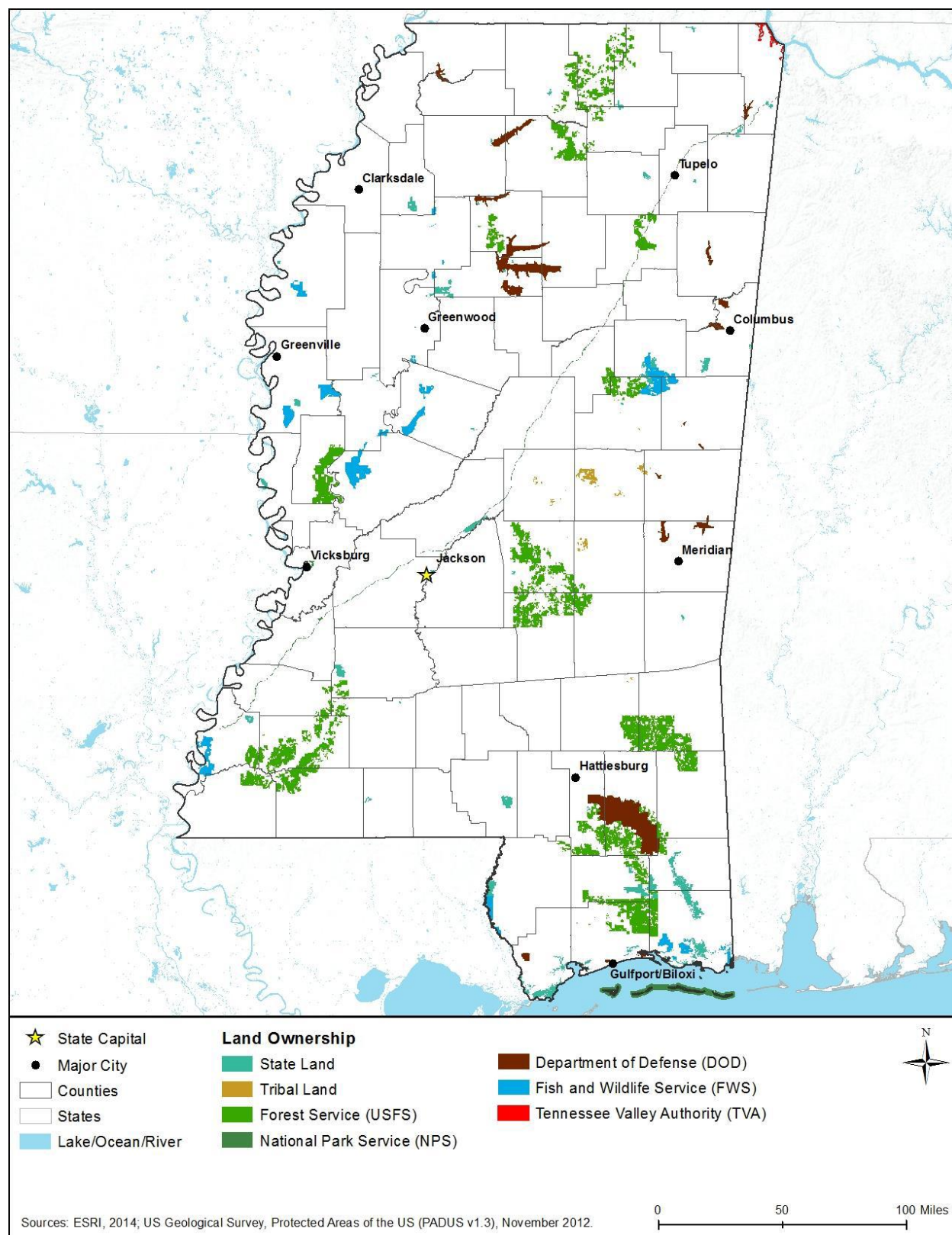


Figure 9.1.7-2: Land Ownership Distribution

9.1.7.5. Recreation

Mississippi consists of lowlands, with several large rivers bordering and traversing through the state. The state is known for its wetlands, prime hunting, and fishing locations, and river-based recreation. Tourism within the state is focused on the casino resorts in cities along the Mississippi River and locations connected to African American, Civil War, and Civil Rights history (Mississippi Tourism, 2015). State parks are generally associated with rivers, lakes, or reservoirs. Parks have recreational activities including hiking, bicycling, horseback riding, and other trail use; camping, golfing, and picnicking; boating, fishing, and other water activities (Mississippi Department of Wildlife, Fisheries & Parks, 2015). On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, and lake or river access points. Availability of community-level facilities is typically commensurate to the population's needs.

This section discusses recreational opportunities available at various locations throughout Mississippi. For information on visual resources, see Section 9.1.8, Visual Resources, and for information on the historical significance of locations, see Section 9.1.11, Cultural Resources.

Delta Region

The northwest portion of Mississippi consists of the Mississippi Delta, bordered to the west by the Mississippi River and the east by the Yazoo River (see Figure 9.1.7-3).⁹⁶ This region is known for historical plantations and antebellum mansions, blues music, and casino resorts along the Mississippi River (Mississippi Delta Tourism Association, 2015).

The Delta National Forest is known for its waterfowl, campsites, and multi-use trails. The Little Sunflower River Recreational Area specializes in boating, fishing, camping, and hiking (USFS, 2015a). Ten NWRs are located within the Delta Region, with activities including hiking, wildlife viewing, fishing, and licensed, seasonal hunting. Refuges within the Delta Region are popular for photography, with observation towers and other structures for visitors to photograph scenery and wildlife. (USFWS, 2015bv) (USFWS, 2015bw) (USFWS, 2015bx)

⁹⁶ 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 dataset that contains large quantities of information relevant to the Proposed Action. The data was queried to show the Primary Designation Type of area. To show these in the map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for recreational resources. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

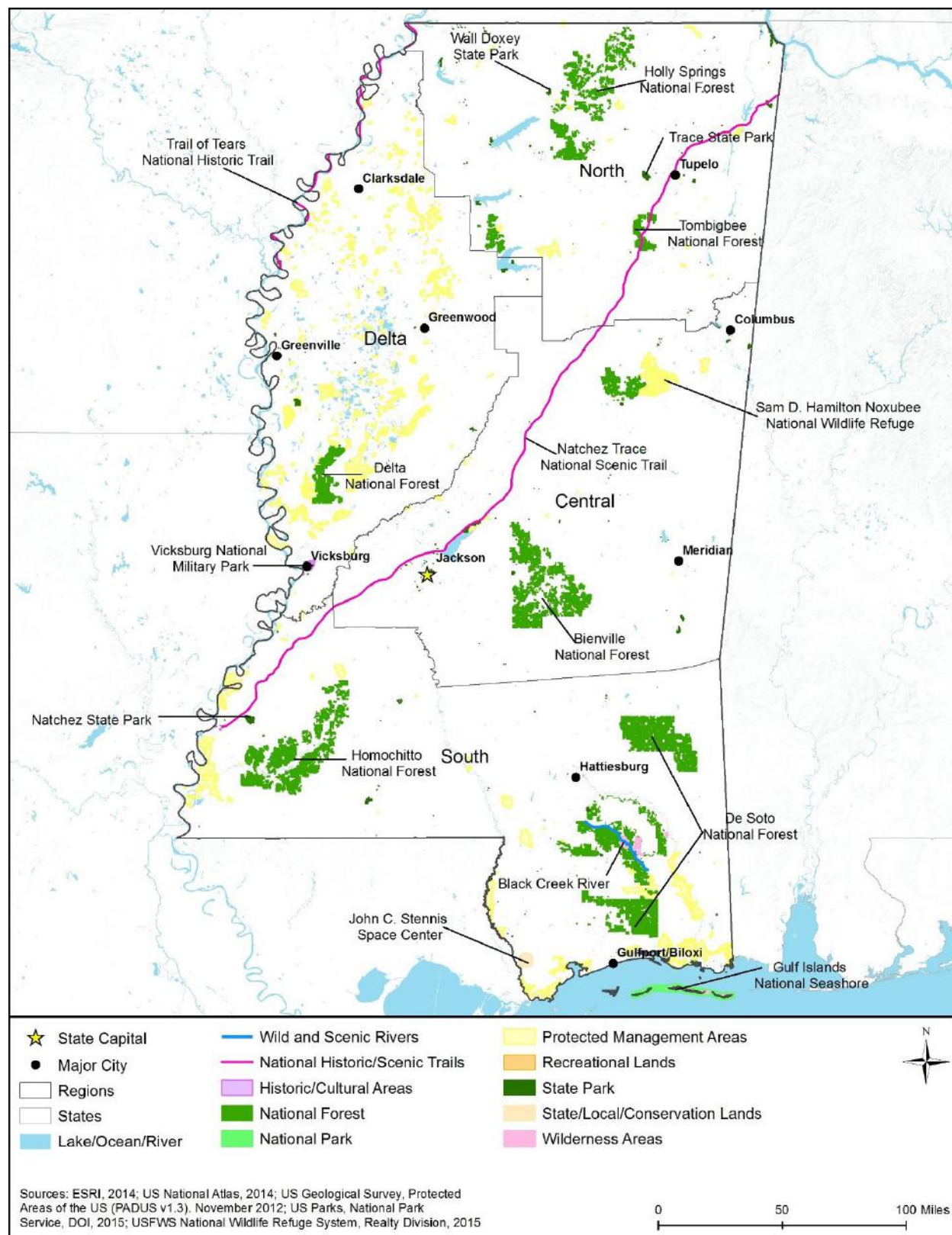


Figure 9.1.7-3: Mississippi Recreation Resources

Northern Region

The Northern Region is bordered to the north by Tennessee, the east by Alabama, and the Mississippi River Delta to the west (see Figure 9.1.7-3). This region, known as the Hills, is popular for iconic and historical locations such as Elvis Presley's birthplace, Nobel Prize Winner William Faulkner's home, and the town of Oxford, popular for its literature and creative community (Mississippi Tourism, 2015).

The Holly Springs National Forest contains the Chewalla Lake and Puskus Lake Recreation Areas: Chewalla Lake is a popular site for swimming and other water sports, while Puskus Lake is a more remote location known for fishing and hiking trails. Recreational opportunities include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; boating, fishing, and other water activities; and licensed, seasonal hunting. (USFS, 2015b)

Central Region

The Central Region is bordered to the east by Alabama, and to the west by the Mississippi River Delta (see Figure 9.1.7-3). Known as the Pines, tourists visit this region for its cultural history: the childhood home of Tennessee Williams and the Jimmie Rodgers Museum are both located in the Central Region (Mississippi Tourism, 2015).

The Tombigbee National Forest contains the Tombigbee River and rolling hills. The Bienville National Forest contains the Leaf and Strong Rivers, noted for fishing. Recreational opportunities include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; boating, fishing, and other water activities; and licensed, seasonal hunting. (USFS, 2015a)

Southern Region

The Southern Region is bordered to the east by Alabama, the south by the Gulf of Mexico, and the west by Louisiana (see Figure 9.1.7-3). This region is known for recreation on the Gulf, including fishing for crabs and crawfish, and Casino Row in Biloxi (Mississippi Tourism, 2015).

The De Soto National Forest is known for year-round recreational activities. The forest contains two National Recreation Trails, the Black Creek Trail and the Tuxachanie Trail, and the Black Creek National Scenic River, popular for kayaking and canoeing. The Homochitto National Forest is popular for hunting. Recreational opportunities include hiking, bicycling, and other trail use; camping and picnicking; boating, fishing, and other water activities; and licensed, seasonal hunting. (USFS, 2015a)

The Gulf Islands National Seashore extends on the Gulf of Mexico from Mississippi to Florida, and has recreational activities including hiking, bicycling, and other trail use; camping and picnicking; and boating, fishing, and other water activities (NPS, 2015c). The Natchez National Historical Park is popular for its visitor's center and tours of restored antebellum homes and plantations (NPS, 2015d).

9.1.7.6. *Airspace*

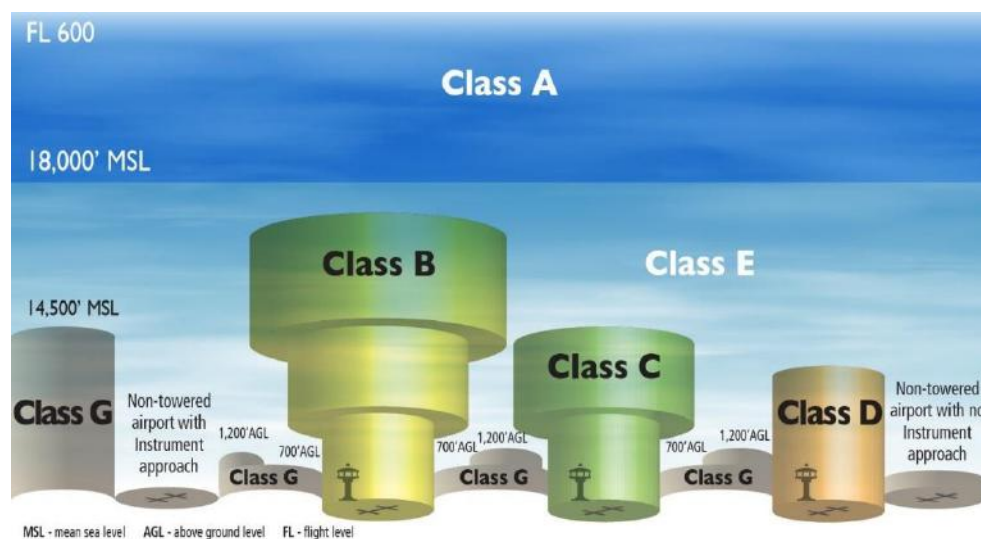
The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs). The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations,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

Airspace Categories

There are two categories of airspace or airspace areas:

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

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 9.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)⁹⁷ service is based on the airspace classification (FAA, 2008).



Source: Derived from (FAA, 2008)

Figure 9.1.7-4: National Air Space Classification Profile

⁹⁷ ATC – Approved authority service to provide safe, orderly, and expeditious flow of air traffic operations (FAA, 2015c).

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL).⁹⁸ 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).⁹⁹
- **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 9.1.7-6).

⁹⁸ 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).”

⁹⁹ IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015c).

Table 9.1.7-6: SUA Designations

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

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

Other Airspace Areas

Other airspace areas, explained in Table 9.1.7-7, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 9.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	<p>There are three types:</p> <ul style="list-style-type: none"> • 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	<p>TFRs are established to:</p> <ul style="list-style-type: none"> • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the state of Hawaii declared national disasters for humanitarian reasons. <p>Only those TFRs annotated with an ending date and time of “permanent” are included in this Final PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.</p>
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

Aerial System Considerations

Unmanned Aerial Systems

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

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

Balloons

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

Obstructions to Airspace Considerations

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

- “Any construction or alteration exceeding 200 ft. above ground level;
- Any construction or alteration:
 - o within 20,000 ft. of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 ft.;
 - o within 10,000 ft. of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 ft.;
 - and
 - o within 5,000 ft. of a public use heliport which exceeds a 25:1 surface.
- Any highway, railroad, or other traverse way whose prescribed adjusted height would exceed the above noted standards;
- When requested by the FAA; and
- Any construction or alteration located on a public use airport or heliport regardless of height or location” (FAA, 2015d).

Construction or alternative facilities (such as towers) that are subject to FCC licensing requirements are also required to have an OE/AAA performed by the FAA Airport Division.

9.1.7.7. Mississippi Airspace

The Mississippi Aeronautics Divisions within the MDOT Aviation Office is responsible for development of “a safe and effective air transportation system in the state of Mississippi” (MDOT, 2015a). Airports in the state are locally owned by cities, counties, or airport authorities. Therefore, the Aeronautics Division mission is to “assist the public-owned airports in developing a safe and effective air transportation system in the state by providing technical, administrative, and financial assistance to airport owners for federal and state funded construction projects” (NASAO, 2015a) (NASAO, 2017). There is one FAA FSDO for Mississippi located in Jackson (FAA, 2016b).

Mississippi 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, 2015b). Figure 9.1.7-5 presents the different aviation airports/facilities residing in Mississippi, while Figure 9.1.7-6 and Figure 9.1.7-7 presents the breakout by public and private airports/facilities. There are approximately 232 airports within Mississippi as presented in Table 9.1.7-8 and Figure 9.1.7-5 through Figure 9.1.7-7 (USDOT, 2015a).

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

Type of Airport or Facility	Public	Private
Airport	79	108
Heliport	1	44
Seaplane	0	0
Ultralight	0	0
Balloonport	0	0
Gliderport	0	0
Total	80	152

Source: (USDOT, 2015b)



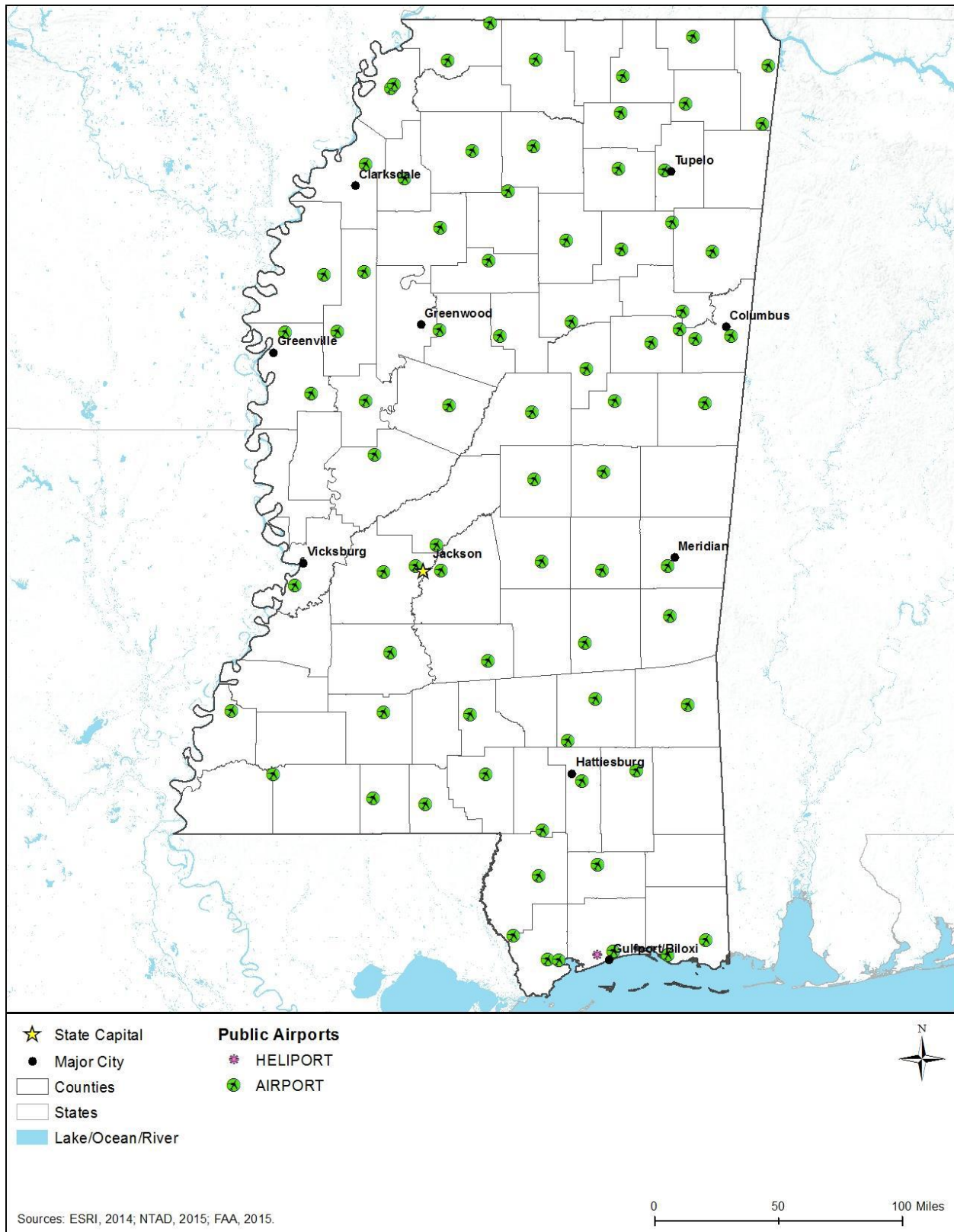


Figure 9.1.7-6: Public Mississippi Airports/Facilities

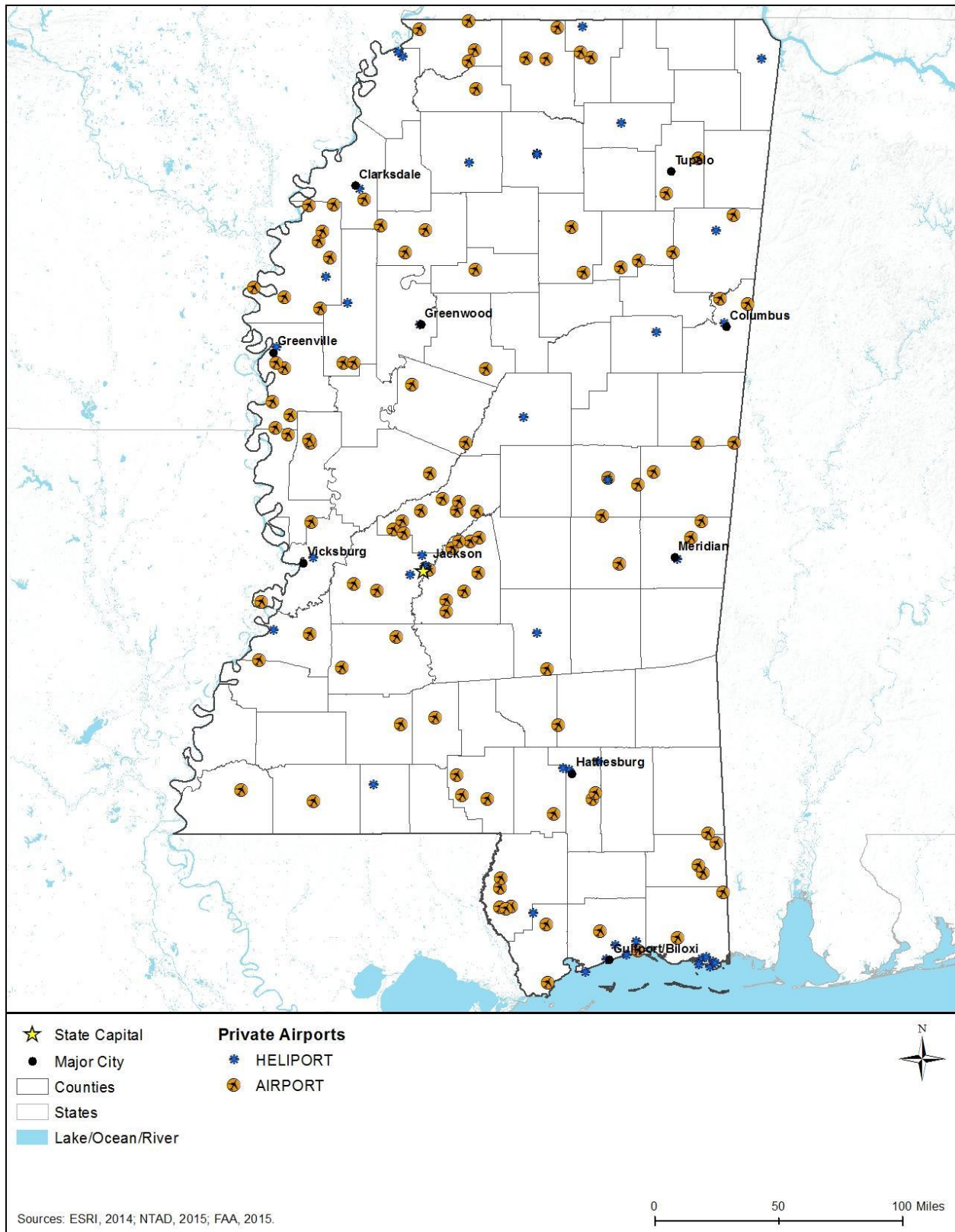


Figure 9.1.7-7: Private Mississippi Airports/Facilities

There are Class C and D controlled airports as follows:

- Two Class C:
 - o Columbus Air Force Base (AFB); and
 - o Jackson-Evers International.
- Thirteen Class D:
 - o Stennis International, Bay St. Louis;
 - o Keesler AFB, Biloxi;
 - o Golden Triangle Regional, Columbus Golden Triangle;
 - o Greenville Municipal;
 - o Greenwood-Leflore, Greenwood;
 - o Gulfport-Biloxi International, Gulfport;
 - o Hawkins Field, Jackson;
 - o Joe Williams Navy Outlying Field, Meridian;
 - o Key Field, Meridian;
 - o Meridian Naval Air Station-McCain Field, Meridian;
 - o Olive Branch;
 - o Trent Lott International, Pascagoula; and
 - o Tupelo Regional (FAA, 2015e).

SUAs (i.e., nine restricted, twelve MOAs, and two alert areas) located in Mississippi are as follows:

- Camp Shelby (Restricted):
 - o R-4401A – Surface to but not including 4,000 feet MSL;
 - o R-4401B – 4,000 feet MSL to but not including 10,000 feet MSL;
 - o R-4401C – 10,000 feet MSL to but not including FL 180;
 - o R-4401D – FL 180 to but not including FL 230; and
 - o R-4401E – FL 230 to FL 290.
- Gainesville – (Restricted):
 - o R-4403 – From surface to 5,000 feet MSL.
- Macon – (Restricted):
 - o R-4404A – Surface to 11,500 feet MSL;
 - o R-4404B – From 1,200 feet AGL to 11,500 feet MSL; and
 - o R-4404C – 11,500 feet MSL to 14,500 feet MSL (FAA, 2015f).

The twelve MOAs for Mississippi are as follows:

- Bullseye:
 - o 1 – 10,000 feet MSL to, but not including, FL 180;
 - o 2 – 5,000 feet MSL to, but not including, FL 180; and
 - o 3 – 11,000 feet MSL to, but not including, FL 180.
- Columbus:
 - o 1 – 8,000 feet MSL to, but not including, FL 180;
 - o 3 – 8,000 feet MSL to, but not including, FL 180; and
 - o 4 – 10,000 feet MSL to, but not including, FL 180.

- De Soto:
 - o 1 – 500 feet AGL to, but not including, 10,000 feet MSL; and
 - o 2 – 100 feet AGL to and including 5,000 feet MSL.
- Meridian:
 - o 1 East – 8,000 feet MSL to, but not including, FL 180;
 - o 2 East – 8,000 feet MSL to, but not including, FL 180;
 - o 1 West – 8,000 feet MSL to, but not including, FL 180; and
 - o 2 West – 8,000 feet MSL to, but not including, FL 180 (FAA, 2015f).

There are two Alert Areas as follows:

- Columbus AFB:
 - o A-440 – Surface to and including 6,500 feet MSL.
- Shuqualak:
 - o A-443 – Surface to 4,000 feet MSL (FAA, 2015f).

The SUAs for Mississippi are presented in Figure 9.1.7-8. There are no TFRs (See Figure 9.1.7-8) (FAA, 2015g). Figure 9.1.7-9 presents the MTRs in Mississippi consisting of sixteen Visual Routes, nine Instrument Routes, and eight Slow Routes.

UAS Considerations

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

Obstructions to Airspace Considerations

Several references in the Mississippi statutes address airspace hazards. As defined in § 61-7-3 of Title 61 Aviation, Chapter 7 Airport Zoning, an airport hazard is “any structure or tree or use of land which obstructs the airspace required for the flight of aircraft in landing or taking-off at any airport or is otherwise hazardous to such landing or taking-off of aircraft,” (State of Mississippi Judiciary, 2015b). Chapter 7 Airport Zoning, § 61-7-17 Permits and Variances states a permit is required “before any new structure or use may be constructed or established and before any existing use or structure may be substantially changed or substantially altered or repaired; and y before any non-conforming structure or tree may be replaced, substantially altered or repaired, rebuilt, allowed to grow higher, or replanted. No permit shall be granted that would allow the establishment or creation of an airport hazard or permit a non-conforming structure or tree or non-conforming use to be made or become higher or become a greater hazard to air navigation,” (State of Mississippi Judiciary, 2015b).

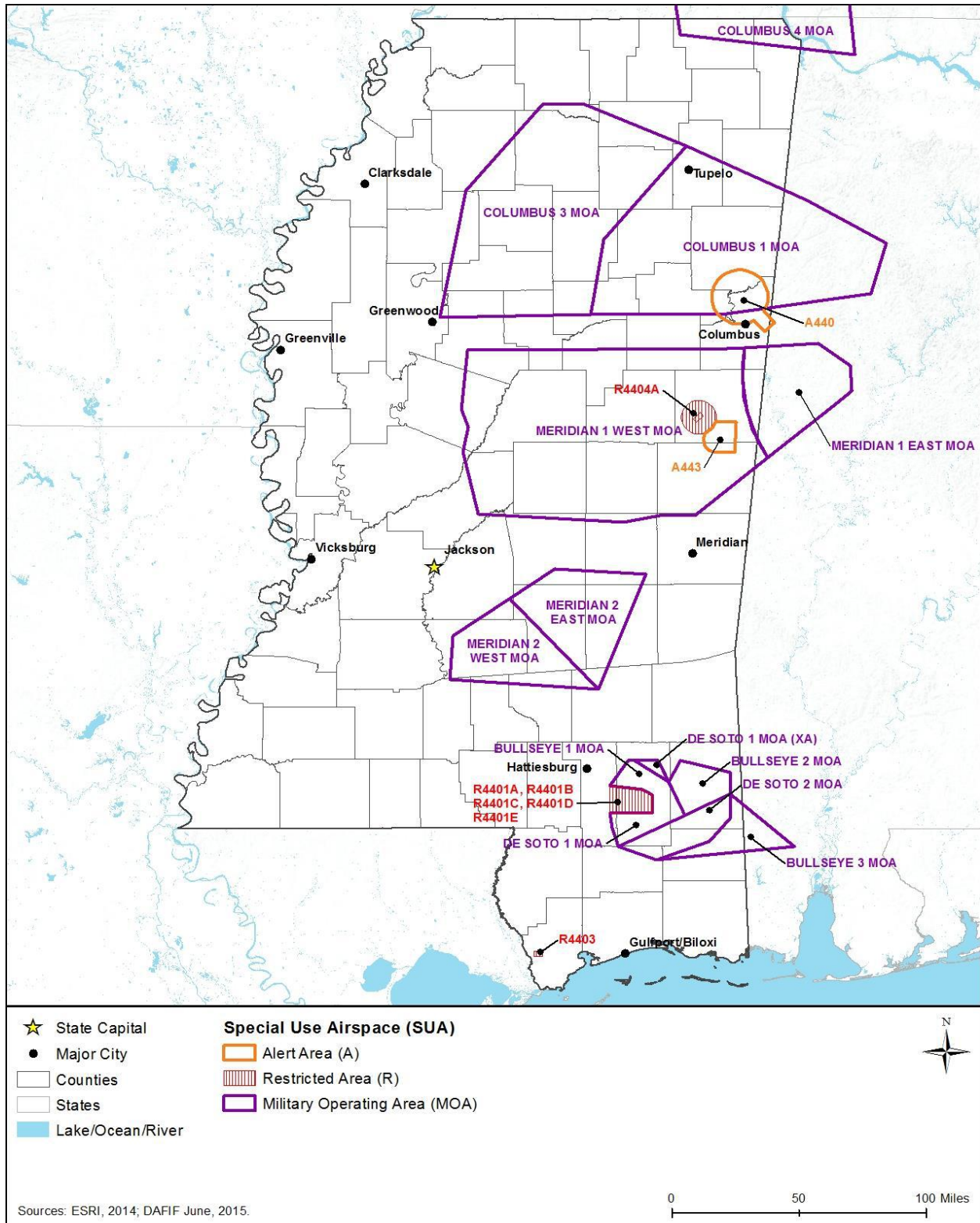


Figure 9.1.7-8: SUAs in Mississippi

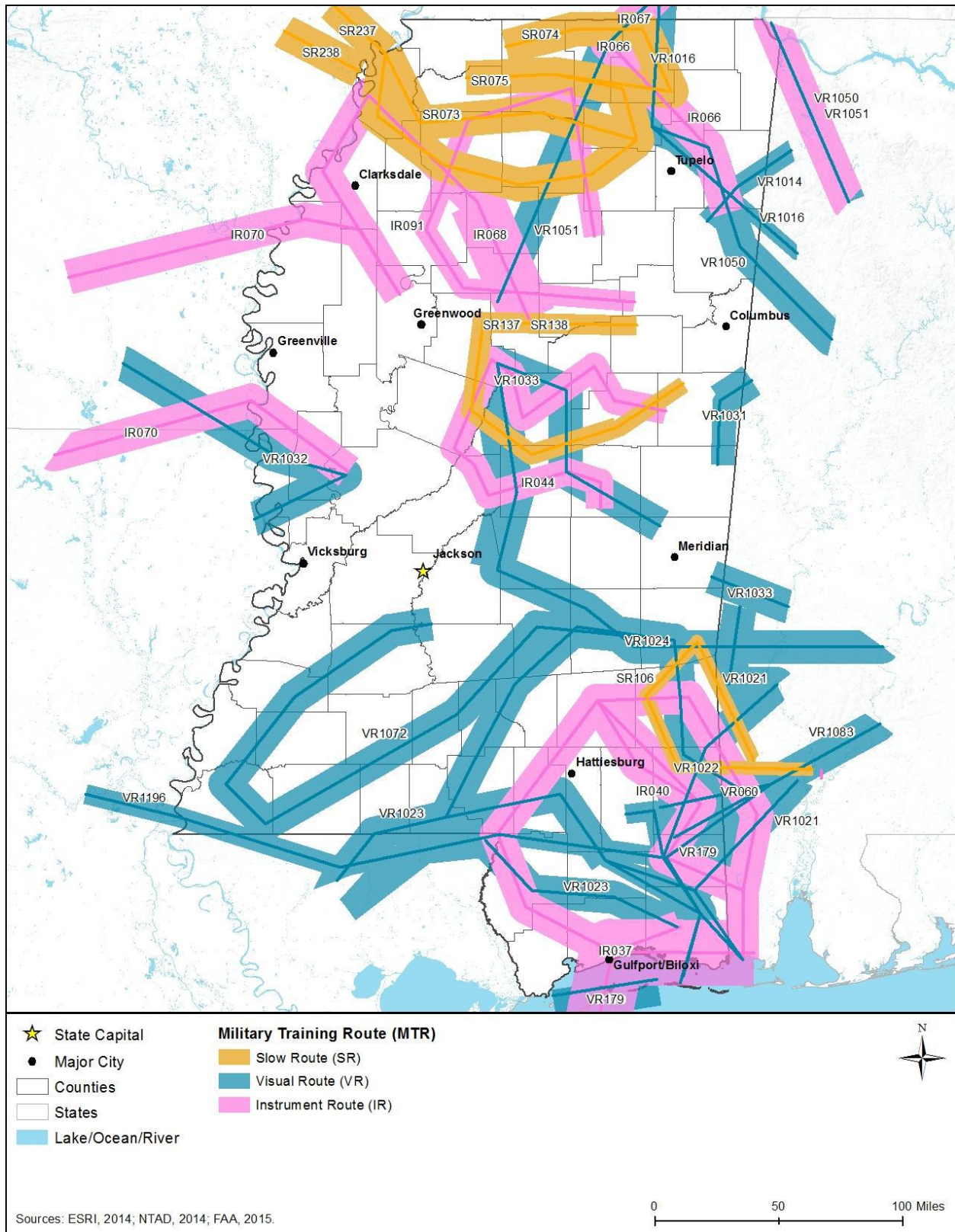


Figure 9.1.7-9: MTRs in Mississippi

9.1.8. Visual Resources

9.1.8.1. Definition of the Resource

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

9.1.8.2. Specific Regulatory Considerations

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

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

State Law/Regulation	Regulatory Agency	Applicability
Miss. Code Ann. § 49-10-1 (2015), Title 49. Conservation And Ecology, Chapter 10. Wildlife Violator Compact , § 49-10-1	Department of Wildlife, Fisheries, and Parks	“The preservation, protection, management, and restoration of wildlife contributes immeasurably to the aesthetic, recreational, and economic aspects of these natural resources.”
Miss. Code Ann. § 49-27-27 (2015), Title 49. Conservation And Ecology, Chapter 27. Coastal Wetlands Protection Act, § 49-27-27	Department of Wildlife, Fisheries, and Parks	“In considering permits to dredge new channels by applicants under subsection (c) of Section 49-27-11, the commission shall take into consideration in addition to Section 47-27-23 the benefit of such channel to the public at large, or to surrounding landowners, and the extent of use projected for the channel, as well as the ecological, economic, commercial, recreational and aesthetic value of the wetlands affected. The commission shall, where practical, require applicants to use existing channels, so as to reduce the coastal wetlands affected.”
Miss. Code Ann. § 51-4-5 (2015), Title 51. Waters, Water Resources, Water Districts, Drainage, And Flood Control, Chapter 4. Mississippi Scenic Streams Stewardship Act, § 51-4-5.	Department of Wildlife, Fisheries, and Parks	“To accomplish this goal, the program must provide a non-regulatory framework to obtain cooperative, voluntary management agreements with riparian landowners to maintain scenic values while ensuring the rights of riparian landowners to continue customary uses along the stream.”

Sources: (State of Mississippi, 2013a) (State of Mississippi, 2010d)

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

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

9.1.8.3. Character and Visual Quality of the Existing Landscape

Mississippi has a wide range of visual resources. The most distinctive region in the state's varied topography is the Mississippi Delta, a flat alluvial plain between the Mississippi and the Yazoo rivers in the western part of the state. A wide belt of longleaf yellow pine (the piney woods) covers most of southern Mississippi to within a few miles of the coastal-plain grasslands. Most of the state's rivers belong to either the Mississippi or the Alabama River systems, with the Pontotoc Ridge as the divide between the two systems.

The majority of the state is characterized as forested, agricultural, or developed (Table 9.1.7-1 in Section 9.1.7, Land Use, Recreation, and Airspace). Forested areas are the most prevalent visual resource within the state. 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. Agricultural lands are the second most dominant landscape in the state. These areas generally have some abrupt lines and colors between crops and pastures, few tall structures (aside from grain silos and some trees), and no urban development. Lakes, rivers, wetlands, and waterfront lands in Mississippi vary from vegetated riparian areas (areas located on the bank of a watercourse, lake, or tidewater) to oceanside villages, and wide, open lakeside vistas. The consistency, continuity, and lack of view obstructions from major constructed features characterizes the visual attributes of these areas (USGS, 2017b).

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

9.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 9.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Mississippi, there are 1,393 NRHP listed sites, which include three National Heritage Areas, 29 National Historic Landmarks, two National Battlefields, and two National Military Parks (NPS, 2015f). There are 11 State Historic Sites that may also be included in the NRHP, whereas others are not designated at this time.

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

National Heritage Areas

National Heritage Areas (NHAs) are "places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape" (NPS, 2011). These areas help tell the history of the United States. Based on this criteria, NHAs in Mississippi may contain scenic or aesthetic areas considered visual resources or visually sensitive. There are three NHAs in Mississippi: Mississippi Hills, Mississippi Delta, and Mississippi Gulf Coast (Figure 9.1.8-1).

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015g). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 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 Mississippi, there are 39 NHLs, including sites such as the Champion Hill Battlefield, William Faulkner House, and the Old Mississippi State Capitol (Figure 9.1.8-1) (NPS, 2015h). By comparison, there are over 2,500 NHLs in the United States (NPS, 2015g). Figure 9.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

State Historic Sites

State Heritage Sites are likely to contain scenic or aesthetic components that may be considered visual resources or visually sensitive. There are 11 designated historic sites throughout the state from rural areas to urban areas (Table 9.1.8-2) (Mississippi Department of Archives & History, 2015a). For additional information regarding these properties and resources, see Section 9.1.11, Cultural Resources.

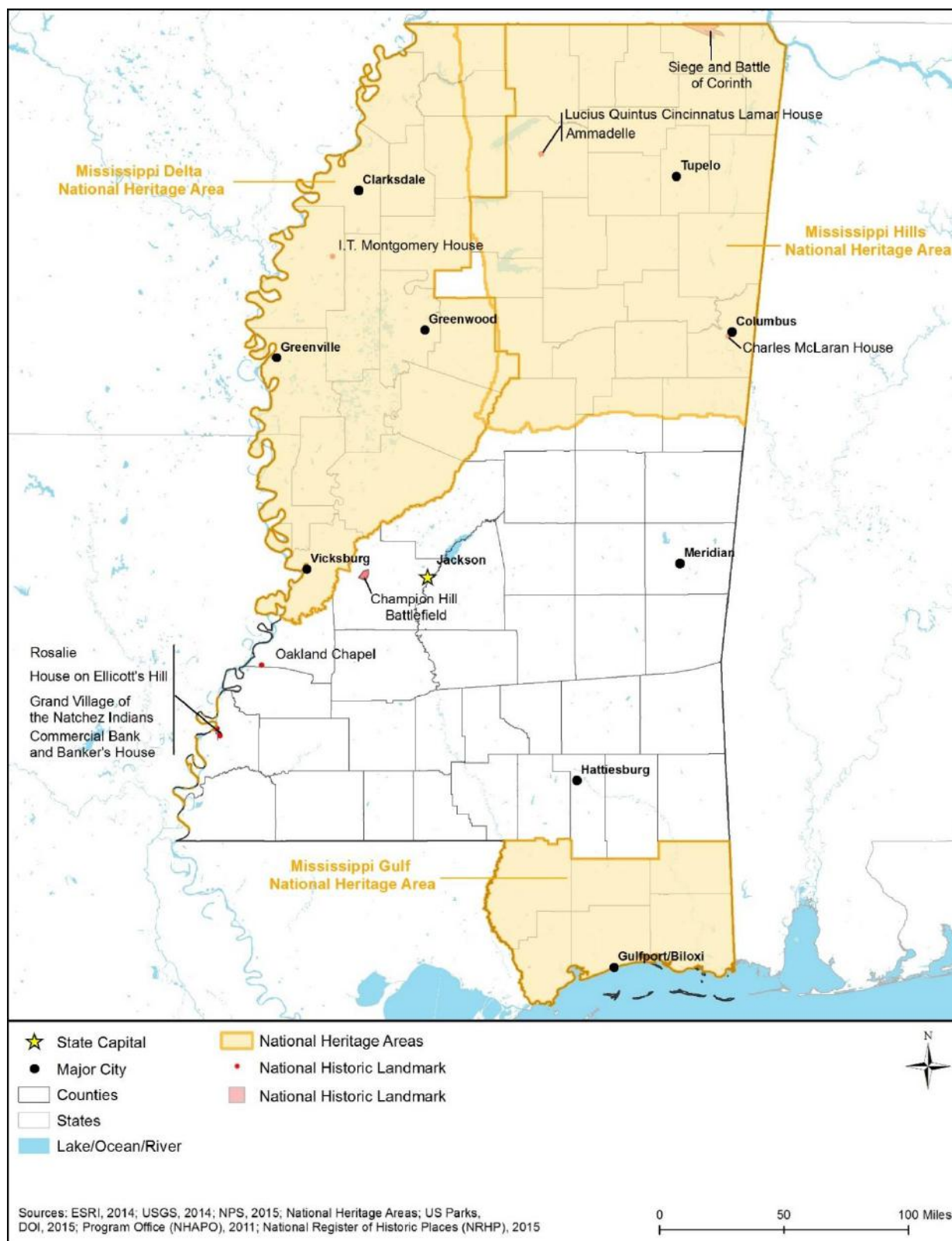


Figure 9.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

Table 9.1.8-2: State Historic Sites

State Historic Site Name	
Charlotte Capers Building	Eudora Welty House and Garden
GM&O Depot	Grand Village of Natchez Indians
Historic Jefferson College	Manship House Museum
Mississippi Governor's Mansion	Mississippi State Capitol
Old Capital Museum	William F. Winter Archives & History Building
Winterville Mounds	

Source: (Mississippi Department of Archives & History, 2015a)

9.1.8.5. Parks and Recreation Areas

Parks and recreation areas include state parks, National Parks, National Recreation Areas, National Seashores, National Forests, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 9.1.7-1 in Section 9.1.7, Land Use, Recreation, and Airspace identifies parks and recreational resources that may be visually sensitive in Mississippi.

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Mississippi residents and visitors. There are 25 state parks located throughout Mississippi (Table 9.1.8-2) (Figure 9.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (Mississippi Department of Wildlife, Fisheries, and Parks, 2015c).¹⁰⁰

¹⁰⁰ 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 dataset that contains large quantities of information relevant to the Proposed Action. The data was queried and further combined by the Primary Designation Type into classifications that fit the multiple types of land applicable for Natural Areas. For this map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for natural areas. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

Table 9.1.8-3: Mississippi State Parks

State Park Name	
Buccaneer	Clark Creek
Clarke	Florewood
George P. Cossar	Golden Memorial
Great River Road	Holmes County
Hugh White	J.P. Coleman
John W. Kyle	Lake Lincoln
Lake Lowndes	LeFleurs Bluff
Legion	Leroy Percy
Natchez	Paul B. Johnson
Percy Quin	Roosevelt
Shepard	Tishomingo
Tombigbee	Trace
Wall Doxey	

Source: (Mississippi Department of Wildlife, Fisheries, and Parks, 2015c)



Source: (Mississippi Department of Wildlife, Fisheries, and Parks, 2015d)

Figure 9.1.8-2: Chimney Bluffs State Park

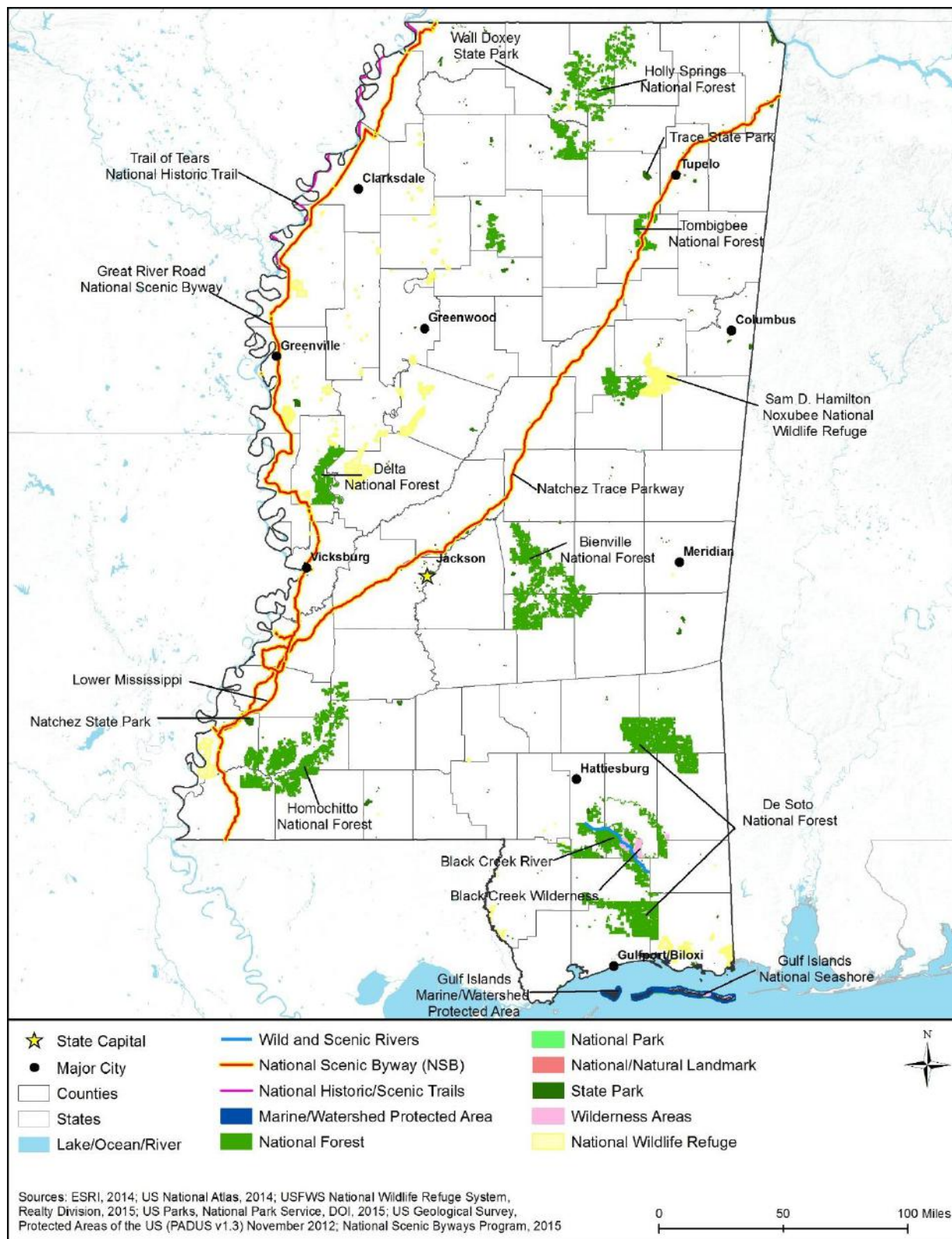


Figure 9.1.8-3: Natural Areas that May be Visually Sensitive

National Park Service

National Parks are managed by the NPS and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. Owned by the U.S. government, these areas are maintained for the public's use. In Mississippi, there are eight¹⁰¹ officially designated NPS units in addition to other NPS affiliated areas, such as National Heritage Areas. There are 3 National Heritage Areas, 2 National Battlefields, 2 National Military Parks, 1 National Parkway, 1 National Seashore (Figure 9.1.8-3), and 1 National Historical Park, 1 National Scenic Trail in Mississippi. Table 9.1.8-3 identifies the NPS units and affiliated areas located in Mississippi. For additional information regarding parks and recreation areas, see Section 9.1.7, Land Use, Recreation, and Airspace.

Table 9.1.8-3: Mississippi NPS Unites and Affiliated Areas

Area Name	
Brices Cross Roads National Battlefield Site	Gulf Islands National Seashore
Mississippi Delta National Heritage Area	Mississippi Gulf National Heritage Area
Mississippi Hills National Heritage Area	Natchez National Historical Park
Natchez Trace Parkway	Natchez Trace National Scenic Trail
Shiloh National Military Park	Tupelo National Battlefield
Vicksburg National Military Park	

Source: (NPS, 2015j)



Source: (NPS, 2015k)

Figure 9.1.8-4: Gulf Islands National Seashore

¹⁰¹ This count is based on the NPS website "by the numbers" current as of 9/30/2014 (NPS, 2015i). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

State and Federal Trails

State-designated trails are found within state parks located throughout the state. There are hundreds of miles of pedestrian, bike, ATV, and equestrian trails open to the public. These trails contain visual resources such as historic views, forest and woodland views, and lake views.

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Scenic Trails (NSTs) are defined as extended trails that “provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which they pass” (NPS, 2012b). The Natchez Trace National Scenic Trail is the only national trail within Mississippi. The trail has five separate sections, totaling 60 miles. It follows along portions of the original Natchez Trace trail, which was 450 miles long (NPS, 2014b).

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

9.1.8.6. Natural Areas

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 as “an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the “forces of nature” and as that which “may also contain ecological, geological, or other features of scientific, education, scenic, or historical value.” Over 106 million acres of federal public lands have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and part of National Park System. These designated wilderness areas are managed by the USFS, BLM, USFWS, and the NPS. (NPS, 2015l)

Mississippi is home to three federally managed Wilderness Areas including Black Creek Wilderness, Leaf Wilderness, and the Gulf Islands Wilderness (Figure 9.1.8-4) (The University of Montana, 2017).

National Forests

The USFS often contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. Owned by the U.S. government, these areas are maintained for the public’s use. In Mississippi, there are six National Forests: Bienville National Forest, Delta National Forest, De Soto National Forest, Holly Springs National Forest, Homochitto National

Forest, and Tombigbee National Forest. For additional information regarding parks and recreation areas, see Section 9.1.7, Land Use, Recreation, and Airspace.

State Forests

The Mississippi Forestry Commission manages three state forests. State forests contain scenic and visual resources of value to the public and to the state.

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. A portion (21 miles) of one river, Black Creek, has been designated a National Wild and Scenic River in Mississippi (Figure 9.1.8-5).



Source: (National Wild and Scenic Rivers, 2015b)

Figure 9.1.8-5: Black Creek Wild and Scenic River

National Wildlife Refuges and State Wildlife Management Areas

NWRs are a network of lands and waters managed by the USFWS. These lands and waters are “set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats” (USFWS, 2015b). There are 14 NWRs in Mississippi (Table 9.1.8-4). Visual resources within the NWRs include views and sites of the coast, beaches, wildlife, rivers, wetlands, forested areas, and other naturally vegetated areas.

Table 9.1.8-4: Mississippi National Wildlife Refuges

NWR Name	
Coldwater River	Dahomey
Grand Bay	Hillside
Hold Collier	Mathews Brake
Mississippi Sandhill Crane	Morgan Brake
Panther Swamp	Sam D. Hamilton Noxubee
St. Catherine Creek	Tallahatchie
Theodore Roosevelt	Yazoo

Source: (USFWS, 2015by)

Managed by the state of Mississippi, Department of Wildlife, Fisheries, and Parks, state Wildlife Management Areas (WMAs) encompass over 665,000 acres within 50 areas (Mississippi Department of Wildlife, Fisheries, and Parks, 2015e). Located throughout the state, WMAs contain rolling hardwood forest hills, scenic streams, wetlands, and other naturally vegetated areas. For additional information on wildlife refuges and management areas, see Section 9.1.6.4., Wildlife.

National Natural Landmarks

National Natural Landmarks (NNLs) are sites designated by the U.S. Secretary of the Interior that “contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education” (NPS, 2014c). These landmarks may be considered visual resources or visually sensitive. In Mississippi, five NNLs exist entirely or partially within the state:

- Chestnut Oak Disjunct;
- Green Ash-Overcup Oak-Sweetgum Research Natural Areas;
- Mississippi Petrified Forest;
- Bienville Pines Scenic Area; and
- Harrell Prairie Hill.

Some of the natural features located within these areas include “one of the largest protected loblolly stands in the region and an ancient forest of fir and maple that was buried in...sands and is now exposed as petrified logs” (NPS, 2012c). Another example, Chestnut Oak Disjunct NNL, contains scenic oak forest that is the southwestern most state within the tree’s range (Figure 9.1.8-6).



Source: (NPS, 2012d)

Figure 9.1.8-6: Chestnut Oak Disjunct NNL

9.1.8.7. 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. Mississippi has two designated National Scenic Byways: Great River Road and Natchez Trace Parkway (Figure 9.1.7-1 in Section 9.1.7 Land Use, Recreation, and Airspace). The National Scenic Byways Program is managed by the USDOT, FHWA.

Similar to National Scenic Byways, Mississippi Scenic Byways are transportation corridors that are of particular statewide interest. There are seven State Scenic Byways (Figure 9.1.7-1 in Section 9.1.7 Land Use, Recreation, and Airspace), including:

- Beach Boulevard;
- Brice's Crossroads Battlefield-Chief Tishomingo;
- Byways to Space;
- Highway 67;
- Highway 605;
- Lower Mississippi; and
- Mississippi Delta Great River Road (MDOT, 2015b).

9.1.9. Socioeconomics

9.1.9.1. *Definition of the Resource*

NEPA requires consideration of socioeconomics in NEPA analysis; specifically, Section 102(A) of NEPA requires federal agencies to “insure the integrated use of the natural and social sciences...in planning and in decision making” (42 U.S.C. § 4332(A)). Socioeconomics refers to a broad, social science-based approach to understanding a region’s social and economic conditions. It typically includes population, demographic descriptors, economic activity indicators, housing characteristics, property values, and public revenues and expenditures. 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 12898.¹⁰² This PEIS addresses environmental justice in a separate section (Section 9.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and recreation (Section 9.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 9.1.1, Infrastructure), and aesthetic considerations (Section 9.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau (Census Bureau) 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

¹⁰² 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).¹⁰³

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

9.1.9.2. Specific Regulatory Considerations

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

9.1.9.3. Communities and Populations

This section discusses the population and major communities of Mississippi (MS) and includes the following topics:

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

Statewide Population and Population Growth

Table 9.1.9-1 presents the 2014 population and population density of Mississippi in comparison to the South Region¹⁰⁴ and the nation. The estimated population of Mississippi in 2014 was 2,994,079. The population density was 64 persons per square mile (sq. mi.), which was

¹⁰³ 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.

¹⁰⁴ The South Region comprises the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, 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.

considerably lower than the population density of both the region (114 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Mississippi was the 31st largest state by population among the 50 states and the District of Columbia, 32nd largest by land area, and had the 33rd greatest population density (U.S. Census Bureau, 2015d) (U.S. Census Bureau, 2015f).

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

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Mississippi	46,923.27	2,994,079	64
South Region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

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

Population growth is an important subject for this PEIS given FirstNet's mission. Table 9.1.9-2 presents the population growth trends of Mississippi from 2000 to 2014 in comparison to the South region and the nation. The state's annual growth rate decreased from 0.42 percent to 0.22 percent in the 2010 to 2014 period compared to 2000 to 2010. The growth rate of Mississippi in the 2010 to 2014 period was considerably lower than the growth rate of the region (1.14 percent) and the nation (0.81 percent).

Table 9.1.9-2: Recent Population Growth of Mississippi

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
Mississippi	2,844,658	2,967,297	2,994,079	122,639	26,782	0.42%	0.22%
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%

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

^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 9.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia's Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis service (ProximityOne, 2015a) (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 Mississippi's population will increase by approximately 369,000 people, or 12.3 percent, from 2014 to 2030.

This reflects an average annual projected growth rate of 0.73 percent, which is considerably higher than (more than double) the historical growth rate from 2010 to 2014. The projected growth rate of the state is slightly lower than that of the region (0.97 percent) and the nation (0.80 percent).

Table 9.1.9-3: Projected Population Growth of Mississippi

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
Mississippi	2,994,079	3,242,016	3,484,847	3,363,432	369,353	12.3%	0.73%
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%

Sources: (ProximityOne, 2015b; UVA Weldon Cooper Center, 2015; U.S. Census Bureau, 2015d)

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

Population Distribution and Communities

Figure 9.1.9-1 presents the distribution and relative density of the population of Mississippi. 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, 2012a; 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 9.1.9-4 provides the populations of the 10 largest population concentrations in Mississippi, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.¹⁰⁵ In 2010, the largest population concentration was the Jackson area,

¹⁰⁵ 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.

which had 351,478 people. The second largest population concentration was the Gulfport area, with a population of 208,948. The smallest of these 10 population concentrations was the Starkville area, with a 2010 population of 30,307. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Mississippi portion of the Memphis area, with an annual growth rate of 6.89 percent. However, this area had a large increase in its area definition that may have taken in some existing populations; thus, the growth rate may reflect this factor as well as organic growth (net in-migration and/or births exceeding deaths). Three of these 10 population concentrations experienced declines in population during this period.

Table 9.1.9-4 also shows that the top 10 population concentrations in Mississippi accounted for 33.7 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 112.9 percent of the entire state's growth. This figure of over 100 percent indicates that the population of the remainder of the state, as a whole, declined from 2000 to 2010.

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

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC) ^a
Columbus	33,066	31,174	31,880	9	(1,892)	-0.59%
Greenville	43,387	35,025	34,403	8	(8,362)	-2.12%
Gulfport	205,754	208,948	214,435	2	3,194	0.15%
Hattiesburg	61,465	80,358	81,997	4	18,893	2.72%
Jackson	292,637	351,478	353,351	1	58,841	1.85%
Memphis (TN/MS/AR) (MS Portion) ^b	65,882	128,310	129,070	3	62,428	6.89%
Meridian	40,373	41,531	42,192	6	1,158	0.28%
Pascagoula	54,190	50,428	50,859	5	(3,762)	-0.72%
Starkville	25,973	30,307	30,618	10	4,334	1.56%
Tupelo	37,365	40,995	42,256	7	3,630	0.93%
Total for Top 10 Population Concentrations	860,092	998,554	1,011,061	NA	138,462	1.50%
Mississippi (statewide)	2,844,658	2,967,297	2,976,872	NA	122,639	0.42%
Top 10 Total as Percentage of State	30.2%	33.7%	34.0%	NA	112.9%	NA

Sources: (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j)

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

^b The large population increase from 2000 to 2010 reflects a large change in the area definition for the Memphis urbanized area (MS Portion), from 47 sq. mi. in 2000 to 95 sq. mi. in 2010.

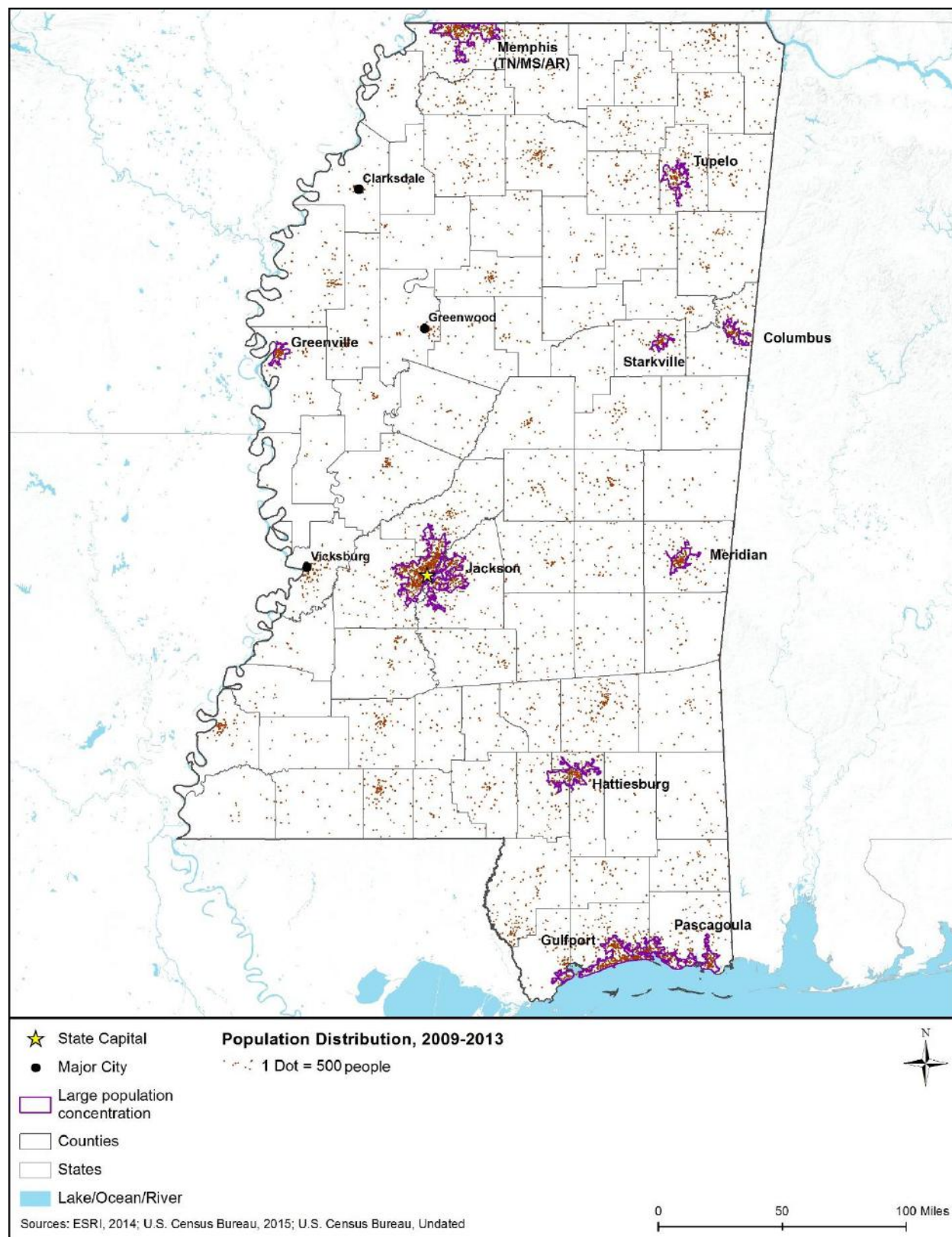


Figure 9.1.9-1: Population Distribution in Mississippi, 2009–2013

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

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

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

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 9.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 9.1.9-5 compares several economic indicators for Mississippi to the South region and the nation. The table presents two indicators of income¹⁰⁶ – per capita and median household – as income is a good measure of general economic health of a region.

Per capita income is total income divided by the total population. As a mathematical average, the very high incomes of a relatively small number of people tend to bias per capita income figures upwards. Nonetheless, per capita income is useful as an indicator of the relative income level across two or more areas. As shown in Table 9.1.9-5, the per capita income in Mississippi in 2013 (\$20,156) was \$4,855 lower than that of the region (\$25,011), and \$8,028 lower than that of the nation (\$28,184) (BLS, 2015b; U.S. Census Bureau, 2013b; U.S. Census Bureau, 2013c; U.S. Census Bureau, 2014a).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 9.1.9-5 shows that in 2013, the MHI in Mississippi (\$38,191) was \$8,371 lower than that of the region (\$46,562), and \$14,059 lower than that of the nation (\$52,250) (BLS, 2015b; U.S. Census Bureau, 2013c; U.S. Census Bureau, 2013b; U.S. Census Bureau, 2014a).

¹⁰⁶ 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, 2013a)

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 9.1.9-5 compares the unemployment rate in Mississippi to the South region and the nation. In 2014, Mississippi's statewide unemployment rate of 7.8 percent was substantially higher than the rate for the region (6.1 percent) and the nation (6.2 percent)¹⁰⁷ (BLS, 2015b; U.S. Census Bureau, 2013c; U.S. Census Bureau, 2013b; U.S. Census Bureau, 2014a).

Table 9.1.9-5: Selected Economic Indicators for Mississippi

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Mississippi	\$20,156	\$38,191	7.8%
South Region	\$25,011	\$46,562	6.1%
United States	\$28,184	\$52,250	6.2%

Sources: (BLS, 2015c; U.S. Census Bureau, 2013b; U.S. Census Bureau, 2013c; U.S. Census Bureau, 2014a)

Figure 9.1.9-2 and Figure 9.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2014a) and unemployment in 2014 (BLS, 2015c) varied by county across the state. These maps also incorporate the same population concentration data as Figure 9.1.9-1 (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015h). Following these two maps, Table 9.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across Mississippi.

Figure 9.1.9-2, as shown below, shows that the majority of counties in Mississippi had 2013 MHI levels below the national median, with a few exceptions. Most of the state's counties had MHI levels in the lowest level grouping shown on the map. Only three counties, surrounding the Mississippi portion of the Memphis area and the Jackson area, had MHI levels above the national median. Table 9.1.9-6 shows that the 2009–2013 MHI in the 10 largest population concentrations ranged from \$26,003 (Starkville area) to \$56,898 (Memphis, Mississippi portion); the state average was \$39,031. The Starkville area also had the smallest population of the areas shown in the table.

Figure 9.1.9-3, as shown below, presents variations in the 2014 unemployment rate across the state, by county. It shows that the great majority of counties had unemployment rates above the national average. Only a small number of counties (seven), mostly near three of the largest population concentrations, had unemployment rates below the national average (that is, better employment performance). Many counties had unemployment rates in lowest level grouping shown on the map (over 8.6 percent). Table 9.1.9-6, as shown below, is consistent; it shows

¹⁰⁷ The timeframe for unemployment rates can change quarterly.

double-digit 2009–2013 unemployment rates in many of the 10 largest population concentrations. The rates ranged from 8.3 percent (Memphis area, Mississippi portion) to 22.4 percent (Greenville area); the state average was 11.1 percent.

Detailed employment data provide useful insights into the nature of a local, state, or national economy. Table 9.1.9-7 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers was lower in Mississippi than in the South region and the nation. The percentage of government workers was higher in the state than in the region and nation. The percentage of self-employed workers in Mississippi was slightly lower than in the region and the nation.

By industry, Mississippi has a mixed economic base and some notable figures in the table are as follows. Mississippi in 2013 had a considerably higher percentage (more than two percentage points) of persons working in “manufacturing” than did the region and nation. It also had a considerably higher percentage of workers in “educational services, and health care and social assistance” than the region. The state had a considerably lower percentage of persons in “professional, scientific, management, administrative, and waste management services” than the region and nation. The rest of the values for Mississippi were within two percentage points (most were within one percentage point) of the region and nation.

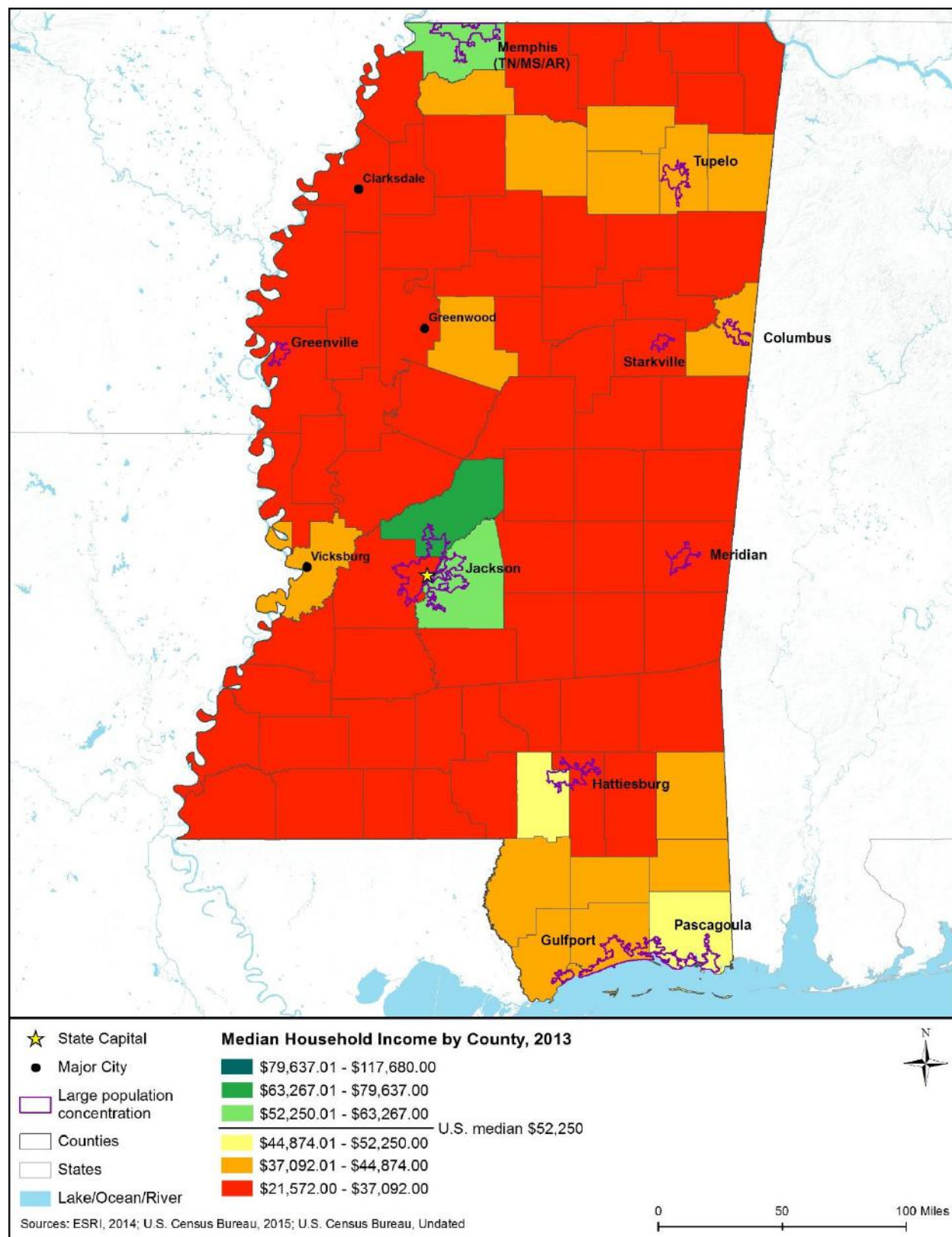


Figure 9.1.9-2: Median Household Income in Mississippi, by County, 2013

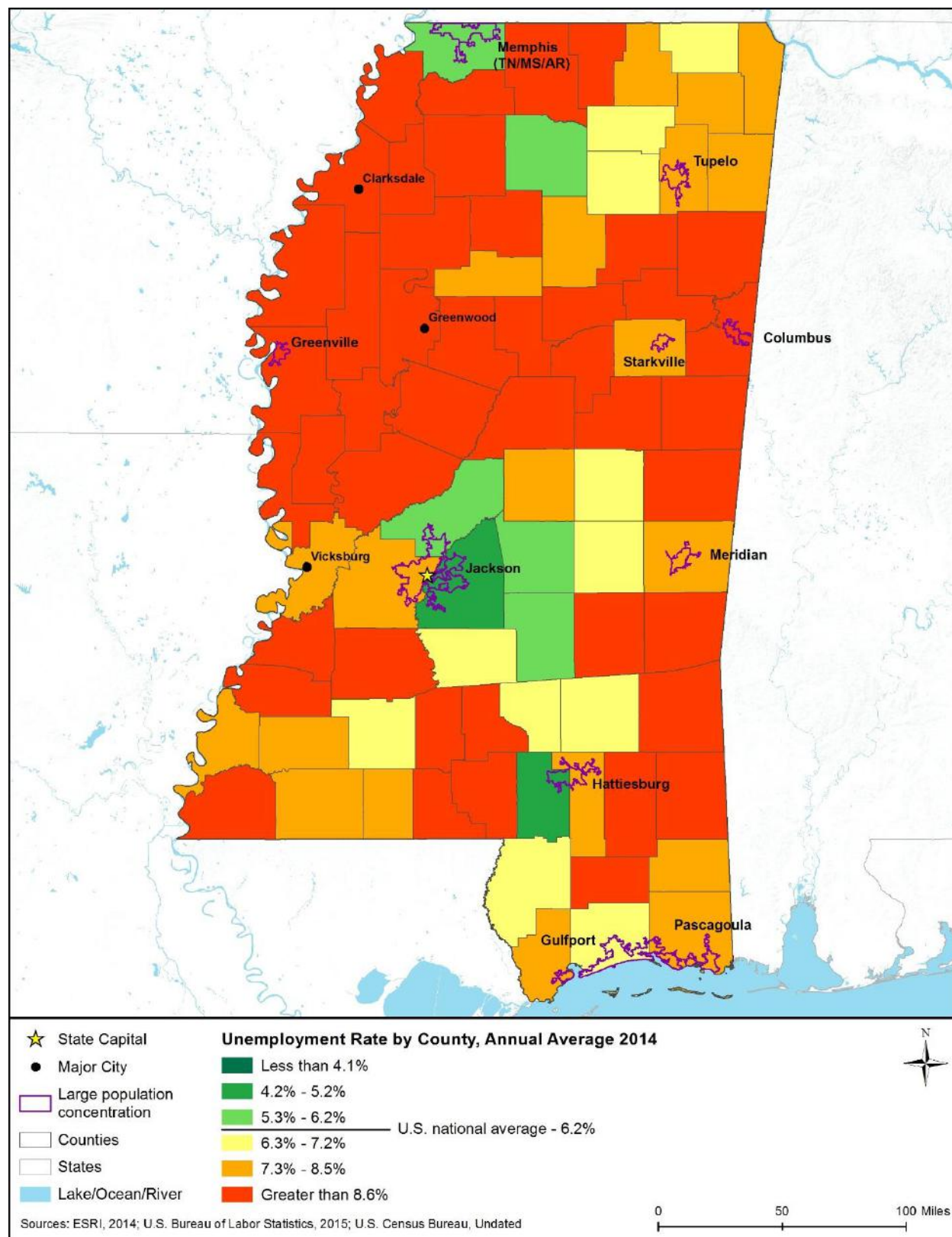


Figure 9.1.9-3: Unemployment Rates in Mississippi, by County, 2014

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

Area	Median Household Income	Average Annual Unemployment Rate
Columbus	\$28,786	18.0%
Greenville	\$27,162	22.4%
Gulfport	\$43,834	10.6%
Hattiesburg	\$38,415	10.7%
Jackson	\$45,971	8.8%
Memphis (TN/MS/AR) (MS Portion)	\$56,898	8.3%
Meridian	\$30,000	14.3%
Pascagoula	\$39,258	11.4%
Starkville	\$26,003	16.5%
Tupelo	\$39,666	9.1%
Mississippi (statewide)	\$39,031	11.1%

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

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

Class of Worker and Industry	Mississippi	South Region	United States
Civilian Employed Population 16 Years and Over	1,196,784	45,145,155	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	76.5%	79.4%	79.7%
Government workers	18.0%	14.5%	14.1%
Self-employed in own not incorporated business workers	5.3%	5.9%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	3.0%	2.4%	2.0%
Construction	6.5%	6.9%	6.2%
Manufacturing	13.5%	9.9%	10.5%
Wholesale trade	2.5%	2.8%	2.7%
Retail trade	12.4%	12.1%	11.6%
Transportation and warehousing, and utilities	5.3%	5.2%	4.9%
Information	1.3%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	4.8%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	6.7%	10.5%	11.1%
Educational services, and health care and social assistance	24.0%	22.0%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.4%	9.9%	9.7%
Other services, except public administration	5.1%	5.2%	5.0%
Public administration	5.3%	4.8%	4.7%

Source: (U.S. Census Bureau, 2013d)

Table 9.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 9.1.9-7 for 2013.

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

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Columbus	6.2%	5.3%	1.9%	7.0%
Greenville	4.4%	4.3%	1.5%	5.8%
Gulfport	7.4%	4.0%	1.6%	7.3%
Hattiesburg	5.0%	4.2%	1.0%	6.1%
Jackson	5.2%	4.3%	2.4%	9.1%
Memphis (TN/MS/AR) (MS Portion)	6.5%	12.0%	1.1%	7.9%
Meridian	6.0%	4.7%	2.7%	5.8%
Pascagoula	4.4%	4.4%	1.4%	5.4%
Starkville	3.4%	1.5%	0.8%	6.5%
Tupelo	3.4%	3.1%	1.5%	7.1%
Mississippi (statewide)	6.9%	5.7%	1.4%	6.3%

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

Housing

The housing stock is an important socioeconomic component of communities. The type, availability, and cost of housing in an area reflect economic conditions and affect quality of life. Table 9.1.9-9 compares Mississippi to the South region and nation on several common housing indicators.

As shown in Table 9.1.9-9, in 2013, Mississippi had a lower percentage of housing units that were occupied (85.0 percent) than the region (85.2 percent) or nation (87.6 percent). Of the occupied units, Mississippi had a higher percentage of owner-occupied units (67.2 percent) than the region (64.6 percent) or nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Mississippi in 2013 (69.2 percent) was higher than the in region (63.8 percent) and considerably higher than in the nation (61.5 percent). The homeowner vacancy rate in Mississippi (2.2 percent) matched the rate for the region and was slightly higher than the rate for the nation (1.9 percent). This rate reflects “vacant units that are

‘for sale only’” (U.S. Census Bureau, 2013a). The vacancy rate among rental units was higher in Mississippi (8.7 percent) than in the region (8.5 percent) or nation (6.5 percent).

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

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Mississippi	1,283,192	85.0%	67.2%	2.2%	8.7%	69.2%
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, 2013e)

Table 9.1.9-10 provides housing indicators for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does present variation in these indicators for population concentrations across the state and compared to the state average for the 2009 to 2013 period.

Table 9.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Mississippi, 2009–2013

Area	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Columbus	14,062	88.1%	49.1%	2.2%	4.7%	68.4%
Greenville	14,708	82.9%	51.6%	2.8%	10.9%	72.2%
Gulfport	98,926	82.1%	58.8%	3.9%	17.5%	66.1%
Hattiesburg	35,796	88.3%	49.6%	1.5%	10.0%	60.9%
Jackson	147,704	88.4%	61.7%	2.0%	10.7%	69.5%
Memphis (TN/MS/AR) (MS Portion)	49,190	93.5%	72.0%	2.5%	6.4%	79.9%
Meridian	19,118	84.6%	51.7%	4.5%	13.5%	65.0%
Pascagoula	23,443	80.6%	62.3%	2.7%	20.1%	70.9%
Starkville	13,053	85.7%	36.5%	3.9%	8.4%	44.7%
Tupelo	18,169	88.9%	63.6%	2.6%	9.0%	71.6%
Mississippi (statewide)	1,277,522	85.2%	69.4%	2.0%	11.1%	69.6%

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

Property Values

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

Table 9.1.9-11 provides indicators of residential property values for Mississippi 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, 2013a).

The table shows that the median value of owner-occupied units in Mississippi in 2013 (\$97,500) was lower than the corresponding values for the South region (\$137,752) and the nation (\$173,900).

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

Geography	Median Value of Owner-Occupied Units
Mississippi	\$97,500
South Region	\$137,752
United States	\$173,900

Source: (U.S. Census Bureau, 2013e)

Table 9.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. The median property value for these 10 communities ranged from \$75,200 in the Greenville area to \$146,000 in the Starkville area; the state median value was \$99,900. It is interesting to note that the lowest and highest property values were both in the two areas – Greenville and Starkville – that had the two lowest median household incomes (Table 9.1.9-6).

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

Area	Median Value of Owner-Occupied Units
Columbus	\$112,300
Greenville	\$75,200
Gulfport	\$140,900
Hattiesburg	\$141,000
Jackson	\$137,400
Memphis (TN/MS/AR) (MS Portion)	\$144,700
Meridian	\$84,800
Pascagoula	\$102,600

Area	Median Value of Owner-Occupied Units
Starkville	\$146,000
Tupelo	\$117,200
Mississippi (statewide)	\$99,900

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet projects may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes¹⁰⁸ are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized and therefore are best considered in the deployment phase of FirstNet.

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

Table 9.1.9-13 shows that the state government in Mississippi received more total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments in Mississippi received less total revenue per capita than their counterpart governments in the region and nation. The state government in Mississippi had higher levels per capita of intergovernmental revenues¹⁰⁹ from the federal government than its counterpart governments in the region and nation. Additionally, Mississippi local governments had slightly higher levels per capita of intergovernmental revenues from the federal government than their counterparts in the region and lower levels than their counterpart governments in the nation. Mississippi state and local governments obtained considerably less revenue per capita from property taxes than their counterpart governments in the region and the nation. General sales taxes on a per capita basis were higher for the Mississippi state government than for its counterparts in the region and nation. Local governments in Mississippi reported no revenue from general sales taxes. Selective sales taxes on a per capita basis were slightly higher for the Mississippi state government, and considerably lower for local governments, when compared to counterpart governments in the region and nation. State and local governments in Mississippi

¹⁰⁸ 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).

¹⁰⁹ Intergovernmental revenues are those revenues received by one level of government from another level of government, such as shared taxes, grants, or loans and advances (U.S. Census Bureau, 2006).

reported minimal revenue from public utility taxes. The state government in Mississippi reported more revenue from individual income taxes, on a per capita basis, than its counterpart governments in the region, and less revenue than counterpart governments in the nation. For corporate income taxes, on a per capita basis the state government in Mississippi matched the nation's figure and exceeded that of its counterpart governments in the region. Local governments in Mississippi reported no revenue from individual and corporate income taxes.

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

Type of Revenue	Mississippi		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue (\$M)	\$18,765	\$12,685	\$524,374	\$449,683	\$1,907,027	\$1,615,194
Per capita	\$6,287	\$4,250	\$5,148	\$4,414	\$6,075	\$5,145
Intergovernmental from Federal (\$M)	\$7,725	\$540	\$160,706	\$18,171	\$514,139	\$70,360
Per capita	\$2,588	\$181	\$1,578	\$178	\$1,638	\$224
Intergovernmental from State (\$M)	\$0	\$4,587	\$0	\$115,088	\$0	\$469,147
Per capita	\$0	\$1,537	\$0	\$1,130	\$0	\$1,495
Intergovernmental from Local (\$M)	\$84	\$0	\$2,815	\$0	\$19,518	\$0
Per capita	\$28	\$0	\$28	\$0	\$62	\$0
Property Taxes (\$M)	\$24	\$2,570	\$2,073	\$109,687	\$13,111	\$432,989
Per capita	\$8	\$861	\$20	\$1,077	\$42	\$1,379
General Sales Taxes (\$M)	\$3,072	\$0	\$82,651	\$25,836	\$245,446	\$69,350
Per capita	\$1,029	\$0	\$811	\$254	\$782	\$221
Selective Sales Taxes (\$M)	\$1,324	\$105	\$41,447	\$9,394	\$133,098	\$28,553
Per capita	\$444	\$35	\$407	\$92	\$424	\$91
Public Utilities Taxes (\$M)	\$2	\$57	\$5,101	\$4,745	\$14,564	\$14,105
Per capita	\$1	\$19	\$50	\$47	\$46	\$45
Individual Income Taxes (\$M)	\$1,501	\$0	\$38,637	\$1,226	\$280,693	\$26,642
Per capita	\$503	\$0	\$379	\$12	\$894	\$85
Corporate Income Taxes (\$M)	\$396	\$0	\$8,099	\$114	\$41,821	\$7,210
Per capita	\$133	\$0	\$80	\$1	\$133	\$23

Sources: (U.S. Census Bureau, 2014b; U.S. Census Bureau, 2012b)

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

9.1.10. Environmental Justice

9.1.10.1. Definition of the Resource

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO.¹¹⁰ The fundamental principle of environmental justice is, “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2016d). Under the EO, each federal agency must “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 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 Office of Environmental Justice (USEPA, 2015f) offers guidance on Environmental Justice issues and provides an “environmental justice screening and mapping tool,” EJSCREEN (USEPA, 2015g).

The CEQ guidance provides several important definitions and clarifications that this PEIS utilizes (CEQ, 1997):

- 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.”

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:

¹¹⁰ See <https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice>.

- 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 (The Administrator of the Environmental Protection Agency, 2014).

9.1.10.2. Specific Regulatory Considerations

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to environmental justice for this PEIS. The state of Mississippi has not established an environmental justice policy. MDEQ incorporates the USEPA environmental justice definition, principles and plans by reference and incorporates environmental justice considerations into decisions, particularly in regard to permitting and siting (University of California, Hastings College of Law, 2010). Federal laws relevant to environmental justice are described in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

9.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 9.1.10-1 presents 2013 data on the composition of Mississippi's population by race and by Hispanic origin. The state's population has considerably lower percentages of individuals who identify as Asian (0.9 percent) than the populations of the region (2.6 percent) and the nation (5.1 percent). The state's population has considerably lower percentages of individuals who identify as Some Other Race (0.8 percent) than the populations of the South region (3.3 percent) and the nation (4.7 percent). The state's population has a considerably higher percentage of individuals who identify as Black/African American (37.7 percent) than the populations of the region (18.4 percent) and the nation (12.6 percent). The state's population of persons identifying as White (59.0 percent) is considerably smaller than that of the South region (72.3 percent) or the nation (73.7 percent).

The percentage of the population in Mississippi that identifies as Hispanic (2.7 percent) is considerably smaller than in the South region (18.8 percent), and the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin.

The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Mississippi's All Minorities population percentage (42.6 percent) is somewhat higher than that of the South region (42.3 percent) and considerably higher when compared to the nation's figure (37.6 percent).

Table 9.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Mississippi (24.0 percent) is considerably higher than that for the South region (18.2 percent) and for the nation (15.8 percent).

Table 9.1.10-1: 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		
Mississippi	2,991,207	59.0%	37.7%	0.4%	0.9%	0.0%	0.8%	1.1%	2.7%	42.6%
South Region	102,853,019	72.3%	18.4%	0.9%	2.6%	0.1%	3.3%	2.4%	18.8%	42.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

Source: (U.S. Census Bureau, 2013f)

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

Table 9.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Mississippi	24.0%
South Region	18.2%
United States	15.8%

Source: (U.S. Census Bureau, 2013g)

9.1.10.4. Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D, Environmental Justice Methodology, presents the methodology used in this PEIS to screen each state for the presence of potential environmental justice populations. The methodology builds on CEQ guidance and best practices used for environmental justice analysis. It uses data at the census-block group level; block groups are the smallest geographic units for which regularly updated socioeconomic data are readily available at the time of writing. (See footnote 103 in Socioeconomics for further information on how the data was calculated.)

Figure 9.1.10-1 visually portrays the results of the environmental justice population screening analysis for Mississippi. 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, 2015m; U.S. Census Bureau, 2015n; U.S. Census Bureau, 2015o) and Census Bureau urban classification data (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015h)

Figure 9.1.10-1 shows that a large proportion of Mississippi has high potential for environmental justice populations. The distribution of high potential areas, and that of moderate potential areas, is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations.

It is important to understand how the data behind Figure 9.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups each cover much less than a single square mile. Thus, while large portions of the state outside the areas defined as large population concentrations show Moderate or high potential for environmental justice populations, these low density areas reflect modest numbers of minority or low-income individuals compared to the potential environmental justice populations within densely populated areas. The overall effect of this relative density phenomenon is that the map visually shows large areas of the state having environmental justice potential, but this over-represents the presence of environmental justice populations.

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

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful 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 9.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

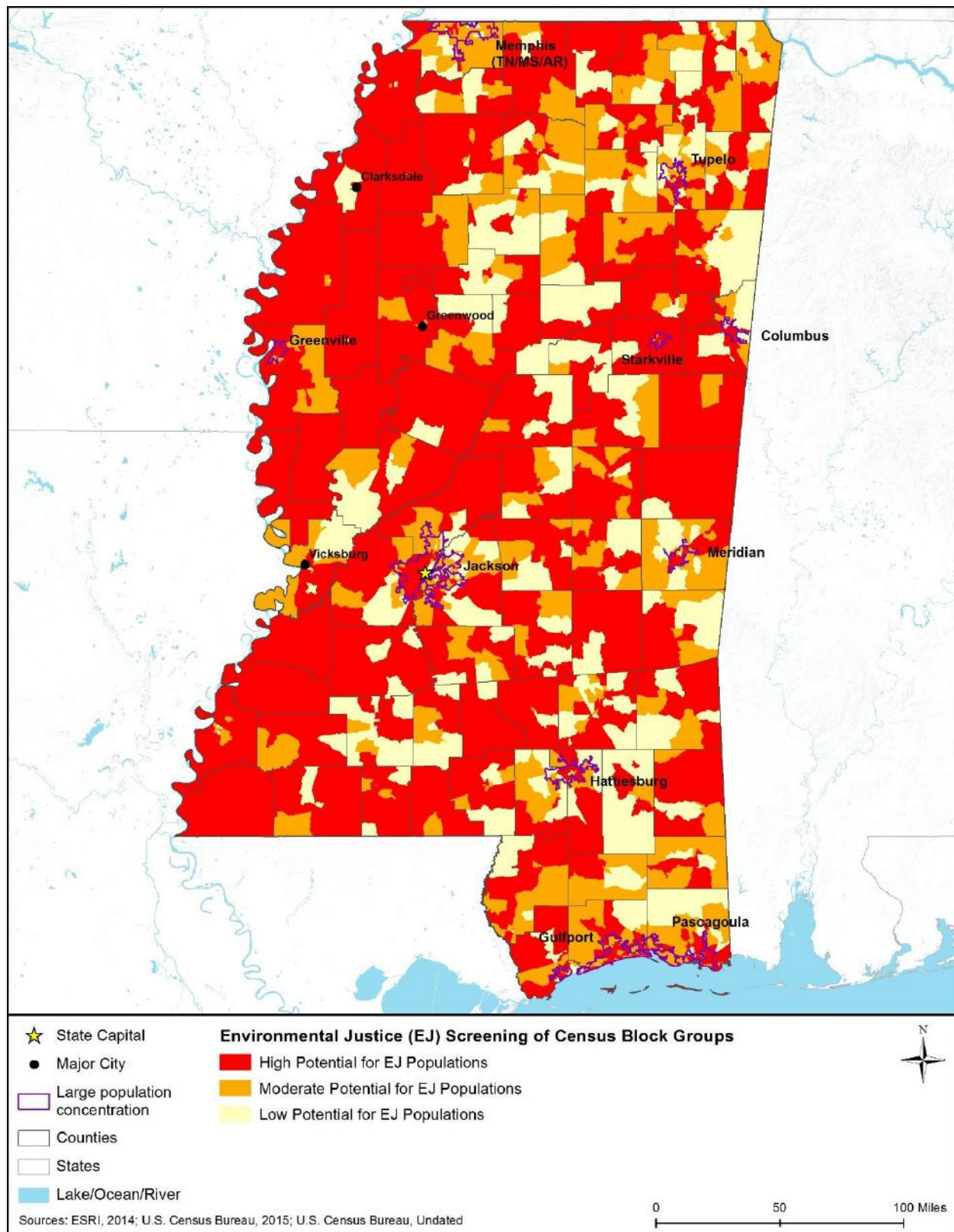


Figure 9.1.10-1: Potential for Environmental Justice Populations in Mississippi, 2009–2013

9.1.11. Cultural Resources

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

9.1.11.2. *Specific Regulatory Considerations*

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

Mississippi does not have state laws and regulations that are similar to the NHPA or NEPA. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations.

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

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

State Law/Regulation	Regulatory Agency	Applicability
Mississippi Antiquities Law Title 39, Chapter 7	Mississippi Department of Libraries, Arts, Archives and History [MDAH]	Establishes the preservation of cultural resources as public policy for Mississippi.
Mississippi State Burial Site Statutes, MS Code 39-7-3 and 39-7-31	MDAH 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 MDAH 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.

Sources: (State of Mississippi, 2010e)

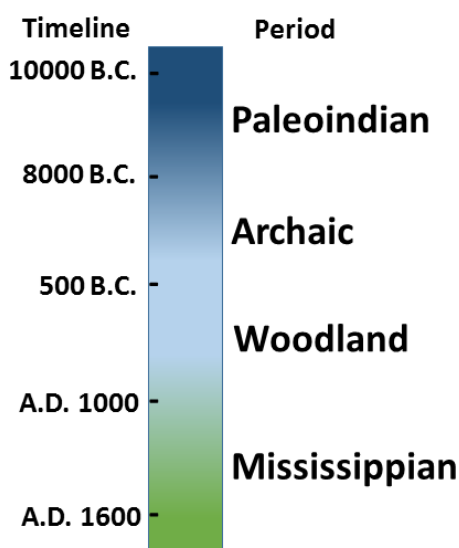
9.1.11.3. Cultural and Natural Setting

Archaeologists believe that humans have inhabited the Mississippi region for more than 12,000 years (Mississippi Department of Archives & History, 2015b). The lack of sites in this region from the earliest period could be due to multiple flooding events along the Mississippi River, erosion, or simply being buried (Mississippi Department of Archives & History, 2015b). The majority of evidence of the region's early human habitation comes from the study of prehistoric and historic archaeological sites. Mississippi contains thousands of archaeological sites, with approximately 170 listed on the National Register of Historic Places (NRHP) (NPS, 2015n). Mississippi encompasses the Lower and Central Mississippi River Valley of eastern present-day North America (Morse & Morse, 1983). Archaeologists typically divide study areas into physiographic regions, and the state falls within the physiographic region of the Atlantic Plains and the physiographic province of the Coastal Plains. (Stewart, 2003)

The following sections provide background on Mississippi's prehistoric periods (10000 B.C. to A.D. 1600) and historic period, post-European contact (since A.D. 1600). This section presents an overview of the initial human habitation in Mississippi and the cultural development that occurred before European contact. Section 9.1.11.4 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 9.1.11.5 provides a current list of significant archaeological sites in Mississippi and tools that the state has developed to ensure their preservation. Section 9.1.11.6 documents the historic context of the state since European contact, and Section 9.1.11.7 summarizes the architectural context of the state during the historic period.

Archaeologists divide Mississippi's prehistory into four periods: Paleoindian (B. C. 10000 B.C. to 8000 B.C.), Archaic (8000 B.C. to 500 B.C.), Woodland (500 B.C. to A.D. 1000 A.D.), and Mississippian (A.D. 1000 to A.D. 1550 A.D.). The following timeline (Sources:

Figure 9.1.11-1) provides a guide to Mississippi's prehistoric habitation. Mississippi encompasses the Lower Mississippi River Valley, central portions of the Mississippi River Valley, and is considered part of the Mississippian archaeological cultural area of North America. Evidence of prehistoric human occupation has been documented throughout Mississippi, with the earliest human occupation evident in the Yazoo Basin, which covers the northwestern quarter of the state (Morgan, *Archaeology and Prehistoric Mississippi*, 2002). As each occupation is roughly defined and identified by artifact styles and technologies, archaeological evidence of these four occupation periods includes a range of artifacts that are uniquely identifiable.



Sources: (Institute of Maritime History, 2015)

Figure 9.1.11-1: Timeline of Prehistoric Human Occupation

Paleoindian Period (10000 – 8000 B.C.)

The Paleoindian Period represents the earliest period of aboriginal occupation in Mississippi. The earliest occupants of the region were nomadic hunter-gatherers who followed the migration patterns of ancestral megafauna. The archaeological materials left by these early inhabitants are associated with Clovis-style projectile point technology, which marks the earliest settlement period of North America. Archaeological studies show that these points had a widespread use across the continents of northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier, Inizan, & Feblot-Augustins, 2002). The introduction of the Dalton projectile point in the Late Paleoindian Period marked a cultural transition point and is one of the first stylistic changes unique to the region. Unlike the Clovis projectile points that have been found widely across the continental United States, the Dalton projectile point is found only in the Midwestern and southeastern areas of the United States (Barnett, 2012).

During the Paleoindian Period, it is assumed that large ancestral megafauna, such as mastodon, mammoth, and bison, were being hunted, as indicated in the archaeological records of

neighboring Missouri, Tennessee, and Arkansas. However, in the Mississippi region, there are no sites containing evidence of direct interactions between the region's Paleoindian people and the now extinct megafauna (Barnett, 2012). As the climate warmed in the Paleoindian Period, oak forests with various nuts and berries, and smaller game likely became primary subsistence resources (Barnett, 2012).

The introduction of smaller and more refined projectile point technology marked a shift in the Paleoindian Period to more sedentary populations. By the Late Paleoindian Period, the archaeological record shows an increase in the number of long-term settlement sites and a "proliferation of regional point types" manufactured from local stone (Barnett, 2012). The Hester site, in Monroe County of northwestern Mississippi, is illustrative of how the aboriginal inhabitants of Mississippi developed Dalton projectile points, along with clear evidence of tool retouching and reshaping, such as basal grinding, edge-serration, and heat-treatment (Brookes, 1979). The Hester site was determined to be a temporary "hunting-butcherer station," possibly used seasonally in keeping with game-animal migration patterns (Barnett, 2012). Based on this and other sites in the region, archaeologists have concluded that people of the period moved in small bands using sites such as this as temporary camps while exploiting the regional resources (Barnett, 2012).

Archaic Period (8000 – 500 B.C.)

The Archaic Period is generally referred to as a transitional period from nomadism to more sedentary lifestyles. During the Early Archaic Period, populations were still primarily nomadic hunter-gatherers, but, with the warming climates, more variability is seen in plant and faunal remains. Archaic Period sites in Mississippi show use of hickory nuts, walnuts, and hackberry, with some sites also including wild plum and acorn (McGahey, 1997). The warming temperatures also made possible the exploitation of freshwater fish and muscles that became abundant in shallow streams (Barnett, 2012). By the Late Archaic Period, sites such as the Pearl River sites in Hancock County show evidence that people were exploiting the abundant saltwater mollusk resources of the area.

With larger and more substantial diets, Archaic Period populations became larger and more sedentary, as evidenced by the size and number of settlements. Early Archaic sites are typically seasonal sites, such as camps in the uplands where the deer and turkey were plentiful during the fall month. Later in the Archaic Period, settlement sites show an expansion of subsistence practices, marked by the use of gourds, wild squashes, and the collection of native plants like chenopodium. (Barnett, 2012)

By the Middle Archaic Period, Mississippi settlement show the first evidence of exchange and trade (Jackson, 2000). For example, large, bifacial Turkey Tail and Benton style points used in ceremonial practices are present in sites from this period (Jackson, 2000). Similarly, caches of large stone blades made of Fort Payne chert, sourced from nearby Alabama, are associated with burial sites throughout the region (Mississippi Department of Archives & History, 2015b). The Denton site (near Lambert, MS) has been characterized as a stone bead manufacturing location (Jackson, 2000). These ground and drilled zoomorphic beads are made from a variety of

materials including jasper, quartzite, trachyte, felsite, and hematite. Pottery began to appear in increasing amounts in sites dated to the Late Archaic Period (Barnett, 2012).

Trade patterns through the eastern and southeastern regions of Mississippi also indicate a risk-sharing pattern where economic risks are distributed among stable, permanent dwelling villages relying heavily on local resources (Barnett, 2012). Trade was conducted for both consumable resource acquisition and for attaining materials to be used in ceremonies, although interregional trade was in decline by the Terminal Archaic Period (Johnson & Brookes, 1989). There appears to be an increase in symbolic and ceremonial practices in the Middle Archaic Period with the advent of the first earthen mounds (Barnett, 2012). To date, only one earthen mound, the Paxton Mound in southwestern Mississippi, can be attributed to the Mississippian Middle Archaic Period. The Paxton Mound has been ascribed the role of a focal, possibly seasonal, gathering location (Barnett, 2012).

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

The Woodland Period in Mississippi can be characterized as an expansion of the Late Archaic traditions rather than an independently transformative period. Pottery production that began in the Late Archaic Period became more widespread during this time as the necessity for long-term food storage increased with increased horticultural and agricultural practices. While exchange patterns waned during the Terminal Archaic Period and beginning of the Woodland Period, archaeologists still see the patterns of shared belief systems among southeastern groups through similar design motifs on ceramic vessels (Mississippi Department of Archives & History, 2015b).

Long-distance exchanges increased during the Middle Woodland Period, after waning initially during the Terminal Archaic Period (Jackson, 2000). New ceremonial traditions began to take place and the practice of burying the dead in flat-topped ceremonial mounds began to emerge (Mississippi Department of Archives & History, 2015b). There was an increase in both local and exotic burial artifacts from this period associated with religious practices and they included items such as copper earspools, beads, conch shell cups, traded tool making material, and varieties of trade ceramics. Burial sites that are substantially more elaborate than others are a marker that by the end of the Middle Woodland Period, some societies in Mississippi may have established heredity-based social stratification (Jackson, 2000).

The cultures of the Woodland Period took advantage of both fresh and saltwater resources, with cultures in the Lower Mississippi River Valley showing “a preference for settling close to slow-moving streams, bottomland, and coastal marshes, [and] with upland hunting camps in the Loess Hills” (Barnett, 2012). Evidence from the southern part of the state indicate that Woodland Period dugout canoes were crafted from cypress trees, through a combination of burning and gouging with stone axes and adzes (Peacock, 1987). By the late Woodland Period, occupation sites were established close to waterways, which were ideal for hunting and would eventually become favored for farming use. The recovery of Late Woodland Period implements, such as the bow and arrow for hunting small game and horticulture tools, lead archaeologists to conclude that settlement sites supported relatively larger populations for long periods.

In the mid-1970s, Mississippi experienced substantial rain and subsequent flooding; causing bank erosion on the coastline of the Homochitto River (Connaway, 1982). The erosion exposed a dugout canoe, and the Sturdivant Fishweir site. The canoe showed signs of careful manufacture by burning and adze gouging (McGahey, 1997). The Sturdivant Fishweir, found exposed on a collapsed embankment, consisted of nearly 300 stakes with evidence of interwoven split cane mats. The weir was placed in the shape of a “V” with a gap at the apex. The weir’s stakes showed clear evidence of being made with the use of stone tools (Luntis, 1992).

Mississippian Period (A.D. 1000 – A.D. 1540)

The Mississippian Period, named for the culture’s association with the river and its tributaries, exhibits a continuation of lifeways from the Woodland Period, but also a shift to urbanization and large population centers, or cities. The period is be marked by the development of large ceremonial town centers, new tool technologies used in the advancement of agricultural practices, and crushed-shell tempered ceramics that were used for both ceremonial and utilitarian purposes.

Perhaps the most recognizable characteristic of this period are the large earthen mounds that still dot the landscape throughout the state. These large mounds served as temples, mortuaries, administrative sites, and chiefs’ houses (Mississippi Department of Archives & History, 2015b). Archaeologists have gathered evidence that these mounds were constructed by hand, using baskets to carry loads of dirt where it was deposited and compacted. Ramps were incorporated into the side of the mounds for easier access to the summit (Mississippi Department of Archives & History, 2015b). The construction size and techniques of these ceremonial centers indicates a high population density and “an obvious hierarchy of stratified sites” (Brain, 1978).

In some ceremonial centers, several mounds surround a central plaza where the chief or families of high status lived. It is believed that the majority of the population lived in large fortified villages outside the ceremonial center (Mississippi Department of Archives & History, 2015b). The presence of fortified centers is generally an indicator of warring with nearby groups, and to control trade and exchange (Morgan, 1997). Standard Mississippian houses were generally small, rectangular shapes, and constructed of wattle and daub (Mississippi Department of Archives & History, 2015b). These “farmsteads” can be found in groups as large as 100, or as isolated sites. Unfortunately, much of the archaeological evidence of smaller Mississippian sites has been discovered during the course of modern construction grading, which has impacted many of the sites before they can be adequately documented (Barnett, 2012).

A wide variety of crushed shell-tempered pottery has been documented in vessels ranging from crude utilitarian ware to finely crafted effigy bottles for ceremonial purposes (Mississippi Department of Archives & History, 2015b). Also during this period, new varieties of agricultural tools were introduced. Archaeologists believe that many of the agricultural implements were constructed of biodegradable wood and shells, and have since disappeared (Brown, 1926). Stone tools, however, have largely remained intact and provide insight into the way agriculture was practiced during this period. Stone hoes, spades, and other “digging

implements” were constructed out of both high-quality chert and lower quality materials (Brown, 1926).

One of the notable ceremonial mound centers is the Emerald Mound, constructed strategically abutting the Natchez Trace Trail that connected the Natchez area with the southern Appalachian Mountains of the northeast (Barnett, 2012). The mound center has been studied extensively as it is thought to have played an important role in the rise of aboriginal social stratification (Brain, 1978). The Emerald Mound encompasses seven acres on a modified hill with the “head and shoulders at the western end of the earthwork” and the corners laid out in the four cardinal directions (Barnett, 2012). The dominant mound, among eight smaller mounds, stands close to sixty feet above the surrounding ground surface. Within the mound, finely crafted ceramics decorated in curvilinear designs of scrolls, meanders, and spirals have been documented, as have grave goods including carved stone pipes and heat-treated triangular projectile points (Morgan, 1997).

9.1.11.4. Federally Recognized Tribes of Mississippi

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there is only one federally recognized tribe in Mississippi: The Mississippi Band of Choctaw Indians. The Choctaw reservation land covers 35,000 acres across 10 counties and has 10,000 members, as shown in Figure 9.1.11-2. Additionally, the figure depicts the general historic location of officially federally recognized tribes that were known to exist in this region of the United States, but are no longer present in the state.

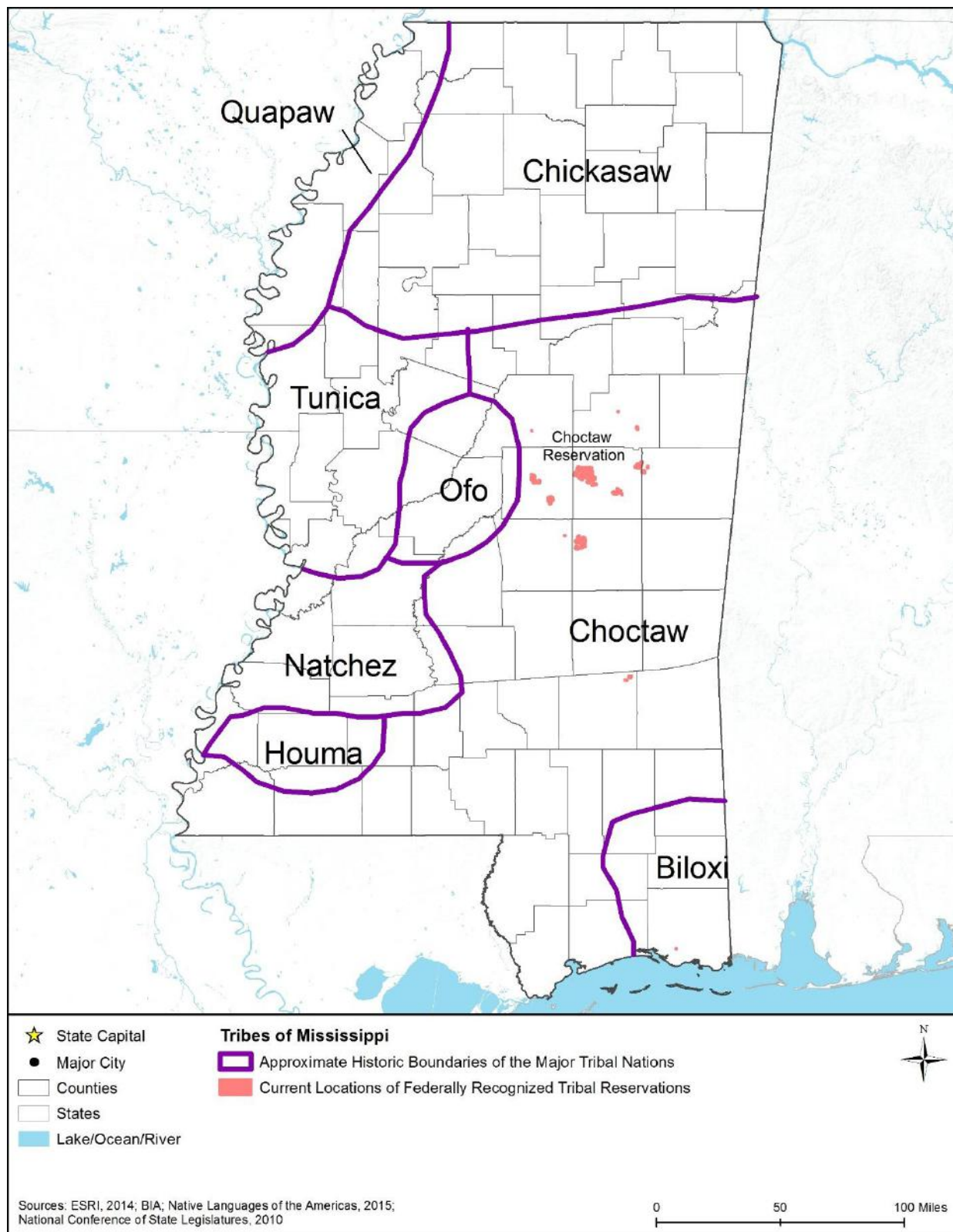


Figure 9.1.11-2: Federally Recognized Tribes in Mississippi¹¹¹

9.1.11.5. Significant Archaeological Sites of Mississippi

As previously mentioned in Section 9.1.11.3 there are approximately 170 archaeological sites in Mississippi listed on the National register of Historic Places. Table 9.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites is listed on the NPS NRHP website: <http://www.nps.gov/nr/> (NPS, 2015n).

Table 9.1.11-2: NRHP Listed Archaeological Sites in Mississippi

Closest City	Site Name	Type of Site
Aberdeen	Baker Mound	Prehistoric
Aberdeen	Crawford Site	Prehistoric
Aberdeen	Word Mound	Prehistoric
Alcorn	Catledge Archeological Site	Prehistoric
Alligator	Alligator Mounds	Prehistoric
Amory	Cotton Gin Port Site	Historic - Aboriginal, Prehistoric
Amory	Hester-Standifer Creek Site	Prehistoric
Amory	Inzer Site	Historic - Aboriginal, Prehistoric, Military
Amory	Lawson Site	Prehistoric
Amory	Mound Cemetery Site	Prehistoric
Arcola	Arcola Mounds	Prehistoric
Avalon	Teoc Creek Site	Prehistoric
Batesville	Batesville Mounds (22PA500)	Prehistoric
Batesville	Fredrickson No. 2 (22PA821)	Prehistoric
Bay Springs	Archeological Site No. 22JS572	Prehistoric
Bay Springs	Archeological Site No. 22JS587	Prehistoric
Belzoni	Belzoni Mound (22HU500)	Prehistoric
Belzoni	Jaketown Site	Prehistoric
Biloxi	Bass, Raymond, Site (22HR636)	Prehistoric
Biloxi	JOSEPHINE (Shipwreck)	Shipwreck
Bovina	Floyd Mound	Prehistoric
Bruinsburg	Smithfield Site	Prehistoric
Canton	Doak's Stand Treaty Site	Historic
Canton	Strawberry Fields Site (22MD644)	Prehistoric
Canton	Tilda Bogue	Prehistoric
Carrollton	Malmaison Site	Historic - Aboriginal
Carthage	Steep Mound Site (22LK26)	Prehistoric
Cary	Cary Site (22SH507)	Prehistoric

¹¹¹ Figure 9.1.11-2 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.

Closest City	Site Name	Type of Site
Clarksdale	Barner Site (22CO542)	Prehistoric
Clarksdale	Carson Mounds	Historic - Aboriginal, Prehistoric
Clarksdale	Davis, Rufus, Site	Historic - Aboriginal, Prehistoric
Clarksdale	Oliver Site	Prehistoric
Coahoma	Parchman Place Site	Prehistoric
Coahoma	Salomon (Salmon) Site	Prehistoric
Columbus	Butler Mound and Village Site	Prehistoric
Columbus	James Creek No. 1 Site	Prehistoric
Columbus	MacKay Mound	Prehistoric
Columbus	Plymouth	Historic - Aboriginal
Coxs Ferry	Bardin Mound (22HI537)	Prehistoric
Crenshaw	Canon Site (22TU523)	Prehistoric
Crowder	Spivey Site	Prehistoric
Cruger	French Site (22HO565)	Historic - Aboriginal, Prehistoric
Deasonville	Deasonville Archeological Site	Prehistoric
Denton	Denton Site	Prehistoric
Dundee	Dundee Site (22TU501)	Prehistoric
Edwards	Dupree Mound and Village Archeological Site	Prehistoric
Ellisville	Fishtrap Bluff Fishweir	Historic - Aboriginal
Enterprise	Lavelle Site	Prehistoric
Evansville	Beaverdam Site	Prehistoric
Evansville	Evansville Mounds (22TU502)	Prehistoric
Evansville	Owens Site (22TU512)	Prehistoric
Farrell	Humber Site	Historic - Aboriginal, Prehistoric
Fearns Springs	Nanih Waiya Mound And Village	Historic - Aboriginal, Prehistoric
Fort Adams	Smith Creek Site	Prehistoric
French Camp	Janet's Mound	Prehistoric
Friars Point	Dickerson Site (22CO502)	Prehistoric
Gautier	Applestreet Site (22JA530)	Prehistoric
Gautier	Graveline Mound Site (22JK503)	Prehistoric
Goodman	Cowser, Joe, Place Site (22HO507)	Prehistoric
Goshen Springs	White Perch Paradise Site (22MD641)	Prehistoric
Goshen Springs	Armstrong Site (22RA576)	Prehistoric
Grace	Grace Archeological Site	Prehistoric
Greenville	Winterville Site	Prehistoric
Greenwood	Rowland Site	Prehistoric
Greenwood	Black Site	Prehistoric
Grenada	Dell Bullion Mound (22TL998)	Prehistoric
Hattiesburg	Burkett's Creek Archeological Site	Prehistoric
Holcomb	Wild Wings Mounds (22GR713)	Prehistoric
Holly Bluff	Savory Site (22SH518)	Prehistoric
Holly Bluff	Spanish Fort Site (22SH500)	Prehistoric

Closest City	Site Name	Type of Site
Holly Bluff	Fairview Landing (22YZ561)	Prehistoric
Holly Bluff	Holly Bluff Site	Prehistoric
Hollywood	Johnson Cemetery Site (22TU516)	Prehistoric
Houston	Bynum Mound and Village Site (22CS501)	Prehistoric
Houston	Thelma Mound Archaeological Site	Historic - Aboriginal, Prehistoric
Ingomar	Ingomar Mound	Prehistoric
Itta Bena	McLean Site (22LF513)	Prehistoric
Itta Bena	Murphey Site	Prehistoric
Jackson	City Mound (22HI672)	Prehistoric
Kiln	Nugent Site (22HA592)	Prehistoric
Kimberly	Loosa Yokena Archeological Site	Prehistoric
Kirkville	Pharr Mounds	Historic - Aboriginal, Prehistoric
Lake City	Slate Archeological Site	Prehistoric
Lake City	Shellwood Site (22YZ600)	Prehistoric
Lambert	Norman Site	Prehistoric
Lanham	G.W.O. Site	Prehistoric
Lexington	Providence Mound (22HO609)	Prehistoric
Lizelia	Coosha	Historic - Aboriginal
Lorman	Mud Island Creek Complex (22JE508 and 22JE513)	Prehistoric
Lucedale	Bilbo Basin Shell Deposit Site	Prehistoric
Lula	Wilsford	Prehistoric
Macon	Dancing Rabbit Creek Treaty Site	Prehistoric
Madison	Puckshunubbee-Haley Site	Historic, Prehistoric
Marks	Posey Site (22QU500)	Prehistoric
Marks	Shady Grove Site (22QU525)	Prehistoric
Mattson	Spendthrift Site (22CO520)	Prehistoric
Mayersville	Mayersville Archeological Site	Prehistoric
Midnight	Midnight Mound Site (22HU509)	Prehistoric
Midnight	Parker--Summerfield Mound Archeological Site	Prehistoric
Minter City	Falls Site (22LF507)	Prehistoric
Money	Lane's Chapel Site	Prehistoric
Monticello	Lowe--Steen Site (22LW511)	Prehistoric
Monticello	Mill Creek Site	Prehistoric
Natchez	Anna Site	Prehistoric
Natchez	Mazique Archeological Site	Prehistoric
New Augusta	Old Augusta Historic Site	Historic
Newman	Baldwin's Ferry Mound	Prehistoric
Ocean Springs	French Warehouse Site	Historic
Ocean Springs	Back Bay of Biloxi Shipwreck Site	Shipwreck
Old Houlka	Owl Creek Site	Historic - Aboriginal, Prehistoric
Oma	George Mound (22LW591)	Prehistoric

Closest City	Site Name	Type of Site
Palo Alto	Town of Palo Alto	Historic
Palo Alto	Waide Archeological Site	Prehistoric
Pearl	Lewis, L'Dora, Mound (22SI512)	Prehistoric
Pearlington	Claiborne Site (22HA501)	Prehistoric
Pearlington	Jackson Landing Site	Historic - Aboriginal, Prehistoric
Pearlington	SJ Mound (22HA594)	Prehistoric
Pearlington	Three Sisters Shell Midden (22HA596)	Prehistoric
Pearlington	Up the Tree Shell Midden (22HA595)	Prehistoric
Pearlington	Williams Site (22HA585)	Prehistoric
Philadelphia	Nanih Waiya Cave Mound	Historic - Aboriginal
Philipp	Jacks Site	Prehistoric
Picayune	Tiger Hammock Site (22PR594)	Prehistoric
Pickens	Old Hoover Place Site (22HO502)	Prehistoric
Pocahontas	Pocahontas Mound A	Prehistoric
Pocahontas	Pocahontas Mound B	Prehistoric
Pontotoc	Treaty of Pontotoc Site	Historic - Aboriginal
Pope	Hunt Mound (22PA980)	Prehistoric
Port Gibson	Bayou Pierre Site	Prehistoric
Port Gibson	Windsor Site	Prehistoric
Porterville	Sucarnoochee River Fishweir	Historic - Aboriginal
Redwood	Snyder's Bluff	Historic, Military
Rena Lara	Sunflower Landing	Historic, Historic - Aboriginal
Ridgeland	Boyd Mounds Site (22MD512)	Prehistoric
Ridgeland	Natchez Trace, Old, and Choctaw Agency Site	Historic. Historic - Aboriginal
Rienzi	Moore's Creek Site	Prehistoric
Rolling Fork	Leist A Site (22SH520; 22N1)	Prehistoric
Rolling Fork	Rolling Fork Mounds	Military
Rosetta	Sturdivant Fishweir	Historic - Aboriginal
Russum	Centers Creek Mound	Prehistoric
Sidon	Black Site	Prehistoric
Sidon	Rebecca Site	Prehistoric
Sidon	Stratton Archeological Site	Prehistoric
Slate Springs	West Mound	Prehistoric
Sledge	Holly Grove Site	Prehistoric
Stanton	Emerald Mound Site (22AD504)	Historic - Aboriginal, Prehistoric
Starkville	Herman Mound and Village Site	Prehistoric
Starkville	Lyon's Bluff Site	Prehistoric
Sumner	Buford Site (22TL501)	Prehistoric
Tchula	Lee, Frances, Mound Group (22HO654)	Prehistoric
Tchula	Oswego Site (22HO658)	Prehistoric
Terry	Berry Mound and Village Archeological Site	Prehistoric
Tishomingo	Bear Creek Mound and Village Site (22TS500)	Prehistoric

Closest City	Site Name	Type of Site
Tunica	Hollywood Site	Prehistoric
Tupelo	Mutt-Thomason Site	Prehistoric
Valley Park	Aden Site (22IS509; 22M3)	Prehistoric
Vaughan	Casey Jones Wreck Site	Shipwreck
Vicksburg	Fort St. Pierre Site	Historic, Military
Vicksburg	Hyland Mound Archeological Site	Prehistoric
Vicksburg	Lassiter, W. W., Wholesale Grocery Warehouse	Prehistoric
Wakeland	Sweethome Mound	Prehistoric
Washington	Fort Dearborn Site	Military
Washington	Ratcliffe Mound Site	Prehistoric
Webb	Allison Mound (22TL1024)	Prehistoric
West Point	Brogan Mound and Village Site Discontiguous District	Prehistoric
West Point	Colbert and Barton Townsites	Historic
Whaley	Neill Archeological Site	Prehistoric
Whaley	Whaley Archeological Site	Prehistoric
Willows	Nelson, John, Site	Prehistoric
Woodville	Anderson Mound	Prehistoric

Source: (NPS, 2015n)

Mississippi State Cultural Resources Database and Tools

Mississippi State Historic Preservation Office (SHPO)

The SHPO, part of the Mississippi Department of Archives and History – works to preserve the cultural resources of Mississippi. The office is responsible for overseeing preservation programs and maintaining the state archives. A list of all NRHP nominations, along with a larger Historic Resources Inventory database (HRI), is available on the SHPO website (<http://www.apps.mdah.ms.gov/Public/search.aspx>) or review, as well as nomination forms and research materials.

Mississippi Archaeological Association (MAA)

The Mississippi Archaeological Association (<http://www.msarchaeology.org/>) is composed of professional archaeologists and members of the general public. The aim of the MAA is to encourage scientific archaeological investigation and to disseminate information to the public to further the study of Mississippi's prehistory. The MAA's website maintains educational information on the state's archaeology, along with links of interest to other sources of archaeological information related to Mississippi.

9.1.11.6. *Historic Context*

While the Spanish explorer Alonso Alvarez de Pineda became the first European to view the coast of Mississippi in 1519 and helped map the Gulf of Mexico, Spanish explorer and conquistador Hernando de Soto was the first European to explore the Mississippi interior while progressing westward in search of gold in 1540. French exploration occurred during the late 17th century and the French ultimately came to control the area after Rene-Robert, Cavalier de La Salle, explored the region, and named the region “Louisiana” after the French King Louis XIV (Mississippi Department of Archives & History, 2015c). Established in 1699 by Pierre LeMoyne, Sieur d’Iberville, Fort Maurepas was the first French colonial capital and Mississippi’s first settlement (“Old Biloxi”), located in what is now Ocean Springs, until it was moved in 1702 to Mobile due to that location’s superior harbor (Mitchell D. J., 2014a). In 1719, the capital of colonial Louisiana was moved temporarily from Mobile to Biloxi, which was at the time called New Biloxi, and soon moved again to New Orleans, where construction of a permanent capital had begun in 1718 (Mississippi Department of Archives & History, 2015d).

The first half of the 18th century was marked by frequent conflict with the indigenous population (Mitchell D. J., 2014a). During this time, the French settlement of Natchez was established in 1716 at the existing Natchez Indian town and was a key place of trade for the lower Mississippi River Valley. Following the French and Indian War (1754 to 1763), control of the area of Mississippi transitioned to the English, as part of British West Florida, where it would remain through the end of the American Revolution (Mississippi Department of Archives & History, 2015e). Following the American Revolution, the southern portion of Mississippi came under the control of Spain, while the northern portion (including Natchez) became part of the United States in 1798. Tensions between the United States and Spain continued through the end of the 18th century and into the early 19th century, with President James Madison annexing part of the Mississippi coast in 1812. Mississippi was dominated by agriculture for much of its history, with cotton being particularly important (Mitchell D. J., 2014a). The invention of the cotton gin in 1795 fueled expansion of a slave-reliant culture to work large cotton plantations (Mississippi Department of Archives & History, 2015f).

On December 10, 1817, Mississippi entered the Union as the 20th state (Haynes, 1973). 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, 2017). On January 9, 1861, Mississippi became the second state to secede during the Civil War, and would experience heavy casualties among its troops and considerable destruction to its cities and economy (Mississippi Department of Archives & History, 2015g). The Siege of Vicksburg in 1863 was a critically important event, as it disrupted Confederate control of the Mississippi River and helped turn the war in favor of the Union (Mississippi Department of Archives & History, 2015h). After the war, the state dealt with economic and social struggles relating the abolition of slavery, while continuing to rely heavily on agriculture. Lumbering became

important as well, and remained so well into the 20th century (Mississippi Department of Archives & History, 2015i).

During World War I (WWI), Mississippi “provided 66,000 men to the U.S. Army and Navy and...contributed nearly 80 million dollars through the purchase of Liberty Loan Bonds” (Mississippi Department of Archives & History, 2015j). During the Great Depression, like much of the country, Mississippi was the recipient of substantial federal assistance to help ease the economic downturn, with programs like the Civilian Conservation Corps (CCC), Works Progress Administration (WPA), Federal Writer’s Project (FWP), and Federal Art Project (FAP) employing out-of-work residents (Works Progress Administration, 2009). There were 102 CCC camps in Mississippi during the New Deal period (Mississippi Department of Archives & History, 2015k). Mississippi contributed in various ways during World War II (WWII), including establishing multiple prisoner of war camps (Mississippi Historical Society, 2015a). Mississippi was central during the Civil Rights movement of the 1950s and 1960s, and was the site of several critical events, such as the assassination of National Association for the Advancement of Colored People (NAACP) member Medgar Evers in 1963 (McMillen, 1973).

Mississippi has 1,393 NRHPs listed sites, as well as 39 NHLs (NPS, 2014d). Mississippi contains three National Heritage Areas, the Mississippi Delta National Heritage Area, Mississippi Hills National Heritage Area, and Mississippi Gulf Coast National Heritage Area (NPS, 2015f). Figure 9.1.11-3 shows the location of NHA and NRHP sites within Mississippi.¹¹²

¹¹² See Section 9.1.3 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

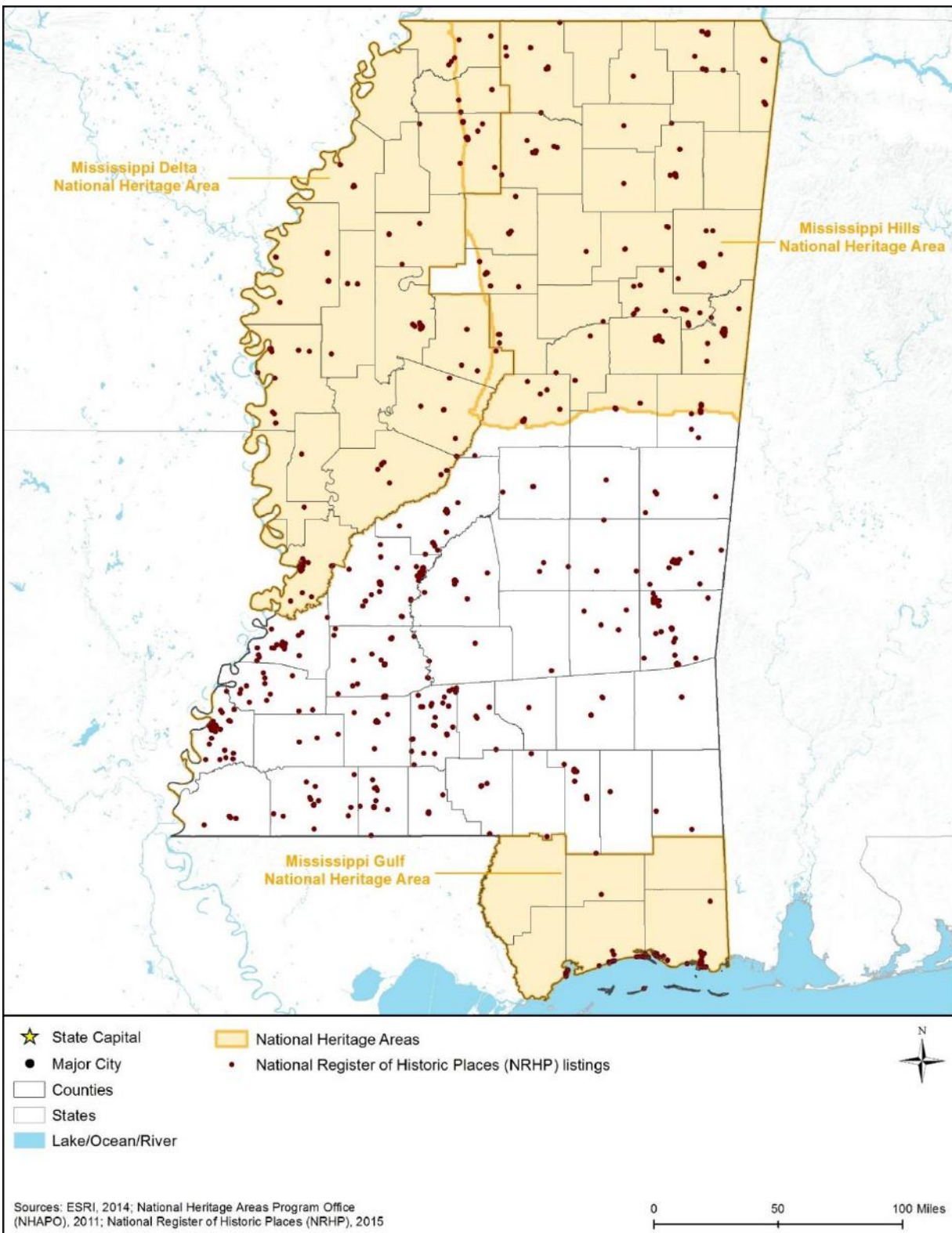


Figure 9.111-3: National Heritage Area (NHA) and National Register of Historic Places (NRHP) Sites in Mississippi

9.1.11.7. Architectural Context

The first European buildings in Mississippi were constructed by the French starting at the end of the 17th century. Structures were built of wood, due to the ample supply of timber and lack of local sources of stone, with locally-made brick and tabby being used to a lesser degree. The Creole Cottage was the most common building type, and “is a one-story, or one-and-one-half-story, house that is one-room deep, two or three rooms wide, with an overhanging roof sheltering an undercut front gallery, or porch. It is usually built on a raised foundation” (Mississippi Historical Society, 2015b). “Many houses had floor-length windows that opened onto the galleries...known as a jib door” (Crocker, 1973). The De LaPoint-Krebs house (1770), in Pascagoula, MS, is an example of a Creole Cottage and is now believed to be the oldest building in the lower Mississippi River Valley (Mississippi Historical Society, 2015b).

After the British gained control of Mississippi in 1763, buildings became more vertical, while still retaining select French elements. King’s Tavern, the oldest building in Natchez, exemplifies this and is built on a raised masonry foundation with two upper floors of wood. Following the American Revolution, building traditions were influenced by Spain, which had taken possession of the Mississippi area. “The best example of Spanish Colonial architecture in Natchez is Texada, a townhouse built in the late 1790s by Manuel Texada,” and is believed to be the city’s first all-brick building (Mississippi Historical Society, 2015b). After the United State took possession of the area at the end of the 18th century, American building forms, such as the center hall house, were incorporated with existing Creole designs (Mississippi Historical Society, 2015b).

Starting in the 19th century, log cabins began to appear in Mississippi, brought by recent American settlers. As with other southern states, vernacular forms – such as single-pen houses, dog trots, I-houses, and Planter’s Cottage houses were common. “The Planter’s Cottage is a small, one-, or one-and-one-half, story house with a center hall and usually either one or two rooms deep” (Mississippi Historical Society, 2015b). In addition to residential structures, “other buildings constructed during this earliest period, such as courthouses, schools, stores, banks, and churches, were generally one-room structures devoid of any individual architectural character” (Mississippi Historical Society, 2015b).

Architectural styles built in Mississippi starting in the early 19th century include the Federal style, of which the Auburn (1812), in Natchez, MS, is a good example. Greek Revival came into style next, starting in the second quarter of the 19th century, and continued to be used heavily until after the Civil War. “Perhaps the most famous Greek Revival buildings in Mississippi are the Old Capitol, circa 1840, and the Governor’s Mansion, circa 1842,” both of which are in Jackson, MS (Mississippi Historical Society, 2015b). In the majority of the state’s large plantation houses, “central hallways divided the eight-room, two-story houses equally. Most of the houses had a parlor or double parlors, dining room, and a guest bedroom on the lower level” (Crocker, 1973). “Other special purpose buildings behind some of the big houses included a privy, a garcons’ room, a billiard room, a school room, a dairy house (for cooling dairy products), a smokehouse (for curing meat), a carriage house, and stables” (Crocker, 1973).

Romantic styles gained popularity in the second half of the 19th century and included styles such as Gothic Revival, used frequently for churches, and Italianate. The late 19th century was dominated by the Victorian styles, such as Second Empire, Queen Anne, and Victorian Vernacular (Mississippi Historical Society, 2015b). Starting during the late 19th century, but especially during the early 20th century, revival architecture gained favor, with Classical Revival and Colonial Revival appearing on a variety of building types. “The Levee Street Railroad Station in Vicksburg, 1907, and Hawkins Field Terminal in Jackson, circa 1935, are good examples of this style used for transportation buildings” (Mississippi Historical Society, 2015c).

Craftsman architecture came into popularity following WWI, drawing on the Arts and Crafts movement, with Modern architecture being popular with a certain degree of overlap in the periods. Modern architectural styles include Art Deco, Art Moderne, and International (Mississippi Historical Society, 2015c). During the Great Depression, public buildings and public facilities were constructed through various New Deal work programs. Post Offices are a great example of these, and have been documented extensively (National Register of Historic Places, 1981). From 1934 to 1942, the CCC was responsible for the development of several state parks and the architecture found within these parks (National Register of Historic Places, 1996). Ranch houses were commonly built during the Midcentury Era as suburbs grew, with these housing developments often being accompanied by large suburban shopping centers (Mississippi Historical Society, 2015c). Selected historic architectural styles found in Mississippi are shown in Figure 9.1.1-4.



Top Left – University of Mississippi, Lyceum Building (Oxford, MS) – (Historic American Buildings Survey, 1975)
Top Middle – Courthouse (Gulfport, MS) – (Detroit Publishing Company, 1906)
Top Right – Dunleith Mansion (Natchez, MS) – (Highsmith, 1980)
Bottom Left – Billie Eaton House (Tishomingo, MS) – (Northwest corner - Billie Eaton House, Old Natchez Trace, Tishomingo, Tishomingo County, MS, 1933)
Bottom Right – Old Water Power Grist Mill (Macon, MS) – (Historic American Buildings Survey, 1933)

Figure 9.1.11-4: Representative Architectural Styles of Mississippi

9.1.12. Air Quality

9.1.12.1. Definition of the Resource

Air Quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography¹¹³ 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)¹¹⁴ or micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) determined over various periods of time (averaging time).¹¹⁵ This section discusses the existing air quality in Mississippi. USEPA designates areas within the United States as attainment,¹¹⁶

¹¹³ Topography: The unique features and shapes of the land (e.g., valleys and mountains).

¹¹⁴ Equivalent to 1 milligram per liter (mg/L).

¹¹⁵ Averaging Time: “The period over which data are averaged and used to verify proper operation of the pollution control approach or compliance with the emissions limitation or standard” (USEPA, 2015h).

¹¹⁶ Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015i).

nonattainment,¹¹⁷ maintenance,¹¹⁸ or unclassifiable¹¹⁹ depending on the concentration of air pollution relative to ambient air quality standards. Information is presented regarding national and state ambient air quality standards and nonattainment areas that would be potentially more sensitive to impacts from implementation of the Proposed Action or alternatives.

9.1.12.2. Specific Regulatory Considerations

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, nitrogen dioxide (NO₂), particulate matter (PM_{2.5} and PM₁₀), ozone (O₃), and sulfur dioxide (SO₂). The NAAQS establish various standards, either primary¹²⁰ or secondary,¹²¹ 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, 2016e). A description of the NAAQS is presented in Mississippi Appendix A, Table A-1. Mississippi has fully adopted the Primary and Secondary NAAQS as promulgated by the USEPA (MDEQ, 2014e). In addition to the NAAQS, Mississippi has established a standard on odorous substances “in concentrations sufficient to adversely and unreasonably A) affect human health and well-being; B) interfere with the use or enjoyment of property; or C) affect plant or animal life” (MDEQ, 2014e).

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). The USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Mississippi Appendix A, Table A-2 presents a list of federally regulated HAPs. (USEPA, 2016f)

¹¹⁷ Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015i).

¹¹⁸ Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment (USEPA, 2015i).

¹¹⁹ Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant (USEPA, 2015i).

¹²⁰ 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, 2015i).

¹²¹ 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, 2015i).

Title V Operating Permits/State Operating Permits

Mississippi has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015j). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015j). Mississippi DEQ describes the applicability of Title V operating permits in Chapter 6 of the Air Quality Standards and Regulations. Mississippi requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 9.1.12-1). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 9.1.12-1: Major Air Pollutant Source Thresholds

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

Source: (USEPA, 2014b)

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

In addition to Title V operating permits, the Mississippi DEQ issues general permits to construct and operate under Mississippi Rule 2.11 of Mississippi Administrative Code Part 2, Chapter 2 (General Permits) for moderate sources or modifications¹²² and synthetic minor sources.¹²³

Exempt Activities

Mississippi Rule 2.13 of Mississippi Administrative Code Part 2, Chapter 2 identifies the following source categories as exempt from the requirement to obtain permits to operate or construct:

- Under Rule 2.13(D)(5), “Stationary sources, other than incinerators or CAFOs, which neither emit nor have potential uncontrolled emissions of, 10 TPY or more of either PM₁₀, SO₂, NO_x, CO or VOC, nor 1.0 PY of a HAP, nor 2.5 TPY of all HAPS” (MDEQ, 2014f);
- Boilers with less than 10,000,000 BTU/hour total rated input capacity; and
- Mobile sources (MDEQ, 2014f).

¹²² Moderate Modification: “Any modification in which the source is making enforceable emissions reductions to avoid major source requirements of Title 11, Part 2, Chapter 5, or Rule 2.5.E. of these regulations” (Mississippi Forestry Commission, 2014).

¹²³ Synthetic Minor Sources: “Any stationary source which would otherwise constitute a major source as defined by Miss. Admin. Code, Title 11, Part 2, Chapter 6..., except that the owner or operator of the stationary source elects for federally enforceable emissions limitations” (Mississippi Forestry Commission, 2014).

Temporary Emissions Sources Permits

Mississippi Rule 6.3(E) of 11 Mississippi Administrative Code Part 2, Chapter 6 allows an installation owner or operator to “...apply for a single permit authorizing [major source] emissions from similar operations...at multiple, temporary locations” (MDEQ, 2014g).

State Preconstruction Permits

Under Rule 2.1 of 11 Mississippi Administrative Code Part 2, Chapter 2, Mississippi DEQ requires “any new stationary source or modification of a stationary source [to] have a permit to construct or multi-media permit incorporating such permit before beginning construction” (MDEQ, 2014f).

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

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

Table 9.1.12-2: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO _x)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an OTR	100
Ozone (NO _x)	Maintenance	100
Ozone (VOC)	Maintenance outside an OTR	100
CO, SO ₂ , NO ₂	All Nonattainment and Maintenance	100
PM ₁₀	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100

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

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

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

If an action does not result in an emissions increase above the *de minimis* levels in Table , 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 , 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,¹²⁵ the agency would have to fulfill one or more of the following:

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

State Implementation Plan Requirements

The Mississippi SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Mississippi's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Mississippi's SIP actions are codified under 40 CFR Part 52 Subpart Z. A list of all SIP actions for all six criteria pollutants can be found on the Mississippi DEQ website: http://www3.epa.gov/region4/air/sips/ms/toc_ms.htm.

¹²⁵ Conformity: Compliance with the State Implementation Plan.

9.1.12.3. *Environmental Setting: Ambient Air Quality*

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas (USEPA, 2016h).

Figure 9.1.12-1 and Table 9.1.12-3, below, present the nonattainment areas in Mississippi as of January 30, 2015. The year(s) listed in the table for each pollutant indicate when USEPA promulgated the standard for that pollutant; note that, for lead, PM_{2.5}, O₃, and SO₂, both standards listed are in effect. Table 9.1.12-3 contains a list of the counties and their respective current nonattainment status for 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. Unlike Table 9.1.12-3, Figure 9.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM₁₀, and PM_{2.5} merge in the figure to count as a single pollutant.

Table 9.1.12-3: Mississippi Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO ₂	PM ₁₀	PM _{2.5}		O ₃		SO ₂	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
De Soto									X-5		

Source: (USEPA, 2017b)

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

Air Quality Monitoring and Reporting

The Mississippi DEQ measures air pollutants at 11 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network. Annual Mississippi Ambient Air Quality Reports are prepared, containing pollutant data summarized by county. The Mississippi DEQ updates pollution levels of ozone and PM_{2.5} on a daily basis on AirNow¹²⁶ website:

http://airnow.gov/index.cfm?action=airnow.local_state&stateid=25.

In 2014, no criteria pollutants exceeded federal standards (MDEQ, 2014h).

¹²⁶ AirNow is a government website that posts daily Qir Quality Index for more than 400 cities.

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).

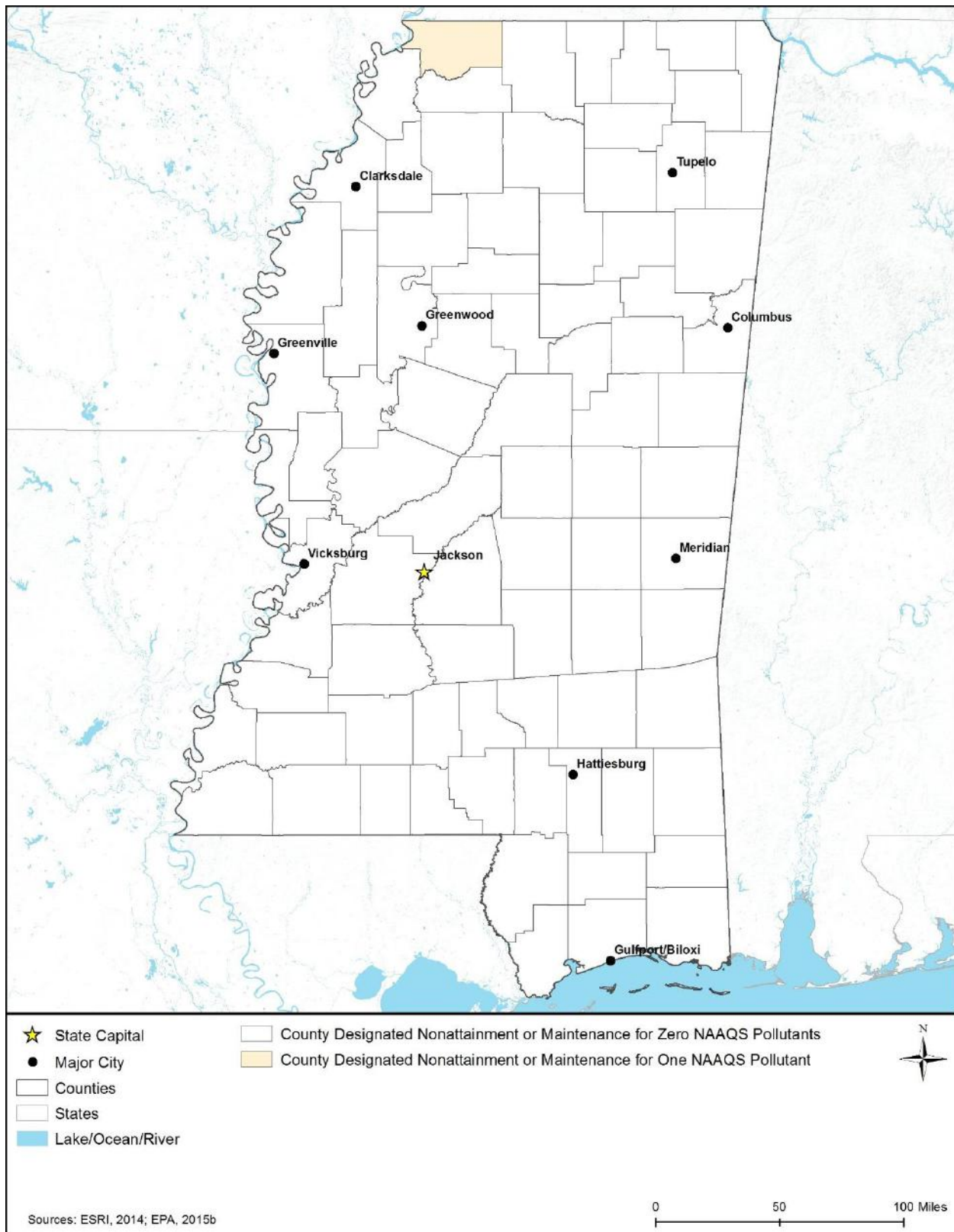


Figure 9.1.12-1: Nonattainment and Maintenance Counties in Mississippi

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 kilometers¹²⁷ of a Class I area. “The EPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. “Historically, the USEPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers¹²⁸ (the normal useful range of EPA-approved Gaussian plume models” (USEPA, 1992).

- Mississippi does not contain Federal Class I areas. All other 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). Alabama and Louisiana have a Class I area where the 100-kilometer buffer intersects a few Mississippi counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office.
- Figure 9.1.12-2 provides a map of Mississippi highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 9.1.12-2 correspond to the numbers and Class I areas listed in Table 9.1.12-4.

Table 9.1.12-4: Relevant Federal Class I Areas

# ^a	Area	Acreage	State
1	Sipsey Wilderness Area	12,646	AL
2	Breton Wilderness Area	5,000+	LA

Source: (FAA, 2015a)

^a The numbers correspond to the shaded regions in Figure 9.1.12-2

¹²⁷ The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

¹²⁸ The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

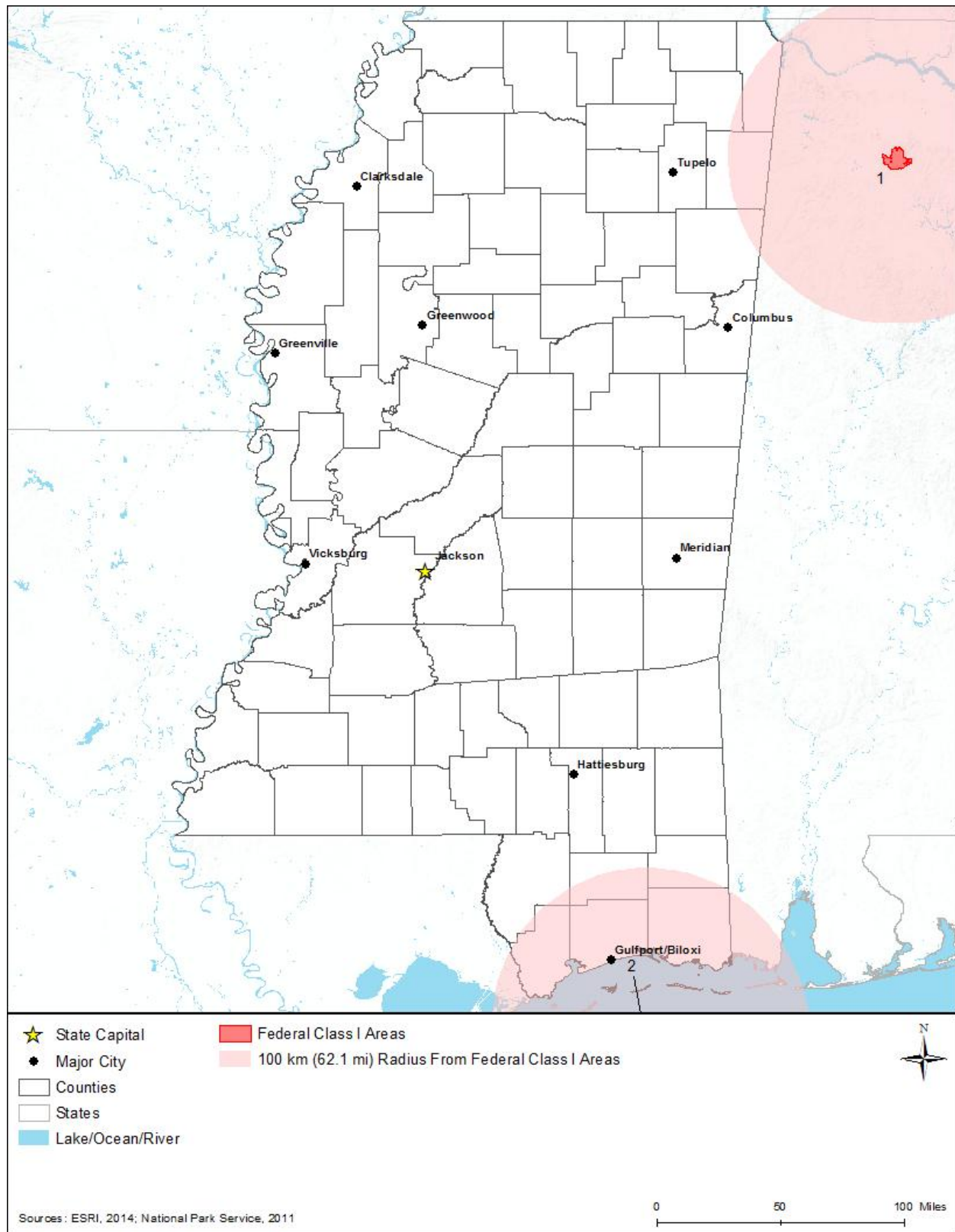


Figure 9.1.12-2: Federal Class I Areas with Implications for Mississippi

9.1.13. Noise and Vibrations

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

9.1.13.1. Definition of the Resource

Noise is a form of sound caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2017c). 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 (DOT, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2007). 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 (DOT, 2006):

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

Figure 9.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.



Source: (Sacramento County Airport System, 2015)

Prepared by: Booz Allen Hamilton

Leq: Equivalent Continuous Sound Level

Figure 9.1.13-1: 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 (DOT, 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 causing 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 9.1.13-1 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 (FAA, 2006).

Table 9.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)

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

Source: (FAA, 2006)

VdB = vibration decibels

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

9.1.13.2. Specific Regulatory Considerations

As identified in Appendix C, Environmental Laws and Regulations, the Noise Control Act of 1972, along with its subsequent amendments (e.g., Quiet Communities Act of 1978 [42 U.S.C. Parts 4901–4918]), delegates authority to the states to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Although no federal noise regulations exist, the USEPA has promulgated noise guidelines (USEPA, 1974). Similarly, most states have no quantitative noise-limit regulations.

Mississippi does not have any state-wide noise regulations that would apply to the Proposed Action. However, many cities and towns may have local noise ordinances to manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Large cities and towns, such as Jackson and Gulfport, 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).

9.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Mississippi varies widely based on the area and environment of the area. The population of Mississippi can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 9.1.11-1 illustrates noise values for typical community settings and events that are representative of what the population of Mississippi may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Mississippi. As such, this section describes the areas where the population of Mississippi can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Jackson (and its neighboring boroughs and cities), and Gulfport.
- **Airports:** Areas surrounding airports tend to be more sensitive to noise due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012a). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports are in the proximity of urban communities; therefore, aircraft operations (arrivals/departures) can result in noise exposure in the surrounding areas to be at higher levels with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Mississippi, Jackson-Evers International Airport

(JAN) and Gulfport-Biloxi International Airport (GPT) have more than 194,000 annual operations combined (FAA, 2015h). These operations result in increased ambient noise levels in the surrounding communities. See Section 9.1.1.3, Transportation, and Figure 9.1.7-5 for more information about airports in the state.

- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (FHWA, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living in those areas. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015d). See Section 9.1.1.3, Transportation, and Figure 9.1.1-1 for more information about the major highways in the state.
- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (DOT, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (DOT, 2015). Mississippi has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend mainly from Jackson and Gulfport to other cities in Mississippi, Arkansas, Louisiana, and Alabama, such as the Burlington Northern Santa Fe and CSX railways. There are also a number of other rail corridors that join these major rail lines and connect with other cities (MDOT, 2009). See Section 9.1.1.3, Transportation, and Figure 9.1.1-1 for more information about rail corridors in the state.
- **National and State Parks:** The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. National and state parks, historic areas, and monuments are protected areas. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014e). Mississippi has eight NPS units and five National Natural Landmarks (National Parks Conservation Association, 2015) (NPS, 2015o). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 9.1.8, Visual Resources for more information about national and state parks for Mississippi.

9.1.13.4. 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 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, 1984). Most cities, towns, and villages in Mississippi have at least one school, church, or park, in addition to likely having other noise or vibration-sensitive receptors. There are most likely thousands of sensitive receptors in Mississippi.

9.1.14. Climate Change

9.1.14.1. Definition of the Resource

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

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012c). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO₂-equivalent (MT CO₂e¹²⁹), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO₂ only, the units are in million metric tons (MMT CO₂). Where the document references emissions of multiple GHGs, the units are in MMT CO₂e.

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

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see Section 9.2, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation; 3) sea level; and 4) severe weather events (including tropical storms, flooding, tropical cyclones, and hurricanes).

¹²⁹ CO₂e refers to Carbon Dioxide Equivalent, “A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMT CO₂e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMT CO₂e = (million metric tons of a gas) * (GWP of the gas)” (USEPA, 2016i).

9.1.14.2. Specific Regulatory Considerations

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

Mississippi has not established any goals to reduce GHG emissions to combat climate change. The Governor signed four bills into law in 2013 intended to increase energy efficiency (Mississippi Governor's Office, 2013), which could have an indirect effect on GHG emissions (particularly CO₂) over the long-term, but these were not explicitly intended to combat climate change or its impacts. No state-level legislation has been passed related to community resilience in the face of rising sea levels, increased heat, or other climate-change related impacts, although individual cities such as Biloxi have passed local regulations to factor in the impacts of sea level rise in flood and other hazard mitigation planning (City of Biloxi, 2013) and included climate change in city planning documents (City of Biloxi, 2008).

9.1.14.3. *Mississippi Greenhouse Gas Emissions*

Estimates of Mississippi's total GHG emissions vary. The Department of Energy's (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as methane (CH₄) and nitrous oxide (NO_x), but not at the state level (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2014c). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

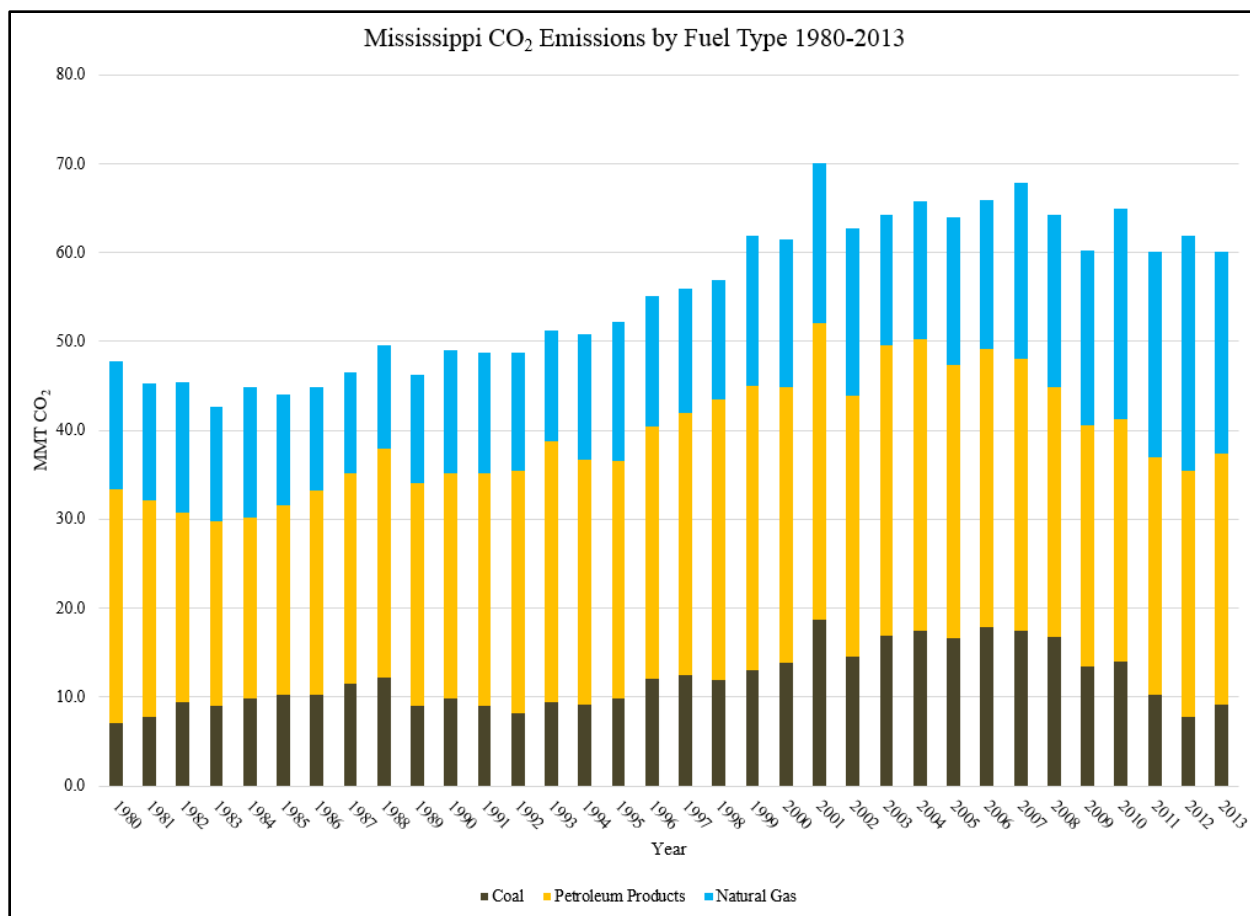
For the purposes of this PEIS, the EIA data on CO₂ emissions are used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH₄, they are described and cited.

According to the EIA, Mississippi emitted a total of 64.1 million metric tons (MMT) of CO₂ in 2013 (EIA, 2015d). Emissions were dominated by petroleum in the transportation and natural gas in the electric power sector (Table 9.1.14-1) (EIA, 2014a). Annual emissions between 1980 and 2013 are presented in Figure 9.1.14-1. Between 1980 and 2001, Mississippi's GHG emissions increased by 46.6 percent (although 2001 was an anomalous year, with unusually high coal-related emission). Emissions fluctuated between 2001 and 2012 but the overall trend since 2001 has been downward, caused by reductions in emissions from coal (even as emissions from natural gas have increased) and moderate decreases in emissions from petroleum (EIA, 2013a). Mississippi was ranked 32nd among the states and the District of Columbia for total CO₂ emissions in 2014, and 19th for per capita CO₂ emissions (EIA, 2014b).

Table 9.1.14-1 Mississippi CO₂ Emissions by Fuel Type and Sector, 2014

Fuel Type (MMT)		Source (MMT)	
Coal	11.0	Residential	1.9
Petroleum Products	29.8	Commercial	1.7
Natural Gas	23.3	Industrial	11.2
		Transportation	25.6
		Electric Power	23.7
TOTAL	64.1	TOTAL	64.1

Source: (EIA, 2014c)



Source: (EIA, 2013b)

Figure 9.1.14-1: Mississippi CO₂ Emissions by Fuel Type 1980-2013

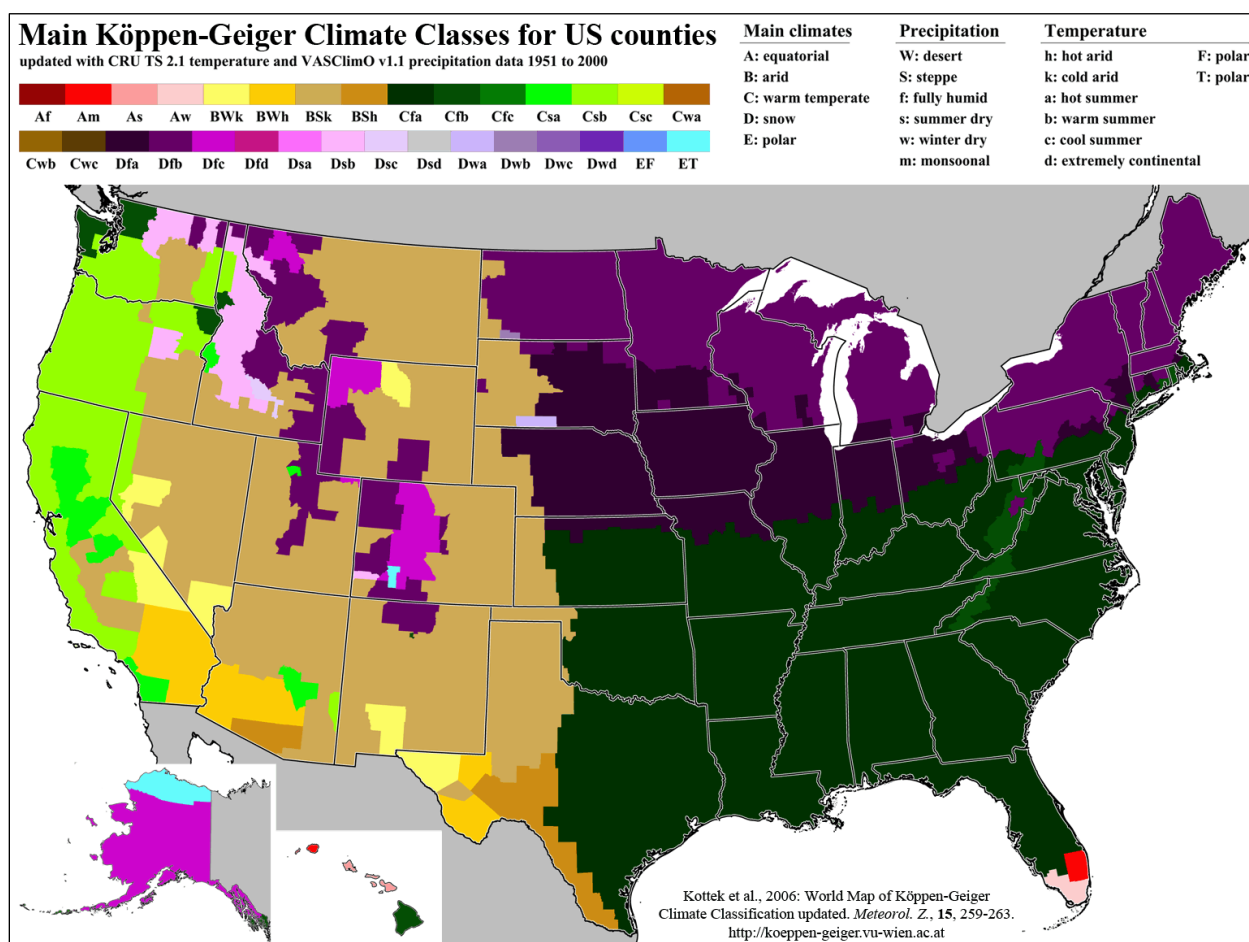
Mississippi does not currently have an official state-level greenhouse gas inventory. Mississippi is a small petroleum and natural gas producer and has little to no coal production compared to other states. (EIA, 2016b). Coal-related emissions are expected rise in 2016 as a result of a second coal mine beginning full operation in Kemper County and supplying a new power plant. Mississippi has three oil refining facilities that process approximately 364,000 barrels of crude oil per day. Petroleum production has increased in the last decade which also increased related emissions. (EIA, 2016b)

Although the two largest power plants in Mississippi are fueled by coal, natural gas is the main resource used for electricity generation which results in high natural gas-related CO₂ emissions. Mississippi's large underground salt caverns used to store natural gas, as well as its natural gas processing industry also contribute to these high emissions. Natural gas production is been low since the mid-1950s but had a production high in the 1980s: today Mississippi produces about 60 billion cubic feet of natural gas, or about 1 percent of the Nation's total. (EIA, 2016b)

9.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the “The composite or generally prevailing weather conditions of a region, throughout the year, averaged over a series of years.” (NWS, 2009). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based “upon general temperature profiles related to latitude” (NWS, 2011). 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 Mississippi is classified as climate group (C). Climates classified as (C) are warm, with humid summers and mild winters. During winter months, “the main weather feature is the mid-latitude cyclone” (NWS, 2011). During summer months, thunderstorms are frequent. Mississippi has one sub-climate category, which is described in the following paragraphs.



Source: (Kottek, 2006)

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

Cfa – The Köppen-Geiger climate classification system classifies the entirety of Mississippi 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, 2011) (NWS, 2006)

The following sections discuss the current state of Mississippi's climate with regard to air temperature, precipitation, sea level, and extreme weather events (e.g., tropical storms, flooding, tornadoes, and hurricanes) in the state's climate region Cfa.

Air Temperature

The climate of Mississippi is classified as a humid, subtropical climate with temperate winters and long, hot summers. In areas along the coast, annual temperatures average approximately 68 °F, while annual temperatures in the north average approximately 62 °F. In general, "Mississippi has a climate characterized by absence of severe cold in winter but by the presence of extreme heat in summer" (Office of the Mississippi State Climatologist, 2015). Temperatures in Mississippi regularly exceed 100 °F in many areas of the state and can drop to zero or below an average of once in every five years. The highest temperature to occur in Mississippi was on July 29, 1930 with a record high of 115 °F in Holly Springs (SCEC, 2015). The lowest temperature to occur in Mississippi was on January 30, 1966 with a record low of negative 19 °F in Corinth (SCEC, 2015). (Office of the Mississippi State Climatologist, 2015)

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

Cfa – The capital of Mississippi, Jackson, is located in a south central region of the state and within the climate classification zone Cfa. The average annual temperature in Jackson is approximately 64.6 °F; 47.6 °F during winter months; 80.6 °F during summer months; 64.4 °F during spring months; and 65.5 °F during autumn months (NOAA, 2015i). Biloxi, located along the southern coast of Mississippi, is also within the climate classification zone Cfa. The average annual temperature in Biloxi is approximately 68.4 °F; 53.1 °F during winter months; 82.0 °F during summer months; 68.0 °F during spring months; and 70.1 °F during autumn months (NOAA, 2015i).

Precipitation

Although the state is subject to both droughts and flooding, precipitation throughout Mississippi is fairly evenly distributed throughout the year. One of Mississippi's leading climatic influencer is the Gulf of Mexico, which "delivers energy and moisture" in addition to modifying seasonal rainfall and temperature patterns throughout the state. Prevailing southerly winds also have an impact on the state, as the "winds provide moisture for high humidity and potential discomfort from May through September" (Office of the Mississippi State Climatologist, 2015). "Locally

violent and destructive thunderstorms” are also a threat to the state, with an average of 60 storms occurring per year. (Office of the Mississippi State Climatologist, 2015) (Wax, 2015)

Precipitation in the state ranges from approximately 50 to 65 inches from northern to southern regions, with measurable snow or sleet falling in “some parts of state in 95% of the years” (Office of the Mississippi State Climatologist, 2015). However, although uncommon, trends in precipitation can also be highly variable. For example, in 2007 areas of east-central Mississippi received an annual total of 33.93 inches of rainfall. Climatologically, there is a 5 percent chance of receiving less than 36.14 inches of rainfall in this area. Two years later, in 2009, the same area received approximately 86.11 inches of rainfall, with only a 1 percent chance of receiving more than 84.79 inches of rainfall. (Office of the Mississippi State Climatologist, 2015)

The greatest 24-hour precipitation accumulation to occur was on July 9, 1968 with a total of 15.68 inches in Columbus (SCEC, 2015). The greatest 24-hour snowfall accumulation to occur was on December 23, 1963 with a total of 18 inches in both Mount Pleasant and Tunica (SCEC, 2015).

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

Cfa – The capital of Mississippi, Jackson, is located in a south central region of the state and within the climate classification zone Cfa. The average annual precipitation accumulation in Jackson is approximately 54.13 inches; 14.88 inches during winter months; 13.17 inches during summer months; 14.38 inches during spring months; and 11.71 inches during autumn months (NOAA, 2015i). Biloxi, located along the southern coast of Mississippi, is also within the climate classification zone Cfa. The average annual precipitation accumulation in Biloxi is approximately 64.83 inches; 15.09 inches during winter months; 20.43 inches during summer months; 15.16 inches during spring months; and 14.15 inches during autumn months (NOAA, 2015i).

Sea Level

Mississippi has approximately 44 miles of coastline and 359 miles of tidal shoreline (U.S. Department of Commerce, 2015). Much of this shoreline is at risk for damage from strong winds, heavy rainfall, flooding, and tropical storms and/or hurricanes. Furthermore, coastal wetlands along the Mississippi Delta are disappearing, as land subsidence and sea level rise accelerate. Since 1900, approximately eight inches of “warming-driven global sea level rise” has occurred, with approximately 0.07 inches of rise occurring per year (Climate Central, 2014) (The Union of Concerned Scientists, 2013). As sea level continues to rise, the risks associated with living along the coast also rise. Hurricane Katrina in 2005 and Superstorm Sandy in 2012 highlighted the risks and vulnerabilities of living near unprotected tidal shoreline. (Union of Concerned Scientists, 2011)

Severe Weather Events

Since 1895, eight hurricanes have struck the coastline of Mississippi. Easily one of the state's most deadly and destructive flooding events occurred in 2005, as a result of Hurricane Katrina. Hurricane Katrina made landfall as a Category 3 storm, with winds reaching approximately 127 miles per hour (mph). Hurricane force winds and storm surge lasted approximately 17 hours. In Biloxi, the recorded high water marks reached 34.1 feet above mean sea level. In addition to the massive storm surge produced by the hurricane, rainfall totals of eight to fifteen inches occurred. In total, 238 people were killed, over 6,000 were injured, and 700 are still missing in Mississippi alone. The total cost of damages were estimated at approximately \$160 billion throughout the Gulf Region, private and government (in 2005 dollars). In addition, over 15 million people were impacted economically and otherwise, with over 273,000 people housed in hurricane relief shelters and approximately 114,000 housed in FEMA trailers. (NWS, 2015a)

During another historically significant flooding event in 1979, flooding along the Tombigbee River and tributaries above Columbus led to nine deaths and over \$700 million in damages. This flooding event was the result of a wet winter and early spring season, where 10 to 12 inches of rain fell over portions of the Upper Pearl, Tombigbee, Big Black, and Upper Chickasawhay River Basins. Moderate flooding occurred along the Tombigbee River and Columbus tributaries, with the most extensive and significant damage occurring along the Pearl River System, where record flooding occurred all the way to the mouth of the river in Louisiana. (NWS, 2015a)

Historically, Mississippi is also prone to long track (100+miles) tornado outbreaks, particularly during the spring season. Since 1950, "when the official tornado database began, a total of 26 violent, long track tornadoes have occurred across the United States" (Mississippi Emergency Management Agency, 2015). Southeastern states account for 16, (or 62 percent) of the total, violent long track tornadoes. Mississippi specifically has experienced eight (or 31 percent) of the nation's total violent, long track tornadoes. In total, these eight violent, long track tornadoes have led to 224 deaths and an estimated 2,375 injuries. Averaged out, approximately 28 deaths and 297 injuries occur per violent, long track tornado in Mississippi. In addition, Mississippi has experienced three of the nation's top ten deadliest tornadoes before the official tornado database began; Natchez in 1840, Tupelo in 1936, and Purvis in 1908, ranking second, fourth, and seventh respectively. (Mississippi Emergency Management Agency, 2015)

During one particular case of extreme rainfall, record flooding occurred throughout much of Jackson and along the Pearl River after nearly 20 inches of rain fell during a 20-hour period on April 12, 1979. As a result, the Pearl River was pushed beyond its flood stage of 18 inches in Jackson to almost 43 inches. (Wax, 2015)

"Straight line damaging winds are common across Mississippi any time of the year." Although not classified as a tornado, these winds can sometimes inflict just as much, if not more damage than a tornado. Although they can occur during any time of the year, straight line wind storms are most common to Mississippi during spring months and peak during the summer months. During one particularly historical event in October 2012, wind speeds reached between 80 and 90 miles per hour (mph). (NWS, 2015b)

Hailstorms in Mississippi can occur throughout the year, “as long as temperature aloft are cold enough to support freezing of the hailstone, and won’t melt the hail as it falls” (NWS, 2015b). Hailstorms are most common during spring months. In addition, the majority of large hail (two inches or large) reports occur during spring. Although Mississippi does not experience many hailstorms during autumn months, statistically, they do increase again during winter months. During one historic hailstorm event on March 18, 2013, hailstones the size of ping pong balls, tennis balls, and softballs fell over several locations in central Mississippi. “The largest of the hailstone fell across portions of the Jackson metro area during rush hour,” causing extensive damage to thousands of vehicles and buildings (NWS, 2015b). The softball sized hailstones that fell over Clinton were the third largest hailstones to fall in Mississippi since 1950 and the “seventh largest to fall in the state for any month of the year” (NWS, 2015b). The largest hailstone to fall in Mississippi was approximately 5 inches in diameter and fell over Lafayette County on April 10, 1962. (NWS, 2015b)

9.1.15. Human Health and Safety

9.1.15.1. Definition of the Resource

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

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and manmade or natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency (RF) emissions, addressed in Section 2.4. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 9.1.1.

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.

9.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Mississippi, this resource area is regulated by the Mississippi Department of Employment Security (MSDES), and the MDEQ. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must

be approved by OSHA. Mississippi does not have an OSHA-approved “State Plan,” therefore, private and public sector occupational safety and health programs in Mississippi are enforced by OSHA. Public health is regulated by the Mississippi State Department of Health (MSDH).

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Laws and Executive Orders. Table 9.1.15-1 below summarizes the major Mississippi laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

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

State Law/Regulation	Regulatory Agency	Applicability
11 Mississippi Administrative Code: Part 3, Chapter 2	MDEQ	Promote the voluntary remediation of contaminated sites and establishes remediation requirements based on public health and environmental risks.
11 Mississippi Administrative Code: Part 3, Chapter 5	MDEQ	Standards to preserve the quality of the groundwater as a drinking water resource.
11 Mississippi Administrative Code: Part 6, Chapter 1	MDEQ	Establishes wastewater regulations and outlines the permitting process related to for the NPDES.
11 Mississippi Administrative Code: Part 8, Chapter 1	MDEQ	Regulates surface mining to minimize hazards by requiring reclamation of mined land.

Source: (MDEQ, 2013c)

9.1.15.3. Environmental Setting: Existing Telecommunication Sites

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

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

telecommunication workers, and the general public who may be observing the work or transiting the area (International Finance Corporation, 2007).

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes¹³⁰ are examples of when confined space work is necessary. Installation of telecommunication activities involves laying conduit and in small trenches (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016c)

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

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

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

Noise 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 9.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and

¹³⁰ 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.

impact the public living in the vicinity, observing the work, or transiting through the area. (OSHA, 2016c)

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

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

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

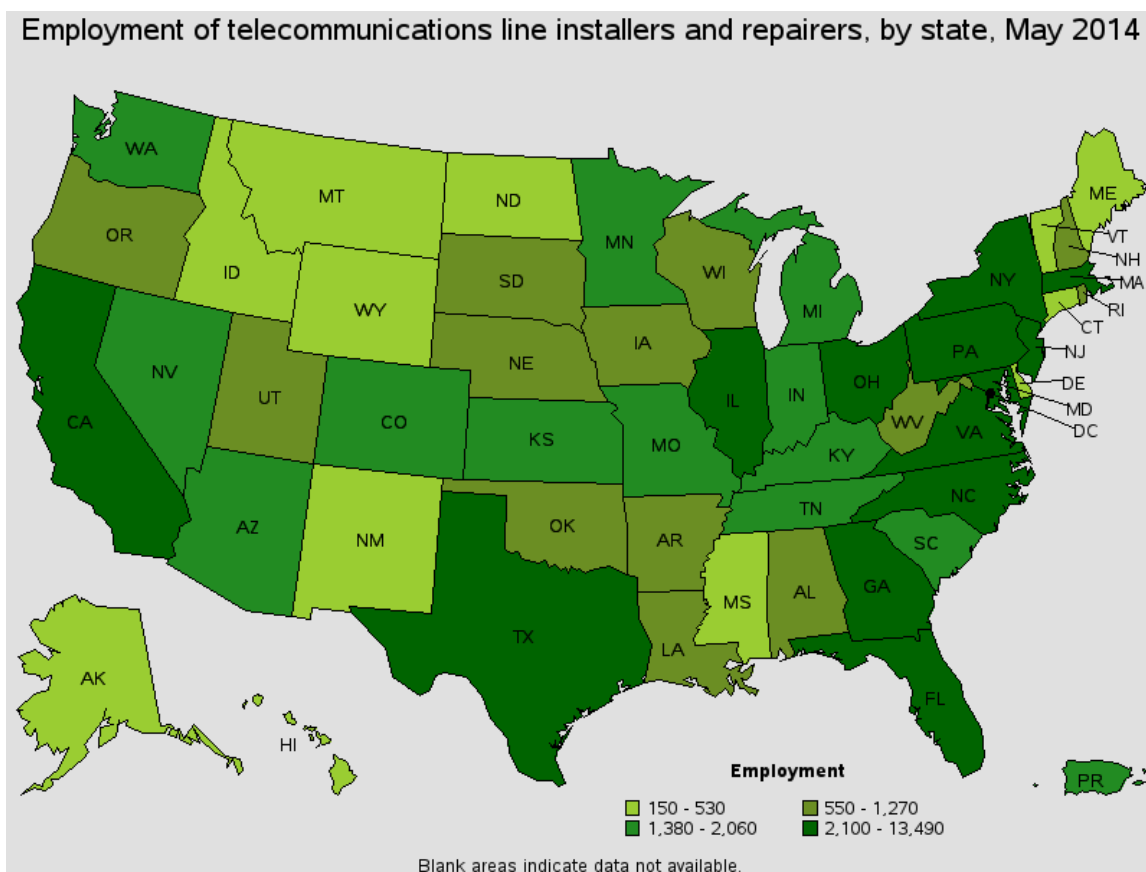
Telecommunication Worker Occupational Health and Safety

The 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 517) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as either telecommunication equipment installers and repairers, except line installers (SOC code 49-2022), or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2014, there were 1,850 telecommunication equipment installers and repairers, and 530 telecommunication line installers and repairers (Figure 9.1.15-1) working in Mississippi

(BLS, 2015d). BLS data related to nonfatal occupational injuries or illnesses is not available for Mississippi (BLS, 2015e). Nationwide, there were 1.9 nonfatal occupational injury cases in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013a).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; 7 due to slips, trips, or falls; and 3 due to unknown causes), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013b). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Mississippi has not had any fatalities within the telecommunications industry or telecommunications occupations since 2003, when data are first available. By comparison, within the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 71 fatalities in Mississippi since 2003, including 6 fatalities¹³¹ in 2014 (BLS, 2015h)



Source: (BLS, 2015d)

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

¹³¹ BLS Census of Fatal Occupational Injuries data for 2014 is for preliminary reporting only. Final data is expected to be released in spring 2016 (BLS, 2015f).

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. Environmental and public health data are reported at the federal level through the Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, in Mississippi, between 1999 and 2013, there were 25 fatalities due to a fall from, out of, or through a building or structure; 11 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 32 fatalities due to exposure to electric transmission lines (Centers for Disease Control and Prevention, 2015a). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

9.1.15.4. Environmental Setting: Contaminated Properties at or near Telecommunication Sites

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

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program¹³² 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.

Mississippi's Groundwater Assessment and Remediation Division administers the Superfund Program, and is managed under MDEQ (MDEQ, 2007b). As of December 2015, Mississippi had 32 RCRA Corrective Action site,¹³³ 210 brownfield sites, and 9 proposed or final Superfund/NPL sites (USEPA, 2015k). Based on a December 2015 search of USEPA's Cleanups in My Community (CIMC) database, there is one RCRA Corrective Action site (Timco Inc. near Wiggins, MS) (USEPA, 2015l) and no Superfund sites (USEPA, 2015e) in Mississippi

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 (USEPA, 2011).

¹³³ Data gathered using USEPA's CIMC search on December 7, 2015, for all sites in Mississippi, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (U.S. Census Bureau, 2012b).

where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

The MDEQ's Assessment and Remediation Branches supervises the Mississippi Brownfields Program, which encourages cleanup of contaminated sites for redevelopment and economic gain (MDEQ, 2007c). An example of a brownfield site is the West Side School in West Point, MS. The city received a \$200,000 grant from the USEPA to decontaminate the vacant school and redevelop the site. (USEPA, 2015m)

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of December 2015, Mississippi had 319 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, Mississippi released 67.5 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the chemicals, paper, and electric utilities industries. This accounted for 1.65 percent of nationwide TRI releases, ranking Mississippi 16 of 56 U.S. states, and territories based on total releases per square mile. (USEPA, 2015o)

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, Mississippi had 96 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System. (USEPA, 2015n)

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

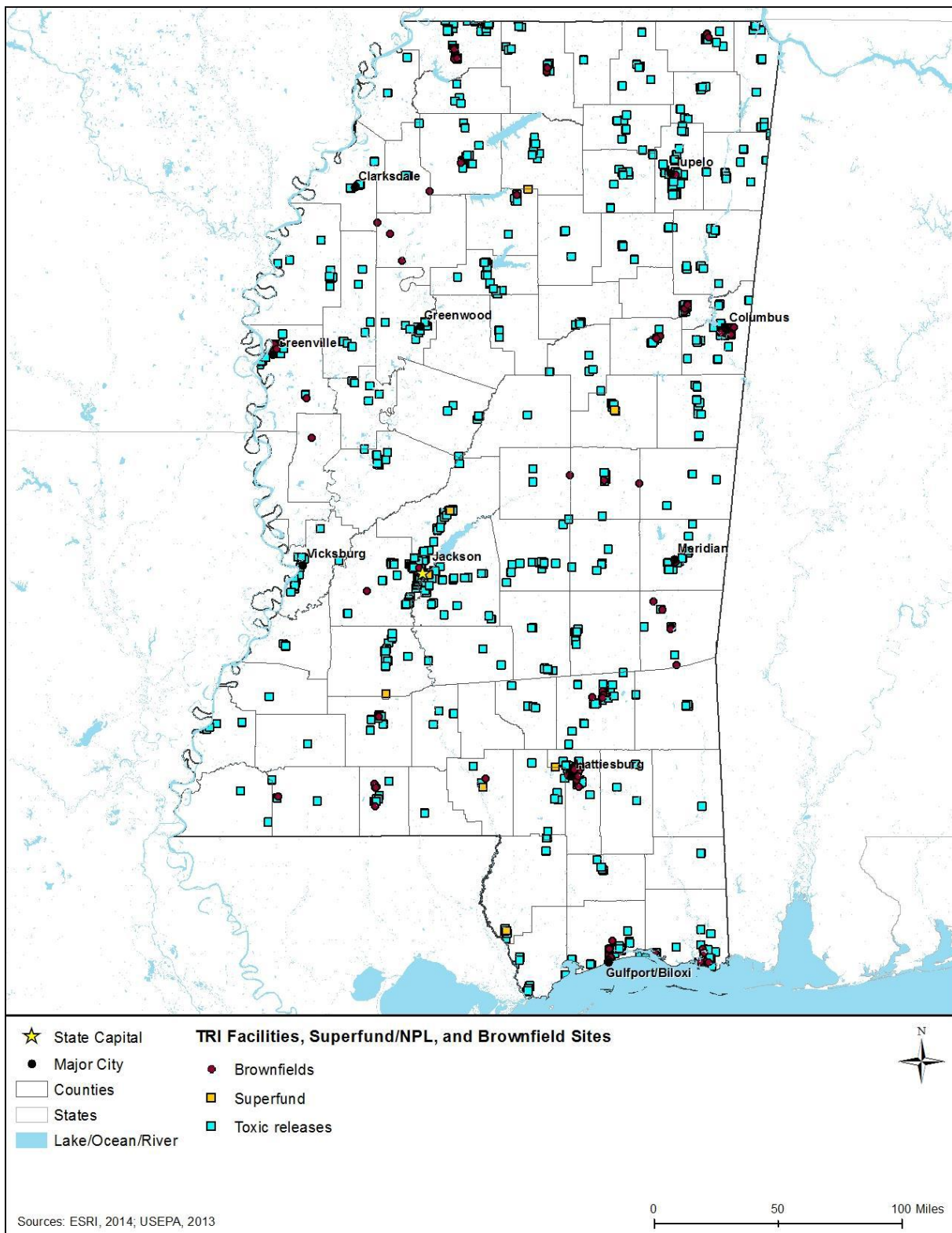


Figure 9.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Mississippi (2013)

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of December 2015, there were no USEPA-regulated telecommunications sites in Mississippi (USEPA, 2015p). These sites may be regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Mississippi had three occupational fatalities each in 2003 and 2007, and three "occupational fatalities in 2014 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, 2015h). Nationwide, the BLS reported three fatalities in 2011 and three "fatalities in 2014 within the telecommunications industry" (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015g). In 2014, BLS also reported four "fatalities within the telecommunications line installers and repairers occupation" (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014).

Public Health and Safety

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

The Centers for Disease Control and Prevention, National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography. In 2003, the most recent data available, Mississippi reported a rate of two injuries and fatalities due to reported acute toxic substance release incidents per 100,000 population (Centers for Disease Control and Prevention, 2015b).

Spotlight on Mississippi Superfund Sites: Southeastern Wood Preserving

The Southeastern Wood Preserving site is a 25-acre property in Canton, MS. Between 1928 and 1979, several wood-treatment companies operated at this location, using coal tar, creosote, and pentachlorophenol (PCP) as wood preservatives. During its period of operation, the facility is estimated to have discharged 50,000 gallons of wastewater into nearby Batchelor Creek (Figure 9.1.15-3), which flows through a park, a residential area, and the center of Canton, MS. In 2009, the USEPA began an emergency cleanup by stabilizing 8,000 cubic yards of contaminated sludge from onsite wastewater holding ponds, building a containment area, and removing contaminated sediment from the creek. (USEPA, 2015q)

In 2012, the USEPA sampled residential yards south of the site, where Batchelor Creek is prone to flooding into adjacent neighborhoods. The Agency for Toxic Substances and Disease Registry (ATSDR) evaluated the samples, and concluded that dioxin and polycyclic aromatic hydrocarbon (PAH) contamination in soil presented a public health hazard for children and long-term residents, increasing their risk of cancer (Agency for Toxic Substances and Disease Registry, 2014). Since 2013, the USEPA has removed contaminated soil from 12 residential properties and 7 commercial properties (USEPA, 2015q).

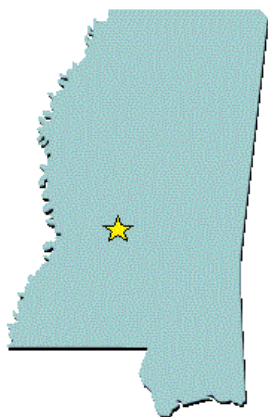


Figure 9.1.15-3: Aerial View of the Southeastern Wood Preserving Site, Batchelor Creek, and Residential Areas, Canton, MS

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

Another health and safety hazard in Mississippi includes surface and subterranean mines. In 2015, the Mississippi mining industry ranked 44th for non-fuel minerals (primarily construction sand and gravel, crushed stone, clays, and industrial sand and gravel) generating a value of \$192M (USGS, 2016b). Health and safety hazards at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (BLM, 2015).

The MSDEQ Mining and Reclamation Division is responsible for regulating surface mining and reclamation in the Mississippi (MDEQ, 2007d). Figure 9.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Mississippi, where Priority 1 and 2 sites pose a significant risk to human health and safety, and Priority 3 sites pose a risk to the environment. As of December 2015, Mississippi had no Priority 1 AMLs, three underground Priority 2 AMLs (each containing unfunded problem areas), and one Priority 3 AML (U.S. Department of the Interior, 2015a).



Source: (U.S. Department of the Interior, 2015b)

Figure 9.1.15-4: High Priority Abandoned Mine Lands in Mississippi (2015)

Telecommunication Worker Occupational Health and Safety

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

Public Health and Safety

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

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

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 early 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.

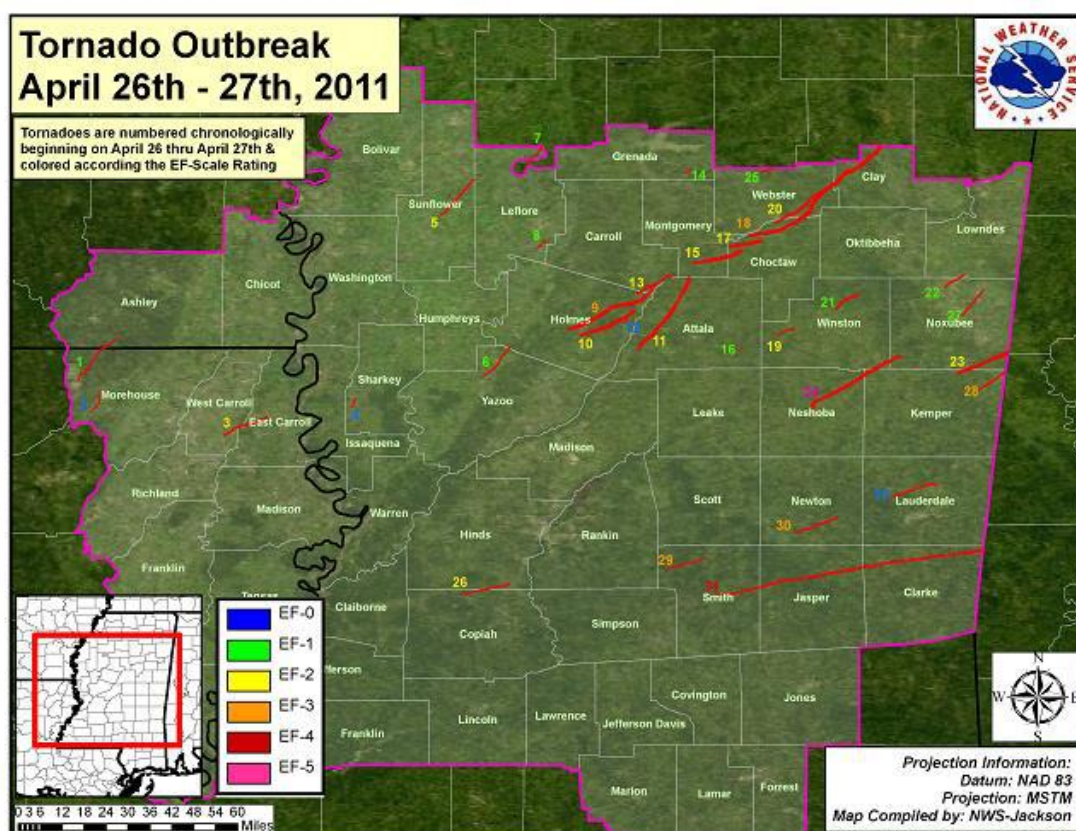
Currently, MSDH and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters. However, the National Response Center (NRC), managed by the U.S. Coast Guard, compiles reports for oil spills, chemical releases, or other maritime security incidents and contains incident reports related to occupational health and safety. Of the 172 NRC-reported incidents for Mississippi in 2015 with known causes, only 6 were attributed to natural disaster (tornado and natural phenomenon), while the majority (166) were attributed to manmade disasters (primarily equipment failure and operator error) (U.S. Coast Guard, 2015). For example, during Mississippi River flooding in May 2011, 4 fuel oil tanks were swept away from the Lehman-Roberts Co, an asphalt contractor near Friars Point, MS (Coahoma County), and an additional 10,000-gallon fuel tank on the site was reportedly compromised. Two of the tanks were found and secured, but two were still missing by the next day (U.S. Coast Guard, 2011). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters.

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, Mississippi had 20 weather-related fatalities (1 due to flooding, 1 due to lightning, 16 due to tornados, and 2 due to wind) and 211 non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2016)

Spotlight on Mississippi Natural Disasters: 2011 Tornado Outbreak

Between April 25 and 27, 2011, the southeast United States experienced a series of devastating tornadoes. According to the National Oceanic and Atmospheric Administration (NOAA), multiple tornadoes were reported in Mississippi, including two severe tornadoes; an EF-5 (wind gusts over 200 miles per hour [mph]) formed in Neshoba County, MS, and an EF-4 (wind gusts between 166 and 200 mph) formed in Smith County, MS and travelled over 90 miles into Alabama (Figure 9.1.15-5). (NOAA, 2011a) The EF-4 tornado in Smith County travelled northeast, snapping utility poles, and destroying several mobile homes and small buildings. Seven people were killed and 35 injured by the storm. (NOAA, 2011b)

The 2011 tornadoes also destroyed more than 100 high-tension power line towers and multiple radio and cellular towers, causing large wide-scale interruption of power and communication service. Damaged communication lines between weather forecast offices and their radio transmitters prevented warning information from being transmitted to the public. In one case, a county manager used his personal portable generator to power the communications tower at the county's emergency operations center. (NOAA, 2011c)



Source: (NOAA, 2011a)

Figure 9.1.15-5: Map of Tornado Tracks Through Central Mississippi

9.2. ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental impacts, beneficial, or adverse, resulting from the Proposed Action and Alternatives. As this is a programmatic evaluation, site- and project-specific issues are not assessed. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews.

At the programmatic level, the categories of impacts are defined 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 Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the proposed Alternatives.

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

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

9.2.1. Infrastructure

9.2.1.1. Introduction

This section describes potential impacts to infrastructure in Mississippi associated with construction, deployment, and operation of the Proposed Action and Alternatives. Chapter 16, Best Management Practices (BMPs) and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 9.2.1-1. As described in Section 9.2, 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.

Table 9.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level

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

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

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

NA = Not Applicable

9.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport or harbor operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., departments of transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment.

Based on the impact significance criteria presented in Table 9.2.1-1, such impacts would be *less than significant* at the programmatic level due to the temporary nature of deployment activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

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

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

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

The Proposed Action and Alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 9.2.1-1, at the programmatic level, any potential impacts would be *less than significant* during deployment. As

described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be *less than significant* 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 Additionally, Mississippi has over 3,000 commercial towers and FirstNet may be able to lease or leverage such assets for public safety use. Anticipated impacts would be *less than significant* at the programmatic level due to the limited extent and temporary nature of deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

At the programmatic level, the activities proposed by FirstNet would have *less than significant* impacts on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

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.

9.2.1.4. 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 under the conditions described below:

- **Wired Projects**
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* at the programmatic level to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
 - o **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would have *no impacts* at the programmatic level to infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
 - o **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.
 - o **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to infrastructure at the programmatic level. The section below addresses potential impacts to infrastructure if construction of

new boxes, huts, or other equipment is required near or adjacent to local infrastructure assets.

- Satellites and Other Technologies
 - o Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment. Transportation capacity and safety and access to emergency services would not be impacted.
 - o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that, at the programmatic level, this activity would have *no impact* on infrastructure resources.

Activities with the Potential to Have Impacts at the Programmatic Level

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

- Wired Projects
 - o New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs),¹³⁵ huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase; however, it is anticipated that this tie-in would cause *less than significant* impacts at the programmatic level as the activity would be temporary and minor.
 - o New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing telecommunications poles.
 - o Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
 - o New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in limited nearshore or inland bodies of water would not impact infrastructure resources

¹³⁵ Points of Presence are connections or access points between two different networks, or different components of one network.

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 shore or the banks of waterbodies that accept submarine cable, depending on the exact site location and proximity to existing infrastructure.

- o 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 infrastructure. However, if installation of transmission equipment such as small boxes or huts, or access roads required ground disturbance, then the 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
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower 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.
 - o Deployable Technologies: Deployable technologies such as COWs, COLTs, and SOWs are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that 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 potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* at the programmatic level to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur. These potential impacts would be expected to be minor and temporary as explained above and therefore, *less than significant* at the programmatic level.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would also likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location

information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and also minimize disruptions and misinformation resulting from limited or disrupted service. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.

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, at the programmatic level, in *less than significant* impacts to infrastructure at the programmatic level even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. 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

and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. At the programmatic level, if usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access road or utility ROWs, *less than significant* impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

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

9.2.2. Soils

9.2.2.1. Introduction

This section describes potential impacts to soil resources in Mississippi 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 9.2.2-1. As described in Section 9.2, 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.

Table 9.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

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

Based on the impact significance criteria presented in Table 9.2.2-1, building of 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 (see Chapter 16).

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 9.2.2-1, and due to the relatively small-scale (less than 1 acre) of most FirstNet project sites, *less than significant* impacts from the minimal topsoil mixing is expected at the programmatic level. Additionally, implementation of BMPs and mitigation measures (Chapter 16) could 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. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 9.1.2.4, Soil Suborders). Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts. The most compaction susceptible soil suborders in Mississippi are hydric soils with poor drainage conditions, which include Aqualfs, Aquents, Aquepts, Aquerts, Aquults,

Fluvents, Sapristis, Udepts, and Udolls. These suborders constitute approximately 34.6 percent of Mississippi's land area,¹³⁶ which are found mostly only in the southwestern and northeastern portions of the state (see Figure 9.1.2-2). The potential for compaction or rutting impact would be generally low at FirstNet network deployment sites where other soil types predominate.

Based on impact significance criteria presented in Table 9.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be *less than significant* 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. Potential impacts could be further reduced with the implementation of BMPs and mitigation measures.

9.2.2.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific 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 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 soil resources under the conditions described below:

- **Wired Projects**
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and points of presence structures and would have *no impact* on soil resources at the programmatic level because it would not produce perceptible changes to soil resources.
 - o **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would be conducted electronically through existing infrastructure, with *no impacts* to soil resources 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. 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 would depend on the proximity of such infrastructure to the landing site.

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.

- o New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would have *no impacts* on soil resources at the programmatic level because there would be no ground disturbance associated with this activity (see Section 9.2.4, 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.
- o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no 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.
- o 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
 - o 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 soil 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 would have *no impact* on soil resources at the programmatic level 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.
 - o Collocation on Existing Aerial Fiber Optic Plant: As stated above, collocation with no ground disturbance would result in *no impacts* to soil resources at the programmatic level. However, topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
 - o 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 at the programmatic level, 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.
 - o New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in or near bodies of water would not impact soil resources at the programmatic level because there would be no soils to impact. However, installation of fiber optic plants in limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shores or the banks of waterbodies that accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.

- o Installation of Optical Transmission or Centralized Transmission Equipment: 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 that 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
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
 - o Collocation on Existing Wireless Tower, Structure, or Building: As stated above, collocation that would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
 - 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, where feasible. 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 earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* at the programmatic level to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be *less than significant* at the programmatic level due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.2.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

Impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be *less than significant* at the programmatic level due to the small scale and short term nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to soil resources at the programmatic level associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. At the programmatic level, 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to soil resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.2, Soils.

9.2.3. Geology

9.2.3.1. Introduction

This section describes potential impacts to Mississippi geology resources associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geological resources were evaluated using the significance criteria presented in Table 9.2.3-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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 9.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level

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

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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within a landslide area.	No likelihood of a project activity located within a landslide hazard area.
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological Resources Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

9.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts on the project, such as seismic hazards, and landslides, 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 geological resources are discussed below.

Seismic Hazard

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

As discussed in Section 9.1.3.8, Mississippi is at risk to experiencing moderate earthquake events (Figure 9.1.3-5). Although no earthquake over magnitude 4.6 on the Richter scale has ever occurred in the state, the state's proximity to the New Madrid Seismic Zone (NMSZ) puts it at risk to experiencing moderate earthquake events. Based on the impact significance criteria presented in Table 9.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have *no impact* on seismic activity at the programmatic level; however, seismic impacts to the Proposed Action could be *potentially significant* at the programmatic level if FirstNet's deployment locations were within high-risk earthquake hazard zones or active fault zones. Given the potential for earthquakes in or near Mississippi, some amount of infrastructure could be subject to earthquake hazards. 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.

Volcanic Activity

Volcanoes were considered but not analyzed for Mississippi, as they do not occur in Mississippi; 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 9.1.3.8, widespread portions of Mississippi are at moderate to severe risk of experiencing landslide events. Based on the significance criteria presented in Table 9.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level as it is likely that the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be *potentially significant* if FirstNet's deployment locations were within areas in

which landslides are highly prevalent. The highest potential for landslides in Mississippi is in southeastern portions of the state and within the Mississippi River Valley. To the extent practicable, FirstNet would likely avoid deployment in areas that are susceptible to landslide events. However, given that several of Mississippi's major cities, including Greenville, Vicksburg, Jackson, and Hattiesburg, are in or near areas that experience landslides with moderate to high frequency, some amount of infrastructure could be subject to landslide hazards. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners 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, is subject to misalignment, alteration, or, in extreme cases, destruction. All of these activities could result in connectivity loss.

As discussed in Section 9.1.3.8 and shown in Figure 9.1.3-6, portions of Mississippi are vulnerable to land subsidence due to karst topography. Based on the significance criteria presented in Table 9.2.3-1, at the programmatic level, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have *less than significant* impacts; however, subsidence impacts to the Proposed Action could be *potentially significant* to the Proposed Action if FirstNet's deployment locations were within areas at high risk to karst topography. To the extent practicable, FirstNet would likely avoid deployment in known areas of karst topography. However, where infrastructure is subject to subsidence hazards, BMPs and mitigation measures could help avoid or minimize the potential impacts. 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 Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources is not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. 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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 9.2.3-1, impacts to paleontological resources could be *potentially significant* at the programmatic level if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 9.1.3.6, fossils are abundant throughout parts of Mississippi. 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. Additionally, 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. Implementation of BMPs and mitigation measures could further help avoid or minimize the potential impacts. 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.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 9.2.3-1, impacts could be *potentially significant* if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and *less than significant* at the programmatic level as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures could be implemented to help avoid or minimize the potential impacts. 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 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 geological 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 9.1.1, Proposed Action Infrastructure, the following are likely to have *no impacts* to geologic resources under the conditions described below:

- **Wired Projects**
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. 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.
 - o **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.
 - o **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to geologic resources at the programmatic level because there would be no ground disturbance. 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 associated with ground disturbing activities.
 - o **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no 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**
 - o **Collocation on Existing Wireless Tower, Structure, or Building:** Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in *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.
 - o **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 are discussed below.

- Satellites and Other Technologies
 - o Satellite -Enabled Devices and Equipment: In most cases, installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would *not impact* 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 likely 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 POPs, 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 landslides, earthquakes, and other 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. However, 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 specific 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.
- o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water is not expected to impact geologic resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- o Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, if installation of equipment were to take place in existing facilities, there would be *no impact* to/from geologic resources. However, if installation of transmission equipment would occur in existing boxes or huts 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
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or 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.
 - o 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.

- o 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
 - o Satellite-Enabled Devices and Equipment: As stated above, 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. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could result in incidental removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet Proposed Actions 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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* to geological 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 because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.3.4. Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this Alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would result in *no impacts* to geologic resources (or from geologic hazards) at the programmatic level as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be *less than significant* at the programmatic level due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative because there would be no ground disturbance.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as the deployment would be temporary and likely would attempt to avoid locations that was subject to increased seismic activity, landslides, and land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* to geologic resources (or from geologic hazards) as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.3, Geology.

9.2.4. Water Resources

9.2.4.1. Introduction

This section describes potential impacts to water resources in Mississippi 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.

9.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table . As described in Section 9.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with BMPS 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 9.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity; violation of various regulations including: CWA, SDWA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> 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	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> 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>)

9.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Less than 10 percent of Mississippi's rivers and streams were assessed for water quality but those that were assessed, are in good condition; similar conditions were found for the state's estuaries, bays, and lakes (see Table 9.1.4-2, Figure 9.1.4-3). For example, a main cause of impairment for major rivers in Mississippi, such as the Big Black, Pearl, and Tombigbee, is biological impairment (MDEQ, 2014d). Mississippi lakes are threatened by elevated levels of mercury and pesticides. The MDEQ monitors pesticide levels in the Yazoo River Basin, and maintains a fish tissue monitoring program to determine extent of mercury contamination in the state's waters. MDEQ issues fish consumption advisories for various waterbodies throughout the state including the Gulf of Mexico. (MDEQ, 2014c)

Deployment activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal on site exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs 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 could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, and Safe Drinking Water Act), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 9.2.4-1, water quality impacts would likely be *less than significant* at the programmatic level and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching¹³⁷ or tower construction were to occur near or below the existing water table (depth to water), then dewatering would be anticipated at the location. Residual contaminated groundwater could be encountered during dewatering activities. Construction activities would need to comply with Mississippi dewatering requirements. Any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Mississippi aquifers, there is little potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifers. Based on the impact significance criteria presented in Table 9.2.4-1, there would likely be *less than significant* impacts on groundwater quality at the programmatic level within most of the state. In areas where groundwater is close to the surface, 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 human beings, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 9.2.4-1, 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, would not substantially increase impervious surfaces, structures would not impede or redirect

¹³⁷ 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).

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,¹³⁸ 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.

Implementation of BMPs and mitigation measures could reduce the risk of additional impacts to floodplain degradation (see Chapter 16).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could change drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms, could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 9.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered *less than significant* at the programmatic level.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Where stormwater is contained on site and does not flow to or impact surface waterbodies offsite on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development (LID) techniques for stormwater.

¹³⁸ A water year is defined as “the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.” (USGS, 2016c)

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river, create a substantial and measurable increase in the rate and amount of surface water, or change the hydrologic regime, and any effects would be short-term, impacts to 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 . At the programmatic level, projects that include minor consumptive use of surface water with *less than significant* impacts on discharge (do not direct large volumes of water into different locations) on a temporary basis (no more than six months) are likely to have *less than significant* impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely, at the programmatic level, to have *less than significant* impacts include:

- Construction of any structure in a 100-year or 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns offsite or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be *less than significant* impacts at the programmatic level to flow alteration. BMPs, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 9.1.4.7, groundwater provides more than 90 percent of Mississippi's drinking water supply. Generally, the water quality of Mississippi's aquifers is suitable for drinking and daily water needs. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. (MDEQ, 2015e) 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 in groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Storage of petroleum or chemical products.
- Use of pesticides, herbicides, or insecticides during or after construction of a commercial, industrial, or recreational use.
- Commercial generation, treatment, storage, or disposal of hazardous wastes.

Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities should be *less than significant* at the programmatic level since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. It is likely that areas that utilize groundwater for potable water purposes would be avoided. According to Table 9.2.4-1, *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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.4.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including 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 in a range of impacts from *no impacts* to *less than significant with BMPs and mitigation measures incorporated* at the programmatic level depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water

resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts at the Programmatic Level

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

- **Wired Projects**
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to water resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
 - o **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to water resources at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - o **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance, construction in floodplains, or use of motorized equipment near streams.
 - o **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have *no impact* on water resources 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**
 - o **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. 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. Implementing BMPs and mitigation measures could reduce impact intensity.

- o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland 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.
- o 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.
- o 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.
- o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to water resources at the programmatic level.
- Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of

suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.

- 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 land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites or deployment in unpaved areas. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be *no impacts* to water resources 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 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this Alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to water resources at the programmatic level if those activities occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up, and therefore would have *less than significant* impacts at the programmatic level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be *no impacts* at the programmatic level to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods of time, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies; however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be *less than significant* at the programmatic level. Site maintenance, including mowing or herbicides, may result in *less than significant* effects to water quality at the programmatic level, due to the small-scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation

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

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to water resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.4, Water Resources.

9.2.5. Wetlands

9.2.5.1. Introduction

This section describes potential impacts to wetlands in Mississippi 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.

9.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table . As described in Section 9.2, 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 wetlands addressed in this section are presented as a range of possible impacts.

Table 9.2.5-1: 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 404 of the CWA.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Indirect effects: ^b Change in Function(s) ^c Change in Wetland Type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> 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 (USACE 2014). Category 1 are the highest quality, highest functioning wetlands

^b Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type

^c Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

9.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, 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 more than 4.2 million acres of palustrine and estuarine wetlands throughout Mississippi (USFWS, 2017a). Palustrine (freshwater) wetlands found on river and lake floodplains along the western and eastern half of the state, while estuarine/marine wetlands are found in the southern portion of the state, as shown in Figure 9.1.6-1 (Chapman et. al., 2004).

Based on the impact significance criteria presented in Table 9.2.5-1, the deployment activities would most likely have *less than significant* direct impacts on wetlands at the programmatic level. Additionally, the deployment activities would be unlikely to violate applicable federal, state, or locally required regulations.

In Mississippi, as discussed in Section 9.1.5.4, Wetlands, the state considers certain wetland communities, specifically estuarine wetlands along the Gulf coast, as areas of special value due to their global or regional scarcity, local/national importance, or habitat they support. If any of the proposed deployment activities were to occur in these wetlands of special concern, *potentially significant* impacts could occur. These wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work to avoid *potentially significant* impacts to wetlands. 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 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 *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 9.2.5-1, 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. To minimize any potential impacts to wetlands, BMPs, and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in Mississippi 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.
- *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:¹³⁹ Change in Function(s)¹⁴⁰ or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to high- and low-quality wetlands would be *less than significant* 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 Mississippi 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.

¹³⁹ Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type

¹⁴⁰ Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- *Wildlife Habitat:* Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- *Recreational Value:* Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- *Groundwater Recharge:* Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to the significance criteria defined in Table 9.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered *less than significant* at the programmatic level. In areas of the state with high quality wetlands, there could be *potentially significant* impacts at the project level that may require site-specific analysis depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts to wetlands.

9.2.5.4. 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, 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**
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to 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.
 - o **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**
 - o **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launched for other purposes, and the use of portable devices that use satellite technology would have *no impact* on wetlands since there would be no ground disturbance.
 - o **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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, it is anticipated that this activity would have *no impact* on wetlands at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- **Wired Projects**
 - o **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity

- to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.
- o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.
 - o New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
 - o Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
 - Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, 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
 - o 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.

- o Deployment of drones, balloons, or blimps, piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be *less than significant* at the programmatic level due to the small 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 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 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 if maintenance application of herbicides occurs to control vegetation along ROWs and near structures. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are not expected to be *less than significant* at the programmatic level due to the limited nature of deployment activities. It is also anticipated that 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.5.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands because of implementation of this Alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to wetlands at the programmatic level. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be *less than significant* at the programmatic level due to the small-scale and temporary duration of expected FirstNet deployment activities in any one location. 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 Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

It is anticipated that there would be *less than significant* impacts at the programmatic level to wetlands associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility rights-of-way would be utilized for maintenance and inspection

activities. Site maintenance, including mowing or herbicides, is anticipated to result in *less than significant* impacts to wetlands at the programmatic level due to the limited nature of site maintenance activities, including mowing and application of herbicides. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on wetlands, as explained above. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to wetlands from the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.5, Wetlands.

9.2.6. Biological Resources

9.2.6.1. Introduction

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Mississippi associated with deployment and operation of the Proposed Action and its Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.6.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on terrestrial vegetation, wildlife, fisheries, and aquatic habitats were evaluated using the significance criteria presented in Table 9.2.6-1. As described in Section 9.2, 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 9.2.6.3, 9.2.6.4, and 9.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 9.2.6.6 for impact assessment methodology and significance criteria associated with threatened and endangered species and species of conservation concern in Mississippi.

Table 9.2.6-1: 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), MBTA, and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Mississippi 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Mississippi for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Mississippi for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress, or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Mississippi 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Mississippi 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 <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Mississippi.		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, 2016i)

9.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Mississippi are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are permanent or temporary loss or disturbance of individual plants. Based on the impact significance criteria presented in Table 9.2.6-1, direct injury or mortality impacts could be significant 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, these events are expected to be relatively small in scale and therefore would have *less than significant* impacts at the programmatic level. The implementation of BMPs and mitigation measures and avoidance measures could help to minimize or altogether avoid potential impacts to plant population survival. 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.

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. A large portion of Mississippi has experienced extensive land use changes from agriculture, while areas surrounding major cities have experienced extensive land use change from urbanization. However, portions of the state remain relatively unfragmented, particularly the De Soto National Forest, Bienville National Forest, and Holly Spring National Forest.

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, would be undertaken to minimize or avoid potential impacts. 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.

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

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action given the small-scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action given the small-scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity. In Mississippi, noxious weeds are regulated by the Mississippi Department of Agriculture and Commerce and addressed in Chapter 69-25-7 of the Mississippi Administrative Code. The Plant Act was amended in 2014 to include a list of noxious plants.

As described in Section 9.1.6.4, when non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. The potential to introduce invasive plants within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. Overall, these

impacts are expected to be *less than significant* at the programmatic level due to the small-scale and localized nature of likely FirstNet activities. BMPs 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. 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 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 at the programmatic level, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology,¹⁴¹ and the nature as well as the extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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 terrestrial vegetation under the conditions described below:

- **Wired Projects**
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to terrestrial vegetation at the programmatic level because there would be no ground disturbance.

¹⁴¹ Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

- Satellites and Other Technologies
 - o Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
 - o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have *no impact* on terrestrial vegetation at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
 - o New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
 - o New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
 - o Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings

and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

- o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, the vegetation loss, and invasive species effects.
- Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
 - o Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. Despite the variability, these

impacts are expected to be *less than significant* at the programmatic level due to the small scale and limited geographic scope of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 9.1.1, 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 *no impacts* to terrestrial vegetation at the programmatic level associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. Site maintenance, including mowing or herbicides, may result in *less than significant* effects at the programmatic level due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however impacts are expected to be *less than significant* at the programmatic level due to the small-scale of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

Therefore, potential impacts to terrestrial vegetation as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As described above, at the programmatic level, implementation of deployable technologies could result in *less than significant* impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. Nonetheless, impacts are expected to remain *less than significant* at the programmatic level due to the relatively small scale of FirstNet activities at individual locations. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain *less than significant* at the programmatic level. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts to terrestrial vegetation at the programmatic level associated with routine operations and maintenance, and monitoring due to the relatively small-scale of likely FirstNet project sites. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to terrestrial vegetation as a result of the No Action Alternative.

Environmental conditions would therefore be the same as those described in Section 9.1.6.3, Terrestrial Vegetation.

9.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and invertebrates occurring in Mississippi and Mississippi's near offshore environment (i.e., less than two miles from the edge of the coast) are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 9.2.6-1, *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 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, see below). 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.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Mississippi. 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-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.

Marine Mammals

Marine mammals swimming or hauled out on land are sensitive to boats, aircraft, and human presence. Noises, vibrations, smells, sounds, and sights may elicit a flight reaction. Trampling deaths associated with haulout disturbance are known source of mortality for seals but are not anticipated from likely FirstNet deployment activities.

Entanglements from marine debris as well as ingestion of marine debris could result in injury or death to marine mammals. Marine debris is any manmade object discarded, disposed of, or abandoned that enters the marine environment. Entanglements from marine debris are not anticipated from FirstNet activities.

The whale species known to occur offshore of Mississippi are also protected under the ESA. Environmental consequences pertaining to these whales are discussed in Section 9.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (FAA, 2012b).

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

Direct mortality and injury to birds of Mississippi 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, 2016¹⁴² state that communication towers are “currently estimated to kill between four and five million birds per year”, although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. 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 19, BMPs and Mitigation Measures, for BMPs and mitigation measures that

¹⁴² See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to birds from tower lighting. Site-specific analysis and/or consultation with FWS may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If siting considerations and BMPs and mitigation measures are implemented (Chapter 16), potential impacts could be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures (including possible “take”), as defined through consultation with USFWS.

Reptiles and Amphibians

Some of Mississippi’s reptiles and amphibians are widespread throughout the state, while some species are found only in specific environments (MDWFP, 2005). 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.

Four species of marine turtles – all listed as threatened or endangered under the ESA – occur in Mississippi’s offshore environment. Environmental consequences pertaining to these reptiles are discussed in Section 9.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

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 terrestrial invertebrate populations of Mississippi are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

As described in Section 9.2.6.3, 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. These potential impacts are described for Mississippi’s wildlife species below. 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.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Mississippi and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bears) 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).

Marine Mammals

The West Indian manatee and bottle-nose dolphin (*Tursiops* sp.) regularly inhabit Mississippi's tidal waters. In addition, species of whales could be observed off the coast of Mississippi, including finback whales and humpback whales. Manatees often use secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, mating, and calving (USFWS, 2001a). Manatees could be temporarily excluded from a resource due to the presence of humans, noise, vibrations, or vessel traffic during deployment activities. Effects on manatees from exclusion from resources would be low magnitude and temporary in duration.

Loss of habitat or exclusions from these areas for manatees, dolphins, and whales could be avoided or minimized by implementing BMPs and mitigation measures (see Chapter 16). Environmental consequences pertaining to the endangered whales and threatened West Indian manatee protected under the ESA are discussed in Section 9.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP) 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 other human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced in IBAs within the state as 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 passerine¹⁴³ species from disturbance or displacement from construction activities is likely to be

¹⁴³ 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.

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 Mississippi's amphibians and reptiles typically consist of wetlands and, in some cases as with the timber rattlesnake, the surrounding upland forest. Impacts are expected to be *less than significant* at the programmatic level 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) could be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 9.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Mississippi's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.¹⁴⁴

Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to invertebrates are expected at the programmatic level. Impacts to sensitive invertebrate species are discussed below in Section 9.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, impacts are expected to remain *less than significant* at the programmatic level (except for birds and bats) due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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

¹⁴⁴ See Section 9.2.5, Wetlands, for a discussion of BMPs for wetlands.

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 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.

Marine Mammals

Repeated disturbance (e.g., from vessel traffic) could cause stress to individuals resulting in lower fitness and productivity. Given that the majority of FirstNet deployment activities are not expected to be located offshore or in the oceanic environment, at the programmatic level, *less than significant* impacts to *no impacts* would be anticipated for marine mammals.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur. Depending on the Proposed Action 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, 2002) (Grigor'ev, 2003) (Panagopoulos, 2008).

Few studies of the effects of RF exposure on wild animal populations have been conducted due to the difficulty of performing controlled studies on wild subjects. Those that have been conducted are observational in nature (i.e., documenting of reproductive success and behavior in birds near RF-emitting facilities). These studies lack controls on exposure levels or other potentially confounding factors. Nevertheless, findings from these studies indicate reduced survivorship at all life stages; physiological problems related to locomotion and foraging success; and behavioral changes that resulted in delayed or unsuccessful mating in several species of nesting birds (Balmori, 2005) (Balmori, 2009) (Balmori & Hallberg, 2007) (Manville, 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,¹⁴⁵ 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, and repeated disturbances would not occur. Depending on the project type and location,

¹⁴⁵ 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.

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, at the programmatic level, potential impacts are anticipated to be *less than significant* due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Additionally, FirstNet would attempt to avoid areas of known migratory pathways. Potential effects to migration patterns of Mississippi's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and invertebrates are described below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. 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.¹⁴⁶

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.

Marine Mammals

Noise and vibrations associated with the installation of cables in the near/offshore waters of coastal Mississippi could impact marine mammal migration patterns, though impacts are likely to be short-term provided the noise and vibration sources are not wide ranging and below Level

¹⁴⁶ A location chosen by an animal for hibernation.

A and B sound exposure thresholds.¹⁴⁷ Marine mammals have the capacity to divert from sound sources during migration, and therefore impacts are expected to be *less than significant* at the programmatic level since noise and vibrations-generating activities would be of short duration and are not likely to result in long-term avoidance. BMPs and mitigation measures (see Chapter 16) could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, as a group shorebirds migrating through Mississippi undertake some of the longest-distance migrations of all animals. Mississippi has 33 IBAs throughout the state serving as important stopover, breeding, and wintering areas for migratory birds (NAS, 2015c). 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.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate in Mississippi. For example, the dusky gopher frog migrates between its larval habitat and post-larval habitat. Larval habitat for the dusky gopher frog consist of depressional wetlands, while post-larval habitat consists of upland long-leaf pine forests (USFWS, 2015aw). 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 and mitigation measures could help to further avoid or minimize the potential impacts.

¹⁴⁷ Level A: 190 dB re 1μPa (rms) for seals and 180 dB re 1μPa (rms) for whales, dolphins, and porpoises. It is the minimum exposure criterion for injury at the level at which a single exposure is estimated to cause onset of permanent hearing loss. Level B: 160 dB re 1μPa (rms). It is defined as the onset of significant behavioral disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (Southall, et al., 2007).

Invertebrates

The majority of FirstNet deployment or operation activities are likely to be small scale in nature. *No effects* to migratory patterns of Mississippi'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 (except for birds and bats which are anticipated to be *less than significant with BMPs and mitigation measures incorporated*, see below) due to the short-term and limited nature of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. 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 black bears, has the potential to negatively affect body condition and reproductive success of mammals in Mississippi. For example, pregnant black bears use certain types of habitats that allow for more effective defense of their cubs from predators (FWC, 2015).

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, 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.

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.

Marine Mammals

Although unlikely, the displacement of female seals from preferred pupping habitats due to deployment and operations may reduce fitness and survival of pups potentially affecting overall productivity. However, activities are likely to be small-scale in nature and contribute only minimally to minor, short-term displacement, and BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Disturbance to hauled out seals from activities associated with the Proposed Action could result in the abandonment, or death of offspring, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

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, 2002) (Grigor'ev, 2003) (Panagopoulos, 2008). Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in embryonic mortality (DiCarlo, 2002) (Manville, 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. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 9.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. Any disturbance of known nesting sites on beaches could result in reproductive effects to species. For

example, the hawksbill sea turtle travels from its habitat in shallow coastal waters to remote nesting sites on beaches in the Gulf of Mexico and Caribbean (USFWS, 2015y).

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, or alter water quality through sediment infiltration or obstruction of natural water flow to pools, though BMPs 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.

Invertebrates

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. In Mississippi, exotic wildlife species are regulated by MDWFP. A permit must be obtained from MDWFP prior to importing, possessing, purchasing, transferring or selling a wildlife species that is not normally domesticated in Mississippi (MDWFP, 2015c).

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites; although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, potential impacts are expected to be *less than significant* at the programmatic level.

Potential invasive species effects to Mississippi's wildlife are described below.

Terrestrial Mammals

In Mississippi, feral hogs adversely impact several native 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. The importation, transportation, or release of wild hogs into the state is prohibited (MDWFP, 2015d).

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 terrestrial mammals as a result of the introduction of invasive species.

Marine Mammals

Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water; therefore, the introduction of non-native species would be unlikely to occur. Overall, potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, and limited potential deployments in aquatic environments. 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 marine 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 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 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 from machinery or laborers during 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 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 invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects could pose a threat to Mississippi's forest and agricultural resources. 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 invertebrate species 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 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.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to wildlife resources 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 because those activities would not require ground disturbance.

- o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have *no impact* on wildlife resources 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
 - o New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise and vibrations, associated with the above activities 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.
 - o New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individuals as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
 - o Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.

- o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shores or banks of waterbodies that accept submarine cables could potentially impact wildlife, marine mammals in particular (see Section 9.2.4, Water Resources, for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality, habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical time periods, effects to migratory patterns as well as reproductive effects and indirect injury/ mortality could occur.
- o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.
- Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
 - o Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise and vibration disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise 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 with the exception of impacts to birds and bats, which are expected to be *less than significant with BMPs and mitigation measures incorporated*. Some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

At the programmatic level, 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 because there would be no ground disturbance. Site maintenance that might include mowing or limited application of herbicides may result in *less than significant* effects to wildlife at the programmatic level, including direct injury/mortality to less mobile wildlife or exposure to contaminants from accidental spills from maintenance equipment. 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 state communication towers are "currently estimated to kill between four and five million birds per year", although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Therefore, impacts to birds may result in *less than significant* impacts with BMPs and mitigation measures added.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individuals and unlikely to cause population-level impacts, and therefore would likely be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result, at the programmatic level, in *less than significant* impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* at the programmatic level because deployment activities are expected to be temporary and localized, likely affecting only a small number of wildlife. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts at the programmatic level because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. Proposed FirstNet actions at specific individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to wildlife resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.6.4, Terrestrial Wildlife.

9.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Mississippi and Mississippi's near offshore environment are discussed in this section.

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, 2012d).

Based on the impact significance criteria presented in Table 9.2.6-1, *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, direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed. BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the

breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location depending on the nature of the deployment activity. Therefore, potential impacts are expected to be *less than significant* at the programmatic level. Additionally, deployment activities with potential impacts under the MSFCMA or other 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 the deployment activities, and BMPs and mitigation measures to protect water resources (see Section 9.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and small-scale, and therefore are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are not anticipated, and therefore impacts are expected to be *less than significant* at the programmatic level, though 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 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 9.1.1, Proposed Action Infrastructure, the following are expected to have *no impacts* to fisheries and aquatic habitats under the conditions described below:

- Wired Projects
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise 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 habitat 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 deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
 - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality;

- and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
- o New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
 - o Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shores or banks of waterbodies 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.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.
 - Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, or structural hardening 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. 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected due to the limited extent and temporary nature of the operational activities.

It is anticipated, at the programmatic level, that there would be *less than significant* impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance activities that may result in accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to have *less than significant* effects to fisheries and aquatic habitats at the programmatic level due to the limited nature of such activities and the likely small quantities of potentially harmful liquids used.

Fisheries and aquatic invertebrates could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to fisheries and aquatic habitats associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* at the programmatic level due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that

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

Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, at the programmatic level, 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 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 BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to fisheries and aquatic habitats as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.6.5, Fisheries and Aquatic Habitats.

9.2.6.6. Threatened and Endangered Species

This section describes potential impacts to threatened and endangered species in Mississippi's inland and offshore environment associated with deployment and operation of the Proposed Action and Alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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 9.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as *may affect, likely to adversely affect; may affect, not likely to adversely affect; and no effect*. 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 9.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under <i>likely to adversely affect</i> category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the <i>likely to adversely affect</i> threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large <i>adverse effect</i> on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 9.2.6-2, any direct injury or mortality of a listed species at the individual-level, 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, could be *potentially significant*. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Mississippi 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.

Terrestrial Mammals

Two endangered and one threatened terrestrial mammals are federally listed and known to occur in the state of Mississippi; they are the gray bat, the Indiana bat, and the northern long-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, 2015n). Direct mortality or injury to the federally listed gray bat could occur if caves were flooded or blocked off while bats were present (USFWS, 1997a) (USFWS, 2008b). 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 terrestrial 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.

Marine Mammals

Two federally listed whale species and one manatee species are known to occur in Mississippi's near offshore environment; they are the finback whale, humpback whale, and the West Indian manatee. Direct injury or mortality could occur from entanglements from marine debris as well as ingestion of marine debris, but are unlikely due to the limited nature of expected FirstNet activities in a marine environment. Impacts would likely be isolated, individual events and therefore these potential impacts *may affect, but are not likely to adversely affect*, listed marine

mammal species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Birds

Four endangered and two threatened are federally listed and known to occur in Mississippi; they are the least tern, Mississippi sandhill crane, piping plover, red knot, red-cockaded woodpecker, and wood stork. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts *may affect, but are not likely to adversely affect*, listed bird species at the programmatic level as FirstNet would attempt to avoid deployment activities in areas where they are known to nest. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One endangered amphibian species is federally listed and known to occur in the state of Mississippi, the dusky gopher frog. Direct mortality to these species could occur in construction zones either by excavation activities or by vehicle strikes. Potential effects would likely be isolated, individual events, and FirstNet would attempt to avoid, as practicable and feasible, areas where the species may occur. Therefore, potential impacts *may affect, but are not likely to adversely affect*, this amphibian at the programmatic level.

One endangered and four threatened terrestrial reptile species are federally listed and known to occur in Mississippi; they are the Alabama red-belly turtle, black pine snake, gopher Tortoise, ringed map turtle, and yellow-blotched turtle. Direct mortality to these species could occur in construction zones either by excavation activities or by vehicle strikes, but these potential effects would likely be isolated, individual events. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed reptile species at the programmatic level.

Four federally listed marine reptiles are also known to occur in the coastal area and offshore environment of Mississippi; they are the hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. Direct mortality or injury could occur from accidental trampling at nest sites if eggs are present during the Proposed Action, but are unlikely as FirstNet would attempt to avoid these areas and potential effects would likely be isolated, individual events. Direct mortality or injury could occur from watercraft and vessels strikes, but are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed marine reptile species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be

implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Two endangered and three threatened fish species are federally listed and known to occur in Mississippi; they are the Atlantic sturgeon, bayou darter, pallid sturgeon, smalltooth sawfish, and snail darter. Direct mortality or injury to these species could occur from entanglements resulting from the Proposed Action, but are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed fish species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

There are 12 endangered and four threatened invertebrate species federally listed and known to occur in Mississippi as summarized in Table 9.1.6-8. Fifteen of these federally listed species are mussels and one is a butterfly. Direct injury or mortality could occur to Mitchell's Satyr Butterfly if land clearing or excavation activities associated with the Proposed Action occurred in an area inhabited by the species. However, FirstNet would attempt to avoid these areas.

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 changes in water quality from ground disturbing activities causing stress and lower productivity resulting from the Proposed Action. Potential impacts *may affect, but are not likely to adversely affect*, listed invertebrate species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Two endangered and one threatened plant species are federally listed and known to occur in the state of Mississippi; they are the Louisiana quillwort, the pondberry, and Price's potato-bean. Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt to avoid, as practicable and feasible, areas where these species may occur; therefore, potential impacts *may affect, but are not likely to adversely affect*, listed plant species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

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, marine mammals, birds, terrestrial reptiles and marine reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Mississippi are described below.

Terrestrial Mammals

Noise, vibrations, light, and other human disturbances associated with the Proposed Action could affect federally listed terrestrial mammals, including the gray bat, the Indiana bat, and the northern long-eared bat, (USFWS, 1997a). Impacts would be directly related to the frequency, intensity, and duration of these activities; however, they are anticipated to be small-scale and localized. FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed terrestrial 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.

Marine Mammals

The two federally listed whale species are found in the offshore areas of Mississippi are migrants. Therefore, no long-term reproductive effects to federally listed marine mammals are expected as a result of the Proposed Action.

The West Indian manatee often uses secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, mating, and calving (USFWS, 2015i). Noise, vibrations, light, and other human disturbances associated with the Proposed Action could affect manatees within or in the vicinity of Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. However, the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed marine 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

Noise, vibrations, light, or other human disturbance within nesting areas could cause federally listed birds, such as the piping plover, to abandon their nests or relocate to less desirable locations, or may result in stress to individuals, reducing survival and reproduction (USFWS, 2015s). The majority of FirstNet deployment activities would not occur on beaches, and FirstNet would attempt to avoid, as practicable and feasible, areas where these species may occur. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely*

affect, 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.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, resulting from ground disturbing activities could cause stress to federally listed species, resulting in lower productivity. For example, the Dusky gopher frog is sensitive to pesticides and chemicals that could affect their eggs and larvae, and result in low reproductive success (USFWS, 2015aw). Land clearing activities, noise, vibrations and other human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. Reproductive effects could occur from accidental trampling at nest sites if eggs are present during the Proposed Action, but are unlikely as FirstNet would attempt to avoid these areas and potential effects would likely be isolated, individual events. FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed reptile or amphibian species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. 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.

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 for species such as the bayou darter (USFWS, 2012g)(see Section 9.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction of the federally listed fish species in Mississippi are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, 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 mussel species, such as the black clubshell, known to occur in Mississippi. This species “require[s] clean, swiftly moving stable streams with pools and riffles. Work activities that affect channel geometry (depth, width) or that increase sedimentation and water turbidity could have adverse impacts on these species” (USFWS, 2013c). In addition, introduction of invasive aquatic species could indirectly affect mussels as a result of fish populations that they rely on for their reproductive cycle being altered (USFWS, 2012h). Deployment activities are not expected

to cause changes to water quality that could result in impacts, as the majority of FirstNet deployment activities would not occur in an aquatic environment. Introduction of non-native plants could indirectly affect the federally listed Mitchell's Satyr Butterfly as a result of habitat degradation and could result in reduced survival and reproduction (USFWS, 1999). FirstNet would attempt to avoid, as practicable and feasible, areas where this invertebrate may occur. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, these invertebrate species BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. 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.

Plants

Potential reproductive impacts could occur from ground-disturbing activities to listed plant species, such as the Louisiana quillwort, as a result of the Proposed Action. "Threats [to this species] include activities that increase stream sedimentation, reduce stream flow, and reduce the overstory canopy cover" (USFWS, 2013c). However, FirstNet would attempt to avoid areas where these species occur. Therefore, potential impacts *may affect, but are not likely to adversely affect*, these plant species at the programmatic level. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

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, marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Mississippi 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 Mississippi. Further, increased human disturbance, noise, vibrations, and vehicle traffic could cause stress to these species, causing species such as the Indiana bat to abandon breeding locations or alter migration patterns. Terrestrial mammals have the capacity to divert from sound sources during feeding and migration. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but would likely not adversely affect*, these terrestrial 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.

Marine Mammals

Noise and vibrations associated with the installation of cables in the near/offshore waters of coastal Mississippi could affect marine mammal migration patterns, though impacts are likely to be short-term provided the noise and vibration sources are not wide ranging and below Level A and B sound exposure thresholds. Marine mammals, such as the humpback whale, have the capacity to divert from sound sources during migration. The majority of FirstNet deployment projects would not occur in the aquatic environment; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed marine 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 red knot has been found to fly up to 9,300 miles from their breeding and wintering sites and often return to the same sites year and after year in Mississippi. 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 to avoid, as practicable and feasible, areas where these species are known to occur; therefore at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, 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.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of the federally listed reptile species, resulting in reduced survival and productivity; however, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed reptiles or amphibians. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore potential impacts, at the programmatic level, *may affect, but are not likely to adversely affect*, listed reptile or amphibian species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Changes in water quality as a result of ground disturbing activities could impact food sources for the federally fish species in Mississippi. Further, increased human disturbance, noise, 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, at the programmatic level, 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 mussels resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact foraging behavior. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, 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

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* 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, and invertebrates with designated critical habitat in Mississippi are described below.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Mississippi. 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.

Marine Mammals

No designated critical habitat occurs for marine mammals in Mississippi. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

Two federally listed bird species in Mississippi have federally designated critical habitat. Critical habitat for the Mississippi sandhill crane has been designated in Jackson County. Critical habitat for the piping plover has been designated in coastal areas of Hancock, Harrison, and Jackson Counties. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for listed bird species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. 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 critical habitat has been designated for the other federally listed bird species in Mississippi; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles and Amphibians

Three of the federally listed amphibians and reptiles in Mississippi have federally designated critical habitat. Critical habitat for the loggerhead sea turtle was designated along the beaches of Horn Island and Petit Bois Island in Jackson County. Critical habitat for the dusky gopher frog was designated in Forrest, Harrison, Jackson, and Perry Counties.

Land clearing, excavation activities, and other ground disturbing activities in this region of Mississippi could lead to habitat loss or degradation, which could affect the loggerhead sea turtle and dusky gopher frog depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for listed reptiles or amphibians. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed reptile and amphibian species in Mississippi; therefore, *no effect* to these 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 species in Mississippi has federally designated critical habitat. Critical habitat for the Atlantic sturgeon (Gulf subspecies) includes portions of the Pearl River and Bogue Chitto, portions of the Pascagoula River and its tributaries, and much of the Mississippi coast. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water and therefore would not likely disturb critical habitat. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts, at the programmatic level, *may affect, but would likely not adversely affect*, designated critical habitat for the listed sturgeon. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed fish species in Mississippi; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Invertebrates

Seven of the federally listed invertebrate species in Mississippi have federally designated critical habitat. Critical habitat for the Alabama moccasinshell was designated in the East Fork Tombigbee River, Bull Mountain Creek, Buttahatchee River, and Luxapalila Creek in northeast Mississippi. Critical habitat for the Cumberlandian combshell was designated in Bear Creek, Tishomingo County. Critical habitat for the orangenacre mucket was designated in the Buttahatchee River, East Fork Tombigbee River, Bull Mountain Creek and Luxapalila Creek in the eastern portion of Mississippi. Critical habitat for the ovate clubshell was designated in Buttahatchee River, East Fork Tombigbee River, Bull Mountain Creek and Luxapalila Creek in the eastern portion of Mississippi. Critical habitat for the rabbitsfoot was designated in the Big Sunflower River in Sunflower County, Bear Creek in Tishomingo County, and the Big Black River in Hinds and Warren Counties. Critical habitat for the slabside pearlymussel was designated along Bear Creek in Tishomingo County. Critical habitat for the southern clubshell was designated in the East Fork Tombigbee River, Bull Mountain Creek, Buttahatchee River, and Luxapalila Creek in northeast Mississippi.

Land clearing, excavation activities, and other ground disturbing activities in these regions of Mississippi could lead to habitat loss or degradation, which could affect these invertebrates depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat for the listed invertebrates. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in Mississippi; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Plants

No designated critical habitat occurs for plants in Mississippi. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result, 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.

Activities Likely to Have No Effect at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no effect* to 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.

- o 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, to threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
 - o Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened and endangered because those activities would not require ground disturbance.
 - o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have *no impact* on protected species at the programmatic level.

Activities with the Potential to Affect Listed Species at the Programmatic Level

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
 - o New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., 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 vibration, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
 - o New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.

- o Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
- o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shores or banks of waterbodies that accept submarine cables could potentially impact threatened and endangered species and their habitat, particularly aquatic species (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. If activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
- o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be *no impacts* to threatened and endangered species or their habitats 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
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.

Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise and vibration disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore potential impacts *may affect*, but are not likely adversely affect protected species at the programmatic level. 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, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts.

It is anticipated that operational impacts *may affect, but are not likely to adversely affect* threatened and endangered species at the programmatic level due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, *may affect, but are not likely to adversely affect* threatened and endangered species at the programmatic level, as they would be conducted infrequently, and BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur. Therefore, listed species may be affected at the programmatic level, but are not likely to

be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species may be affected at the programmatic level, 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 to avoid, as practicable and feasible, areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies *may affect, but is not likely to adversely affect*, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat at the programmatic level. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that operational activities are not likely to adversely effect, threatened and endangered species, and their habitats at the programmatic level as a result of routine operations, management, and monitoring. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effect* on threatened and endangered species as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.6.6, Threatened and Endangered Species and Species of Concern.

9.2.7. Land Use, Recreation, and Airspace

9.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Mississippi 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.7.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on land use, recreation, and airspace resources were evaluated using the significance criteria presented in Table 9.2.7-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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.

Table 9.2.7-1: 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 BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, vibrations, 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

9.2.7.3. Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of rights-of-way or easement, 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 aboveground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 9.2.7-1, *less than significant* impacts 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.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 9.2.7-1, *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

The deployment, operation, and maintenance of facilities and the acquisition of ROW or easement could influence access to public or private recreation land or activities. Localized, short-term accessibility to recreation land or activities could be impacted by the deployment and maintenance of structures, towers, roads, and other permanent features. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 9.2.7-1, *less than significant* impacts 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. Crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features could temporarily impact enjoyment of recreation land. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise or vibration impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 9.2.7-1, *less than significant* impacts 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 locations. Use of aerial technologies could result in SUA considerations.

Based on impact significance criteria presented in Table 9.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, First Net would be unlikely to have a significant impact on airspace resources. Therefore the potential impacts to Airspace is expected to be *less than significant* at the programmatic level.

9.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action 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 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 9.1.1, Proposed Action Infrastructure, the following are likely to have *no impacts* to land use, recreation, and airspace resources under the conditions described below:

- **Wired Projects**
 - o **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
 - **Land Use:** See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - **Recreation:** See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - **Airspace:** *No impacts* to airspace would be anticipated at the programmatic level since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See Section 9.1.7.5 Obstructions to Airspace Considerations).
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
 - **Land Use:** 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 at the Programmatic Level* 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 9.1.7.5 Obstructions to Airspace Considerations).
- o New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
 - Land Use: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - Airspace: Installation of new poles would *not have an effect* at the programmatic level on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- o 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 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 are anticipated to airspace from collocations.
- o 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 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 recreation because it would not impede access to recreational resources.
 - Airspace: Lighting of dark fiber would have *no impacts* at the programmatic to airspace.
- o New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shores or the banks of waterbodies that accept submarine cable.
 - Land Use: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* 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 flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See Section 9.1.7.5 Obstructions to Airspace Considerations).
- o Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
 - Land Use: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
 - Airspace: *No impacts* at the programmatic 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
 - 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, structure, or building.
 - Land Use: There would be *no impacts* at the programmatic 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 at the Programmatic Level* below.
 - Airspace: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
- Deployable Technologies
 - o Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
 - Land Use: It is anticipated that there would be *no impacts* at the programmatic 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 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 at the Programmatic Level* below.
- Satellites and Other Technologies
 - o Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.

- Land Use: It is anticipated that there would be *no impacts* 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: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
- Airspace: See *Activities with the Potential to Have Impacts at the Programmatic Level* 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 land use, recreation, or airspace, it is anticipated, at the programmatic level, that this activity would have *no impact* to 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**
 - o **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
 - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
 - Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
 - o **New Build – Aerial Fiber Optic Plant:** Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
 - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.

- Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
- Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
- o New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore or inland bodies of water and the constructing landings and/or facilities on shores or the banks of waterbodies that 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 or 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.
- o Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
 - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
 - Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
- Wireless Projects
 - o New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts at the programmatic level 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 in Section 9.1.7.6. 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 Mississippi's airports.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
 - Land Use: *No impacts* 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
 - o Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
 - Land Use: *No impacts* are anticipated at the programmatic level – see previous section.
 - Recreation: *No impacts* are anticipated at the programmatic level – see previous section.
 - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Mississippi airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
 - Satellites and Other Technologies
 - o Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.

- Land Use: *No impacts* are anticipated at the programmatic level – see previous section.
- Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
- Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities. Potential impacts to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstructions. These potential impacts are expected to be *less than significant* at the programmatic level due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. Operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for inspections.

The degree of change in the visual environment (see Section 9.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner’s ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be *less than significant* at the programmatic level due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 9.1.7, Land Use, Recreation, and Airspace.

9.2.8. Visual Resources

9.2.8.1. Introduction

This section describes potential impacts to visual resources in Mississippi 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 9.2.8-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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 9.2.8-1: Impact Significance Rating Criteria for Visual Resources at Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

9.2.8.3. Description of Environmental Concerns

Adverse Change in Aesthetic Character of Scenic Resources or Viewsheds

A primary concern during and following construction of structures, towers, roads or other permanent features is the long-term disruption of scenery and viewsheds. In Mississippi, 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 9.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered *potentially significant* at the programmatic level 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 9.2.8-1, 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 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.

9.2.8.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to visual resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant impacts 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 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 visual resources under the conditions described below:

- **Wired Projects**
 - o **Collocation on Existing Aerial Fiber Optic Plant:** While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting and pole replacement would be limited. and would result in *no impacts* to visual resources at the programmatic level
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* 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.
 - o **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 to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- **Satellites and Other Technologies**
 - o **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would have *no impact* at the programmatic level visual resources since those activities would not require ground disturbance or vegetation removal.

- o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have *no impact* 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
 - o New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources at the programmatic level. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
 - o New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, at the programmatic level, *potentially significant* impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would have *no impact* at the programmatic level to visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized and are anticipated to be *less than significant* at the programmatic level.

- Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a 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 be *potentially significant* at the programmatic level.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would likely have *no impact* on visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, potential impacts to the aesthetic character of scenic resources or viewsheds could occur.
 - o Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal, areas of surface disturbance, or additional nighttime lighting.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be *less than significant* at the programmatic level, due to the temporary and small-scale nature of deployment activities. As discussed above, at the programmatic level, potential impacts to night skies from lighting are expected to 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.

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, at the programmatic level, would be *less than significant with BMPs and mitigation measures incorporated* during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 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.

9.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *potential impacts* to visual resources if long-term deployment occurs in scenic areas if staging or landing areas (depending on the type of technology) require surface disturbance or vegetation clearing, or if these areas were within scenic landscapes or required new nighttime lighting, impacts could occur to the aesthetic character of scenic resources or viewsheds. These impacts are expected to be *less than significant* at the programmatic level as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to 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 a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to visual resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.8, Visual Resources.

9.2.9. Socioeconomics

9.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Mississippi 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 9.2.9-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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 9.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Indiscernible impact to property values and/or rental fees.	<i>No impacts</i> to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations, 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 to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Indiscernible economic change.	No change to spending, income, industries, and public revenues.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	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

9.2.9.3. Description of Environmental Concerns

This section discusses at a high level the types of socioeconomic impacts that could result from deployment of the NPSBN. Socioeconomic impacts could be negative or positive. Subsections below address socioeconomic impacts in four general areas, following the breakdown of the significance rating criteria in the table above:

- Impacts to Real Estate;
- Economic Benefits or Adverse Impacts Related to Changes in Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

In addition to the specific impacts noted below, the Proposed Action would likely have broad, beneficial impacts to all four areas in times of disaster, by improving the response of public safety personnel. Reduced damages and faster recovery would result. This would support property values; maintain corporate income, personal income, and government revenues; preserve jobs; and reduce disruptions to populations.

Impacts to Real Estate

Deployment of the NPSBN has the potential to improve property values in areas that have reduced property values due to below average public safety communication services. Improved services would reduce response times and improve responses. These effects would reduce the potential for economic losses and thus support investments in property and greater market value for property. Any increases in property values are most likely in areas that have low property values and below average public safety communication services. Increases are less likely in areas that already have higher property value. As discussed in Affected Environment, property values vary across Mississippi. Median values of owner-occupied housing units in the 2009–2013 period ranged from approximately \$75,000 in the Greenville area to \$146,000 in the Starkville area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One

study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing *no effect* beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, *may affect* property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to \$7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and *less than significant* 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, 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 Mississippi. The average annual unemployment rate in 2014 was 7.8 percent, considerably higher than the national rate of 6.2 percent. The great majority of counties in Mississippi had unemployment rates above the national average. Only a small number of counties (seven), mostly near three of the largest population concentrations, had unemployment rates below the national average (that is, better employment performance).

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system designers may be located in one or a few specific offices. While such employment concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 9.2.2-1 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 at the programmatic level. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

9.2.9.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 9.2.9-1. 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

- Satellites and Other Technologies
 - o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have *no impact* at the programmatic level on socioeconomic resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below 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
 - o Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be

- small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* 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 and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development

of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:

- Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise and 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
 - o Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

In general, the abovementioned activities would have *less than significant* beneficial socioeconomic impacts 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. 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 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 Mississippi. 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.

9.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater

numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and therefore *less 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall *impacts would be less than significant* at the programmatic level.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise, vibrations, and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be *less than significant* at the programmatic level as they would be limited to a relatively small number of sites within Mississippi. 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 deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to socioeconomics from the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 9.1.9, Socioeconomics.

9.2.10. Environmental Justice

9.2.10.1. Introduction

This section describes potential impacts to environmental justice in Mississippi associated with construction/deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 9.2.10-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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 9.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations.	Magnitude or Intensity	Direct and disproportionately high and <i>adverse effects</i> on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	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

9.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas That Have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment” (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise 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 Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* “adverse” and “disproportionately high” in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 9.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 9.1.10.4) as

having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 9.1.10.3, Environmental Setting: Minority and Low-Income Populations, the Black/African American percentage of the population in Mississippi is substantially higher than that of the region and the nation. The state's percentage of All Minorities is somewhat higher than that of the South region and considerably higher than that of the nation. The poverty rate of Mississippi is considerably above the rates for the region and nation. A large proportion of Mississippi has high potential for environmental justice populations. The distribution of high potential areas, and that of moderate potential areas, is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. Further analysis using the data developed for the screening analysis in Section 9.1.10.4, Environmental Justice Screening Results, may be useful. In addition, USEPA's EJSCREEN tool and USEPA's lists of environmental justice grant and cooperative agreement recipients may help identify local environmental justice populations (USEPA, 2015g; USEPA, 2016j).

Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts at the Programmatic Level" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

9.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, at the programmatic level, the same type of proposed action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its 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 9.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* at the programmatic level to environmental justice communities under the conditions described below:

- **Wired Projects**
 - o **Use of Existing Conduit – New Buried Fiber Optic Plant:** Installation of fiber optic cable in existing conduit 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 at the programmatic level.
 - o **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have *no impacts* to environmental justice at the programmatic level. If physical access were 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* at the programmatic level on environmental justice communities.
- **Satellites and Other Technologies**
 - o **Satellite-Enabled Devices and Equipment:** It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, impacts at the programmatic level to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
 - o **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice, it is anticipated that this activity would have *no impact* on environmental justice 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**
 - o **New Build – Buried Fiber Optic Plant:** New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise, vibrations,

- and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
- o New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities on shores or the banks of waterbodies that accept submarine cable could temporarily generate noise, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise, vibrations, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise, vibrations, and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, 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.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise, vibrations, and dust and disrupt

traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- o Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise, vibrations, and dust could be temporarily generated, and traffic could be temporarily disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise, vibrations, and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be *less than significant* at the programmatic level 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise and 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to environmental justice communities as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.10, Environmental Justice.

9.2.11. Cultural Resources

9.2.11.1. Introduction

This section describes potential impacts to cultural resources in Mississippi 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.11.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 9.2.11-1. 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 effects on cultural resources addressed in this section are presented as a range of possible effects.

Table 9.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect ^a	Effect, but not Adverse	No Effect
Physical damage to and/or destruction of historic properties ^b	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect ^a	Effect, but not Adverse	No Effect
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

^a Whereas mitigation measures for other resources discussed in this 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 tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

^b Per NHPA, a “historic property” is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project’s APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to American Indian tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

9.2.11.3. Description of Environmental Concerns

Physical Damage to and/or Destruction of Historic Properties

One of the primary environmental concerns during deployment activities is damage to or destruction of historic and cultural resources. Deployment involving ground disturbance has the potential to damage or destroy archaeological sites, and the attachment of communications equipment to historic building and structures has the potential to cause damage to features that are historically significant.

Based on the impact significance criteria presented in Table 9.2.11-1, 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 Mississippi, some deployment activities may be in these areas, in which case BMPs (see Chapter 16) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially *adverse 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 adverse effect 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.

9.2.11.4. Potential Impacts of the Preferred Alternative

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

Deployment Effects

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no effect* to potentially *adverse effects* at the programmatic level depending on the deployment scenario or site-specific conditions. 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 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 impacts* to cultural resources under the conditions described below:

- **Wired Projects**
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no effect* 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 effect* 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 effect* on cultural resources because there would be no ground disturbance and no perceptible visual changes.
- **Satellites and Other Technologies**
 - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would have *no effect* on cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have *no effect* on cultural resources 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
 - o New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
 - o New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as coastal areas of Mississippi where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Impacts to cultural resources could also potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological sites (archaeological deposits are frequently associated with bodies of water), and the associated structures could have visual effects on historic properties.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no effect* on cultural resources at the programmatic level. However, there could be potentially *adverse effects* to 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.
 - o Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- Wireless Projects
 - o New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas such as Natchez that have larger numbers of historic public buildings.
 - o Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential 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 at the programmatic level as the potential *adverse effects* would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Effects

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in effects similar to the abovementioned deployment effects. It is anticipated that there would be *no effect* at the programmatic level to cultural resources

associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.11.5. 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, potential impacts to cultural resources as a result of implementation of this Alternative could be as described below.

Deployment Effects

As explained above, implementation of deployable technologies could result in effects on cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in effects on archaeological sites. These activities could affect, but not adversely affect, cultural resources at the programmatic level 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Effects

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that 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 at the programmatic level to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be *no effects* to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, effects on 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 effect* on cultural resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.11, Cultural Resources.

9.2.12. Air Quality

9.2.12.1. Introduction

This section describes potential impacts to Mississippi'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.

9.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Mississippi's air quality were evaluated using the significance criteria presented in Table 9.2.12-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with 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 Mississippi's air quality addressed in this section are presented as a range of possible impacts.

Table 9.2.12-1: 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> 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

9.2.12.3. 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 Mississippi that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 9.1.12, Air Quality).

Based on the significance criteria presented in Table 9.2.12-1, 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 Mississippi; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present in Mississippi (Figure 9.1.12-1), 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).

9.2.12.4. 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 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 air quality at the programmatic level under the conditions described below:

- Wired Projects
 - o 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.
 - o Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create no new sources of emissions.
- Satellites and Other Technologies
 - o 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.
 - 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 air quality resources, it is anticipated that this activity would have *no impact* on those resources 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 deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
 - 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 fugitive dust and products of combustion from the use of vehicles and heavy equipment.
- 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 could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
 - o Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
 - o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of waterbodies 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.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
 - Wireless Projects
 - o New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducting excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If the delivery of additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
 - Deployable Technologies
 - o 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 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 communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *less than significant* impacts to air quality at the programmatic level associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be *less than significant* at the programmatic level as they would still be limited in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient air quality 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.

9.2.13. Noise and Vibrations

9.2.13.1. Introduction

This section describes potential noise and vibration impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Mississippi. 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.

9.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise and vibration impacts of the Proposed Action were evaluated using the significance criteria presented in Figure 9.1.13-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with 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 Mississippi addressed in this section are presented as a range of possible impacts.

Table 9.2.13-1: 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 levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA. Vibration levels would exceed 65 VdB for human receptors and 100 VdB for buildings.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Noise and vibration levels resulting from project activities would exceed natural sounds, but would not exceed typical noise and vibration levels from construction equipment or generators.	Natural sounds would prevail. Noise and vibration 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)

9.2.13.3. 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 vibration could cause impacts on residential areas, or other facilities that are sensitive to noise and vibration, 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 9.1.13, Noise and Vibrations).

Based on the significance criteria presented in Table 9.2.13-1, noise and vibration impacts, at the programmatic level would likely be *less than significant* given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise 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.

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise and vibration impacts and while others would not. In addition, the same type of Proposed Action Infrastructure could result in a range of *no impacts to less than significant impacts* 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 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 development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise or vibration impacts under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibrations generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise or vibration impacts.
- **Satellites and Other Technologies**
 - **Satellite Enabled Devices and Equipment:** The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise and vibrations would be emitted during installment of this equipment. Noise and vibrations caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to *no impact* on noise or vibration-sensitive resources at the programmatic level.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise or vibration-sensitive resources, it is anticipated that this activity would have *no impact* on those resources at the programmatic level.

Activities with the Potential for Impacts at the Programmatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could create noise and vibration impacts at the programmatic level 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**
 - **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 vibration 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, POPs, huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise and vibration levels from the use of vehicles and machinery.
- o Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise and vibration levels from the use of heavy equipment and machinery.
- o Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise and vibration levels if the activity required the use of heavy equipment for grading or other purposes.
- o New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland 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 shores or the banks of waterbodies that 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
 - o New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise and vibrations. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could also increase noise and vibration levels.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could temporarily impact local noise environment temporarily. Vibration impacts are expected to be negligible.
 - o Deployable Technologies: The type of deployable technology used would dictate the types of noise 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. 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 vibration levels would be achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 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

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 or 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.13.4. Alternatives Impact Assessment

The following section assesses potential noise and vibration impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred

Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise and vibration impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise and vibrations from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise levels. Several vehicles traveling together could also create short-term noise and vibration impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise and vibration 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise and vibration in the area. However, deployable technologies could be deployable to areas with few existing facilities, so noise impacts and vibration could be minimal in those area. 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 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient noise or vibrations. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies. Noise and vibrations would therefore be the same as described in Section 9.1.13, Noise.

9.2.14. Climate Change

9.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Texas 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.14.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on climate and potential climate change impacts on the Proposed Action's installations and infrastructure were evaluated using the significance criteria presented in Table 9.2.14-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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)

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 9.2.14-1: 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 9.2.14.5, Potential Impacts of the Preferred Alternative	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No increase in 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

9.2.14.3. Projected Future Climate

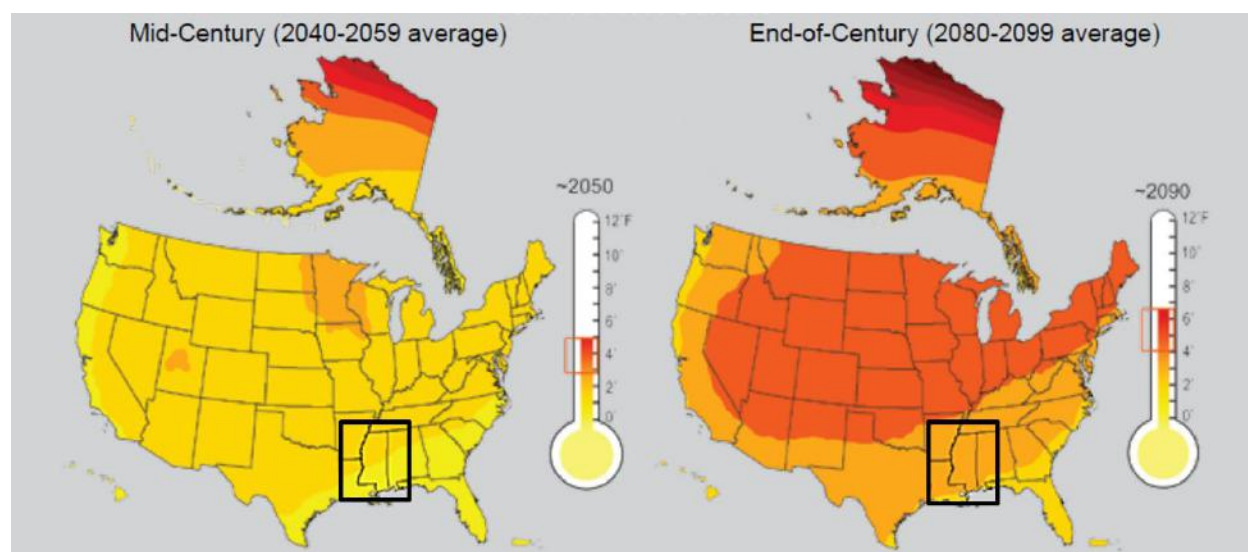
Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. There have been increasing numbers of days above 95 °F and nights above 75°F, and decreasing numbers of extremely cold days since 1970 in the Southeast. 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 9.2.14-1 and Figure 9.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Mississippi from a 1969 to 1971 baseline.

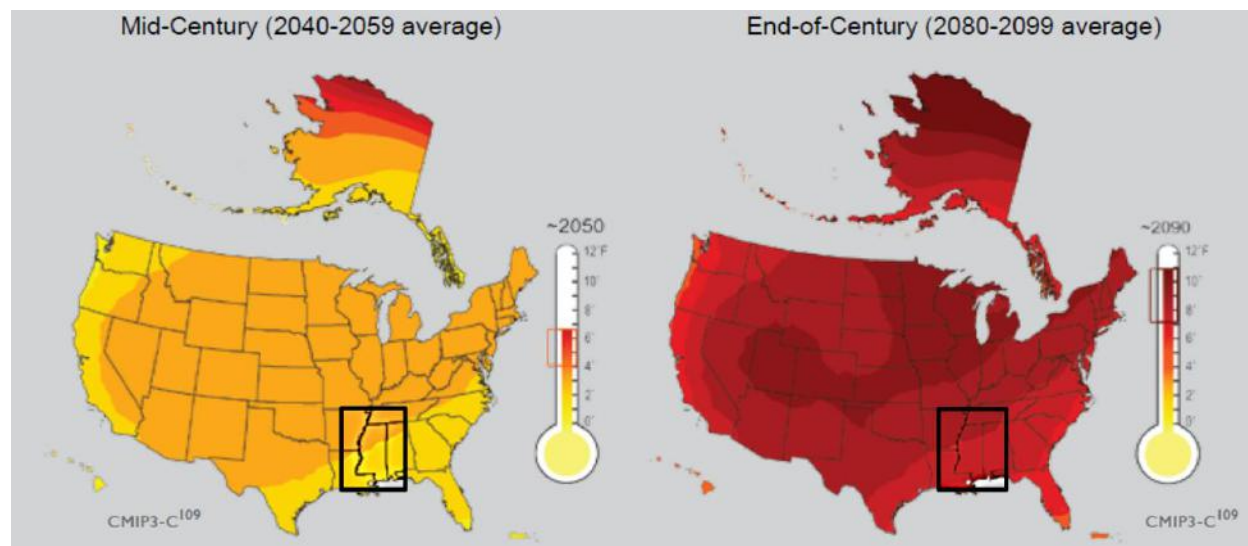
Cfa – Figure 9.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the northern most portion of the state of Mississippi under a low emissions scenario would increase by approximately 4 °F, and in the remainder of the state temperatures would increase by 3 °F. By the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Mississippi would increase by approximately 5 °F. (USGCRP, 2009)

Figure 9.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5 °F in the northern half of the state and by approximately 4 °F in the southern half of the state. Under a high emissions scenario for the period (2080 to 2099) in the Cfa region of Mississippi, temperatures would increase by approximately 9° F in the northern most portion of the state and by 8 °F in the remainder of the state. (USGCRP, 2009)



Source: (USGCRP, 2009)

Figure 9.2.14-1: Mississippi Low Emission Scenario Projected Temperature Change



Source: (USGCRP, 2009)

Figure 9.2.14-2: Mississippi High Emission Scenario Projected Temperature Change

Precipitation

Predicting future precipitation patterns in the Southeast are much less certain than 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)

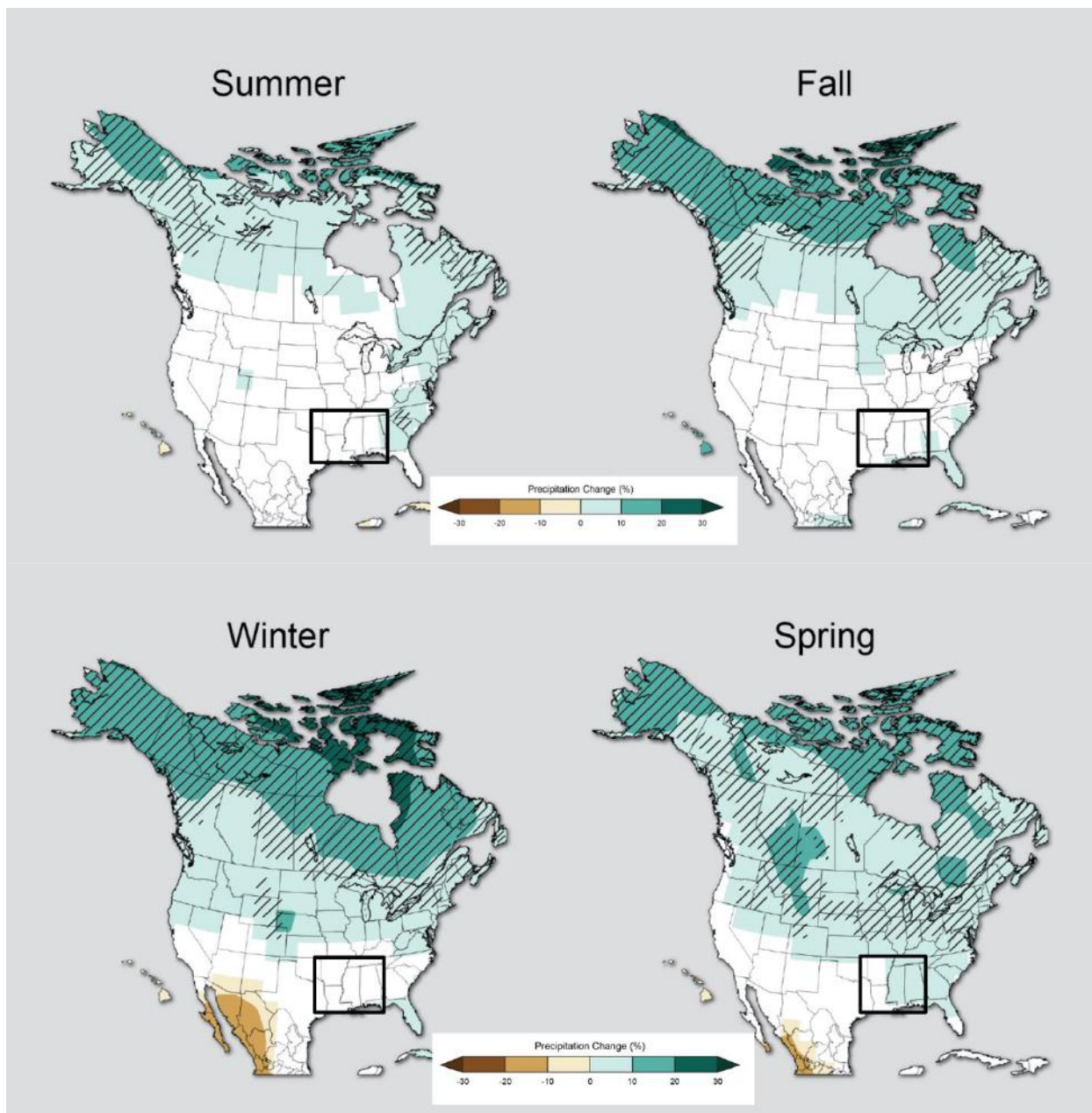
In Mississippi, there is an expected increase of about 10 percent in the number of consecutive dry days under a low emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario in the northern half of the state there is a projected increase of about 10 percent in the number of consecutive dry days, and an increase of 20 percent in the southern half of the state. An increase in consecutive dry days could lead to drought. (USGCRP, 2014c)

Figures 9.2.14-3 and 9.2.14-4 show predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline. Figure 9.2.14-3 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 9.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014c)

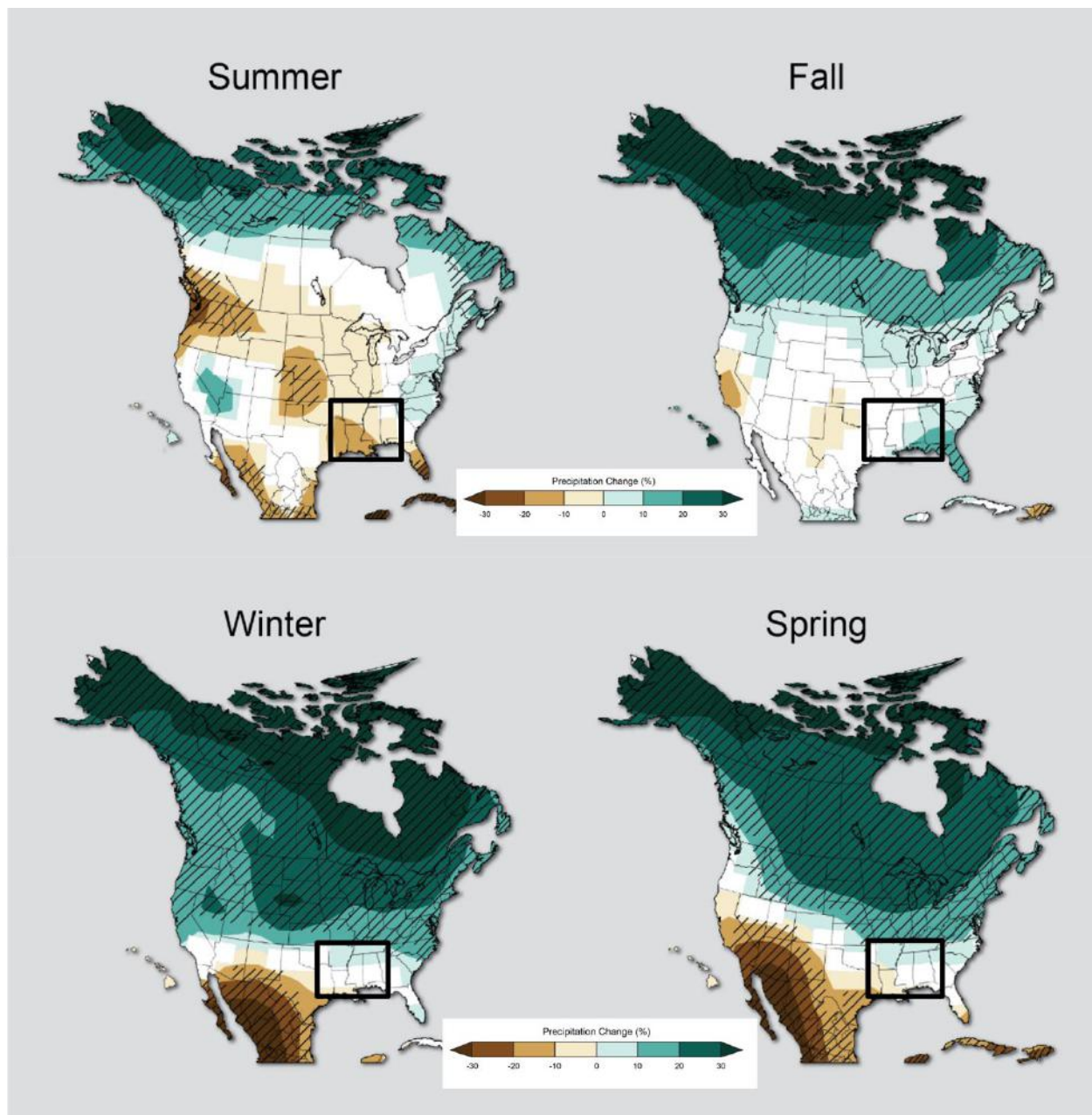
Cfa - Figure 9.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation is expected to remain constant in winter and summer. In spring, precipitation in this scenario is expected to increase 10 percent in the majority of the state, and remain constant in the southern most portion of the state. Fall precipitation is expected to remain constant in the majority of the state with projected increases of 10 percent in the southern most portion of the state. (USGCRP, 2014c)

Figure 9.2.14-4 shows that if emissions continue to increase, winter and spring precipitation will increase 10 percent in the northern portion of Mississippi, remain constant in the southern half of the state, and decrease 10 percent in a tiny southwest portion of Mississippi over the period 2071 to 2099. In summer, precipitation in this scenario could decrease as much as 20 percent in the southwest portion of the state, and decrease 10 percent in the majority of the state while precipitation will remain constant in small portions of the east. Fall precipitation will increase 10 percent or remain constant depending on the portion of the state. (USGCRP, 2014c)



Source: (USGCRP, 2014c)

Figure 9.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario



Source: (USGCRP, 2014c)

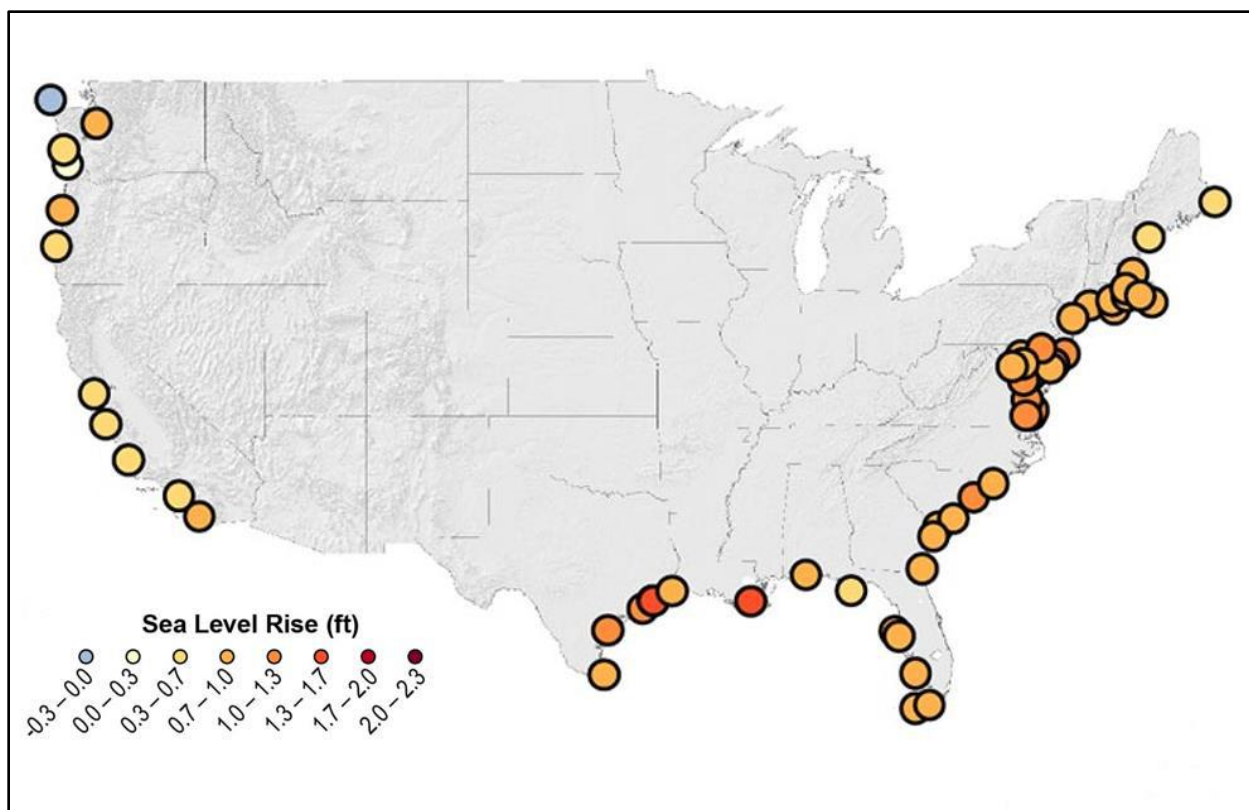
Figure 9.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Sea Level

Several factors would continue to affect sea level rise in the future. Glacier melt adds water to the ocean, and increasing ocean temperatures result in thermal expansion. Worldwide, “glaciers have generally shrunk since the 1960s, and the rate at which glaciers are melting has accelerated over the last decade. The loss of ice from glaciers has contributed to the observed rise in sea level” (USEPA, 2012c). When water warms, it also expands, which contributes to sea level rise in the world’s oceans. “Several studies have shown that the amount of heat stored in the ocean has increased substantially since the 1950s” (USEPA, 2012c). Sea level and currents could be influenced by the amount of heat stored in the ocean (USEPA, 2012c).

The amount of sea level rise would vary in the future along different stretches of the U.S. coastline and under different absolute global sea level rise scenarios. Variation in sea level rise along different stretches of coast is mostly due to varying rates of land subsidence (also known as relative sea level rise). In the National Climate Assessment (NCA) potential sea level rise scenarios were reported. These scenarios were developed based on varying degrees of ocean warming and ice sheet loss as estimated by organizations like IPCC (NOAA 2012). Figure 9.2.14-5 and 9.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 9.2.14.6-5 shows an 8 inch global sea level rise above 1992 levels by 2050 and Figure 9.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014d).

Cfa – Figure 9.2.14-5 presents an 8-inch global average sea level rise above 1992 levels, which would result in a 0.7 to 1 foot sea level rise in 2050 along the coast of Mississippi. Figure 9.2.14-6 indicates that a 1.24-foot sea level rise above 1992 level would result in a 1.0 to 1.3 foot sea level rise in 2050 along the coast of Mississippi. (USGCRP, 2014d)



Source: (USGCRP, 2014d)

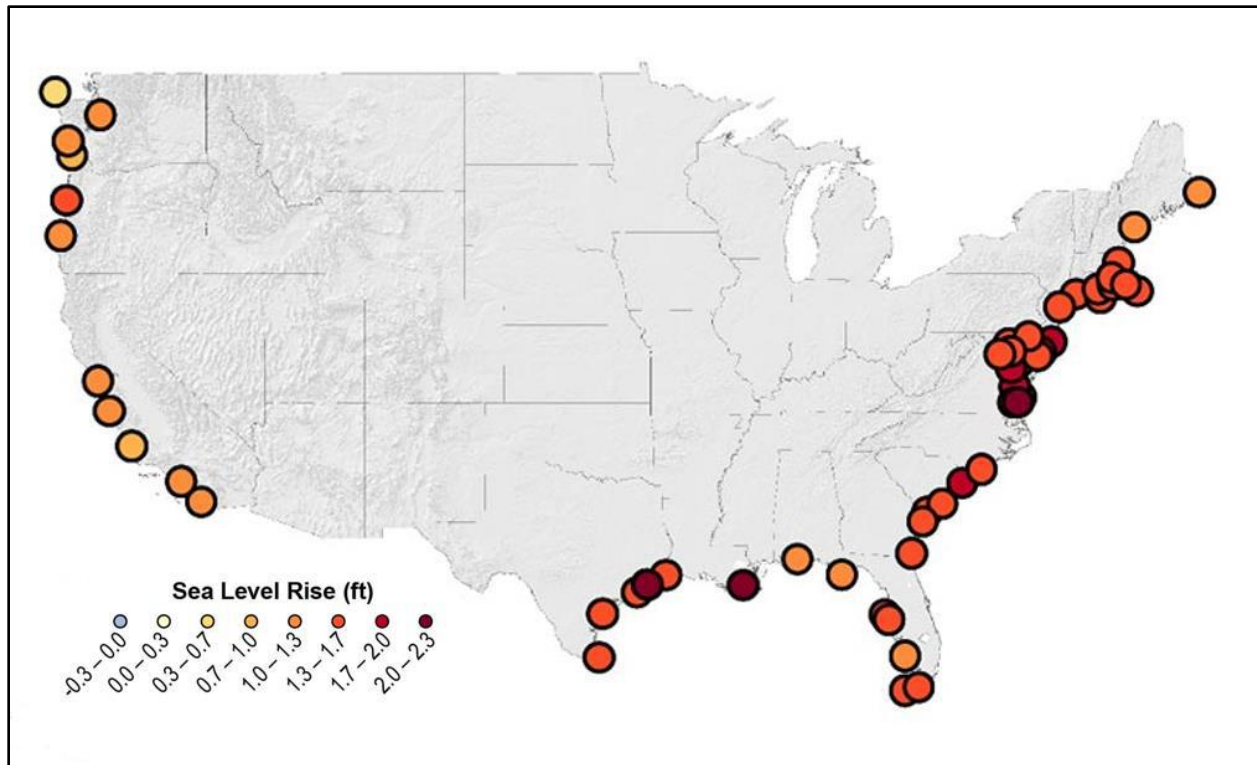
Figure 9.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as thunderstorms and hurricanes. Trends in thunderstorms and hurricanes 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 such as hurricanes. Recent research has yielded insights into the connections between warming and factors that cause severe storms. For example, atmospheric instability and increases in wind speed with altitude link warming with tornadoes and thunderstorms. Additionally, research has found a link between warming and conditions favorable for severe thunderstorms. However, more research is required to make definitive links between severe weather events and climate change. (USGCRP, 2014b)

U.S. coastal waters are expected to experience more intense hurricanes with related increases in wind, rain, and storm surges (but not necessarily an increase in the number of storms that make landfall) (USGCRP, 2014b). Changes in hurricane intensity are difficult to project because there are contradictory effects at work. Warmer oceans increase storm strength with higher winds and increased precipitation. However, changes in wind speed and direction with height are also projected to increase in some regions; this tends inhibit storm formation and growth. Current research suggests stronger, more rain-producing tropical storms and hurricanes are generally

more likely, though such storms may form less frequently; ultimately, more research would provide greater certainty (USGCRP, 2009).



Source: (USGCRP, 2014d)

Figure 9.2.14-6: 1.24-foot Sea Level Rise Above 1992 Levels by 2050

9.2.14.4. Description of Environmental Concerns

Greenhouse Gas Emissions

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts, and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO₂ emissions from fossil fuels.

Based on the impact significance criteria presented in Table 9.2.14-1, climate change impacts as a result of GHG emissions could be significant 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. These impacts will be considered fully in Chapter 18, Cumulative Impacts. No BMPs will be described for this aspect of the resource.

Sea level rise could significantly impact the entire coastline of Mississippi, resulting in erosion and permanent loss of coastal habitat and profoundly impacting the location and disposition of plant and animal communities. Mississippi River flooding from extreme rainfall events could also impact ecosystems through increased erosion and sedimentation. (USGCRP, 2014e)

Forest ecosystems in the Southeast, including Mississippi, may be at a higher risk of more frequent and extensive wildland fires, particularly during the periods of extended drought that are forecasted under warming scenarios. (Mitchell, 2014b)

The South is forecasted for longer and more intense heatwaves as this century progresses, which may negatively impact air quality, human health, air quality, and the economy as people are less able to work outside and other productivity impacts of long periods of excessive heat. (USGCRP, 2014e)

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.

The coast and inland Mississippi are at risk for stronger hurricanes as a result of climate change. Sea level rise would increase the height, areal extent, and persistence of coastal flooding during these events (USGCRP, 2014f). Stronger storms may also increase the potential for damage from high winds and wind-borne debris.

In inland areas of Mississippi out of the immediate path of coastal storm surge are nevertheless at risk of flooding. Climate change is projected to increase the frequency and severity of torrential downpours which in turn may increase the potential for flash floods as well as severe flooding during hurricanes (USGCRP, 2014f).

Urban areas in particular will be at risk of increased intensity and duration of heat waves (USGCRP, 2014g). Extended periods of extreme heat may increase demand for electricity, impede the operation of the grid in the South (DOE, 2015) and overwhelm the capacity of onsite equipment needed to keep microwave and other transmitters cool.

Based on the impact significance criteria presented in Table 9.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

9.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

Given this assessment is programmatic and does not include any site-specific locations or deployment technology, it is impossible to determine the actual GHG emissions associated with any of the action alternatives. This information could only be captured once the site-specific information is determined. However, an assessment of potential impacts is provided in this section based on the potential emissions associated with the various activities that could occur as a result of the implementation of the Preferred Alternative in Mississippi, including deployment and operation activities.

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of impacts from *no impacts* to *less than significant 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* to climate change under the conditions described below:

- **Wired Projects**
 - o **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.
 - o **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**
 - o **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.

- o Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts at the Programmatic Level

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wireless Projects
 - o New Build – Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
 - o New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
 - o Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
 - o New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
 - o Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
 - o New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with

construction, as 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
 - o COWs, COLTs, or 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.
 - o Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant at the programmatic level if large numbers of piloted or unmanned aircraft were used for a sustained period of time (i.e., months to years). Emissions would depend on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. 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* at the programmatic level; although geographically large (all 50 states, 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be *potentially significant* to *less than significant with BMPs and mitigation measures incorporated* at the programmatic level 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.

9.2.14.6. Alternatives Impact Assessment

The following section assesses potential impacts to climate associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be *less than significant* 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. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. These activities are expected to be *less than significant* at the programmatic level due the limited duration of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

Climate change effects have the most noticeable impacts over a long period. 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, 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 9.1.14, Climate Change.

9.2.15. Human Health and Safety

9.2.15.1. Introduction

This section describes potential impacts to human health and safety in Mississippi 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

9.2.15.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on human health and safety were evaluated using the significance criteria presented in Table 9.2.15-1. As described in Section 9.2, Environmental Consequences, the categories of impacts are defined, 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 9.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	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 Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	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 Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Manmade Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	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

9.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that 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 9.2.15-1, occupational injury impacts could be *potentially significant* at the programmatic level if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical or chemical hazard extends beyond the restricted access of 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, 2017).

1. Engineering controls;
2. Work practice controls;
3. Administrative controls; and then
4. Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes,¹⁴⁸ chain locks, bollards, storage containers (for storing equipment and chemicals), or signage and caution tape. Other forms of engineering controls could include machinery designed to manipulate the quality of the work environment, such as ventilation blowers. Whenever practical, engineering controls may result in the complete removal of the hazard from the work site, an example of which would be the transport and offsite disposal of hazardous waste or asbestos containing materials.

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of

¹⁴⁸ Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents (OSHA, 2016d).

employer specific workplace rules and operational practices (OSHA, 2017). 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 Proposed Action sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet contractors 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, 2017). 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.

No State Plan - The Mississippi Department of Employment Security (MDES) is not authorized by OSHA to administer a state program for public or private sector employers. Therefore, MDES defers all regulatory authority and enforcement for occupational safety relating to FirstNet site work to the leadership and interpretation of OSHA.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions because of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 9.2.15-1, human health impacts could be significant at the programmatic level if FirstNet deployment sites are near contaminated properties or abandoned land mines. 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 MS DENR, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, and applicable Mississippi state laws in order to protect workers and the 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 OSHA may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRA's help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRA's take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

Natural and Manmade Disasters

The impacts of natural and manmade disasters are likely to present unique health and safety hazards, as well as exacerbate pre-existing hazards, such as degrading occupational work conditions and disturbing existing environmental contamination. The unique hazards presented by natural and manmade disasters may include, fire, weather incidents (e.g., floods, tornadoes, hurricanes, etc.), earthquakes, vandalism, large- or small-scale chemical releases, utility disruption, community evacuations, or any other event that abruptly and drastically denudes the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure. Additionally, such natural and manmade disasters

could directly impact public safety communication infrastructure assets through damage or destruction.

Based on the impact significance criteria presented in Table 9.2.2-1, human health impacts could be significant at the programmatic level if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a *less than significant* beneficial impact, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. 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.

9.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to human health and safety and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could, at the programmatic level, result in a range of *no impacts* to *less than significant with mitigation*, depending on the deployment scenario or site-specific activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure development scenarios described in Section 9.1.1, Proposed Action Infrastructure, the following are likely to have *no impacts* at the programmatic level to human health and safety under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be *no impacts* at the programmatic level 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 ROWs, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- o New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- o Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- o New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in limited nearshore and inland bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or the banks of waterbodies 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.
- o Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers

being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects
 - o New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
 - o Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
 - o The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions 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, vibrations, and noise. The

possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.

- Satellites and Other Technologies
 - o Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would *not impact* human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, and environmental contamination), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of this infrastructure could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure, and release of hazardous chemicals and hazardous waste. 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. At the programmatic level, it is anticipated that there would be *less than significant* impacts to human health and safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise 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.

9.2.15.5. Alternatives Impact Assessment

The following section assesses potential impacts to human health and safety associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to human health and safety at the programmatic level. 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 were an electrical generator, then there would also likely be a need to manage fuel onsite. These activities could result in *less than significant* impacts at the programmatic level to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise 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 explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to human health and safety at the programmatic level associated with routine inspections. Use of PPE or other mitigation measures may be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be *less than significant* at the programmatic level because of the small-scale of likely FirstNet activities; activities associated would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to human health and safety as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 9.1.15, Human Health and Safety.

MS APPENDIX A – AIR QUALITY

Table A-1: National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Primary Standard ^a		Secondary Standard		Notes
		µg/m ³	ppm	µg/m ³	Ppm	
CO	8-hour	10,000	9	-	-	Standard is not to be exceeded more than once per year.
	1-hour	40,000	35	-	-	
Lead	3-month	0.15 ^b	-	Same as Primary		Rolling average. Not to be exceeded.
NO _x	1-hour	188	0.100	-	-	98 th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
	Annual	100	0.053	Same as Primary		Annual Mean.
PM ₁₀	24-hour	150	-	-	-	Not to be exceeded more than once per year on average over 3 years.
PM _{2.5}	Annual	12	-	15	-	Annual mean, averaged over 3 years.
	24-hour	35	-	Same as Primary		98 th percentile, averaged over 3 years.
O ₃	8-hour	147	0.075 ^c	Same as Primary		Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
SO _x	1-hour	196	0.075 ^d	-	-	99 th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
	3-hour	-	-	1,300	0.5	Not to be exceeded more than once per year.

Source: (USEPA, 2014d)

^a The standard may be expressed both sets of units. A blank cell, containing a dash, indicates that there is no primary or secondary standard for the specific pollutant and averaging time.

^b “Final Rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m³ as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

^c Final Rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, USEPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard (“anti-backsliding”). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

^d Final Rule signed June 2, 2010. The 1971 annual and 24-hour SO₂ standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.”

Table A-2: Federally Regulated Hazardous Air Pollutants (HAPs)

POLLUTANT	CAS#	POLLUTANT ^a	CAS#
Acetaldehyde	75070	Chlorobenzilate	510156
Acetamide	60355	Chloroform	67663
Acetonitrile	75058	Chloromethyl methyl ether	107302
Acetophenone	98862	Chloroprene	126998
2-Acetylaminofluorene	53963	Cresols/Cresylic acid (isomers and mixture)	1319773
Acrolein	107028	o-Cresol	95487
Acrylamide	79061	m-Cresol	108394
Acrylic acid	79107	p-Cresol	106445
Acrylonitrile	107131	Cumene	98828
Allyl chloride	107051	2,4-D, salts and esters	94757
4-Aminobiphenyl	92671	DDE	3547044
Aniline	62533	Diazomethane	334883
o-Anisidine	90040	Dibenzofurans	132649
Asbestos	1332214	1,2-Dibromo-3-chloropropane	96128
Benzene (including benzene from gasoline)	71432	Dibutylphthalate	84742
Benzidine	92875	1,4-Dichlorobenzene(p)	106467
Benzotrichloride	98077	3,3-Dichlorobenzidine	91941
Benzyl chloride	100447	Dichloroethyl ether (Bis(2-chloroethyl)ether)	111444
Biphenyl	92524	1,3-Dichloropropene	542756
Bis(2-ethylhexyl)phthalate (DEHP)	117817	Dichlorvos	62737
Bis(chloromethyl)ether	542881	Diethanolamine	111422
Bromoform	75252	N,N-Diethyl aniline (N,N-Dimethylaniline)	121697
1,3-Butadiene	106990	Diethyl sulfate	64675
Calcium cyanamide	156627	3,3-Dimethoxybenzidine	119904
Caprolactam	105602	Dimethyl aminoazobenzene	60117
Captan	133062	3,3'-Dimethyl benzidine	119937
Carbaryl	63252	Dimethyl carbamoyl chloride	79447
Carbon disulfide	75150	Dimethyl formamide	68122
Carbon tetrachloride	56235	1,1-Dimethyl hydrazine	57147
Carbonyl sulfide	463581	Dimethyl phthalate	131113
Catechol	120809	Dimethyl sulfate	77781
Chloramben	133904	4,6-Dinitro-o-cresol, and salts	534521
Chlordane	57749	2,4-Dinitrophenol	51285
Chlorine	7782505	2,4-Dinitrotoluene	121142
Chloroacetic acid	79118	1,4-Dioxane (1,4-Diethyleneoxide)	123911
2-Chloroacetophenone	532274	1,2-Diphenylhydrazine	122667
Chlorobenzene	108907	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	106898

POLLUTANT	CAS#
Epichlorohydrin (1-Chloro-2,3-epoxypropane)	106898
1,2-Epoxybutane	106887
Ethyl acrylate	140885
Ethyl benzene	100414
Ethyl carbamate (Urethane)	51796
Ethyl chloride (Chloroethane)	75003
Ethylene dibromide (Dibromoethane)	106934
Ethylene dichloride (1,2-Dichloroethane)	107062
Ethylene glycol	107211
Ethylene imine (Aziridine)	151564
Ethylene oxide	75218
Ethylene thiourea	96457
Ethylidene dichloride (1,1-Dichloroethane)	75343
Formaldehyde	50000
Heptachlor	76448
Hexachlorobenzene	118741
Hexachlorobutadiene	87683
Hexachlorocyclopentadiene	77474
Hexachloroethane	67721
Hexamethylene-1,6-diisocyanate	822060
Hexamethylphosphoramide	680319
Hexane	110543
Hydrazine	302012
Hydrochloric acid	7647010
Hydrogen fluoride (Hydrofluoric acid)	7664393
Hydrogen sulfide	7783064
Hydroquinone	123319
Isophorone	78591
Lindane (all isomers)	58899
Maleic anhydride	108316
Methanol	67561
Methoxychlor	72435
Methyl bromide (Bromomethane)	74839
Methyl chloride (Chloromethane)	74873
Methyl chloroform (1,1,1-Trichloroethane)	71556
Methyl ethyl ketone (2-Butanone)	78933
Methyl hydrazine	60344

POLLUTANT ^a	CAS#
Methyl iodide (Iodomethane)	74884
Methyl isobutyl ketone (Hexone)	108101
Methyl isocyanate	624839
Methyl methacrylate	80626
Methyl tert butyl ether	1634044
4,4-Methylene bis(2-chloroaniline)	101144
Methylene chloride (Dichloromethane)	75092
Methylene diphenyl diisocyanate (MDI)	101688
4,4'-Methylenedianiline	101779
Naphthalene	91203
Nitrobenzene	98953
4-Nitrobiphenyl	92933
4-Nitrophenol	100027
2-Nitropropane	79469
N-Nitroso-N-methylurea	684935
N-Nitrosodimethylamine	62759
N-Nitrosomorpholine	59892
Parathion	56382
Pentachloronitrobenzene (Quintobenzene)	82688
Pentachlorophenol	87865
Phenol	108952
p-Phenylenediamine	106503
Phosgene	75445
Phosphine	7803512
Phosphorus	7723140
Phthalic anhydride	85449
Polychlorinated biphenyls (Aroclors)	1336363
1,3-Propane sultone	1120714
beta-Propiolactone	57578
Propionaldehyde	123386
Propoxur (Baygon)	114261
Propylene dichloride (1,2-Dichloropropane)	78875
Propylene oxide	75569
1,2-Propylenimine (2-Methyl aziridine)	75558
Quinoline	91225
Quinone	106514
Styrene	100425

POLLUTANT	CAS#
Styrene oxide	96093
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746016
1,1,2,2-Tetrachloroethane	79345
Tetrachloroethylene (Perchloroethylene)	127184
Titanium tetrachloride	7550450
Toluene	108883
2,4-Toluene diamine	95807
2,4-Toluene diisocyanate	584849
o-Toluidine	95534
Toxaphene (chlorinated camphene)	8001352
1,2,4-Trichlorobenzene	120821
1,1,2-Trichloroethane	79005
Trichloroethylene	79016
2,4,5-Trichlorophenol	95954
2,4,6-Trichlorophenol	88062
Triethylamine	121448
Trifluralin	1582098
2,2,4-Trimethylpentane	540841
Vinyl acetate	108054
Vinyl bromide	593602
Vinyl chloride	75014
Vinylidene chloride (1,1-Dichloroethylene)	75354

POLLUTANT ^a	CAS#
Xylenes (isomers and mixture)	1330207
o-Xylenes	95476
m-Xylenes	108383
p-Xylenes	106423
Antimony Compounds	
Arsenic Compounds (inorganic including arsine)	
Beryllium Compounds	
Cadmium Compounds	
Chromium Compounds	
Cobalt Compounds	
Coke Oven Emissions	
Cyanide Compounds ^b	
Glycol ethers ^c	
Lead Compounds	
Manganese Compounds	
Mercury Compounds	
Fine mineral fibers ^d	
Nickel Compounds	
Polycyclic Organic Matter ^e	
Radionuclides (including radon) ^f	
Selenium Compounds	

Source: (USEPA, 2013c)

^a For all listings above which contain the word “compounds” and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical’s infrastructure.

^b X’CN where X = H’ or any other group where a formal dissociation may occur. For example KCN or Ca(CN)₂

^c Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol R-(OCH₂CH₂)_n-OR’ where:

n = 1, 2, or 3;

R = alkyl C7 or less; or

R = phenyl or alkyl substituted phenyl;

R’ = H or alkyl C7 or less; or

OR’ consists of carboxylic acid ester, sulfate, phosphate, nitrate, or sulfonate.

^d Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

^e Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100 ° C.

^f A type of atom which spontaneously undergoes radioactive decay.

MS APPENDIX B – BIOLOGICAL RESOURCES

Table B-1: S1-Ranked Terrestrial Communities in Mississippi

Vegetative Community Type	EPA Ecoregion(s)^a	Description	Distribution
American Wildcelery Bed	Southern Coastal Plain	Seagrass bed of submerged strap- or ribbon-like leaves from several inches to several feet in length. Prefers freshwater along muddy substrates.	Bays, bayous, and rivers along coastal mainland and in Mississippi Sound
Barrier Island Macroscopic Algae Bed	Southern Coastal Plain	Predominantly composed of macrophytic red algae that are attached to benthic shell material.	Southern Florida coast
Barrier Island Seagrass Bed	Southern Coastal Plain	Seagrass beds dominated by turtle grass.	Mississippi's barrier islands
Beech Magnolia Forest	Southeastern Plain and Mississippi Valley Loess Plain	Occurs in transitional areas from upland longleaf pine hills to stream bottoms. American beech and magnolias are the dominant trees of the canopy, but this layer can be very diverse with several species of hardwoods and pines also occurring.	Southern part of the State
Chalk Bluff Black Belt Prairie	Southeastern Plain	Flat prairie lands dominated by little bluestem and yellow Indiangrass.	Northeastern part of the State
Chestnut Oak Slope and Ridge Forest	Southeastern Plain	Typically composed of chestnut oak with a combination of northern red oak, black oak, and/or chinkapin oak. The associated steep slopes are underlain by limestone, shale, and chert beds of the Carboniferous formation.	Northeastern corner of the State
Forested Canebrake	Southeastern Plain, Mississippi Valley Loess Plain, and Mississippi River Alluvial Plain	Extensive, impenetrable giant cane thickets formed along the levees of stream corridors.	Southern and western Mississippi
Jackson Prairie	Southeastern Plain	Diverse complement of grasses and forbs dominated by Switchgrass and yellow Indiangrass.	Central Mississippi
Longleaf Pine Clay Glade	Southeastern Plain	Forests found in upland areas that have loamy soils over clay or clay loam soils on a relatively level to gently sloping plain.	Southern part of the State
Long Leaf Pine-Saw Palmetto Woodland	Southeastern Plain	Typically consist of an open canopy of longleaf pines with a scattered saw palmetto shrub layer. The soils are excessively well-drained, sugary, white sands. The saw palmetto shrub layer may become dense under a dormant season burning regime.	Southern part of the State

Vegetative Community Type	EPA Ecoregion(s)^a	Description	Distribution
Long Leaf Pine Clay Savanna	Southeastern Plain	Forests found in upland areas that have loamy soils over clay or clay loam soils on a relatively level to gently sloping plain. Presence of the blue muhly, which forms the dominant groundcover under a sparse canopy of longleaf pines.	Southern part of the State
Maritime Live Oak Forest	Southern Coastal Plain	Comprised of live native live and upland laurel oak and an understory dominated by saw palmetto.	Barrier Islands in the Gulf of Mexico
Maritime Slash Pine Flatwoods/Savanna	Southern Coastal Plain	Delineated from other coastal slash pine woodlands by the dominance of saltmeadow cordgrass in its understory. Species of this community can tolerate seasonally wet or saturated soils.	Intertidal areas along Mississippi's coastline.
Mesic Calcareous Bluff Forest	Southeastern Plain and Mississippi Valley Loess Plain	Forests found over predominately calcareous soils derived from ancient marine deposits. The canopy is formed by mixed hardwoods.	Southern part of the State
Mississippi River Sandfield Mixed Herbland	Mississippi River Alluvial Plain	Dry sand plains on terraces created by Mississippi River flooding after flood water retreat. Includes diverse herbaceous groundcover dominated by brome grass, six weeks fescue and prickly pear cactus. Generally remains treeless.	Western part of the State along the Mississippi River
Pond (Natural)	Mississippi River Alluvial Plain	Temporary wetlands that hold water during the winter spring season but typically dry out in the summers.	Western part of the State
Quaking Bog	Southeastern Plain	Contains deep organic, mucky soils. Get their name because they "tremble" under foot traffic. These bogs often have a thick layer of slowly decomposing peat.	Southern part of the State
Shell Midden Shrub/Woodland	Southern Coastal Plain	A unique shrub community occurring along intertidal marsh fringes and on small islands within the marsh. Plants found include southern red cedar, coral bean, gum bully, red buckeye, yucca and prickly pear.	Bays and bayous along Mississippi's southern coast.
Tidal River Edge Shrub Wetland	Southern Coastal Plain	Habitats along tidal river channel.	Along Mississippi's Gulf of Mexico coastline
Unvegetated Sandshore	Southern Coastal Plain	Natural sand beaches.	Along Mississippi's Gulf of Mexico coast
Vertisol Black Belt Prairie	Southeastern Plain	Flat prairie lands dominated by Big bluestem grass.	Northeastern part of the State

Vegetative Community Type	EPA Ecoregion(s)^a	Description	Distribution
Wet Calcareous Cliffs	Southeastern Plain	Dominated by American alumroot, hairy alumroot and jewelweed, rooted on bare rock slopes. Seepage from ridges above the cliffs keep these slopes wet through most of the year.	Northeastern part of the State
Wet Coastal Prairie	Southern Coastal Plain	Coastal prairie lands dominated by wire and switch grasses.	Along Mississippi bays and bayous
White Cedar Swamp Forest	Southeastern Plain	Occurs along small blackwater streams. Atlantic white cedar is a prominent component of the canopy, which also includes sweetbay, swamp tupelo, slash pine and red maple.	Southeastern part of the State
White Water Lily	Southern Coastal Plain	Found in the wettest portion of freshwater marshes. White waterlily, jointed spikesedge, and bulltongue arrowhead form dense colonies. The deeper zones also contain a variety of emergent aquatic plants.	Lowlands and floodplains in the southern part of the State

Source: (MDWFP, 2005)

^a Exact location data not available for all S1 communities in Mississippi; some EPA ecoregion designations are approximate.

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AFB	Air Force Base
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AML	Abandoned Mine Lands
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act of 1979
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
BPWS	Bureau of Public Water Supply
BTOP	Broadband Technology Opportunities Program
BUD	Beneficial Use Determination
CAA	Clean Air Act
CCC	Civilian Conservation Corps
CCR	Consumer Confidence Report
CEQ	Council on Environmental Quality
CFOI	Census on Fatal Occupational Injuries
CGP	Construction General Permit
CIMC	Cleanups in My Community
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CRS	Community Rating System
CWA	Clean Water Act
DEDOL	Delaware Department of Labor
DEQ	Department of Environmental Quality
DOE	Department of Energy
EDACS	Enhanced Digital Access System
EFH	Essential Fish Habitat
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right to Know Act

Acronym	Definition
FAA	Federal Aviation Administration
FAP	Federal Art Project
FCC	Federal Communication Commission
FHWA	Federal Highway Administration
HHRA	Human Health Risk Assessment
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel on Climate Change
JAN	Jackson-Evers International Airport
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Region
LTE	Long Term Evolution
MAC	Mississippi Administrative Code
MBTA	Migratory Bird Treaty Act
MCU	Mississippi Code Unannotated
MDEQ	Mississippi Department of Environmental Quality
MDI	Methylene Diphenyl Diisocyanate
MDMR	Mississippi Department of Marine Resources
MDOT	Mississippi Department of Transportation
MDWFP	Mississippi Department of Wildlife, Fisheries, and Parks
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	Million Metric Tons
MNHP	Mississippi Natural Heritage Program
MS	Mississippi
MSDES	Mississippi Department of Employment Security
MSDH	Mississippi Department of Health
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MSWIN	Mississippi Wireless Integrated Network
MYA	Million Years Ago
N ₂ O	Nitrous Oxide
NAACP	National Association for the Advancement of Colored
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection Repatriation Act

Acronym	Definition
NAICS	North American Industry Classification System
NAS	National Airspace System
NASAO	National Association of State Aviation Officials
NCA	National Climate Assessment
NEPA	National Environmental Policy Act
NERRS	National Estuarine Research Reserve System
NFIP	National Flood Insurance Program
NHA	National Heritage Area
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NMSZ	New Madrid Seismic Zone
NOTAM	Notice to Airmen
NO _x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCS	National Resources Conservation Service
PGA	Peak Ground Acceleration
PPE	Personal Protective Equipment
PSC	Public Service Commission
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetlands
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SF ₆	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Need
SIP	State Implementation Plan
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SO _x	Oxides of Sulfur

Acronym	Definition
SPL	Sound Pressure Level
SUA	Special Use Airspace
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Ozone
WCS	Wetlands Classification Standard
WONDER	Wide-Ranging Online Data for Epidemiologic Research
WPA	Works Progress Administration
WWI	World War I

REFERENCES

The citations in this Final PEIS reflect the most recent information on the referenced site at the time the document was written.

- 40 CFR 230.3(t). (1993, August 25). *Clean Water Act-Guidelines for Specification of Disposal Sites for Dredged or Fill Material*. Retrieved April 6, 2015, from <http://www.ecfr.gov/cgi-bin/text-idx?SID=7977290449ab243f2865159951305a77&node=40:25.0.1.3.24&rgn=div5>
- Advisory Council on Historic Preservation. (2004). *36 CFR Part 800 - Protection of Historic Properties*. Retrieved July 21, 2015, from Advisory Council on Historic Preservation: <http://www.achp.gov/regs-rev04.pdf>
- Agency for Toxic Substances and Disease Registry. (2014, September 8). *Health Consultation*. Retrieved December 7, 2015, from http://www.atsdr.cdc.gov/HAC/pha/SoutheasternWoodPreservingNPLSite/SE%20Wood%20Preserving%20NPL%20Site_HC_Final_09-08-2014_508.pdf
- American Trails. (2015, August 14). *National Trails Training Partnership*. Retrieved September 15, 2015, from <http://www.americantrails.org/resources/feds/NatTrSysOverview.html>
- Amtrak. (2015, December). *South Train Routes*. Retrieved December 4, 2015, from Amtrak: <http://www.amtrak.com/south-train-routes>
- Amtrak. (2016). *Amtrak System Timetable*. Retrieved July 20, 2016, from <https://www.amtrak.com/ccurl/294/1015/Amtrak-System-Timetable-Winter-Spring-2016-rev,0.pdf>
- Anderson, J. R., Hardy, E. E., Roach, J. T., & Witmer, R. E. (1976). *Appendix C: Land Use Definitions*. Retrieved from https://www.usbr.gov/lc/socal/reports/SMappend_C.pdf
- Balmori, A. (2005). Possible Effects of Electromagnetic Fields from Phone Masts on a Population of WhiteStork (*Ciconia ciconia*). *Electromagnetic Biology and Medicine*, 24: 109-119.
- Balmori, A. (2009). Electromagnetic Pollution from Phone Masts Effects on Wildlife. *Pathophysiology. Electromagnetic Fields (EMF) Special Issue*, 16 (2-3): 191-199.
- Balmori, A., & Hallberg, O. (2007). The Urban Decline of the House Sparrow (*Passer domesticus*): A Possible Link with Electromagnetic Radiation. *Electromagnetic Biology and Medicine*, 26: 141-151.
- Barnett, J. F. (2012). *Mississippi's American Indians*. The University of Alabama Press.
- Bay Saint Louis Harbor. (2015, December). *Bay Saint Louis Harbor*. Retrieved December 2015, from Bay Saint Louis: <http://baystlouis39520.wix.com/harbor>
- Berven, K., & Grudzien, T. (1990). Dispersal in the wood frog (*Rana sylvatica*): implications for genetic population structure. *Evolution, Volume 44*(Issue 8), 2047-2056. Retrieved from http://www.jstor.org/stable/2409614?seq=1#page_scan_tab_contents
- BLM. (1984, April). *Manual 8400 - Visual Resource Management*. Retrieved July 22, 2015, from https://www.blm.gov/sites/blm.gov/files/program_recreation_visual%20resource%20management_quick%20link_BLM%20Manual%20Section%208400%20-%20Visual%20Resource%20Management.pdf
- BLM. (2015, January 6). *Abandoned Mine Lands Portal - Staying Safe*. Retrieved September 29, 2015, from Bureau of Land Management: <http://www.abandonedmines.gov/ss.html>

- BLS. (2013a). *Incidence rate and number of nonfatal occupational injuries by industry and ownership, 2013 (U.S.)*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/osh/os/ostb3966.pdf>
- BLS. (2013b). *Fatal occupational injuries to private sector wage and salary workers, government workers, and self-employed workers by industry, all United States, 2013*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/cfoi/cftb0277.pdf>
- BLS. (2014). *Table A-5. Fatal occupational injuries by occupation and event or exposure, all United States, 2014*. Retrieved September 29, 2015, from 2014 Census of Fatal Occupational Injuries (preliminary data): <http://www.bls.gov/iif/oshwc/cfoi/cftb0290.pdf>
- BLS. (2015a, May). *U.S. Bureau of Labor Statistics*. Retrieved from May 2015 State Occupational Employment and Wage Estimates Mississippi: http://www.bls.gov/oes/current/oes_ms.htm
- BLS. (2015b). *Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages*. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages, file staaata.zip. Retrieved April 2015, from <http://www.bls.gov/lau/rdsenp16.htm>
- BLS. (2015c). *Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages*. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages, file staaata.zip. Retrieved April 2015, from <http://www.bls.gov/lau/rdsenp16.htm>
- BLS. (2015d, March 25). *May 2014 State Occupational Employment and Wage Estimates Mississippi*. Retrieved December 4, 2015, from Occupational Employment Statistics: http://www.bls.gov/oes/current/oes_ms.htm#49-0000
- BLS. (2015e, November 13). *Incidence rates of nonfatal occupational injuries and illnesses by industry and case types (Mississippi)*. Retrieved December 4, 2015, from http://www.bls.gov/iif/state_archive.htm#MS
- BLS. (2015f, November 19). *Schedule of upcoming releases and access to archived news releases*. Retrieved February 16, 2016, from Injuries, Illnesses, and Fatalities: http://www.bls.gov/iif/osh_nwrl.htm
- BLS. (2015g, September 21). *Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data*. Retrieved September 18, 2015, from Census of Fatal Occupational Injuries (2011 forward): <http://www.bls.gov/iif/oshcfoi1.htm>
- BLS. (2015h). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved December 4, 2015, from Injuries, Illnesses, and Fatalities: http://www.bls.gov/iif/state_archive.htm#MS
- BLS. (2016, March 30). *Telecommunications: NAICS 517*. Retrieved from Industries at a Glance: <http://www.bls.gov/iag/tgs/iag517.htm>
- Bond, S., Sims, S., & Dent, P. (Eds.). (2013). *Towers, Turbines, and Transmission Lines: Impacts on Property Value*. Chichester, West Sussex, United Kingdom: Wiley-Blackwell.
- Brain, J. P. (1978). Late Prehistoric Settlement Patterning in the Yazoo Basin and the Natchez Bluffs Regions of the Lower Mississippi Valley. In B. D. Smith, *Mississippian Settlement Patterns* (pp. 331-365). New York, New York: Academia Press, Inc.
- Brookes, S. O. (1979). *The Hester Site - An Early Archaic Occupation in Monroe County, Mississippi*. Jackson, Mississippi: Mississippi Department of Archives and History.

- Brown, C. S. (1926). *Archaeology of Mississippi*. Oxford, Mississippi: Mississippi Geological Survey .
- Calhoun, A., & DeMaynadier, P. (2007). *Science and conservation of vernal pools in northeastern North America: ecology and conservation of seasonal wetlands in northeastern North America*. Retrieved from http://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/Ch12_ScienceConservationofVernalPools.pdf
- CEC. (2011, April). *North American Terrestrial Ecoregions - Level III*. Retrieved from USEPA Ecoregions of North America: ftp://ftp.epa.gov/wed/ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf
- Centers for Disease Control and Prevention. (2015a, December 3). CDC WONDER: Underlying Cause of Death, 1999-2013 Results. Retrieved December 3, 2015, from <http://wonder.cdc.gov/>
- Centers for Disease Control and Prevention. (2015b, December 11). *National Environmental Public Health Tracking Network*. Retrieved December 11, 2015, from <http://ephrtracking.cdc.gov/showHome.action>
- CEQ. (1997, December). *Environmental Justice: Guidance Under the National Environmental Policy Act*. Retrieved April 2015, from http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf
- CEQ. (2016). *Final NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*. Retrieved June 2014, from https://ceq.doe.gov/guidance/ceq_guidance_nepa-ghg-climate_final_guidance.html
- Chapman et. al. (2004). *Ecoregions of Mississippi*. Retrieved July 25, 2016, from ftp://newftp.epa.gov/EPADDataCommons/ORD/Ecoregions/ms/ms_eco_pg.pdf
- Charpentier, V., Inizan, M. L., & Feblot-Augustins, J. (2002). Fluting in the Old World: The Neolithic Projectile Points of Arabia. *Lithic Technology*, 27(1), 39-46. Retrieved August 2015, from <http://www.jstor.org/stable/23273456>
- CIO Council. (2015). *Data Center Consolidation and Optimization*. Retrieved from <https://cio.gov/drivingvalue/data-center-consolidation/>
- City of Biloxi. (2008). *City of Biloxi Comprehensive Plan Update*. Retrieved from <http://www.biloxi.ms.us/departments/community-development/comprehensive-plan/update/>
- City of Biloxi. (2013). *City of Biloxi Hazard Mitigation/Floodplain Management Plan*. Retrieved December 31, 2015, from <http://www.biloxi.ms.us/residents/storm-and-flood-preparedness/hazard-mitigation/>
- City of Lincoln. (2015). *What are Saline Wetlands?* Retrieved July 2015, from <http://lincoln.ne.gov/city/parks/parksfacilities/wetlands/wetlandsinfo.htm>
- Climate Central. (2014, June). *California, Oregon, Washington and the Surging Seas*. Retrieved from A Vulnerability Assessment with Projections for Sea Level Rise and Coastal Flood Risk: <http://sealevel.climatecentral.org/uploads/ssrf/Report-CA-OR-WA.pdf>
- Connaway, J. M. (1982). *The Sturdivant Fishweir, Amite County, Mississippi*. Retrieved December 2015, from JSTOR: http://www.jstor.org/stable/pdf/40713440.pdf?seq=1#page_scan_tab_contents

- Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of wetlands and deepwater habitats of the United States*, FWS/OBS-79/31. Retrieved April 5, 2015, from <http://www.fws.gov/wetlands/Documents/classwet/index.html>
- Crocker, M. W. (1973). *Historic Architecture in Mississippi*. Jackson: University & College Press of Mississippi.
- CSC. (2007, March). Retrieved from Telecommunications Facilities: An Illustrated Primer on the Siting of Facilities within Connecticut and Throughout the Nation: http://www.ct.gov/csc/lib/csc/csc_tower_3_07.pdf
- Detroit Publishing Company. (1906). Court House, Gulfport, Miss. *Library of Congress Prints and Photographs Online Catalog*. Gulfport, Mississippi: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/det.4a13385/>
- DiCarlo, A. N. (2002). Chronic Electromagnetic Field Exposure Decreases HSP70 Levels and Lowers Cytoprotection. *Cellular Biochemistry*, 447-454.
- DMR. (2016). *Saltwater Fish Common to Mississippi*. Retrieved September 12, 2016, from Mississippi Department of Marine Resources: <http://www.dmr.ms.gov/joomla16/images/publications/fish-poster.pdf>
- Dockery III, D. (1997). *WINDOWS INTO MISSISSIPPI'S GEOLOGIC PAST*. Retrieved December 2015, from [https://www.deq.state.ms.us/MDEQ.nsf/pdf/Geology_Circular-WindowsIntoMississippi%E2%80%99sGeologicalPast/\\$File/Circular%206.pdf?OpenElement](https://www.deq.state.ms.us/MDEQ.nsf/pdf/Geology_Circular-WindowsIntoMississippi%E2%80%99sGeologicalPast/$File/Circular%206.pdf?OpenElement)
- DOE. (2005). *Evaluation of Radionuclides of Uranium, Thorium, and Radium Associated with Produced Fluids, Precipitates, and Sludges from Oil, Gas, and Oilfield Brine Injection Wells in Mississippi*. Retrieved December 2015, from National Energy Technology Laboratory: <http://www.netl.doe.gov/research/oil-and-gas/project-summaries/completed-env/de-fg26-02nt15227>
- DOE. (2015). *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions*. Washington, DC: Department of Energy. Retrieved December 15, 2015
- DOT. (2006, May). *FTA Noise and Vibration Impact Assessment*. Retrieved from <https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/fta-noise-and-vibration-impact-assessment>
- DOT. (2015). *Federal Railroad Administration Horn Noise FAQ*. Retrieved 07 22, 2015, from <https://www.fra.dot.gov/Page/P0599>
- eBird. (2015a). *eBird range map--bald eagle*. Retrieved from http://ebird.org/ebird/map/baleag?bmo=1&emo=12&byr=2011&eyr=2015&__hstc=75100365.64b7254677ac8cc5c8f21aa17c0b9689.1442877327577.1442877327577.1442877327577.1&__hssc=75100365.4.1442877327577&__hsfp=3470679313#_ga=1.21938685.790432658.1442877326
- eBird. (2015b). *eBird range map--golden eagle*. Retrieved from http://ebird.org/ebird/map/goleag?bmo=1&emo=12&byr=2011&eyr=2015#_ga=1.21938685.790432658.1442877326
- Edinger, G. J., Evans, D. J., Gebauer, S., Howard, T. G., Hunt, D. M., & Olivero, A. M. (2014, March). *Ecological Communities of New York State*. Retrieved March 19, 2015, from A revised and expanded edition of Carol Reschke's Ecological Communities of New York State.: <http://www.dec.ny.gov/animals/97703.html>

- EIA. (2011, July). *Greenhouse Gas Emissions Overview*. Retrieved 07 28, 2015, from Emissions of Greenhouse Gases in the United States:
http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm
- EIA. (2013a). *State CO2 Emissions - 1980 to 2013*. Retrieved from
<http://www.eia.gov/environment/emissions/state/>
- EIA. (2013b). *State CO2 Emissions - 1980 to 2012*. Retrieved from
<http://www.eia.gov/environment/emissions/state/>
- EIA. (2014a). *State CO2 Emissions - 1980 to 2013*. Retrieved from
<http://www.eia.gov/environment/emissions/state/>
- EIA. (2014b, October 26). *State-Level Energy-Related Carbon Dioxide Emissions 2000-2013*. Retrieved April 26, 2016, from <http://www.eia.gov/environment/emissions/state/analysis/>
- EIA. (2014c). *State CO2 Emissions - 1980 to 2012*. Retrieved September 14, 2015, from
<http://www.eia.gov/environment/emissions/state/>
- EIA. (2015a, December). *Electricity Data Browser- Mississippi*. Retrieved December 2015, from U.S. Electricity Data Browser:
<http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=000000002&sec=g&linechart=ELEC.GEN.ALL-MS-99.A&columnchart=ELEC.GEN.ALL-MS-99.A&map=ELEC.GEN.ALL-MS-99.A&freq=A&start=2001&end=2015&chartindexed=0&ctype=linechart<ype=pin&rtyp>
- EIA. (2015b, December). *Mississippi Profile Overview*. Retrieved December 2015, from U.S. Electricity Data Browser: <http://www.eia.gov/state/?sid=MS#tabs-3>
- EIA. (2015c). *Mississippi State Energy Profile*. Retrieved 10 2015, December, from
<http://www.eia.gov/state/print.cfm?sid=MS>
- EIA. (2015d, October 26). *State CO2 Emissions - 1980 to 2013*. Retrieved April 26, 2016, from
<http://www.eia.gov/environment/emissions/state/>
- EIA. (2016a). *Glossary - Electricity*. Retrieved from U.S. Energy Information Administration:
<https://www.eia.gov/tools/glossary/?id=electricity>
- EIA. (2016b, April 16). *Mississippi - State Profile and Energy Estimates*. Retrieved September 14, 2015, from <http://www.eia.gov/state/?sid=MS>
- EIA. (2017a, February). *Electric Power Monthly with Data for December 2016*. Retrieved from
https://www.eia.gov/electricity/monthly/current_year/february2017.pdf
- EIA. (2017b, May 18). *Mississippi State Profile and Energy Estimates*. Retrieved December, from <https://www.eia.gov/state/data.php?sid=MS>
- EIA. (2017c, May 31). *Petroleum and Other Liquids*. Retrieved from
<https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mcrfpmsl&f=a>
- EIA. (2017d). *Rankings: Crude Oil Production, February 2017*. Retrieved from U.S. States State Profiles and Energy Estimates: <https://www.eia.gov/state/rankings/?sid=US#/series/46>
- EIA. (2017e). *Rankings: Natural Gas Marketed Production, 2015*. Retrieved June 5, 2017, from U.S. State Profiles and Energy Estimates:
<https://www.eia.gov/state/rankings/?sid=US#/series/47>
- EIA. (2017f, May 18). *Mississippi Profile Data*. Retrieved from Mississippi State Profile and Energy Estimates: <https://www.eia.gov/state/data.php?sid=MS#ReservesSupply>
- EIA. (2017g). *Rankings: Coal Production, 2015*. Retrieved June 5, 2017, from
<https://www.eia.gov/state/rankings/?sid=US#/series/48>

- Engels, e. a. (2014, May 15). Anthropogenic Electromagnetic Noise Disrupts Magnetic Compass Orientation in a Migratory Bird. *Nature*. doi:10.1038/nature13290
- Executive Office of the President. (1994, February). *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Retrieved April 2015, from 59 Federal Register 7629: <https://federalregister.gov/a/94-3685>
- FAA. (2006, May). *Transit Noise and Vibration Impact Assessment*. Retrieved from https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf
- FAA. (2007, August). *Hearing and Noise in Aviation*. Retrieved from <https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing.pdf>
- FAA. (2008). *Chapter 14 Airspace*. Retrieved June 2015, from Pilot's Handbook of Aeronautical Knowledge: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2014.pdf
- FAA. (2012a, April 5). *Advisory Circular AC 36-3H*. Retrieved July 22, 2015, from http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC36-3H%20Chg%201.pdf
- FAA. (2012b). *Evaluation for new obstruction lighting techniques to reduce avian fatalities*. Technical {Circular}, Federal Aviation Administration. Retrieved from <http://www.tc.faa.gov/its/worldpac/techrpt/tctn12-9.pdf>
- FAA. (2013). *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. Washington D.C.: U.S. Department of Transportation Federal Aviation Administration.
- FAA. (2014, January). *Federal Aviation Administration, Air Traffic Organization*. Retrieved June 2015, from http://www.faa.gov/about/office_org/headquarters_offices/ato/
- FAA. (2015a, June 25). *Airport Data and Contact Information*. Retrieved December 4, 2015, from http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015b, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from http://www.faa.gov/about/office_org/field_offices/fsdo/
- FAA. (2015c). *Aeronautical Information Manual*. Retrieved August 2015, from http://www.faa.gov/air_traffic/publications/media/aim.pdf
- FAA. (2015d). *Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)*. Retrieved July 2015, from Federal Aviation Administration: <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>
- FAA. (2015e, August 6). *FAA Air Traffic Organization Policy, JO 7400.9SZ, Airspace Designations and Reporting Points*. (F. A. U.S. Department of Transportation, Producer) Retrieved October 2015, from FAA, Regulations & Policies, Orders & Notices: http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.list/parentTopicID/10
- FAA. (2015f). *Air Traffic Organization Policy Order JO 7400.8Y, Subject: Special Use Airspace*. Federal Aviation Administration, Airspace Policy and Regulations Group. Retrieved July 2015, from [http://www.faa.gov/documentLibrary/media/Order/7400.8Y_\(2016\).pdf](http://www.faa.gov/documentLibrary/media/Order/7400.8Y_(2016).pdf)
- FAA. (2015g). *FAA TFR List*. Retrieved July 2015, from <http://tfr.faa.gov/tfr2/list.html>

- FAA. (2015h). *Aviation System Performance Metrics (ASPM) Database*. Retrieved 07 22, 2015, from
http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy14-commercial-service-enplanements.pdf
- FAA. (2016a, April 27). *Volume 7 Investigation Chapter 5 Conduct a Complaint Investigation*. Retrieved from
http://fsims.faa.gov/wdocs/8900.1/v07%20investigation/chapter%2005/07_005_001.htm
- FAA. (2016b, November 10). *Flight Standards District Offices*. Retrieved from
https://www.faa.gov/about/office_org/field_offices/fsdo/?state=ms
- FAA. (2016c, October 18). *Obstruction Marking and Lighting*. Retrieved from
https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_Change_1_Obstruction_Marking_and_Lighting_10062016.pdf
- FAA. (2016d). *Specification for Obstruction Lighting*. Retrieved from
https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5345-43GH.pdf
- FCC. (2000, August). *Deployment of Advanced Telecommunications Capability: Second Report*. Retrieved Nov 16, 2015, from
https://transition.fcc.gov/Bureaus/Common_Carrier/Orders/2000/fcc00290.pdf
- FCC. (2012, March 13). *Final Programmatic Environmental Assessment for the Antenna Structure Registration Program*. Retrieved from
https://apps.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf
- FCC. (2013). *Universal Service Monitoring Report*. Retrieved from
https://apps.fcc.gov/edocs_public/attachmatch/DOC-330829A1.pdf
- FCC. (2014a). *Internet Access Services: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau. Federal Communications Commission. Retrieved July 14, 2016, from
https://apps.fcc.gov/edocs_public/attachmatch/DOC-329973A1.pdf
- FCC. (2014b). *Local Telephone Competition: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau. Retrieved July 14, 2016, from
https://apps.fcc.gov/edocs_public/attachmatch/DOC-329975A1.pdf
- FCC. (2015a). *Master PSAP Registry, V 2.0*. PSAP Registry Data Report. Retrieved July 20, 2016, from <https://www.fcc.gov/general/9-1-1-master-psap-registry#block-menu-block-4>
- FCC. (2015b, June 17). *Antenna Structure Registration*. Retrieved June 17, 2015, from Federal Communications Commission:
<http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>
- FCC. (2016a, March). *National Broadband Plan Chapter 16 Public Safety*. Retrieved March 29, 2016, from Broadband.gov: <http://www.broadband.gov/plan/16-public-safety/>
- FCC. (2016b, February 1). *Tower and Antenna Siting*. Retrieved February 10, 2016, from
<https://www.fcc.gov/general/tower-and-antenna-siting>
- FCC. (2016c, June). *Detail - Microwave*. Retrieved from Application Search Help:
http://wireless2.fcc.gov/helpfiles/applicationSearch/ad_microwave.html
- FCC. (2017, January). *Opportunities to Reduce Bird Collisions with Communications Towers*. Retrieved from
https://www.fcc.gov/sites/default/files/Light_Changes_Information_Update_Jan_2017.pdf

- FEMA. (2000). *44 CFR Section 59.1 of the National Flood Insurance Program (NFIP) Regulations: Definitions of NFIP Terms*. Retrieved May 2015, from <http://www.fema.gov/media-library/assets/documents/12437?id=3064>
- FEMA. (2006). *Hurricane Katrina*. Retrieved from <http://www.fema.gov/media-library/assets/images/45294>
- FEMA. (2010, March). *Guidelines for Estimation of Percolation losses for NFIP Studies*. Retrieved August 6, 2015, from FEMA: http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl_perc.pdf
- FEMA. (2013). *Unit 3: NFIP Flood Studies and Maps*. Retrieved May 2015, from http://www.fema.gov/media-library-data/20130726-1539-20490-0241/nfip_sg_unit_3.pdf
- FEMA. (2014a, May). *Chapter 8: Floodplain Natural Resources and Functions*. Retrieved May 2015, from <https://training.fema.gov/hiedu/docs/fmc/chapter%208%20-%20floodplain%20natural%20resources%20and%20functions.pdf>
- FEMA. (2014b, May). *Chapter 2: Types of Floods and Floodplains*. Retrieved May 2015, from <http://training.fema.gov/hiedu/docs/fmc/chapter%202%20-%20types%20of%20floods%20and%20floodplains.pdf>
- FEMA. (2014c, May). *The National Flood Insurance Program Community Status Book*. Retrieved December 14, 2015, from <http://www.fema.gov/cis/MS.pdf>
- FEMA. (2014d, May). *Community Rating System*. Retrieved December 14, 2015, from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communities_May_1_2014.pdf
- FEMA. (2014e, June). *Community Rating System*. Retrieved from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communities_May_1_2014.pdf
- FEMA. (2015, April). *Floodplain Management Fact Sheet*. Retrieved May 2015, from <https://www.fema.gov/floodplain-management-fact-sheet>
- Fenneman, N. (1916). *Physiographic Subdivision of the United States*. Retrieved April 2015, from <http://www.pnas.org/content/3/1/17.full.pdf?ck=nck>
- FGDC. (2013, August). *Classification of Wetlands and Deepwater Habitats of the United States*. Retrieved April 17, 2015, from FGDC Subcommittee on Wetlands Data: <http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013>
- FHWA. (2009, October). *Advances in Wildlife Crossing Technologies*. Retrieved July 12, 2016, from Public Roads: <http://www.fhwa.dot.gov/publications/publicroads/09septoct/03.cfm>
- FHWA. (2011, 7 14). *Highway Traffic and Construction Noise*. Retrieved 07 27, 2015, from [fhwa.dot.gov](http://www.fhwa.dot.gov): http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix
- FHWA. (2013, September 3). *National Scenic Byways Program - Intrinsic Qualities: Identification and Distinctions*. Retrieved May 2016, from http://www.fhwa.dot.gov/hep/scenic_byways/byway_quality/analysis/iq_identification.cfm
- FHWA. (2014, October 21). *Public Road Length*. Retrieved December 4, 2015, from <http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm10.cfm>
- FHWA. (2015a, May 28). *Bridges by State and County 2014*. Retrieved December 4, 2015, from <http://www.fhwa.dot.gov/bridge/nbi/no10/county14b.cfm#ms>

- FHWA. (2015b, December). *Route Log and Finder List*. Retrieved December 4, 2015, from Federal Highway Administration:
http://www.fhwa.dot.gov/planning/national_highway_system/interstate_highway_system/routefinder/index.cfm
- FHWA. (2015c, December). *Mississippi*. Retrieved December 4, 2015, from
<http://www.fhwa.dot.gov/byways/states/MS>
- FHWA. (2015d, 05 28). *Highway Traffic Noise*. Retrieved 07 22, 2015, from
http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm
- Fiber Optic Association. (2010). *Guide to Fiber Optics & Premises Cabling*. Retrieved September 21, 2015, from Safety in Fiber Optic Installations:
<http://www.thefoa.org/tech/safety.htm>
- Fluery, B. E. (2000). *The Salt Marsh*. Retrieved December 11, 2015, from
<http://www.tulane.edu/~bfleury/envirobio/saltmarsh.html>
- FWC. (2015). *Land Mammals - Black Bear*. Retrieved from
<http://myfwc.com/wildlifehabitats/profiles/mammals/land/black-bear/>
- GADNR. (2009). *Percina tanasi - snail darter*. Retrieved from
http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/account_s/fishes/percina_tanasi.pdf
- Galbraith, H., Maloney, K., Hamilton, H., & Puckett, C. (2013). *The secret lives of mussels: America's most endangered species!* Retrieved from
http://www.usgs.gov/blogs/features/usgs_top_story/the-secret-lives-of-mussels-americas-most-endangered-species/
- GAO. (2013). *Data Center Consolidation: Strengthened Oversight Needed to Achieve Billions of Dollars in Savings*. Retrieved from <http://www.gao.gov/products/GAO-13-627T>
- Grigor'ev, I. (2003). Biological Effects of Mobile Phone Electromagnetic Field on Chick Embryo (Risk Assessment Using the Mortality Rate). 541-3.
- Haynes, R. V. (1973). *A History of Mississippi: Volume 1*. (R. A. McLemore, Ed.) Jackson: University & College Press of Mississippi.
- Highsmith, C. M. (1980). Dunleith is an antebellum mansion in Natchez, Mississippi. *Library of Congress Prints and Photographs Online Catalog*. Natchez, Mississippi: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/highsm.13126/>
- Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R., & Treweek, J. (1997). Bird Disturbance: Improving the Quality and Utility of Disturbance Research. *Journal of Applied Ecology*, 34(2): 275-288.
- Historic American Buildings Survey. (1933). Historic American Buildings Survey James Butters, Photographer June 17, 1936 Front (North View) - Old Water Power Grist Mill, Macon, Noxubee County, MS. *Library of Congress Prints and Photographs Online Catalog*. Macon, Mississippi: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/hhh.ms0077.photos/?sp=1>
- Historic American Buildings Survey. (1975). *View from northeast. - University of Mississippi, Lyceum Building, University Circle, Oxford, Lafayette County, MS*. Retrieved January 2016, from <http://www.loc.gov/resource/hhh.ms0255.photos/?sp=1>
- Idaho State University. (2000). *Environmental Geology*. Retrieved March 20, 2016, from http://geology.isu.edu/wapi/EnvGeo/EG4_mass_wasting/EG_module_4.htm
- ILDNR. (2015). *Critical Resource Waters*. Retrieved from
<http://dnr.state.il.us/wetlands/gis/criticalwaters.htm>

- Institute of Maritime History. (2015). *Rainsford Island Archaeological Survey*. Retrieved August 2015, from <http://www.maritimehistory.org/content/rainsford-island-archaeological-survey>
- International Code Council. (2014, August 1). *Mississippi State Adoptions*. Retrieved from <https://www.iccsafe.org/about-icc/government-relations/map/mississippi/>
- International Finance Corporation. (2007, April 30). *Environmental, Health, and Safety Guidelines for Telecommunications*. Retrieved from <http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final+-+Telecommunications.pdf?MOD=AJPERES&id=1323152343828>
- IPCC. (2007). *Climate Change 2007: Synthesis Report*. Retrieved October 2013, from Intergovernmental Panel on Climate Change: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis*. Intergovernmental Panel on Climate Change. Retrieved from <https://www.ipcc.ch/report/ar5/wg1/>
- ITU-T. (2012). *Series L: Construction, Installation and Protection of Cables and Other Elements of Outside Plant*. International Telecommunication Union, Telecommunication Standardization Sector of ITU, Geneva. Retrieved July 20, 2016, from https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-L.90-201202-I!!PDF-E&type=items
- IWC. (2016). *Ship Strikes: Collisions between whales and vessels*. Retrieved August 4, 2016, from <https://iwc.int/ship-strikes>
- Jackson Municipal Airport Authority. (2015a, December). *Leadership*. Retrieved December 4, 2015, from <http://jmaa.com/jmaa-history/leadership/>
- Jackson Municipal Airport Authority. (2015b, December). *Enplaned and Total Passengers CY*. Retrieved December 4, 2015, from <http://jmaa.com/wp-content/uploads/2013/01/Enplaned-Total-Passengers-Calendar-Year7.pdf>
- Jackson Municipal Airport Authority. (2015c, December). *Air Operations*. Retrieved December 4, 2015, from <http://jmaa.com/wp-content/uploads/2013/01/Air-Operations11.pdf>
- Jackson Municipal Airport Authority. (2015d, December). *Air Cargo*. Retrieved December 4, 2015, from <http://jmaa.com/wp-content/uploads/2013/01/Air-Cargo12.pdf>
- Jackson, H. E. (2000, October). *Trade and Exchange in Prehistoric Mississippi*. Retrieved December 2015, from Mississippi Archaeological Association: <http://www.msarchaeology.org/maa/jackson.pdf>
- Johnson, J. K., & Brookes, S. O. (1989). *Benton Points, Turkey Tails, and Chache Blades: Middle Archaic Exchange in the Midsouth*. Retrieved December 2015, from JSTOR: http://www.jstor.org/stable/40712909?seq=1#page_scan_tab_contents
- Jones, C., & Carter, C. (1989). Annotated checklist of the recent mammals of Mississippi. *Occasional Papers, The Museum, Texas Tech University*, 128, 1-9. Retrieved from <http://www.nsrll.ttu.edu/publications/opapers/ops/op128.pdf>
- Kottke, M. (2006). *World Map of the Köppen-Geiger Climate Classification*. Offenbach, Germany and Vienna, Austria: Gebrüder Borntraeger. Retrieved from http://koeppen-geiger.vu-wien.ac.at/pics/KG_USA_UScounty.gif
- Levitt, B., & Lai, H. (2010). *Biological Effects from Exposure to Electromagnetic Radiation Emitted by Cell Tower Base Stations and Other Antenna Arrays*. *Environ. Rev.* 18. doi:doi:10.1139/A10-018

- Luntis, A. (1992, May). *Prehistoric Fishweirs in Eastern North America*. Retrieved December 2015, from Allen Luntis: <http://www.lutins.org/thesis/>
- Manville, A. (2007, February 2). Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, “Effects of Communication Towers on Migratory Birds.”
- Manville, A. (2015, March 5). Recommendations For Additional Research and Funding to Assess Impacts of Non-ionizing Radiation to Birds and Other Wildlife. Emorandum to Dr. J. McGlade, Science Advisor to United Nations Environment Program, Key Research Needs Affecting Wildlife. 2.
- Manville, A. (2016a). Impacts to Birds and Bats Due to Collisions and Electrocutions from Some Tall Structures in the United States: Wires, Towers, Turbines and Solar Arrays — State of the Art in Addressing the Problems. In I. Angelici (Ed.), *Problematic Wildlife: a Cross-Disciplinary Approach* (pp. Chap 20, pp 415-442). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-22246-2_20
- Manville, A. (2016b, July 14). A Briefing Memo: What We Know, Can Infer, and Don’t Yet Know About Impacts From Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife — for Public Release. Peer-Reviewed Briefing Memo.
- McGahey, S. O. (1997). *Paleoindian/Early Archaic Period*. Retrieved December 2015, from Mississippi Department of Archives and History: <http://trails.mdah.ms.gov/stateplan/CHAPTER1.pdf>
- McMillen, N. R. (1973). *A History of Mississippi: Volume II*. (R. A. McLemore, Ed.) Jackson: University & College Press of Mississippi.
- MDEQ. (1991). *Fossil Whale*. Retrieved December 2015, from [http://www.deq.ms.gov/MDEQ.nsf/pdf/Geology_Pamphlet3FOSSILWHALEStateFossilofMississippi/\\$File/Pamphlet%203.pdf?OpenElement](http://www.deq.ms.gov/MDEQ.nsf/pdf/Geology_Pamphlet3FOSSILWHALEStateFossilofMississippi/$File/Pamphlet%203.pdf?OpenElement)
- MDEQ. (2005). *Mississippi Storm Water Pollution Prevention Plan (SWPPP) Guidance Manual for Construction Activities*. Retrieved December 2015, from [https://www.deq.state.ms.us/MDEQ.nsf/pdf/epd_construction_guidance/\\$File/construction_guidance.pdf?OpenElement](https://www.deq.state.ms.us/MDEQ.nsf/pdf/epd_construction_guidance/$File/construction_guidance.pdf?OpenElement)
- MDEQ. (2007a). *Wetlands Protection*. Retrieved December 6, 2015, from http://www.deq.state.ms.us/mdeq.nsf/page/WQCB_Steam_Wetland_Alteration03
- MDEQ. (2007b). Retrieved December 11, 2015, from Groundwater and Remediation Division: https://www.deq.state.ms.us/MDEQ.nsf/page/GARD_home?OpenDocument
- MDEQ. (2007c). *Brownfields Program*. Retrieved December 7, 2015, from https://www.deq.state.ms.us/MDEQ.nsf/page/GARD_brownfields?OpenDocument
- MDEQ. (2007d). *Mining and Reclamation Division*. Retrieved December 7, 2015, from http://www.deq.state.ms.us/mdeq.nsf/page/geology_mining_and_reclamation
- MDEQ. (2010, January 28). *Wastewater Regulations For National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*. Retrieved from [https://www.deq.state.ms.us/mdeq.nsf/pdf/Main_WPC-1/\\$File/WPC-1%20as%20ammended%2001%2028%2010.pdf?OpenElement](https://www.deq.state.ms.us/mdeq.nsf/pdf/Main_WPC-1/$File/WPC-1%20as%20ammended%2001%2028%2010.pdf?OpenElement)
- MDEQ. (2013a, December). *Status Report On Solid Waste Management Facilities And Activities*. Retrieved December 2015, from Mississippi Department of Environmental Quality:

- [https://www.deq.state.ms.us/MDEQ.nsf/pdf/SW_2013AnnualReport/\\$File/2013%20Annual%20Report.pdf?OpenElement](https://www.deq.state.ms.us/MDEQ.nsf/pdf/SW_2013AnnualReport/$File/2013%20Annual%20Report.pdf?OpenElement)
- MDEQ. (2013b). *Mississippi State Management Plan for Aquatic Species*. Retrieved from Mississippi State Management Plan for Aquatic Species:
http://www.anstaskforce.gov/State%20Plans/FINA_MS_AIS_Management_Plan_Mar_2013.pdf
- MDEQ. (2013c, August 26). *Environmental Regulations Effective August 26, 2013*. Retrieved from
http://www.deq.state.ms.us/mdeq.nsf/page/legal_ENVIRONMENTALREGULATIONSEffectiveAugust262013
- MDEQ. (2014a). *Relief Map of Mississippi*. Retrieved December 2015, from
[http://www.deq.state.ms.us/MDEQ.nsf/pdf/Geology_ReliefMapofMississippi/\\$File/MS_Relief_Map_2014.pdf?OpenElement](http://www.deq.state.ms.us/MDEQ.nsf/pdf/Geology_ReliefMapofMississippi/$File/MS_Relief_Map_2014.pdf?OpenElement)
- MDEQ. (2014b). *Mississippi Commission on Environmental Quality Regulations for Water Quality Criteria For Intrastate, Interstate, And Coastal Waters*. Retrieved July 26, 2016, from [http://mdeq.ms.gov/mdeq.nsf/pdf/WQSB_WQSB-RegulationsforWaterQualityCriteria/\\$File/Regulations%20for%20Water%20Quality%20Criteria.pdf?OpenElement](http://mdeq.ms.gov/mdeq.nsf/pdf/WQSB_WQSB-RegulationsforWaterQualityCriteria/$File/Regulations%20for%20Water%20Quality%20Criteria.pdf?OpenElement)
- MDEQ. (2014c). *State of Mississippi Water Quality Assessment 2014 Section 305(b) Report*. Retrieved December 11, 2015, from
[http://deq.state.ms.us/MDEQ.nsf/pdf/FS_2014_MS_305b_report/\\$File/2014_305b_final.pdf?OpenElement](http://deq.state.ms.us/MDEQ.nsf/pdf/FS_2014_MS_305b_report/$File/2014_305b_final.pdf?OpenElement)
- MDEQ. (2014d). *Mississippi 2014 Section 303(d) List of Impaired Water Bodies*. Retrieved December 14, 2015, from
<http://www.deq.state.ms.us/MDEQ.nsf/96993513175ce45586256d260067cfde/e9edfb5201d8e99586257d500048f8d6?OpenDocument>
- MDEQ. (2014e, November 20). *Title 11 Miss. Admin. Code Part 2 Chapter 4*. Retrieved September 3, 2015, from
[http://www.deq.state.ms.us/mdeq.nsf/pdf/legal_11Miss.Admin.CodePt.2Ch.4October242013/\\$File/11%20Miss.%20Admin.%20Code%20Pt.%202.,%20Ch.%204.,%20October%2024,%202013.pdf?OpenElement](http://www.deq.state.ms.us/mdeq.nsf/pdf/legal_11Miss.Admin.CodePt.2Ch.4October242013/$File/11%20Miss.%20Admin.%20Code%20Pt.%202.,%20Ch.%204.,%20October%2024,%202013.pdf?OpenElement)
- MDEQ. (2014f, November 20). Title 11 Miss. Admn. Code Part 2, Chapter 2.
- MDEQ. (2014g, November 20). Title 11 Miss. Admin. Code Part 2 Chapter 6.
- MDEQ. (2014h). 2014 Air Quality Data Summary. Mississippi. Retrieved from
[http://www.deq.state.ms.us/mdeq.nsf/pdf/Air_2014AirQualityDataSummary/\\$File/2014%20Air%20Quality%20Data%20Summary.pdf?OpenElement](http://www.deq.state.ms.us/mdeq.nsf/pdf/Air_2014AirQualityDataSummary/$File/2014%20Air%20Quality%20Data%20Summary.pdf?OpenElement)
- MDEQ. (2015a, December). *General Permits*. Retrieved December 2015, from Mississippi Department of Environmental Quality:
http://www.deq.state.ms.us/mdeq.nsf/page/epd_epdgeneral
- MDEQ. (2015b, December). *Operator Training and Certification*. Retrieved December 2015, from Mississippi Department of Environmental Quality:
https://www.deq.state.ms.us/mdeq.nsf/page/OT_opcert?OpenDocument
- MDEQ. (2015c). *Pearl River Basin*. Retrieved December 11, 2015, from
http://www.deq.state.ms.us/MDEQ.nsf/page/WMB_Pearl_River_Basin?OpenDocument

- MDEQ. (2015d). *Coastal Streams Basin*. Retrieved December 11, 2015, from http://www.deq.state.ms.us/MDEQ.nsf/page/WMB_Coastal_Streams_Basin?OpenDocument
- MDEQ. (2015e, April). *State of Mississippi Ground Water Quality Assessment*. Retrieved December 14, 2015, from [https://www.deq.state.ms.us/mdeq.nsf/pdf/GPB_MSGroundwaterQualityAssessment305b_2015/\\$File/305b_2015%20Final.pdf?OpenElement](https://www.deq.state.ms.us/mdeq.nsf/pdf/GPB_MSGroundwaterQualityAssessment305b_2015/$File/305b_2015%20Final.pdf?OpenElement)
- MDEQ. (2017). *Title 11: Mississippi Department of Environmental Quality, Part 6: Wastewater Pollution Control Regulations*. Retrieved June 5, 2017, from [http://www.deq.state.ms.us/mdeq.nsf/pdf/WQSB_WQSB-RegulationsforWaterQualityCriteria/\\$File/Regulations%20for%20Water%20Quality%20Criteria.pdf?OpenElement](http://www.deq.state.ms.us/mdeq.nsf/pdf/WQSB_WQSB-RegulationsforWaterQualityCriteria/$File/Regulations%20for%20Water%20Quality%20Criteria.pdf?OpenElement)
- MDMR. (1999a, January). *Mississippi's Coastal Wetlands*. Retrieved December 6, 2015, from <http://www.dmr.state.ms.us/joomla16/images/publications/mississippi-coastal-wetlands.pdf>
- MDMR. (1999b, January). *Mississippi's Coastal Wetlands*. Retrieved December 11, 2015, from <http://www.dmr.state.ms.us/joomla16/images/publications/mississippi-coastal-wetlands.pdf>
- MDMR. (2015a). *Wetland Permitting*. Retrieved December 7, 2015, from <http://www.dmr.ms.gov/index.php/coastal-resources-management/wetland-permitting>
- MDMR. (2015b). *Grand Bay NERR*. Retrieved December 11, 2015, from <http://www.dmr.ms.gov/index.php/programs/grand-bay-nerr>
- MDMR. (2015c). *Guide Mississippi Saltwater Fishing: Rules and Regulations*. Retrieved July 27, 2016, from <http://www.dmr.ms.gov/images/publications/2015-16%20Rules%20%20Regs%20combined%20for%20website.pdf>
- MDMR. (2017). *Title 49: Conservation and Energy Chapter 27: Coastal Wetlands Protection Act Coastal Wetlands Protection Act*. Retrieved June 5, 2017, from <http://www.dmr.ms.gov/joomla16/images/coastal-preserves/coastal-wetlands-protection-act.pdf>
- MDOT. (2009). *Mississippi Department of Transportation Railroad Map*. Retrieved December 7, 2015, from http://sp.gomdot.com/Intermodal%20Planning/Freight,%20Rails,%20Ports%20and%20Waterways/Documents/Rails_Map_2012_Front.pdf
- MDOT. (2011, June). *MS State Rail Plan*. Retrieved December 4, 2015, from <http://sp.gomdot.com/Intermodal%20Planning/Freight,%20Rails,%20Ports%20and%20Waterways/Documents/Mississippi%20State%20Rail%20Plan.pdf>
- MDOT. (2012, November 20). *Mississippi Scenic Byways*. Retrieved December 4, 2015, from <http://sp.mdot.ms.gov/Office%20of%20Highways/Planning/Maps/MS%20Scenic%20Byway%20Maps/Mississippi%20Scenic%20Byways.pdf>
- MDOT. (2015a). *Aeronautics, MDOT, Mississippi Department of Transportation*. Retrieved December 2015, from <http://mdot.ms.gov/portal/aeronautics.aspx>
- MDOT. (2015b, December 12). *MS Scenic Byway Maps*. Retrieved December 12, 2015, from <http://sp.mdot.ms.gov/Office%20of%20Highways/Planning/Maps/Pages/MS-Scenic-Byways-Maps.aspx>
- MDOT. (2016). *Mississippi Ports*. Retrieved July 25, 2016, from <http://mdot.ms.gov/ports/default.htm>

- MDWFP. (2005). *Mississippi Comprehensive Wildlife Conservation Strategy*. Retrieved December 8, 2015, from <https://www.mdwfp.com/media/63792/cwcs.pdf>
- MDWFP. (2008). *Crawfish of Mississippi*. Retrieved from http://www.mdwfp.com/media/128945/2008_crawfish_checklist_based_on_fitzpatrick_2002.pdf
- MDWFP. (2012). *Mississippi amphibians and reptiles*. Retrieved from https://www.mdwfp.com/media/128854/mississippi_herpetology_checklist_013012.pdf
- MDWFP. (2014). *Endangered species of Mississippi*. Retrieved from https://www.mdwfp.com/media/279708/endangered_species_of_mississippi.pdf
- MDWFP. (2015a). *Wildlife and Hunting*. Retrieved December 8, 2105, from <https://www.mdwfp.com/wildlife-hunting/wmas/mississippi-wildlife-management-areas-something-for-everyone.aspx>
- MDWFP. (2015b). *Mississippi hunting rules and regulations*. Retrieved from <https://www.mdwfp.com/law-enforcement/hunting-rules-regs.aspx>
- MDWFP. (2015c). *Mississippi state code on possession of wildlife species*. Retrieved from <http://www.offthewallemposium.com/primates/laws/wlex.pdf>
- MDWFP. (2015d). *Wild hog regulations in Mississippi*. Retrieved from <http://www.mdwfp.com/wildlife-hunting/wild-hog-program/wild-hog-regulations-in-mississippi.aspx>
- MDWFP. (2015e, January 21). *Digest of Mississippi Freshwater Commercial Fishing Laws and Regulations*. Retrieved July 27, 2016, from http://www.mdwfp.com/media/261967/commercial_fishing_guide_2015.pdf
- MDWFP. (2015f). *Freshwater mussels of Mississippi*. Retrieved from http://www.mdwfp.com/media/128939/checklist_of_mississippi_mussels.pdf
- MEMA. (2012). *State Hazard Mitigation Plan (2013)*. Retrieved December 2015, from <http://www.msema.org/wp-content/uploads/2012/06/State-Hazard-Mitigation-Plan-2013.pdf>
- Merriam Webster Dictionary. (2015a). *Airspace*. Retrieved June 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/airspace>
- Merriam Webster Dictionary. (2015b). *Sea Level*. Retrieved July 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/sea%20level>
- Michigan State University. (2016, November). *West's Annotated Mississippi Code. Title 49. Conservation and Ecology. Chapter 5. Fish, Game and Bird Protection and Refuges. Nongame and Endangered Species Conservation*. Retrieved from Animal Legal and Historical Center: <https://www.animallaw.info/statute/ms-endangered-species-chapter-5-fish-game-and-bird-protection-and-refuges-nongame-and>
- Mississippi Delta Tourism Association. (2015). *The Mississippi Delta*. Retrieved December 2015, from <http://www.visitthedelta.com/>
- Mississippi Department of Agriculture and Commerce. (2014). *Laws - Plant Pest Programs*. Retrieved from <https://www.mdac.ms.gov/agency-info/laws-regulations/laws-plant-pest-programs/>
- Mississippi Department of Archives & History. (2015a, December 14). *Visit*. Retrieved December 14, 2015, from <http://www.mdah.ms.gov/new/>
- Mississippi Department of Archives & History. (2015b, December). *Mississippi Department of Archives and History*. Retrieved December 2015, from <http://trails.mdah.ms.gov/paleoindian.shtml>

- Mississippi Department of Archives & History. (2015c, December). *Mississippi History Timeline: 1519–1797 » 1519-1698*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1519-1698/>
- Mississippi Department of Archives & History. (2015d, December). *Mississippi History Timeline: 1519–1797 » 1699-1762, French Dominion*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1699-1762-french-dominion/>
- Mississippi Department of Archives & History. (2015e, December). *Mississippi History Timeline: 1519–1797 » 1763-1778, English Dominion*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1763-1778-english-dominion/>
- Mississippi Department of Archives & History. (2015f, December). *Mississippi History Timeline: 1519–1797 » 1779-1797, Spanish Dominion*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1779-1797-spanish-dominion/>
- Mississippi Department of Archives & History. (2015g, December). *Mississippi History Timeline: 1833-1865 » 1861*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1861/>
- Mississippi Department of Archives & History. (2015h, December). *Mississippi History Timeline: 1833-1865 » 1863*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1863/>
- Mississippi Department of Archives & History. (2015i, December). *Mississippi History Timeline: 1903-1928 » 1915*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1915/>
- Mississippi Department of Archives & History. (2015j, December). *Mississippi History Timeline: 1903-1928 » 1917*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1917/>
- Mississippi Department of Archives & History. (2015k, December). *Mississippi History Timeline: 1929-1945 » 1933*. Retrieved December 2015, from <http://mdah.state.ms.us/timeline/zone/1933/>
- Mississippi Department of Marine Resources. (2015). *Mississippi Department of Marine Resources*. Retrieved December 2015, from <http://www.dmr.state.ms.us/joomla16/>
- Mississippi Department of Wildlife, Fisheries & Parks. (2015). *Amenities*. Retrieved December 2015, from Tishomingo State Park: <https://www.mdwfp.com/media/14610/amenitieswithmaplarge081915.jpg>
- Mississippi Department of Wildlife, Fisheries, and Parks. (2015a). *Mississippi Wildlife Action Plan*. Retrieved from Mississippi Wildlife Action Plan: https://www.mdwfp.com/media/289701/mdwfp_2015_2025_2.pdf
- Mississippi Department of Wildlife, Fisheries, and Parks. (2015b). *Mississippi Wildlife, Fisheries, and Parks*. Retrieved December 2015, from <https://www.mdwfp.com/>
- Mississippi Department of Wildlife, Fisheries, and Parks. (2015c, December 14). *State Parks and Destinations*. Retrieved December 14, 2015, from <http://www.mdwfp.com/parks-destinations/ms-state-parks.aspx>
- Mississippi Department of Wildlife, Fisheries, and Parks. (2015d, December 14). *Lake Lowndes State Park*. Retrieved December 14, 2015, from <http://www.mdwfp.com/parks-destinations/ms-state-parks/lake-lowndes.aspx>
- Mississippi Department of Wildlife, Fisheries, and Parks. (2015e, December 13). *Wildlife and Hunting*. Retrieved December 13, 2015, from <http://www.mdwfp.com/wildlife-hunting/wmas/mississippi-wildlife-management-areas-something-for-everyone.aspx>

- Mississippi Emergency Management Agency. (2013). *Mississippi Hazard Mitigation Plan*. Retrieved December 11, 2015, from <http://www.msema.org/wp-content/uploads/2012/07/StateHazardMitigationPlan.pdf>
- Mississippi Emergency Management Agency. (2015, October). *Mississippi Fall Severe Weather Preparedness Week*. Retrieved from National Weather Service: <http://www.msfa.ms.gov/FallSWPW2015.pdf>
- Mississippi Forestry Commission. (2010). *Public Lands*. Retrieved December 2015, from <http://www.mfc.ms.gov/public-lands.php>
- Mississippi Forestry Commission. (2014). *2014 Annual Report*. Retrieved December 2015, from <http://www.mfc.ms.gov/annual-reports.php>
- Mississippi Governor's Office. (2013, May 14). *Gov. Phil Bryant Enacts Major Energy Efficiency Legislation*. Retrieved December 31, 2015, from <http://www.governorbryant.com/gov-phil-bryant-enacts-major-energy-efficiency-legislation/>
- Mississippi Historical Society. (2015a, December). *German Prisoners of War in Mississippi, 1943-1946*. Retrieved December 2015, from <http://mshistory.k12.ms.us/articles/233/german-prisoners-of-war-in-mississippi-1943-1946>
- Mississippi Historical Society. (2015b, December). *Architecture in Mississippi: From Prehistoric to 1900*. Retrieved December 2015, from <http://mshistorynow.mdah.state.ms.us/articles/327/architecture-in-mississippi-from-prehistoric-to-1900>
- Mississippi Historical Society. (2015c, December). *Architecture in Mississippi During the 20th Century*. Retrieved December 2015, from <http://mshistorynow.mdah.state.ms.us/articles/331/architecture-in-mississippi-during-the-20th-century>
- Mississippi Ornithological Society. (2004). *Checklist of Birds of Mississippi*. Retrieved from Checklist of Birds of Mississippi: <https://www.mdwfp.com/media/129151/moschecklist.pdf>
- Mississippi Secretary of State. (2014b). *16th Section Lands*. Retrieved December 2015, from <http://www.sos.ms.gov/Public-Lands/Pages/16th-Section-Lands.aspx>
- Mississippi Secretary of State. (2015). *2012-2016 Mississippi Blue Book*. Retrieved September 16, 2015, from <http://www.sos.ms.gov/Education-Publications/Pages/Blue-Book.aspx>
- Mississippi State Geological Survey. (1920). *Road-Making Materials of Mississippi*. Retrieved December 2015, from [http://mdeq.ms.gov/MDEQ.nsf/pdf/Geology_Bulletin16/\\$File/Bulletin%2016.pdf?OpenElement](http://mdeq.ms.gov/MDEQ.nsf/pdf/Geology_Bulletin16/$File/Bulletin%2016.pdf?OpenElement)
- Mississippi State University. (2016, July 27). *Fishes of Mississippi*. (Mississippi State University, Division of Agriculture, Forestry and Veterinary Medicine, Forest and Wildlife Research Center) Retrieved July 27, 2016, from <http://www.cfr.msstate.edu/wildlife/fisheries/>
- Mississippi Tourism. (2015). *Visit Mississippi*. Retrieved December 2015, from <http://visitmississippi.org/>
- Mississippi Wireless Communications Commission. (2015a, December 3). *MSWIN*. Retrieved December 3, 2015, from <http://www.wcc.ms.gov/Pages/MSWIN.aspx>

- Mississippi Wireless Communications Commission. (2015b, December 3). *About WCC: WCC Legislation*. Retrieved December 3, 2015, from <http://www.wcc.ms.gov/Pages/About.aspx>
- Mississippi Wireless Integrated Network. (2015, December 3). *Mississippi Wireless Integrated Network (MSWIN)*. Retrieved December 3, 2015, from <http://www.radioreference.com/apps/db/?sid=4879>
- Mitchell, D. J. (2014a). *A New History of Mississippi*. Jackson: University Press of Mississippi.
- Mitchell, D. J. (2014b). Future climate and fire interactions in the South Eastern region of the United States. *Forest Ecology and Management*, 316-326.
- MMNS. (2016). *Freshwater Invertebrates*. Retrieved July 27, 2016, from <https://www.mdwfp.com/seek-study/bio-collections/freshwater-invert.aspx>
- Moody, D. W., Carr, J., Chase, E. B., & Paulson, R. W. (1986). *National Water Summary 1986 - Hydrologic Events and Ground-Water Quality*. Retrieved April 5, 2015, from <http://pubs.er.usgs.gov/publication/wsp2325>
- Morgan, D. (1997). *Post-Archaic Period*. Retrieved December 2015, from Mississippi Department of Archives and History: <http://trails.mdah.ms.gov/stateplan/CHAPTER4.pdf>
- Morgan, D. (2002, October). *Archaeology and Prehistoric Mississippi*. Retrieved December 2015, from Mississippi History Now: An online publication of the Mississippi Historical Society: <http://mshistorynow.mdah.state.ms.us/articles/74/archaeology-and-prehistoric-mississippi>
- Morse, D. F., & Morse, P. A. (1983). *Archaeology of the Central Mississippi*. San Diego, CA: Academia Press, Inc.
- MSDH. (2015a, December). *Bureau of Public Water Supply*. Retrieved December 2015, from Mississippi State Department of Health: http://msdh.ms.gov/msdhsite/_static/30,0,76.html
- MSDH. (2015b, December). *Public Water Supply: Questions and Answers*. Retrieved December 2015, from Mississippi State Department of Health: http://msdh.ms.gov/msdhsite/_static/30,425,76.html
- MSDH. (2015c, December). *Consumer Confidence Reports*. Retrieved December 2015, from Mississippi State Department of Health: http://msdh.ms.gov/msdhsite/_static/30,0,76,449.html
- MSDH. (2015d, December). *2014 Water Systems Compliance Report*. Retrieved December 2015, from Mississippi State Department Compliance Report: http://msdh.ms.gov/msdhsite/_static/resources/6288.pdf
- MSPA. (2015a, December). *About US*. Retrieved December 2015, from Mississippi Port Authority: <http://shipmspa.com/carriers-customers/#sthash.yVw6WMWO.dpbs>
- MSPA. (2015b, December). *Facilities*. Retrieved December 2015, from Mississippi Port Authority: <http://shipmspa.com/carriers-customers/facilities/#sthash.vT6gK8Wg.dpbs>
- MSPA. (2015c, December). *Commodities*. Retrieved December 2015, from Mississippi Port Authority: <http://shipmspa.com/carriers-customers/commodities/#sthash.PXw0Og8e.dpbs>
- MSPA. (2015d, December). *Rail, Trucking and Warehousing*. Retrieved December 2015, from Mississippi Port Authority: <http://shipmspa.com/carriers-customers/rail-trucking-warehousing/#sthash.6snZ0oFk.dpbs>
- NAS. (2015a). *Mississippi Flyway*. Retrieved from Mississippi Flyway: <https://www.audubon.org/mississippi-flyway>

- NAS. (2015b). *Important Bird Areas of Mississippi*. Retrieved July 20, 2016, from Important Bird Areas of Mississippi: <http://netapp.audubon.org/IBA/State/US-MS>
- NAS. (2015c). *Important Bird Areas*. Retrieved from <http://ny.audubon.org/important-bird-areas-12>
- NASA. (2013, July). Final Environmental Impact Statement: Sounding Rockets Program at Poker Flat Research Range. Wallops Island, VA. Retrieved July 1, 2016, from <http://netspublic.grc.nasa.gov/main/NASA%20SRP%20at%20PFRR%20FEIS%20Volume%20I.pdf>
- NASAO. (2015a). *Members*. Retrieved December 2015, from National Association of State Aviation Officials: <http://www.nasao.org/about/members/>
- NASAO. (2015b). *Resources*. Retrieved July 2015, from National Association of State Aviation Officials: <http://www.nasao.org/Resources.aspx>
- NASAO. (2017, June 5). Retrieved from National Association of State Aviation Officials: <http://www.nasao.org/>
- National League of Cities. (2007). *National League of Cities*. (Census of Governments) Retrieved May 21, 2015, from Subcounty, General-Purpose Governments by Population-Size Group and State: <http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-structures/number-of-municipal-governments-and-population-distribution>
- National Parks Conservation Association. (2015). *Find a Park: NPCA Southeast Region*. Retrieved 7 8, 2015, from <https://www.npca.org/regions/southeast>
- National Recreation Trails. (2015). *National Recreation Trails Database*. Retrieved November 3, 2015, from <http://www.americantrails.org/NRTDatabase/trailList.php?usrTrailName=&usrTrailState=MO&usrTrailCounty=&usrTrailUse=>
- National Register of Historic Places. (1981). *Four Building Act of 1926 Post Offices and Thirty-Two Public Works Administration Post Offices Thematic Resources*. Memphis: United State Postal Service.
- National Register of Historic Places. (1996). *State Parks in Mississippi built by the CCC between 1934 - 1942*. Jackson: Mississippi Department of Archives and History.
- National Wild and Scenic Rivers. (2015a). *Black Creek, Mississippi*. Retrieved December 10, 2015, from <http://www.rivers.gov/rivers/black-ms.php>
- National Wild and Scenic Rivers. (2015b). *Black Creek, Mississippi*. Retrieved April 8, 2015, from National Wild and Scenic Rivers System: <https://www.rivers.gov/rivers/black-ms.php>
- Natural Resources Management and Environment Department. (2017). *Definitions*. Retrieved June 5, 2017, from Land Cover Classification System: <http://www.fao.org/docrep/003/x0596e/x0596e01e.htm>
- NCED. (2015). *State of Mississippi and All Easements*. Retrieved December 7, 2015, from National Conservation Easement Database: <http://conservationeasement.us/reports/easements>
- NDES. (2014). *Geologic Mapping Program*. Retrieved August 2015, from <http://des.nh.gov/organization/commissioner/gsu/gmp/categories/overview.htm>
- NECWA. (2007). *The Finback Whale (Balaenoptera physalus)*. Retrieved from The Finback Whale (Balaenoptera physalus): <http://www.necwa.org/finback.html>
- NIH. (2015, June). *What is TOXMAP?* Retrieved from National Institutes of Health: <http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html>

- NIST. (2015, March). *Nationwide Public Safety Broadband Network Deployment: Network Parameter Sensitivity Analysis*. U.S. Department of Commerce. National Institute of Standards and Technology (NIST), Wireless Networks Division, Communications Technology Laboratory. Retrieved from <http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8039.pdf>
- NOAA. (2003). *Critical habitat Gulf sturgeon*. Retrieved from <http://www.nmfs.noaa.gov/pr/pdfs/fr/fr68-13370.pdf>
- NOAA. (2005). *Final Gulf Council EFH Amendment*. Retrieved from http://gulfcouncil.org/Beta/GMFMCWeb/downloads/FINAL3_EFH_Amendment.pdf#page=16
- NOAA. (2009). *Amendment 1 to the consolidated highly migratory species fisheries management plan*. Retrieved from <http://www.fisheries.noaa.gov/sfa/hms/documents/fmp/index.html>
- NOAA. (2010). *Essential fish habitat conservation mandate (Gulf of Mexico region)*. Retrieved from http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/generic/documents/pdfs/2013/gom_efh_guide_2010.pdf
- NOAA. (2011a, May 27). *Tornado Outbreak April 25-27, 2011*. Retrieved December 14, 2015, from http://www.srh.noaa.gov/jan/?n=2011_04_25_27_svr
- NOAA. (2011b, September 14). *Smith/Jasper/Clarke Counties Tornado*. Retrieved December 14, 2015, from http://www.srh.noaa.gov/jan/?n=2011_04_25_27_svr_smith_jasper_clarke
- NOAA. (2011c, December). *Service Assessment - The Historic Tornadoes of April 2011*. Retrieved December 14, 2015, from http://www.nws.noaa.gov/os/assessments/pdfs/historic_tornadoes.pdf
- NOAA. (2012). *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. Climate Program Office. Silver Spring: National Oceanic and Atmospheric Administration. Retrieved March 10, 2016, from http://scenarios.globalchange.gov/sites/default/files/NOAA_SLR_r3_0.pdf
- NOAA. (2013a). *Fin whale (Balaenoptera physalus)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm>
- NOAA. (2013b). *Humpback whale-Gulf of Maine*. Retrieved from http://www.nmfs.noaa.gov/pr/sars/2013/ao2013_humpbackwhale-gulfofmaine.pdf
- NOAA. (2014a). *Hawksbill sea turtle (Eretmochelys imbricata)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm>
- NOAA. (2014b). *Loggerhead turtle (Caretta caretta)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm>
- NOAA. (2014c). *Loggerhead turtle (Caretta caretta)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm>
- NOAA. (2014d). *Critical habitat loggerhead sea turtle*. Retrieved from <https://www.federalregister.gov/articles/2014/07/10/2014-15748/endangered-and-threatened-species-critical-habitat-for-the-northwest-atlantic-ocean-loggerhead-sea>
- NOAA. (2015a, August 25). *A Look Back at Hurricane Katrina*. Retrieved December 14, 2015, from http://www.srh.noaa.gov/jan/?n=2005_08_29_hurricane_katrina_outbreak
- NOAA. (2015b). *Flood Related Hazards*. Retrieved July 2015, from <http://www.floodsafety.noaa.gov/hazards.shtml>

- NOAA. (2015c). *Grand Bay National Estuarine Research Reserve*. Retrieved December 8, 2015, from <http://nerrs.noaa.gov/reserves/grand-bay.html>
- NOAA. (2015d). *Guide to essential fish habitat descriptions*. Retrieved from <http://www.greateratlantic.fisheries.noaa.gov/hcd/list.htm>
- NOAA. (2015e). *Essential fish habitat mapper*. Retrieved from <http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html>
- NOAA. (2015f). *Humpback whale (Megaotera novaeangliae)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/mammals/whales/humpback-whale.html>
- NOAA. (2015g). *Kemp's ridley turtle (Lepidochelys kempii)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/kempstridley.htm>
- NOAA. (2015h). *Leatherback turtle (Dermochelys coriacea)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm>
- NOAA. (2015i). *National Oceanic and Atmospheric Administration*. Retrieved from Data Tools: 1981 - 2010 Normals: <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>
- Northwest corner - Billie Eaton House, Old Natchez Trace, Tishomingo, Tishomingo County, MS. (1933). *Library of Congress Prints and Photographs Online Catalog*. Tishomingo, Mississippi: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/hhh.ms0039.photos/?sp=1>
- NPS. (1995, July 12). *National Park Service*. Retrieved September 4, 2015, from The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes: <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm>
- NPS. (2000). *Geologic Glossary*. Retrieved August 2015, from <https://www.nature.nps.gov/geology/usgsnps/misc/glossaryDtoI.html#G>
- NPS. (2010). *Geologic Resources Inventory Scoping Summary -- Natchez Trace Parkway -- Mississippi, Alabama, Tennessee*. Retrieved December 2015, from https://www.nature.nps.gov/geology/inventory/publications/reports/NATR_GRI_scoping_summary_2010-0804.pdf
- NPS. (2011, May 19). *Connecting with Native Americans*. Retrieved April 12, 2015, from http://www.nps.gov/history/tribes/Heritage_Areas.htm
- NPS. (2012a). *Mississippi*. Retrieved December 7, 2015, from National Natural Landmarks Program: <http://www.nature.nps.gov/nnl/state.cfm?State=MS>
- NPS. (2012b, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from <http://nature.nps.gov/nnl/index.cfm>
- NPS. (2012c, June 28). *National Natural Landmarks Program*. Retrieved June 22, 2015, from <http://www.nature.nps.gov/nnl/state.cfm?State=MS>
- NPS. (2012d, June 28). *Chestnut Oak Disjunct*. Retrieved December 12, 2015, from <http://www.nature.nps.gov/nnl/site.cfm?Site=CHOA-MS>
- NPS. (2013, December 10). *Geologic Hazards*. Retrieved September 1, 2015, from Geologic, Energy, and Mineral Resources: <http://www.nature.nps.gov/geology/hazards/>
- NPS. (2014a, June 20). *Prohibition of Unmanned Aircraft in National Parks*. Retrieved June 2015, from <https://www.nps.gov/gaar/learn/news/prohibition-of-unmanned-aircraft-in-national-parks.htm>
- NPS. (2014b, 02 24). *National Trails System*. Retrieved August 13, 2015, from http://www.nps.gov/nts/nts_trails.html

- NPS. (2014c, October 22). *National Natural Landmarks Program*. Retrieved April 21, 2015, from <http://nature.nps.gov/nnl/index.cfm>
- NPS. (2014d, September). *Mississippi*. Retrieved December 2015, from <http://www.nps.gov/state/ms/index.htm>
- NPS. (2014e, 06 16). *National Park Service Science of Sound*. Retrieved 07 22, 2015, from <http://www.nature.nps.gov/sound/science.cfm>
- NPS. (2015a). *Geology of the Coastal Plain*. Retrieved April 2015, from http://www.nps.gov/cue/geology/geo_coastalplain.htm
- NPS. (2015b). *Plants of the Rivers, Lakes, and Wetlands*. Retrieved December 6, 2015, from <http://www.nps.gov/miss/learn/nature/plants-wetlands.htm>
- NPS. (2015c). *Gulf Islands National Seashore*. Retrieved December 2015, from <http://www.nps.gov/guis/index.htm>
- NPS. (2015d). *Natchez National Historical Park*. Retrieved December 2015, from <http://www.nps.gov/natc/index.htm>
- NPS. (2015e). *National Park Service, Find A Park - Mississippi*. Retrieved December 2015, from <http://www.nps.gov/state/ms/index.htm>
- NPS. (2015f). *National Heritage Areas: A Map of All the National Heritage Areas*. Retrieved May 2015, from National Park Service: <http://www.nps.gov/maps/full.html?mapId=01a03739-ab0c-40eb-bc3d-6791d3bb67fa>
- NPS. (2015g, April 27). *National Historic Landmarks Program*. Retrieved April 28, 2015, from <http://www.nps.gov/nhl/INDEX.htm>
- NPS. (2015h, April 15). *Mississippi National Historic Landmarks*. Retrieved December 12, 2015, from www.nps.gov/nhl/find/statelists/ms/MS.pdf
- NPS. (2015i, October 14). *Alabama*. Retrieved October 14, 2015, from <http://www.nps.gov/state/al/index.htm>
- NPS. (2015j, June 17). *Mississippi*. Retrieved December 12, 2015, from <http://www.nps.gov/state/ms/index.htm>
- NPS. (2015k, December 14). *Gulf Islands National Seashore*. Retrieved December 14, 2015, from <http://www.nps.gov/media/photo/gallery.htm?id=89CDC44E-1DD8-B71C-070C285AEC7E1E05>
- NPS. (2015l, December 12). *Wilderness*. Retrieved December 12, 2015, from <http://wilderness.nps.gov/faqnew.cfm>
- NPS. (2015m). *National Register of Historic Places Program: Fundamentals*. Retrieved September 23, 2015, from http://www.nps.gov/nr/national_register_fundamentals.htm
- NPS. (2015n). *National Park Service*. Retrieved December 16, 2015, from <http://www.nps.gov/sapu/learn/historyculture/abo.htm>
- NPS. (2015o, August 3). *Connecticut National Park Service*. Retrieved 8 7, 2015, from <http://www.nps.gov/state/ct/index.htm>
- NPS. (2016, June). *National Historic Landmarks Program*. Retrieved from <https://www.nps.gov/nhl/learn/intro.htm>
- NPS. (2017, June 5). *Trail of Tears: A Journey of Injustice*. Retrieved from <https://www.nps.gov/trte/index.htm>
- NRCS. (1996a). *Soil Quality Resource Concerns: Soil Erosion*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051278.pdf
- NRCS. (1996b). *Soil Quality Resource Concerns: Compaction*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051594.pdf

- NRCS. (1999). *Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys*. Retrieved from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf
- NRCS. (2000, March). *Soil Quality - Urban Technical Note No. 1*. Retrieved from Erosion and Sedimentation on Construction Sites: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053285.pdf
- NRCS. (2003). *Soil Compaction: Detection, Prevention, and Alleviation*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053258.pdf
- NRCS. (2006). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. Retrieved May 2015, from Major Land Resource Area: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf
- NRCS. (2009). *Protecting pollinators*. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/newsroom/photos/?cid=nrcs144p2_057907
- NRCS. (2015a). *What is Soil?* Retrieved June 2015, from Soil Education: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054280
- NRCS. (2015b). *Twelve Orders of Soil Taxonomy*. Retrieved August 2015, from Soils: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053588
- NRCS. (2015c). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved Nov 16, 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf
- NRCS. (2015d). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved July 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf
- NRCS. (2015e). *STATSGO2 Database*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053629
- NRCS. (2015f). *Hydric Soils -- Introduction*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961
- NRCS. (2015g). *Erosion*. Retrieved September 2015, from <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/erosion/>
- NTFI. (2005). *Why Can't We Talk? Working Together to Bridge the Communications Gap to Save Lives: A Guide for Public Officials*. U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. National Task Force on Interoperability (NTFI). Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/204348.pdf>
- NTIA. (2005, October). *Interference Protection Criteria Phase 1 - Compilation from Existing Sources*. Retrieved January 6, 2016, from NTIA Report 05-432: https://www.ntia.doc.gov/files/ntia/publications/ipc_phase_1_report.pdf
- NTIA. (2010a). *Broadband USA: State of Mississippi Fact Sheet*. Retrieved December 3, 2015, from http://www2.ntia.doc.gov/files/grantees/factsheet_state_of_mississippi.pdf
- NTIA. (2010b). *Executive Office of Mississippi [BTOP Infrastructure Grant]*. Retrieved 10 2015, December, from <http://www2.ntia.doc.gov/grantee/executive-office-of-the-state-of-mississippi>
- NTIA. (2014). *Download Data*. Retrieved from National Broadband Map: <http://www.broadbandmap.gov/data-download>
- NWR. (2015). *Ecoregions*. Retrieved from Federation, National Wildlife: <http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecoregions.aspx>

- NWS. (2006). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration:
http://www.srh.noaa.gov/jetstream//global/climate_max.htm
- NWS. (2009, June 25). *Glossary: C*. Retrieved from
<http://w1.weather.gov/glossary/index.php?letter=c>
- NWS. (2011, October 21). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration:
<http://www.srh.noaa.gov/jetstream//global/climate.htm#map>
- NWS. (2015a). *Flooding in Mississippi*. Retrieved from
<http://www.floodsafety.noaa.gov/states/ms-flood.shtml>
- NWS. (2015b). *Mississippi Fall Severe Weather Preparedness Week*. Retrieved from
http://www.srh.noaa.gov/jan/?n=swpw_fall_severethunderstorms
- NWS. (2016, May 13). *Office of Climate, Water, and Weather Services*. Retrieved December 7, 2015, from 2014 Summary of Hazardous Weather Fatalities, Injuries, and Damage by State: <http://www.nws.noaa.gov/om/hazstats/state14.pdf>
- ODG. (2015). *Earthquake Hazards in the Pacific Northwest*. Retrieved March 2015, from
<http://www.oregongeology.org/sub/earthquakes/EQs.htm>
- OECD. (2003, March 12). *Recreational Land*. Retrieved from Glossary of Statistical Terms:
<https://stats.oecd.org/glossary/detail.asp?ID=2256>
- Office of the Mississippi State Climatologist. (2015). *Mississippi State University*. Retrieved from <http://geosciences.msstate.edu/scClimate.htm>
- Olcott, P. G. (1995a). *Carbonate-Rock Aquifers, HA 730-M*. Retrieved May 5, 2015, from
http://pubs.usgs.gov/ha/ha730/ch_m/M-text4.html
- Olcott, P. G. (1995b). *Sandstone Aquifers, HA-730-M*. Retrieved May 5, 2015, from
http://pubs.usgs.gov/ha/ha730/ch_m/M-text5.html
- OSHA. (2002). *Occupational Safety & Health Administration We Can Help*. Retrieved from Hearing Conservation: <https://www.osha.gov/Publications/OSHA3074/osha3074.html>
- OSHA. (2003). *Fact Sheets on Natural Disaster Recovery: Flood Cleanup*. Retrieved December 2013, from https://www.osha.gov/OshDoc/data_Hurricane_Facts/Bulletin2.pdf
- OSHA. (2015). *Communication Towers*. Retrieved from
<https://www.osha.gov/doc/topics/communicationtower/index.html>
- OSHA. (2016a). *OSHA Technical Manual: Noise*. Retrieved May 2016, from Section III: Chapter 5: https://www.osha.gov/dts/osta/otm/new_noise/
- OSHA. (2016b, March 28). *Regulations (Standards - 29 CFR)*. Retrieved from Occupational Safety & Health Administration:
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867
- OSHA. (2016c). *Restoring Communications Systems*. Retrieved February 16, 2016, from Infrastructure Repair and Restoration:
<https://www.osha.gov/SLTC/etools/hurricane/communications.html>
- OSHA. (2016d, May 29). *Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring*. Retrieved from https://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html
- OSHA. (2017). *Recommended Practices for Safety and Health Programs*. (S. L. OSHA Directorate of Technical Support and Emergency Management, & U. Salt Lake City, Editors) Retrieved June 2, 2017, from <https://www.osha.gov/shpguidelines/index.html>

- Page, S. D. (2012, October 15). *Timely Processing of Prevention of Significant Deterioration (PSD) Permits when EPA or a PSD-Delegated Air Agency Issues the Permit*. Retrieved April 21, 2015, from <https://www.epa.gov/nsr/timely-processing-prevention-significant-deterioration-psd-permits-when-epa-or-psd-delegated-air>
- Panagopoulos, D. M. (2008). Mobile Telephony Radiation Effects on Living Organisms. In .. H. Buress (Ed.), *Mobile Telephones* (pp. 107-149). Nova Science Publishers, Inc.
- Peacock, E. (1987, May). *The Prehistory of Hunting and Fishing*. Retrieved December 2015, from Mississippi Archaeological Association: <http://www.msarchaeology.org/maa/peacock1.pdf>
- Port of Pascagoula. (2015a, December). *Location*. Retrieved December 2015, from Port of Pascagoula: <http://www.portofpascagoula.com/location.html>
- Port of Pascagoula. (2015b, December). *About Us*. Retrieved December 2015, from Port of Pascagoula: <http://www.portofpascagoula.com/about.html>
- Port of Pascagoula. (2015c, December). *Public Terminals/Inland Transportation*. Retrieved December 2015, from Port of Pascagoula: <http://www.portofpascagoula.com/terminals.html>
- Port of Pascagoula. (2015d, December). *Port Facts and Stats*. Retrieved December 2015, from Port of Pascagoula: <http://www.portofpascagoula.com/port-facts.html>
- PP. (2017a). *The Devonian in Mississippi, US*. Retrieved from The Paleontology Portal: http://paleoportal.org/index.php?globalnav=time_space§ionnav=state&state_id=30&period_id=13
- PP. (2017b). *The Tertiary in Mississippi, US*. Retrieved December 2015, from The Paleontology Portal: http://paleoportal.org/index.php?globalnav=time_space§ionnav=state&state_id=30&period_id=8
- Project 25.org. (2015a, August 28). *P25 Phase1 FDMA System in Service (June 2015)*. Retrieved August 28, 2015, from http://www.project25.org/images/stories/ptig/docs/P25_Phase_1_FDMA_Systems_REV_2_update_June_2015.pdf
- Project 25.org. (2015b, August 28). *P25 Phase 2 TDMA System in Service June 2015*. Retrieved August 28, 2015, from http://www.project25.org/images/stories/ptig/docs/P25_Phase_2_TDMA_Systems_Updated_June_2015.pdf
- ProximityOne. (2015a). *State Population Projections, Outlook 2030*. Retrieved March 2015, from <https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/>
- ProximityOne. (2015b). *State Population Projections, Outlook 2030*. Retrieved March 2015, from <https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/>
- PSC. (2015a, December). *Public Service Commission*. Retrieved December 2015, from Public Service Commission: <http://www.psc.state.ms.us/mpsc/mpsc.html>
- PSC. (2015b, December). *Electric Division*. Retrieved December 2015, from Public Service Commission: <http://www.mpus.ms.gov/utility/electric/electric.html>
- PSC. (2015c, December). *Investor-Owned*. Retrieved December 2015, from Public Service Commission: <http://www.psc.state.ms.us/labels/electric/ec/Default.aspx>
- PSC. (2015d, December). *Electric Associations*. Retrieved December 2015, from Public Service Commission: <http://www.psc.state.ms.us/labels/electric/ea/Default.aspx>

- PSC. (2015e, December). *Electric Municipals*. Retrieved December 2015, from Public Service Commission: <http://www.psc.state.ms.us/labels/electric/em/Default.aspx>
- PSCR. (2015). *Location-Based Services R&D Roadmap*. U.S. Department of Commerce, National Institute of Standards and Technology (NIST), Public Safety Communications Research (PSCR). Retrieved from <http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1883.pdf>
- Purdue University. (2015). *Hydrologic Soil Groups*. Retrieved June 2015, from <https://engineering.purdue.edu/mapserve/LTHIA7/documentation/hsg.html>
- Purdue University Consumer Horticulture. (2006). *What is Loam?* Retrieved May 19, 2016, from <https://hort.purdue.edu/ext/loam.html>
- Radbruch-Hall, D., Colton, R., Davies, W., Lucchitta, I., Skipp, B., & Varnes, D. (1982). *Landslide Overview Map of the Conterminous United States*. Retrieved December 2015, from <http://pubs.usgs.gov/pp/pp1183/pp1183.html>
- RadioReference.com. (2015a, December 3). *State of Mississippi Radio Reference*. Retrieved December 3, 2015, from <http://www.radioreference.com/apps/db/?stid=28>
- RadioReference.com. (2015b, December 3). *Hancock County*. Retrieved December 3, 2015, from <https://www.radioreference.com/apps/db/?sid=5034>
- RadioReference.com. (2015c, December 3). *Oktibbeha*. Retrieved December 3, 2015, from <https://www.radioreference.com/apps/db/?sid=8004>
- RadioReference.com. (2015d, December 3). *Mississippi Band of Choctaw Indians (P25)*. Retrieved December 3, 2015, from <https://www.radioreference.com/apps/db/?sid=8016>
- Renken, R. A. (1998). *Ground Water Atlas of the United States, HA 730-F*. Retrieved November 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/index.html
- Rogers, D. J., Olshansky, R., & Rogers, B. R. (2004). *Damage to Foundations From Expansive Soils*. Missouri University of Science and Technology. Retrieved March 23, 2015, from http://web.mst.edu/~rogersda/expansive_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf
- Sacramento County Airport System. (2015). *Sacramento County Airport System Noise Page*. Retrieved 6 10, 2015, from http://www.sacramento.aero/scas/environment/noise/noise_101/
- SCEC. (2015). *State Climate Extremes Committee*. (N. O. Administration, Producer) Retrieved 2015, from National Climatic Data Center: <http://www.ncdc.noaa.gov/extremes/scec/records>
- Shropshire, C. (2015). *Land Mammals of Mississippi*. Retrieved from <http://msacad.org/journal/apriljournal/land.html>
- Smithsonian Institution. (2016). *Glossary -- Courtesy of the Department of Paleobiology, National Museum of Natural History, Washington, DC*. Retrieved May 2016, from <http://paleobiology.si.edu/geotime/main/glossary.html#T>
- Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene Jr., C. R., . . . Tyack, P. L. (2007). *Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations*. Retrieved from http://csi.whoi.edu/sites/default/files/literature/Full%20Text%20Part%20I_1.pdf
- State of Mississippi. (2010a). *2010 Mississippi Code: Title 33 - Military Affairs Chapter 15 - Emergency Management and Civil Defense*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2010/title-33/15/33-15-7>

- State of Mississippi. (2010b). *2010 Mississippi Code: Title 77 - Public Utilities and Carriers*. Retrieved from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2010/title-77>
- State of Mississippi. (2010c). *2010 Mississippi Code: Title 77 - Public Utilities and Carriers Chapter 1 - Public Service Commission*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-77/chapter-1>
- State of Mississippi. (2010d). *2010 Mississippi Code: Title 51 - Waters, Water Resources, Water Districts, Drainage, and Flood Control*. Retrieved from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2010/title-51>
- State of Mississippi. (2010e). *2010 Mississippi Code, Title 39 - Libraries, Arts, Archives, and History, Chapter 7 - Antiques*. Retrieved from <http://law.justia.com/codes/mississippi/2010/title-39/7/>
- State of Mississippi. (2012). *2012 Mississippi Code, Title 49 - Conservation Ecology, Chapter 5 - Fish, Game and Bird Protection and Refuges Mississippi Natural Heritage*. Retrieved from Justia US Law: <http://law.justia.com/codes/mississippi/2012/title-49/chapter-5/mississippi-natural-heritage>
- State of Mississippi. (2013a). *2013 Mississippi Code: Title 49 Conservation and Energy*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-49>
- State of Mississippi. (2013b). *2013 Mississippi Code: Title 53 Oil, Gas, and Other Minerals*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-53>
- State of Mississippi. (2013c). *2013 Mississippi Code: Title 39 - Libraries, Arts, Archives, and History*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-39>
- State of Mississippi. (2013d). *2013 Mississippi Code: Title 33 - Military Affairs*. Retrieved June 2, 2017, from <http://law.justia.com/codes/mississippi/2013/title-33>
- State of Mississippi. (2013e). *2013 Mississippi Code: Title 77 - Public Utilities and Carriers Chapter 1 - Public Service Commission*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-61>
- State of Mississippi. (2013f). *2013 Mississippi Code: Title 65: Highways, Bridges, and Ferries*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-65>
- State of Mississippi. (2013g). *2013 Mississippi Code: Title 65 - Highways, Bridges and Ferries Chapter 1 - Transportation Department Article 1 - In General*. Retrieved June 2, 2017, from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-65/chapter-1/article-1/section-65-1-2>
- State of Mississippi. (2013h). *2013 Mississippi Code: Title 49 - Conservation and Ecology Chapter 3 - Fisheries and Wildlife Research*. Retrieved from JUSTIA US Law: <http://law.justia.com/codes/mississippi/2013/title-49/chapter-3/section-49-3-3/>
- State of Mississippi. (2015a). *About Mississippi*. Retrieved September 16, 2015, from <https://www.ms.gov/content/pages/about.aspx>
- State of Mississippi. (2015b). *Mississippi Code of 1972*. Retrieved December 2015, from <http://www.lexisnexis.com/hottopics/mscode/>
- State of Mississippi Judiciary. (2015a). *MS Code Title 61 Aviation (Mississippi Code of 1972 Unannotated)*. Retrieved December 2015, from <http://courts.ms.gov/mscode/mscode.html> and <http://www.lexisnexis.com/hottopics/mscode/>

- State of Mississippi Judiciary. (2015b). *MS Code, Title 61 Aviation, Chapter 7 Airport Zoning*. Retrieved December 2015, from <http://courts.ms.gov/mscode/mscode.html> and <http://www.lexisnexis.com/hottopics/mscode/>
- Stewart, R. A. (2003). *Mississippi Surface Features and Physiography*. Retrieved December 2015, from Samuel P. Faulkner, PhD: <http://www.marshdoc1.com/physiographic-regions-of-mississippi.html>
- The Administrator of the Environmental Protection Agency. (2014, July 24). *U.S. Environmental Protection Agency's "Policy on Environmental Justice for Working with Federally Recognized Tribes and Indigenous Peoples"*. Retrieved from <https://www.epa.gov/sites/production/files/2015-02/documents/ej-indigenous-policy.pdf>
- The City of Gulfport. (2014). *Building Code - Current Adopted Codes*. Retrieved December 2015, from <http://www.gulfport-ms.gov/buildingcodes.shtml>
- The City of Oxford Mississippi. (2015). *Building Department*. Retrieved December 2015, from <http://www.oxfordms.net/business/building-and-development>
- The Union of Concerned Scientists. (2013, April). *Causes of Sea Level Rise*. Retrieved from http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Causes-of-Sea-Level-Rise.pdf
- The University of Montana. (2017). *List Wilderness Areas by Location*. Retrieved June 5, 2017, from Wilderness Connect: <http://www.wilderness.net/NWPS/stateView?state=MS>
- Thompson, W. (2015). *Surficial Geology Handbook for Southern Maine*. Retrieved July 2015, from http://www.maine.gov/dacf/mgs/explore/surficial/sghandbook/surficial_geology_handbook_for_southern_maine.pdf
- U.S. Bureau of Justice Statistics. (2011, July 26). *Census of State and Local Law Enforcement Agencies*. Retrieved from <http://www.bjs.gov/index.cfm?ty=pbdetail&iid=2216>
- U.S. Census Bureau. (2006). *Government Finance and Employment Classification Manual. 2006_classification_manual*. Retrieved July 2015, from http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf
- U.S. Census Bureau. (2009). *Cumulative Estimates of Resident Population Change for the United States*. Washington, D.C.: U.S Census Bureau.
- U.S. Census Bureau. (2010a). *State Area Measurements and Internal Point Coordinates*. Retrieved September 14, 2015, from <https://www.census.gov/geo/reference/state-area.html>
- U.S. Census Bureau. (2010b). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Retrieved June 2015, from Other Census Urban Area Information - Maps, Shapefiles & References: <http://www.census.gov/geo/reference/ua/urban-rural-2010.html>
- U.S. Census Bureau. (2012a). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas first sorted by state FIPS code, then sorted by UACE code. Retrieved June 2015, from http://www2.census.gov/geo/docs/reference/ua/ua_st_list_all.xls
- U.S. Census Bureau. (2012b). American Community Survey, 2012 1-Year Estimates, Table B01003: Total Population. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B01003&prodType=table

- U.S. Census Bureau. (2013a). *Resident Population of the 50 States, the District of Columbia, and Puerto Rico: Census 2000*. File tab02.xls. Retrieved March 2015, from <https://www.census.gov/population/www/cen2000/maps/respop.html>
- U.S. Census Bureau. (2013b). American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars). Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table
- U.S. Census Bureau. (2013c). American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics. Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table
- U.S. Census Bureau. (2013d). American Community Survey, 2013 1-year Estimates, Table DP03, Selected economic characteristics. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP03&prodType=table
- U.S. Census Bureau. (2013e). American Community Survey, 2013 1-Year Estimates, Table DP04, Selected housing characteristics. Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP04&prodType=table
- U.S. Census Bureau. (2013f). American Community Survey, 2013 1-Year Estimates, Table DP05, Demographic and Housing Estimates. Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP05&prodType=table
- U.S. Census Bureau. (2013g). American Community Survey, 2013 1-Year Estimates, Table S1701: Poverty Status in the Past 12 Months. Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1701&prodType=table
- U.S. Census Bureau. (2014a). *Small Area Income and Poverty Estimates (SAIPE), 2013*. Retrieved March 2015, from <http://www.census.gov/did/www/saipe/data/statecounty/data/2013.html>
- U.S. Census Bureau. (2014b). 2012 Census of Governments: Finance – Surveys of State and Local Government Finances, Table LGF001. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=COG_2012_LGF001&prodType=table
- U.S. Census Bureau. (2015a). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014*. Washington, D.C.: US. Census Bureau, Population Division. Retrieved from <http://factfinder.census.gov/bkmk/table/1.0/en/PEP/2014/PEPANNRES/0400000US28.05000>
- U.S. Census Bureau. (2015b, March 11). *Foreign Trade*. Retrieved July 2015, from United States Census Bureau: <http://www.census.gov/foreign-trade/Press-Release/2013pr/12/ft920/index.html>
- U.S. Census Bureau. (2015c, May 28). *U.S. Census Bureau*. Retrieved May 21, 2015, from State and County Quickfacts: <http://www.census.gov/quickfacts/table/PST045215/28,00>

- U.S. Census Bureau. (2015d). *Population Estimates Program, 2010-2014 Data*. NST-EST2014-alldata. Retrieved March 2015, from <http://www.census.gov/popest/data/national/totals/2014/NST-EST2014-alldata.html>
- U.S. Census Bureau. (2015e). *2014 Population Estimates*. Retrieved June 2015, from Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014 - United States -- Metropolitan Statistical Area: <https://www.census.gov/search-results.html?q=Louisiana&page=1&stateGeo=none&searchtype=web&search.x=0&search.y=0>
- U.S. Census Bureau. (2015f). 2010 Census Summary File 1, Table GCT-PH1, Population, Housing Units, Area, and Density. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_GCTPH1.US01PR&prodType=table
- U.S. Census Bureau. (2015g). American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Retrieved April 2015, from <http://dataferrett.census.gov/>
- U.S. Census Bureau. (2015h). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Other Census Urban Area Information - Maps, Shapefiles & References. Retrieved June 2015, from <http://www.census.gov/geo/reference/ua/urban-rural-2010.html>
- U.S. Census Bureau. (2015i). Census 2000 Summary File 1 (SF 1), Table P001, Total Population. Retrieved July 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>
- U.S. Census Bureau. (2015j). American Community Survey, 2009-2013 5-Year Estimates, Table DP05, Demographic and Housing Estimates. Retrieved August 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>
- U.S. Census Bureau. (2015k). 2009-2013 American Community Survey 5-Year Estimates, Table DP03: Selected economic characteristics. Retrieved April, July 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table
- U.S. Census Bureau. (2015l). American Community Survey, 2009-2013 5-year Estimates, Table DP04, Selected housing characteristics. Retrieved April, July 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP04&prodType=table
- U.S. Census Bureau. (2015m). American Community Survey, 2009-2013 5-Year Summary File, Table B03002, Hispanic or Latino Origin by Race. Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015n). American Community Survey, 2009-2013 5-Year Summary File, Table B17021, Poverty Status of Individuals in the Past 12 Months by Living Arrangement. Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015o). American Community Survey, 2009-2013 5-Year Summary File, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months. Retrieved May 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2016). *American Community Survey (ACS)*. Retrieved March 2016, from <http://www.census.gov/programs-surveys/acs/>
- U.S. Coast Guard. (2011). *National Response Center (2011 Reports)*. Retrieved December 7, 2015, from <http://www.nrc.uscg.mil/IIR/IIRSearch.aspx>

- U.S. Coast Guard. (2015, December 7). *National Response Center (2015 Reports)*. Retrieved December 7, 2015, from <http://www.nrc.uscg.mil/IIR/IIRSearch.aspx>
- U.S. Department of Commerce. (2013a, February). *Metropolitan Statistical Areas of Mississippi*. Retrieved December 4, 2015, from U.S. Census Bureau: http://www2.census.gov/geo/maps/metroarea/stcbsa_pg/Feb2013/cbsa2013_MS.pdf
- U.S. Department of Commerce. (2013b, February 21). *Department of Commerce Environmental Justice Strategy*. Retrieved July 2015, from http://open.commerce.gov/sites/default/files/DOC_Environmental_Justice_Strategy.pdf
- U.S. Department of Commerce. (2015). *Coastline of the United States*. Retrieved from <http://www.infoplease.com/ipa/A0001801.html>
- U.S. Department of Interior. (2008). *Navajo Reservoir RMP/FEA Appendix E Noise*. Retrieved 07 22, 2015, from <https://www.usbr.gov/uc/envdocs/ea/navajo/appdx-E.pdf>
- U.S. Department of the Interior. (2015a, December 7). *e-AMLIS Advanced Query*. Retrieved December 11, 2015, from Office of Surface Mining Reclamation and Enforcement: <http://amlis.osmre.gov/QueryAdvanced.aspx>
- U.S. Department of the Interior. (2015b, December 7). *e-AMLIS, Abandoned Mine Land Inventory System*. Retrieved December 7, 2015, from Office of Surface Mining Reclamation and Enforcement: <http://amlis.osmre.gov/Map.aspx>
- U.S. Department of the Interior. (2015c, May 26). *Mine Fires and Burning Refuse*. Retrieved from Mine Fires: <http://www.osmre.gov/programs/tdt/minefires.shtm>
- U.S. Fire Administration. (2015, June 11). *National Fire Department Census*. Retrieved from <http://apps.usfa.fema.gov/census-download/main/download>
- U.S. Government Publishing Office. (2010, April 5). Title 40 Code of Federal Regulations Part 93.153. Retrieved July 20, 2015, from http://www.ecfr.gov/cgi-bin/text-idx?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93_1153&rgn=div8
- U.S. Government Publishing Office. (2011). *Title 7, Agriculture, Chapter 104 - Plant Protection*. Retrieved from <https://www.gpo.gov/fdsys/pkg/USCODE-2011-title7/pdf/USCODE-2011-title7-chap104.pdf>
- Union of Concerned Scientists. (2011). *Mississippi Delta, LA, USA*. Retrieved from <http://www.climatehotmap.org/global-warming-locations/mississippi-delta-la-usa.html>
- University of California Museum of Paleontology. (2011, May). *Geologic Time Scale*. Retrieved June 2016, from <http://www.ucmp.berkeley.edu/help/timeform.php>
- University of California, Hastings College of Law. (2010). *Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases, Fourth Edition*. Retrieved August 2015, from <http://gov.uchastings.edu/public-law/docs/ejreport-fourthedition1.pdf>
- University of Minnesota. (2001). *Soils and Landscapes of Minnesota*. Retrieved July 2015, from <http://www.extension.umn.edu/agriculture/tillage/soils-and-landscapes-of-minnesota/>
- University of Virginia Weldon Cooper Center. (2015). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file *USProjections_2020to2040_all_data_updated_noshapefile.zip*. Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- USACE. (2015a). *Grenada Lake History*. Retrieved December 11, 2015, from <http://www.mvk.usace.army.mil/Missions/Recreation/GrenadaLake/HistoryandMission.aspx>

- USACE. (2015b). *Sardis Lake History*. Retrieved December 11, 2015, from <http://www.mvk.usace.army.mil/Missions/Recreation/SardisLake/HistoryandMissions.aspx>
- USACE. (2017). *Nationwide Permits*. Retrieved June 5, 2017, from <http://www.mvk.usace.army.mil/Missions/Regulatory/Permits/Nationwide-Permits/>
- USACE Vicksburg District. (2015). *Nationwide Permits*. Retrieved December 7, 2015, from <http://www.mvk.usace.army.mil/Missions/Regulatory/Permits/NationwidePermits.aspx>
- USDA. (2014a). *2012 Census of Agriculture, Mississippi*. Retrieved December 2015, from http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Mississippi/
- USDA. (2014b). *2014 State Agriculture Overview, Mississippi*. Retrieved December 2015, from http://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=MISSISSIPPI
- USDA. (2015a). *Mississippi Wetlands Reserve Program*. Retrieved December 7, 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ms/programs/easements/acep/?cid=nrcs142p2_017233
- USDA. (2015b). *Ecoregions of the United States*. Retrieved from <http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/>
- USDA. (2015c). *Plant Pests and Diseases*. Retrieved from https://www.aphis.usda.gov/wps/portal/aphis/ourfocus/planthealth?1dmy&urile=wcm%3Apath%3a%2FAPHIS_Content_Library%2FSA_Our_Focus%2FSA_Plant_Health%2FSA_Domestic_Pests_And_Diseases
- USDOT. (2015a). *National Transportation Atlas Database*. Retrieved July 2015, from Bureau of Transportation Statistics National Transportation Atlas Database: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html
- USDOT. (2015b). *National Transportation Atlas Database*. Retrieved 2015 August, from http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html
- USEPA. (1973, July 27). *National Service Center for Environmental Publications - Impact Characterization of Noise. (NTID 73.4)*. Retrieved August 5, 2015, from USEPA.gov: <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9101DPQN.TXT>
- USEPA. (1974, March). *Information On Levels Of Environmental Noise Requisite To Protect Public Health and Welfare With An Adequate Margin Of Safety*. Retrieved from <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=2000L3LN.TXT>
- USEPA. (1979, March 19). Notification to Federal Land Manager Under Section 165(d) of the Clean Air Act. Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/fdlnmgr.pdf>
- USEPA. (1992, October 19). *Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts, U.S. Environmental Protection Agency*. (J. S. Seitz, Ed.) Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/class1.pdf>
- USEPA. (1995). *America's wetlands: Our vital link between land and water*. Retrieved April 21, 2015, from U.S. Environmental Protection Agency, EPA843-K-95-001: <http://water.epa.gov/type/wetlands/fish.cfm>

- USEPA. (2010, March 24). Revisions to the General Conformity Regulations. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity/final-revisions-general-conformity-regulations>
- USEPA. (2011, December 12). *CERCLA Overview*. Retrieved from EPA Superfund: <http://www.epa.gov/superfund/policy/cercla.htm>
- USEPA. (2012a). *Water: Estuaries and Coastal Watersheds*. Retrieved April 5, 2015, from Basic Information about Estuaries: <http://water.epa.gov/type/oceb/nep/about.cfm>
- USEPA. (2012b, May). *List of 156 Mandatory Class I Federal Areas*. Retrieved April 20, 2015, from Visibility: <http://www3.epa.gov/airquality/visibility/class1.html>
- USEPA. (2012c). *Climate Change Indicators in the United States 2012*. Retrieved October 2013, from <https://www3.epa.gov/climatechange/pdfs/climateindicators-full-2012.pdf>
- USEPA. (2012d, November 01). *Fact Sheet - Managing Ozone Air Quality: Findings on Failure to Submit Elements of 1997 Ozone NAAQS State Implementation Plan*. Retrieved July 21, 2015, from <http://www.epa.gov/groundlevelozone/fs20080317.html>
- USEPA. (2013a, February 21). *EPA Terminology Services (TS)*. (U.S. Environmental Protection Agency) Retrieved July 28, 2015, from http://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do
- USEPA. (2013b, August 13). *General Conformity*. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity>
- USEPA. (2013c, August 8). The Clean Air Act Amendments of 1990 List of Hazardous Air Pollutants. Retrieved April 20, 2015, from <http://www.epa.gov/ttn/atw/orig189.html>
- USEPA. (2014a). *Watershed Assessment, Tracking & Environmental Results System*. Retrieved December 2, 2015, from Mississippi Assessment Data for 2012: http://ofmpub.epa.gov/tmdl_waters10/attains_state.control?p_state=MS
- USEPA. (2014b, October 28). Who Has to Obtain a Title V Permit. *Title V Operating Permits*. Retrieved April 20, 2015, from <https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit>
- USEPA. (2014c, July). *U.S. Greenhouse Gas Inventory Report 1990-2013*. Retrieved 07 28, 2015, from Greenhouse Gas Emissions: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#data>
- USEPA. (2014d, October 21). National Ambient Air Quality Standards (NAAQS). Retrieved April 20, 2015, from <http://www.epa.gov/air/criteria.html>
- USEPA. (2015a, January). *Chesapeake Bay Glossary*. Retrieved July 15, 2015, from http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Chesapeake%20Bay%20Glossary
- USEPA. (2015b, May). *Sole Source Aquifer Protection Program*. Retrieved July 2015, from <http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/solesourceaquifer.cfm>
- USEPA. (2015c). *What is EPA doing to help restore the Gulf of Mexico?* Retrieved December 8, 2015, from <http://www.epa.gov/gulfofmexico/what-epa-doing-help-restore-gulf-mexico>
- USEPA. (2015d). *USEPA Terms Index*. Retrieved from https://iaspub.epa.gov/sor_internet/registry/termreg/
- USEPA. (2015e, December 7). Cleanups in My Community List Results. Retrieved December 7, 2015, from

- [http://ofmpub.epa.gov/apex/cimc/f?p=108:35:15391560285498:::35:P35_State_code,P35_ADV_QUERY:MS,\(\(SF_EI_HE_CODE=%27N%27\)\)](http://ofmpub.epa.gov/apex/cimc/f?p=108:35:15391560285498:::35:P35_State_code,P35_ADV_QUERY:MS,((SF_EI_HE_CODE=%27N%27)))
- USEPA. (2015f). *Environmental Justice*. Retrieved July 2015, from <https://www.epa.gov/environmentaljustice>
- USEPA. (2015g). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved July 2015, from <http://www2.epa.gov/ejscreen>
- USEPA. (2015h, July 17). Technology Transfer Network - Basic Information. Retrieved July 17, 2015, from http://cfpub.epa.gov/oarweb/mkb/basic_information.cfm
- USEPA. (2015i, January 30). Designations. Retrieved April 20, 2015, from <http://www.epa.gov/airquality/greenbook/define.html>
- USEPA. (2015j, July 14). *Air Permit Programs*. Retrieved April 20, 2015, from Air Quality Planning and Standards: <http://www3.epa.gov/airquality/permj.mp.html>
- USEPA. (2015k, December 7). *Cleanups in my Community*. Retrieved December 7, 2015, from http://ofmpub.epa.gov/apex/cimc/f?p=cimc:73:::71:P71_WELSEARCH:MS|State|MS|||true|true|true|true|true|-1|sites|N|basic
- USEPA. (2015l, December 7). Cleanups in My Community List Results. Retrieved December 7, 2015, from [http://ofmpub.epa.gov/apex/cimc/f?p=108:35:15391560285498:::35:P35_State_code,P35_ADV_QUERY:MS,\(\(RCRA_EI_HE_CODE=%27N%27\)\)](http://ofmpub.epa.gov/apex/cimc/f?p=108:35:15391560285498:::35:P35_State_code,P35_ADV_QUERY:MS,((RCRA_EI_HE_CODE=%27N%27)))
- USEPA. (2015m, May 28). *EPA Awards \$400K in Brownfields Grants to Cleanup and Revitalize West Point, Mississippi*. Retrieved December 11, 2015, from <http://yosemite.epa.gov/opa/admpress.nsf/0/1E3303CB49F8923C85257E530061EEC5>
- USEPA. (2015n, November 12). Envirofacts - PCS-ICIS. Retrieved December 7, 2015, from <http://www3.epa.gov/enviro/facts/pcs-icis/search.html>
- USEPA. (2015o, March). *2013 TRI Analysis: State - Mississippi*. Retrieved December 7, 2015, from http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?&pstate=MS&pyear=2013
- USEPA. (2015p, December 7). Envirofacts Search Results. Retrieved December 7, 2015, from http://iaspub.epa.gov/enviro/efsystemquery.multisystem?fac_search=primary_name&fac_value=&fac_search_type=Beginning+With&postal_code=&location_address=&add_search_type=Beginning+With&city_name=&county_name=&state_code=MS&TribalLand=0&TribeType=selectTribe
- USEPA. (2015q, December 7). *Site Information for Southeastern Wood Preserving*. Retrieved December 7, 2015, from http://cumulis.epa.gov/supercpad/cursites/dsp_ssppSiteData1.cfm?id=0402253#Why
- USEPA. (2016a). *Terms & Acronyms Search Page*. Retrieved from https://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do
- USEPA. (2016b, February 21). *Ecoregions of North America*. Retrieved from Western Ecology Division: https://archive.epa.gov/wed/ecoregions/web/html/na_eco.html
- USEPA. (2016c, May 28). *Waste and Cleanup Risk Assessment Glossary*. Retrieved from Vocabulary Catalog: https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Waste%20and%20Cleanup%20Risk%20Assess

- USEPA. (2016d). *Environmental Justice*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/>
- USEPA. (2016e, January). *Overview of the Clean Air Act and Air Pollution*. Retrieved May 21, 2015, from <https://www.epa.gov/clean-air-act-overview>
- USEPA. (2016f, May 18). *Hazardous Air Pollutants*. Retrieved May 25, 2016, from <https://www.epa.gov/haps>
- USEPA. (2016g, May 19). *De Minimis Levels*. Retrieved from <https://www3.epa.gov/airquality/genconform/deminimis.html>
- USEPA. (2016h, December 20). *NAAQS Table*. Retrieved from <https://www.epa.gov/criteria-air-pollutants/naaqs-table>
- USEPA. (2016i, May 29). *Glossary of Climate Change Terms*. Retrieved from <https://www3.epa.gov/climatechange/glossary.html>
- USEPA. (2016j, March). *Grants and Programs*. Retrieved July 2015, from <http://www3.epa.gov/environmentaljustice/grants/index.html>
- USEPA. (2017a, February 27). *Why are wetlands important?* Retrieved from <https://www.epa.gov/wetlands/why-are-wetlands-important>
- USEPA. (2017b, February 13). *Nonattainment Areas for Criteria Pollutants (Green Book)*. Retrieved June 5, 2017, from <https://www.epa.gov/green-book>
- USEPA. (2017c, April 3). *Clean Air Act Title IV - Noise Pollution*. Retrieved from <https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution>
- USFS. (2009a, Sept 30). *Chapter 90 Communications Site Management*. Retrieved Nov 16, 2015, from Forest Service Handbook 2709.11 - Special Uses Handbook: http://www.fs.fed.us/specialuses/documents/Comm_Use_Policy_2709.11_90.doc
- USFS. (2009b). *Soil-Disturbance Field Guide*. USDA. Retrieved from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFS. (2009c). *Mississippi's Forests, 2006*. Retrieved December 2015, from <http://www.srs.fs.usda.gov/pubs/32904>
- USFS. (2015a). *National Forests in Mississippi*. Retrieved December 2015, from <http://www.fs.usda.gov/mississippi>
- USFS. (2015b). *Little Sunflower River Boat Landing*. Retrieved December 2015, from National Forests in Mississippi: https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5213271.pdf
- USFWS. (1977). *Mississippi sandhill crane critical habitat final rule*. Retrieved from http://ecos.fws.gov/docs/federal_register/fr150.pdf
- USFWS. (1983a). *Recovery plan for snail darter*. Retrieved from <http://pbadupws.nrc.gov/docs/ML1217/ML12173A447.pdf>
- USFWS. (1983b). *Recovery plan for snail darter*. Retrieved from <http://pbadupws.nrc.gov/docs/ML1217/ML12173A447.pdf>
- USFWS. (1988). *Ringed sawback turtle recovery plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/Ringed%20Sawback%20Turtle%20RP.pdf
- USFWS. (1989a). *Recovery plan for five tombigbee mussels*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/891114e.pdf
- USFWS. (1989b). *Recovery plan for the fat pocketbook pearly mussel*. Retrieved from https://www.fws.gov/midwest/mussel/documents/fat_pocketbook_recovery_plan.pdf
- USFWS. (1989c). *Recovery plan flat pigtoe*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/891114e.pdf

- USFWS. (1990a). *Recovery plan for the interior population of the least tern*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/900919a.pdf
- USFWS. (1990b). *Recovery plan Alabama red belly turtle*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/900108.pdf
- USFWS. (1990c). *Recovery plan for gopher tortoise*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/901226.pdf
- USFWS. (1990d). *Recovery plan for bayou darter*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/900710.pdf
- USFWS. (1991). *Recovery Plan for Mississippi Sandhill Crane*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/910906.pdf
- USFWS. (1993a). *Recovery plan for yellow blotched turtle*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/930315.pdf
- USFWS. (1993b). *Recovery plan Alabama heelsplitter*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/930413.pdf
- USFWS. (1993c). *Recovery plan for pondberry*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/930923a.pdf
- USFWS. (1993d). *Recovery plan for Price's potato-bean (Apios priceana). Recovery plan for Price's potato-bean (Apios priceana)*. Retrieved from http://www.fws.gov/ecos/ajax/docs/recovery_plans/1993/930210.pdf
- USFWS. (1995). *Recovery plan Gulf sturgeon*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/950922.pdf
- USFWS. (1996). *Recovery plan for Louisiana quillwort*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/960930b.pdf
- USFWS. (1997a). *Gray bat fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/pdf/gray-bat.pdf>
- USFWS. (1997b). *Recovery plan for wood stork*. Retrieved from http://www.fws.gov/northflorida/WoodStorks/Documents/19970127_rpp_Wood-stork-recovery-plan-1997.pdf
- USFWS. (1998, March). *Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf
- USFWS. (1999). *Mitchell's satyr butterfly fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/insects/pdf/mitchell-satyr.pdf>
- USFWS. (2000a). *Recovery plan for Mobile River basin species*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/001117.pdf
- USFWS. (2000b). *Recovery plan oranogenacre mucket*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/001117.pdf
- USFWS. (2000c). *Recovery Plan Ovate Clubshell*. Retrieved from Recovery Plan Ovate Clubshell: http://ecos.fws.gov/docs/recovery_plan/001117.pdf
- USFWS. (2001a). *Recovery plan for Florida manatee*. Retrieved from <http://www.fws.gov/northflorida/Manatee/Recovery%20Plan/manatee-recovery-plan.htm>
- USFWS. (2001b). *Critical habitat piping plover*. Retrieved from <https://www.federalregister.gov/articles/2001/07/10/01-16905/endangered-and-threatened-wildlife-and-plants-final-determination-of-critical-habitat-for-wintering>
- USFWS. (2003a). *Recovery plan for the red-cockaded woodpecker (Picoides borealis)*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/030320_2.pdf

- USFWS. (2003b). *Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for Three Threatened Mussels and Eight Endangered Mussels in the Mobile River Basin*. Retrieved July 19, 2016, from https://www.fws.gov/southeast/hotissues/mussels/proposed_rule.html
- USFWS. (2004a). *Indiana bat (Myotis sodalis)*. Retrieved from <http://www.fws.gov/northeast/pdf/indianabat.fs.pdf>
- USFWS. (2004b). *Designation of Critical Habitat for Five Endangered Mussels in the Tennessee and Cumberland River Basins 69 FR 53136 53180*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2004-08-31/pdf/04-19340.pdf#page=1>
- USFWS. (2004c). *Critical habitat for oranogenacre mucket*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2004-07-01/pdf/04-14279.pdf#page=1>
- USFWS. (2004d). *Critical Habitat for Ovate Clubshell*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2004-07-01/pdf/04-14279.pdf#page=1>
- USFWS. (2004e). *Designation of critical habitat for three threatened mussels and eight endangered mussels in the Mobile River Basin, final rule*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2004-07-01/pdf/04-14279.pdf>
- USFWS. (2005). *Red knot fact sheet*. Retrieved from http://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf
- USFWS. (2006). *Indiana bat (Myotis sodalis) fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/inba/inbafactsht.html>
- USFWS. (2007). *Five year review of fat pocketbook*. Retrieved from <http://www.fws.gov/southeast/5yearReviews/5yearreviews/7Mussels.pdf>
- USFWS. (2008a). *Loggerhead sea turtle recovery plan for northwest Atlantic Ocean population*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/090116.pdf
- USFWS. (2008b). *Ozark Big-eared Bat*.
- USFWS. (2009a). *Soil-Disturbance Field Guide*. Retrieved September 2015, from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFWS. (2009b). *Recovery plan for smalltooth sawfish*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/smalltoothsawfish.pdf
- USFWS. (2011). *Candidate conservation - rabbitsfoot*. Retrieved from <http://www.fws.gov/northeast/pafo/rabbitsfoot.html>
- USFWS. (2012a). *Guidance on developing and implementing an Indiana bat conservation plan*. Retrieved from http://www.fws.gov/northeast/pafo/pdf/IBATconservationplanguidance_PAFO_040412.pdf
- USFWS. (2012b). *Dusky gopher frog critical habitat final rule*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2012-06-12/pdf/2012-13488.pdf>
- USFWS. (2012c). *Sheepnose fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/clams/sheepnose/SheepnoseFactSheetMarch2012.html>
- USFWS. (2012d). *Sheepnose fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/clams/sheepnose/SheepnoseFactSheetMarch2012.html>
- USFWS. (2012e). *Slabside pearlymussel fact sheet*. Retrieved from http://www.fws.gov/daphne/Fact_Sheets/Slabside%20Pearlymussel%20Fact%20Sheet.pdf

- USFWS. (2012f). *Snuffbox fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/clams/snuffbox/SnuffboxFactSheet.html>
- USFWS. (2012g). *bayou darter (Etheostoma rubrum)*. Retrieved July 26, 2016, from <https://www.fws.gov/mississippiES/pdf/bayoudarter/final%20bayou%20darter%20fact%20sheet%20april%202012.pdf>
- USFWS. (2012h). *Rayed bean freshwater mussel (Villosa fabalis)*. Retrieved from <http://www.fws.gov/midwest/endangered/clams/rayedbean/pdf/RayedBeanFactSheet.pdf>
- USFWS. (2013a). *Birds protected by the Migratory Bird Treaty Act*. Retrieved from <http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtintro.html>
- USFWS. (2013b). *Interior least tern 5 year review*. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc4294.pdf
- USFWS. (2013c, February). *Federally Threatened, Endangered, and Candidate Species in Mississippi*. Retrieved July 26, 2016, from https://www.fws.gov/MississippiES/pdf/MS_Species_Habitat_Descriptions_2013.pdf
- USFWS. (2014a). *National Wetlands Inventory website*. Retrieved May 15, 2015, from <http://www.fws.gov/wetlands/>
- USFWS. (2014b). *Candidate species - Section 4 of the Endangered Species Act*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/candidate_species.pdf
- USFWS. (2014c, December 29). *Candidate Conservation/How Can You Help Conservation?* Retrieved from <http://www.fws.gov/endangered/what-we-do/how-you-can-help.html>
- USFWS. (2014d). *Rufa red knot background information and threats assessment*. Retrieved from http://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FIN AL.pdf
- USFWS. (2014e). *Revised recovery plan for the pallid sturgeon*. Retrieved from <http://www.fws.gov/mountain-prairie/species/fish/pallidsturgeon/RecoveryPlan2014.pdf>
- USFWS. (2015a, January 26). *Wetlands Mapper Legend Categories*. Retrieved April 20, 2015, from National Wetland Inventory: <http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html>
- USFWS. (2015aa). *Kemp's ridley sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Kemps-Ridley-Sea-Turtle.pdf>
- USFWS. (2015ab). *Species profile for Kemp's ridley sea turtle (Lepidochelys kempii)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=C00O>
- USFWS. (2015ac). *Leatherback sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Leatherback-Sea-Turtle.pdf>
- USFWS. (2015ad). *Species profile for leatherback sea turtle*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=C00F>
- USFWS. (2015ae). *Loggerhead sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Loggerhead-Sea-Turtle.pdf>
- USFWS. (2015af). *Species profile for loggerhead sea turtle*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=C00U>
- USFWS. (2015ag). *Species profile for Alabama red-belly turtle (Pseudemys alabamensis)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=C01W#crithab

- USFWS. (2015ah, November). *Species profile for black pine snake (Pituophis melanoleucus lodingi)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=C029
- USFWS. (2015ai). *Species profile for black pine snake (Pituophis melanoleucus lodingi)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=C029
- USFWS. (2015aj). *Black pinesnake critical habitat proposed rule*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2015-03-11/pdf/2015-05326.pdf>
- USFWS. (2015ak). *Black pinesnake final rule*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2015-10-06/pdf/2015-25270.pdf>
- USFWS. (2015al). *Species profile for gopher tortoise (Gopherus polyphemus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=C044
- USFWS. (2015am). *Species profile for ringed map turtle (Graptemys oculifera)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=C022
- USFWS. (2015an). *Species profile for yellow-blotched map turtle (Graptemys flavimaculata)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=C025
- USFWS. (2015ao). *Fact sheet Gulf sturgeon*. Retrieved from <http://www.fws.gov/panamacity/resources/SturgeonFactS08.pdf>
- USFWS. (2015ap). *Species profile for Gulf sturgeon (Acipenser oxyrinchus desotoi)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E04W#recovery
- USFWS. (2015aq). *Species profile for bayou darter (Etheostoma rubrum)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E01S
- USFWS. (2015ar). *Species profile for pallid sturgeon (Scaphirhynchus albus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E06X
- USFWS. (2015as). *Species profile for smalltooth sawfish (Pristis pectinata)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E0A9
- USFWS. (2015at). *Final rule for snail darter*. Retrieved from http://ecos.fws.gov/docs/federal_register/fr854.pdf
- USFWS. (2015au, July). *Final rule for snail darter*. Retrieved from http://ecos.fws.gov/docs/federal_register/fr854.pdf
- USFWS. (2015av). *Species profile for snail darter (Percina tanasi)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E010
- USFWS. (2015aw). *Recovery plan for dusky gopher frog*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/2015_07_16_Final%20RP_R_sevosa_08212015%20%281%29.pdf
- USFWS. (2015ax). *Species profile for dusky gopher frog (Rana sevosa)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=D031
- USFWS. (2015ay). *Species profile for Alabama (=inflated) heelsplitter (Potamilus inflatus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F01O#recovery
- USFWS. (2015az). *Species profile for Alabama moccasinshell (Medionidus acutissimus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F038
- USFWS. (2015b, January 26). *Data Limitations, Exclusions and Precautions*. Retrieved May 11, 2015, from <http://www.fws.gov/wetlands/Data/Limitations.html>

- USFWS. (2015ba, October). *Species profile for Alabama moccasinshell (Medionidus acutissimus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F038
- USFWS. (2015bb, March 30). *Federally Threatened and Endangered Invertebrates found in Georgia*. Retrieved from Georgia Ecological Services Field Offices: [http://www.fws.gov/athens/endangered/teinverts%20\(2\).html](http://www.fws.gov/athens/endangered/teinverts%20(2).html)
- USFWS. (2015bc). *Species profile for black clubshell (Pleurobema curtum)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F011
- USFWS. (2015bd). *Species Profile for Cumberlandian combshell (Epioblasma brevidens)*. Retrieved from Species Profile for Cumberlandian combshell (Epioblasma brevidens): <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F01F>
- USFWS. (2015be). *Species profile for fat pocketbook (Potamilus capax)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F00T
- USFWS. (2015bf). *Species profile for flat pigtoe (Pleurobema marshalli)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=F013#recovery
- USFWS. (2015bg). *Species profile for Mitchell's satyr butterfly (Neonympha mitchellii mitchellii)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=I00K>
- USFWS. (2015bh). *Species profile for orangenacre mucket (Lampsilis perovalis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F01S#recovery
- USFWS. (2015bi). *Species profile for rabbitsfoot (Quadrula cylindrica ssp. cylindrica)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F03X>
- USFWS. (2015bj). *Fish and Wildlife Service Southeast Region*. Retrieved from <http://www.fws.gov/southeast/species/invertebrate/rabbitsfoot.html>
- USFWS. (2015bk). *Federal register designation of critical habitat for Neosho mucket and rabbitsfoot, final rule*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2015-04-30/pdf/2015-09200.pdf>
- USFWS. (2015bl). *Species Profile for Sheepnose Mussel (Plethobasus cyphus)*. Retrieved from Species Profile for Sheepnose Mussel (Plethobasus cyphus).
- USFWS. (2015bm). *Species Profile for Slabside Pearlymussel (Pleuroaia dolabelloides)*. Retrieved from Species Profile for Slabside Pearlymussel (Pleuroaia dolabelloides): <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F01Y#recovery>
- USFWS. (2015bn). *Species Profile for Snuffbox mussel (Epioblasma triquetra)*. Retrieved from Species Profile for Snuffbox mussel (Epioblasma triquetra): <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F03J>
- USFWS. (2015bo). *Species profile for southern clubshell (Pleurobema decisum)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F036
- USFWS. (2015bp). *Species profile for southern combshell (Epioblasma penita)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F012
- USFWS. (2015bq). *Species profile for stirrupshell (Quadrula stapes)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F027
- USFWS. (2015br). *Species profile for Louisiana quillwort (Isoetes louisianensis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=S00T
- USFWS. (2015bs). *Species profile for pondberry (Lindera melissifolia)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2CO

- USFWS. (2015bt). *Price's potato-bean*. Retrieved from <http://www.fws.gov/midwest/Endangered/plants/pricesp.html>
- USFWS. (2015bu). *Species profile for Price's potato-bean (Apios priceana)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q1SW#recovery
- USFWS. (2015bv). *Coldwater River National Wildlife Refuge*. Retrieved December 2015, from http://www.fws.gov/refuge/Coldwater_River/
- USFWS. (2015bw). *Dahomey National Wildlife Refuge*. Retrieved December 2015, from <http://www.fws.gov/refuge/Dahomey/>
- USFWS. (2015bx). *Refuge List by State: Mississippi*. Retrieved December 2015, from <http://www.fws.gov/refuges/profiles/ByState.cfm?state=MS>
- USFWS. (2015by, April 12). *Mississippi National Wildlife Refuges*. Retrieved December 12, 2015, from <http://www.fws.gov/refuges/profiles/ByState.cfm?state=MS>
- USFWS. (2015c). *Listed species believed to or known to occur in Mississippi*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=MS&status=listed
- USFWS. (2015d). *Threatened & endangered species active critical habitat report*. Retrieved from <http://ecos.fws.gov/ecp/report/table/critical-habitat.html>
- USFWS. (2015e). *Candidate species believed to or known to occur in Mississippi*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=MS&status=candidate
- USFWS. (2015f). *Species profile for finback whale*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A02O>
- USFWS. (2015g). *Species profile for humpback whale*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A02Q>
- USFWS. (2015h, October). *Species profile for West Indian manatee (Trichechus manatus)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A007>
- USFWS. (2015i). *Species profile for West Indian manatee (Trichechus manatus)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A007>
- USFWS. (2015j). *Species profile for gray bat (Myotis grisescens)*. Retrieved from <https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A04J>
- USFWS. (2015k). *Species profile for Indiana bat (Myotis sodalis)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A000>
- USFWS. (2015l). *Endangered Indiana Bat (Myotis sodalis)*. Retrieved from Endangered Indiana Bat (Myotis sodalis): <https://www.fws.gov/MIDWEST/Endangered/mammals/inba/index.html>
- USFWS. (2015m). *Critical habitat portal*. Retrieved from <http://ecos.fws.gov/crithab/>
- USFWS. (2015n). *Northern long-eared bat fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/nleb/nlebFactSheet.html>
- USFWS. (2015o). *Species profile for northern long-eared bat*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JE>
- USFWS. (2015p). *Species profile for least tern*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B07N
- USFWS. (2015q). *Species profile for Mississippi sandhill crane (Grus canadensis pulla)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B04I
- USFWS. (2015r). *Species profile for piping plover (Charadrius melodus)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079#recovery>

- USFWS. (2015s). *Piping plover, Atlantic Coast population*. Retrieved from <http://www.fws.gov/northeast/pipingplover/overview.html>
- USFWS. (2015t). *Piping plover (Charadrius melodus)*. Retrieved from http://www.fws.gov/charleston/pdf/PIPL_page.pdf
- USFWS. (2015u). *Species profile for red knot (Calidris canutus rufa)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0DM>
- USFWS. (2015v). *Red-cockaded woodpecker recovery*. Retrieved from <http://www.fws.gov/rcwrecovery/rcw.html>
- USFWS. (2015w). *Species profile for red-cockaded woodpecker (Picoides borealis)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B04F>
- USFWS. (2015x). *Species profile for wood stork (Mycteria americana)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B06O
- USFWS. (2015y). *Hawksbill sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/hawksbill-sea-turtle.htm>
- USFWS. (2015z). *Species profile for hawksbill sea turtle (Eretmochelys imbricata)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00E>
- USFWS. (2016a). *USFWS Critical Habitat Map*. Retrieved March 9, 2016, from <http://fws.maps.arcgis.com/home/webmap/viewer.html?webmap=9d8de5e265ad4fe09893cf75b8dbfb77>
- USFWS. (2016b). *Rufa Red Knot (Calidris canutus rufa) [threatened]*. Retrieved July 15, 2016, from <https://www.fws.gov/northeast/njfieldoffice/endangered/redknot.html>
- USFWS. (2016c). *US Counties within Mississippi in which the Alabama Red-Belly turtle, Entire is known to or is believed to occur*. Retrieved July 20, 2016, from <https://ecos.fws.gov/ecp0/profile/countiesByState?entityId=168&state=Mississippi>
- USFWS. (2016d, June 21). *Gopher Tortoise (Gopherus polyphemus)*. Retrieved July 18, 2016, from https://www.fws.gov/northflorida/gophertortoise/gopher_tortoise_fact_sheet.html
- USFWS. (2016e). *US Counties within Mississippi in which the Ovate clubshell, is known to or is believed to occur*. Retrieved July 20, 2016, from <http://ecos.fws.gov/ecp0/profile/countiesByState?entityId=377&state=Mississippi>
- USFWS. (2017a, May 19). *Wetlands Mapper*. Retrieved from National Wetlands Inventory: <https://www.fws.gov/wetlands/data/Mapper.html>
- USFWS. (2017b, March 16). *Endangered and Threatened Wildlife and Plants; Reclassification of the West Indian Manatee From Endangered to Threatened*. Retrieved from <https://www.fws.gov/southeast/pdf/west-indian-manatee-reclassification-final-rule.pdf>
- USGCRP. (2009). *Global Climate Change Impacts in the United States*. Retrieved October 2013, from U.S. Global Change Research Program: <https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>
- USGCRP. (2014a). *National Climate Assessment: Southeast*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/southeast>
- USGCRP. (2014b). *National Climate Assessment: Changes in Storms*. Retrieved July September, 2015, from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/our-changing-climate/changes-storms>
- USGCRP. (2014c). *U.S. Global Change Research Program: Precipitation Change*. Retrieved from National Climate Assessment: <http://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change>

- USGCRP. (2014d). *National Climate Assessment: Coastal Zone Development and Ecosystems*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/coasts#narrative-page-16832>
- USGCRP. (2014e). *National Climate Assessment - Southeast Region*. Retrieved January 4, 2016, from <http://nca2014.globalchange.gov/report/regions/southeast>
- USGCRP. (2014f, April 27). *National Climate Assessment*. Retrieved from Northeast Impacts: <http://nca2014.globalchange.gov/report/regions/northeast#intro-section-2>
- USGCRP. (2014g). *National Climate Assessment - Extreme Weather*. Retrieved October 6, 2015, from <http://nca2014.globalchange.gov/report/our-changing-climate/extreme-weather#intro-section-2>
- USGS. (1981). *Coal Resource Classification System of the U.S. Geological Survey*. Retrieved October 2015, from <http://pubs.usgs.gov/circ/c891/glossary.htm>
- USGS. (1998). *Ground water Atlas of the United States Arkansas, Louisiana, Mississippi HA 730-F*. Retrieved December 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/F-text1.html
- USGS. (1999). *How Ground Water Occurs*. Retrieved February 12, 2013, from U.S. Geological Survey General Interest Publication: http://pubs.usgs.gov/gip/gw/how_a.html
- USGS. (2000). *Land Subsidence in the United States (Fact Sheet 165-00)*. Retrieved September 2013, from <http://water.usgs.gov/ogw/pubs/fs00165/SubsidenceFS.v7.PDF>
- USGS. (2003a). *A Tapestry of Time and Terrain: The Union of Two Maps, Geology and Topography*. Retrieved September 2013
- USGS. (2003b). *National Landslide Hazards Mitigation Strategy – A Framework for Loss Reduction*. Retrieved September 2013, from <http://pubs.usgs.gov/circ/c1244/c1244.pdf>
- USGS. (2010). *What is "Peak Acceleration" or "Peak Ground Acceleration" (PGA)?* Retrieved April 2015, from <http://geohazards.usgs.gov/deaggint/2002/documentation/parm.php>
- USGS. (2011, August). *Gap Analysis Program (GAP)*. Retrieved from National Land Cover, Version 2: <http://gapanalysis.usgs.gov/gaplandcover/data/>
- USGS. (2012a). *Earthquake Glossary - Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/glossary/?term=earthquake>
- USGS. (2012b, November). *Gap Analysis Program (GAP)*. Retrieved from Protected Areas Database of the United States (PADUS), version 1.3 Fee: <http://gapanalysis.usgs.gov/padus/>
- USGS. (2012c, October 12). *Gap Analysis Program, Protected Areas Database of the United States (PADUS) v. 1.3 Fee*. Retrieved October 12, 2015, from <http://gapanalysis.usgs.gov/padus/>
- USGS. (2013a). *Glossary of Glacier Terminology*. Retrieved August 2015, from <http://pubs.usgs.gov/of/2004/1216/text.html#tz>
- USGS. (2013b). *Land Subsidence from Ground-water Pumping*. Retrieved September 2013, from <http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/>
- USGS. (2014a). *Measuring the Size of an Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/topics/measure.php>
- USGS. (2014b). *Understanding Plate Motions*. Retrieved December 2015, from <http://pubs.usgs.gov/gip/dynamic/understanding.html>
- USGS. (2014c). *Mississippi Seismicity Map - 1973 to March 2012*. Retrieved March 2015, from <http://earthquake.usgs.gov/earthquakes/states/mississippi/seismicity.php>
- USGS. (2014d). *Landslide Overview Map of the Conterminous United States*. Retrieved June 2015, from <http://landslides.usgs.gov/hazards/nationalmap/>

- USGS. (2014e, November). *Water Resources of the United States*. Retrieved July 2015, from <http://www.usgs.gov/water/>
- USGS. (2014f). *National Atlas of the United States*. Retrieved Septmeber 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html
- USGS. (2014g, October 10). *National Atlas of the United States*. Retrieved October 10, 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html
- USGS. (2015a, September 8). *Geographic Names Information System (GNIS)*. Retrieved September 8, 2015, from <http://geonames.usgs.gov/apex/f?p=136:1:2933318154716>
- USGS. (2015b). *Water Science Glossary of Terms*. Retrieved June 2015, from <http://water.usgs.gov/edu/dictionary.html#B>
- USGS. (2015c). *Paleontology*. Retrieved July 2015, from <http://www.usgs.gov/science/science.php?term=861>
- USGS. (2015d). *About U.S. Volcanoes*. Retrieved August 2015, from <http://volcanoes.usgs.gov/about/volcanoes/>
- USGS. (2015e). *Structural Geology*. Retrieved July 2015, from <https://mrdata.usgs.gov/catalog/mobile/browse.php?thcode=2&code=1117>
- USGS. (2015f). *Geologic Processes*. Retrieved Nov 16, 2015, from <http://www.usgs.gov/science/science.php?term=1145>
- USGS. (2015g). *Geologic Glossary*. Retrieved December 2015, from <http://geomaps.wr.usgs.gov/parks/misc/glossarya.html>
- USGS. (2015h). *Emergent Wetlands Status and Trends*. Retrieved December 6, 2015, from <http://gom.usgs.gov/GOMEmWetStatusTrends.aspx>
- USGS. (2016a, October). *2012-2013 Minerals Yearbook Mississippi*. Retrieved December 2015, from https://minerals.usgs.gov/minerals/pubs/state/2012_13/myb2-2012_13-ms.pdf
- USGS. (2016b, January 28). *Minerals Commodity Summaries 2016*. Retrieved December 7, 2015, from <http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016.pdf>
- USGS. (2016c, February 10). *Explanations for the National Water Conditions*. Retrieved from Water Resources of the United States: http://water.usgs.gov/nwc/explain_data.html
- USGS. (2017a). *Mineral Commodity Summaries*. Reston: USGS. Retrieved from <http://minerals.usgs.gov/minerals/pubs/mcs/>
- USGS. (2017b, June 5). *Regions Overview*. Retrieved from <https://www2.usgs.gov/state/state.asp?State=MS>
- USGS-NWHC. (2015). *White-nose syndrome*. Retrieved from http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/
- UVA Weldon Cooper Center. (2015). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file USProjections_2020to2040_all_data_udpated_noshapefile.zip. Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- Wax, C. (2015). *Mississippi's "Feast or Famine" Climatic Characteristic*. Retrieved from Mississippi's Climate the Cocorah's State Climates Series: http://www.cocorahs.org/Media/docs/ClimateSum_MS.pdf
- Works Progress Administration. (2009). *Mississippi: The WPA Guide to the Magnolia State*. Jackson: University Press of Mississippi.
- WWF. (2015). *What is an ecoregion?* Retrieved from http://wwf.panda.org/about_our_earth/ecoregions/about/what_is_an_ecoregion/

- Wyde, M. (2016). National Toxicology Program Finds Cell Phone Radiation Causes Cancer. Summary Presentation at BioEM 2016 Meeting, Ghent, Belgium, by M. Wyde, Dir. NTP Studies of Cell Phone Radiation, NIEHS, June 8.
- XSIC. (2015). *The Xerces Society » Satyrs: Mitchell's satyr*. Retrieved from The Xerces Society » Satyrs: Mitchell's satyr: <http://www.xerces.org/mitchells-satyr/>

GIS REFERENCES

- BIA. (2003, December). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2015, from <http://sagemap.wr.usgs.gov/ftp/regional/ind3.html> and <http://www.arcgis.com/home/item.html?id=2e915ef3df48422283e5b2c7d89dfcba>
- BLS. (2015). Socioeconomics: Unemployment. (GIS Metadata) Retrieved August 2015, from Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages.: <http://www.bls.gov/lau/rdsenp16.htm>
- Digital Aeronautical Flight Information File. (2015, June). Land Use, Recreation, and Airspace: MTR Airspace. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: <https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services>
- Digital Aeronautical Flight Information File. (2015, June). Land Use, Recreation, and Airspace: SUA Airspace. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: <https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services>
- Environmental Systems Research Institute (ESRI). (2016). All Maps. (GIS Metadata) Retrieved August 2015, from http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all&_ga=1.174384612.712313298.1421186728&q=rivers&t=group&start=1
- FAA. (2015, June). Infrastructure: Transportation. (GIS Metadata) Retrieved June 2015, from Airport hubs data. Data is updated every 8 weeks. Data downloaded by state: http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). Land Use, Recreation, and Airspace: Composite Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks: http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). Land Use, Recreation, and Airspace: Private Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks. : http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). Land Use, Recreation, and Airspace: Public Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks.: http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FCC. (2014, June). Infrastructure: FCC Towers. (GIS Metadata) Retrieved August 2015, from Data was obtained through a more advanced search by BAH being in direct touch with Cavell, Mertz & Associates to obtain ALL the relevant data across the country.: <http://wireless2.fcc.gov/UlsApp/AsrSearch/asrAdvancedSearch.jsp>

- FCC. (2014, June). Infrastructure: FCC Wireless. (GIS Metadata) Retrieved August 2015, from David F. LaBranche, P.E. Geospatial Information Officer (GIO) OASD (EI&E) 571-372-6768 at Defense Installations Spatial Data Infrastructure (DISDI).: <http://www.broadbandmap.gov/data-download>
- FCC. (2015). Infrastructure: FCC Fiber. (GIS Metadata) Retrieved August 2015, from <http://www.broadbandmap.gov/data-download>
- FHWA. (2015, September 14). Infrastructure: Transportation. (GIS Metadata) Retrieved September 14, 2015, from Byways and National Scenic Trails; Gary A. Jensen; Research Implementation Team Leader; FHWA; 1200 New Jersey Ave, SE Room E76-304: <http://www.fhwa.dot.gov/byways/> https://www.nps.gov/ncrc/programs/nts/nts_trails.html
- FHWA. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved August 2015, from National Scenic Byways Program. Data obtained by Gary A. Jensen, Research Implementation Team Leader, Office of Human Environment HEPH-30, Federal Highway Administration, 1200 New Jersey Avenue, SE Room E76-304, Washington, DC 20590, 202-366-2048, gary.je: <http://www.fhwa.dot.gov/byways/>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from NPS: <https://www.rivers.gov/mapping-gis.php>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). Water Resources: Surface Water / Watershed. (GIS Metadata) Retrieved September 2015, from National Wild and Scenic Rivers Program, NPS, Department of Interior: <https://www.rivers.gov/mapping-gis.php>
- National Audubon Society. (2015). Biological Resources: Important Bird Areas. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally: http://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_Poly/MapServer
- National Conference of State Legislatures. (2010). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2016, from <http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#federal>
- National Heritage Areas Program Office. (2011). Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive. (GIS Metadata) Retrieved August 2015, from Department of Interior, National Parks Service, National Heritage Areas Program Office: <https://www.nps.gov/heritageareas/>
- National Heritage Areas Program Office. (2015, April). Cultural Resources: National Heritage. (GIS Metadata) Retrieved September 2015, from Department of Interior, NPS, National Heritage Areas Program Office: <https://www.nps.gov/heritageareas/>
- Native Languages of the Americas. (2015). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2015, from <http://www.native-languages.org/states.htm>
- NERR. (2012). Water Resources: Estuaries and Critical Resource Waters. (GIS Metadata) Retrieved August 2015, from NOAA, Office of Coastal Management, National Estuarine Research Reserve System (NERRS): <http://cdmo.baruch.sc.edu/get/gis.cfm>
- NPS. (2011). Air Quality: Class 1 Areas. (GIS Metadata) Retrieved August 2015, from <http://science.nature.nps.gov/im/gis/index.cfm>

- NPS. (2015). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior:
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]:
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [National Monuments and Icons]:
http://mapservices.nps.gov/arcgis/rest/services/cultural_resources/nhl_public/MapServer
- NPS. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from United States Park, National Parks Service, Department of Interior [National Scenic and Historic trails]: https://www.nps.gov/ncrc/programs/nts/nts_trails.html
- NPS. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]:
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NRCS. (2006). Soils: Soil Suborders. (GIS Metadata) Retrieved April 2015, from Downloaded by state-level: <https://gdg.sc.egov.usda.gov/>
- NRHP. (2015). Cultural Resources: National Heritage. (GIS Metadata) Retrieved August 2015, from Stutts M. 2014. NRHP. National Register properties are located throughout the U.S. and their associated territories around the globe.:
<https://irma.nps.gov/DataStore/Reference/Profile/2210280>
- U.S. Census Bureau. (2015c). Environmental Justice. (GIS Metadata) Retrieved July 2015, from U.S. Environmental Protection Agency. "EJSCREEN Environmental Justice Mapping and Screening Tool: EJSCREEN Technical Documentation."
<http://www2.epa.gov/ejscreen/technical-documentation-ejscreen>
- U.S. Census Bureau. (2015f, April). Socioeconomics: Population Distribution. (GIS Metadata) Retrieved August 2015, from American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions. 2013_ACSSubjectDefinitions:
http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf
- U.S. Census Bureau. (2015j). Socioeconomics: Median Household Income. (GIS Metadata) Retrieved August 2015, from American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Obtained via Census Bureau online DataFerrett tool.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Environmental Justice. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas:
<http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Median Household Income. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas:
<http://www.census.gov/geo/maps-data/data/tiger-data.html>

- U.S. Census Bureau. (Undated(a)). Socioeconomics: Population Distribution. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code, then USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Unemployment. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code then by USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. DOT Bureau of Transportation Statistics National Transportation Atlas Database. (2015). Infrastructure: Transportation. (GIS Metadata) Retrieved August 2015, from Railroads, Major Highways data:
http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/2015/polyline
- United States National Atlas. (2014). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/
- United States National Atlas. (2014). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/
- USACE. (2015, March 17). Infrastructure: Transportation. (GIS Metadata) Retrieved August 2015, from Port Data. Has since been updated:
<http://www.navigationdatacenter.us/gis/gis1.htm>
- USEPA. (2011). Water Resources: Principal Aquifers. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/dwssa/map-sole-source-aquifer-locations>
- USEPA. (2013). Biological Resources: Ecoregions. (GIS Metadata) Retrieved August 2015, from Level III and IV ecoregions of the continental United States. National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, Map scale 1:3,000,000:
http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm
- USEPA. (2014). Water Resources: Impaired Water. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/waterdata/waters-geospatial-data-downloads>
- USEPA. (2015). Human Health and Safety: TRI. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:
<https://map11.epa.gov/arcgis/rest/services/NEPAssist/NEPAVELayersPublic>
- USEPA. (2015b, April 21). Air Quality: Nonattainment Areas. (GIS Metadata) Retrieved August 2015, from The Green Book Nonattainment Areas for Criteria Pollutants:
https://www3.epa.gov/airquality/greenbook/gis_download.html
- USFWS. (2014). Wetlands. (GIS Metadata) Retrieved August 2015, from State level data layer:
<https://www.fws.gov/wetlands/Data/Data-Download.html>
- USFWS. (2015). Biological Resources: Critical Habitat. (GIS Metadata) Retrieved September 2015, from <https://www.fws.gov/gis/data/national/>
- USFWS. (2015, December 4). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from National Wildlife Refuge Boundaries:
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USFWS. (2015, December 14). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from USFWS National Wildlife Refuge System, Realty Division:
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>

- USGS. (1999 to 2001). Visual Resources: Land Cover. (GIS Metadata) Retrieved August 2015, from USGS GAP Analysis Land Cover, National Land Cover Dataset; Landsat 7 ETM+; Imagery provided for Spring, Summer and Fall dates between 1999 and 2001:
<http://gapanalysis.usgs.gov/gaplandcover/data/download/>
- USGS. (2003, October). Water Resources: Groundwater. (GIS Metadata) Retrieved August 2015, from <http://water.usgs.gov/ogw/aquifer/map.html>
- USGS. (2008). Geology: Karst Subsidence. (GIS Metadata) Retrieved May 2015, from Two data layers within the same source show different varieties of Karst, and were published on different dates:
http://services.arcgis.com/hoKRg7d6zCP8hwp2/arcgis/rest/services/Appalachian_Karst_Features/FeatureServer
- USGS. (2010). Geology: Surface Geology. (GIS Metadata) Retrieved April 2015, from <http://www.arcgis.com/home/item.html?id=2967ae2d1be14a8bf5888b4ac75a01f>
- USGS. (2012). Cultural Resources: Physiographic Provinces. (GIS Metadata) Retrieved April 2015, from Physiographic provinces and regions are made from the same dataset; downloaded by state-level:
http://services.arcgis.com/ZzrwjTRez6FJiOq4/arcgis/rest/services/US_PhysiographicProvinces/FeatureServer
- USGS. (2012). Geology: Landslide Incidence. (GIS Metadata) Retrieved May 2015, from Web service, data is not saved locally:
<https://www.arcgis.com/home/item.html?id=b3fa4e3c494040b491485dbb7d038c8a>
- USGS. (2014). Geology: Seismic Hazard. (GIS Metadata) Retrieved April 2015, from http://services.arcgis.com/VTyQ9soqVukalltT/arcgis/rest/services/USPGA_Seismic_Hazard/FeatureServer
- USGS, Protected Areas of the United States. (2012, 11 30). Land Use, Recreation, and Airspace: Land Ownership. (GIS Metadata) Retrieved August 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update:
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update. :
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, USDA-NRCS, USGS, and USEPA. (2014). Water Resources: Surface Water / Watershed. (GIS Metadata) Retrieved August 2015, from USDA NRCS watershed Boundary Data and Tools:
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/watersheds/dataset/>

Page Intentionally Left Blank.

