Executive Summary

On behalf of the State of Mississippi, the Governor's Office and the Mississippi Hazard Mitigation Council, the Mississippi Emergency Management Agency is submitting this "State of Mississippi Standard Mitigation Plan" for review by the Federal Emergency Management Agency. This Plan is the result of a monumental effort from stakeholders, staff and technical advisors to complete a document that updates the 2018 Standard Mitigation Plan. The updated Plan addresses natural/manmade hazards throughout the state with the expressed purpose of "saving lives and reducing future losses" in anticipation of future events.

Mississippi's Standard Mitigation Plan has been completed with a high degree of public participation. By developing new partnerships and strengthening existing ties with local, state and federal agencies, the Plan reflects the needs of the entire State. Most importantly, the Plan mirrors the mindset of the people of Mississippi, which was learned by carefully listening to ideas and initiatives for hazard mitigation.

"Mitigation Actions" that can be implemented to complete projects that are technically feasible, cost effective and environmentally sound are included within the Plan. It is a "living document" that will be constantly reviewed and updated thus reflecting current strategies and providing opportunities for evaluating the effectiveness of the projects and programs.

While this Plan is being reviewed by the Federal Emergency Management Agency, the State of Mississippi will prepare for full adoption of the plan. This will be accomplished with the following actions:

- The Mississippi Hazard Mitigation Council will review the record of the process and, at the appropriate time, will recommend the adoption of the Plan.
- The Office of the Governor, upon receipt of the Plan with addressed comments and recommendations, and by Executive Order, will adopt the Plan for the State of Mississippi.

This Standard Plan, submitted to the Federal Emergency Management Agency in July 2018 in compliance with local, state and federal requirements, is for the benefit of the people of the State of Mississippi. It is evidence of a great effort by all participants, and the contribution of those involved is greatly appreciated.

The State of Mississippi is continuing to work towards an upgrade from the Standard Plan to "Enhanced Status." This upgrade is an indication of the State's desire to continually improve efforts to mitigate hazards through projects and programs that benefit the people of our State.

The Mississippi Emergency Management Agency hereby submits this Standard Mitigation Plan for consideration by the Federal Emergency Management Agency.

Table of Contents

1. Introduction

1.0 Introduction 1:1

1.1 State Characteristics 1:3

1.2 Plan Adoption 1:15

1.3 Compliance with Federal Laws and Regulations 1:17

2. The Planning Process

2.0 The Planning Process 2:19

2.1 Documenting the Planning Process 2:20

2.2 Coordination with Federal and State Agencies and Interested Groups in the Planning Process 2:22

2.3 Integration with Other Planning Efforts, Programs and Initiatives 2:36

3. Risk Assessment

3.0 Risk Assessment 3:49

3.1 Identifying Hazards 3:53

3.2 Profiling Hazards 3:62

3.3 Tornado Risk Assessment 3:70

3.4 Dam/Levee Failure Risk Assessment 3:103

3.5 Tropical Cyclone Risk Assessment 3:124

3.6 Flood Risk Assessment 3:177

3.7 Wildfire Risk Assessment 3:230

3.8 Drought Risk Assessment 3:246

3.9 Extreme Winter Weather Risk Assessment. 3:254

3.10 Earthquake Risk Assessment 3:271

3.11 Sea Level Rise-Climate Control Risk Assessment 3:272

3.12 Cyberterrorism Risk Assessment 3:273

3.13 Other Significant Hazards Risk Assessment 3:274

3.14 Growth and Development Trends 3:275

3.15 Infrastructure Interdependencies 3:276

4. Comprehensive State Mitigation Program

4.0 Comprehensive State Mitigation Program 4:339

4.1 Goals and Objectives 4:341

4.2 State Capabilities 4:348

4.3 Local Capability Assessment 4:364

4.4 Mitigation Measures 4:373

4.5 Funding Sources 4:386

5. Local Mitigation Planning

5.0 Local Mitigation Planning 5:417

5.1 Local Mitigation Planning Coordination 5:418

5.2 Local Plan Integration 5:422

5.3 Prioritizing Local Technical Assistance 5:425

6. Plan Maintenance Process

6.0 Plan Maintenance Process 6:429

6.1 Monitoring, Evaluating and Updating the Plan 6:430

6.2 Monitoring Progress of Mitigation Actions and Assessment of Mitigation Actions 6:433

7. Appendices

7.0 XXXXXXX

7.1 XXXXXXX

7.2 XXXXXXX

7.3 XXXXXXX

7.4 XXXXXXX

7.5 XXXXXXX

1.0: Introduction

In the 2013 Mississippi State Hazard Mitigation Plan, the State identified the following hazards to be widely significant when carrying out its mission and commitment to saving lives and reducing future losses:

- Flooding
- Extreme Winter Weather
- Earthquakes
- Wildfires
- Hurricanes
- Tornadoes
- Dam and Levee Failures

Fundamentally, the hazards will remain the same; however, Climate Change/Sea Level Rise and Cyberterrorism were added.

In accordance with the Code of Federal Regulations 44 (CFR 44), the Disaster Mitigation Act of 2000, and Section 322 of the Robert Stafford Disaster Relief and Emergency Assistance Act, the State of Mississippi has completed this 2018 State of Mississippi Standard Mitigation Plan Update. The update continues to establish an effective framework in which state mitigation initiatives can be implemented to protect lives and property.

The 2007 Standard Mississippi Hazard Mitigation Plan cited the completion of a State of Mississippi Enhanced Hazard Mitigation Plan at the year's end. It was later determined that the State would be unable to complete the requirements of maintaining an enhanced plan due to its limited resources. The State is continuing to enhance its capabilities. However, the pursuit of an enhanced status was reevaluated again during the 2018 plan update. Although the State has improved in enhancing its capabilities, resources are still limited and fulfilling the requirements of an enhanced plan may prove difficult. As a result, the State will continue to enhance its capabilities to make the goal of becoming an enhanced state. The State will continue to be efficient with its resources and use them to approach the mitigation strategies, goals, and actions that are pertinent to Mississippi's safety.

The completion of the "2018 State of Mississippi Standard Mitigation Plan Update" is a pre-requisite for receiving some Federal disaster assistance. This disaster assistance includes Hazard Mitigation Assistance that is available to the State of Mississippi, as well as local Tribes, Cities and Counties. Participants of the 2018 Plan Update may be able to receive funds and use them to save lives and reduce future losses by planning for mitigation and implementation strategies.

In 2007, Governor Haley Barbour established a State of Mississippi Hazard Council by executive order. The Council is comprised of selected State Agency Officers and Directors and the Executive Directors of the organizations representing Counties and Cities throughout the State. No new members have been added to the Council since 2008. Vibrant, strong, and rich with ideals, the Council met quarterly to track completed mitigation strategies and actions, to brainstorm new mitigation strategies, and to review current goals and initiatives. In the 2018 plan update, the Council decided to hold meetings twice yearly. A listing of agencies represented by the Council is available later in this document.

The Hazard Mitigation Council provides guidance in the development of the Plan. Nevertheless, the Council has not minimized the importance of sustaining an integrated and comprehensive approach to mitigation. Therefore, this work is an effort coordinated with State and Local agencies, departments, and focus groups, as well as technical committees and representatives from Federal, State and Local agencies in the development of the Plan. This has been accomplished by first reviewing and incorporating all Local Hazard Mitigation Plans and planning efforts of State and Federal agencies. Then the efforts of others were carefully incorporated to ensure that an effective coordination of all initiatives is central to the implementation of the plan.

The "2018 State of Mississippi Standard Mitigation Plan Update" has been completed with a high degree of public participation by stakeholders, agencies, and the general public. This was accomplished by developing a public participation process at the beginning of the planning process and effectively communicating the process as the project was developed. State plan surveys were posted to state agencies websites to increase public feedback. The result is that the concerns and ideas of the public are reflected in the Plan and mitigation action items have been developed to address the issues identified.

The "State of Mississippi Standard Mitigation Plan" is a "living document". The Plan serves as a guide for hazard mitigation activities and provides a tool for implementing the most effective strategies. The Plan will be reviewed constantly as it is used, and continuous improvement of the Plan will be reflected in updates and revisions as needed, with a scheduled plan update to be completed at least every five years. Each section of the 2018 Mississippi Standard Hazard Mitigation Plan has been reviewed and/or updated to reflect changes from 2013, until now.

This plan, through its strategy of saving lives and reducing future losses, will contribute to the sustainability of the State of Mississippi. This sustainability will provide a balance in the economic, social and natural assets of the State resulting in a place that people want to be as they live, work and play.

Mississippi's Standard Hazard Mitigation Plan – "Saving Lives and Reducing Future Losses.

Summary of Changes

- Statistical information has been updated to reflect Mississippi at its current status.
- The narrative has been updated to reflect purposes set forth by the State of Mississippi.
- Section 1 has been reviewed. All figures, tables, and graphics have been updated to reflect any charges that have occurred since 2013 plan update.

1.1: State Characteristics

General Information

The State of Mississippi lies in the southern portion of the United States. Mississippi is the 32nd largest state in the United States with a total land area, including water, of 46,906.96 square miles. According to 2010 Census information, the state is 32nd among other states with a population of 2,967,996. The name Mississippi is derived from Ojibwa, a Native American or Algonquian language, and it means "Great River". Mississippi is referred to as the "Hospitality State" and the "Magnolia State." These nicknames are a reflection of the welcoming spirit of Mississippi's residents and the beautiful magnolia trees found here. The State is diverse with each region exhibiting its own unique characteristic. Whether you are listening to the blues in the Delta or relaxing on the beaches of the Mississippi Gulf Coast, Mississippi has much to offer.

Mississippi's flag was first adopted in a 1894 Special Session of the Mississippi Legislature. The official flag, which contains red, white and blue bars and stars, was chosen on April 17, 2001 by voters of the state. The stars, of which there are 13, represent the original states of the Union.

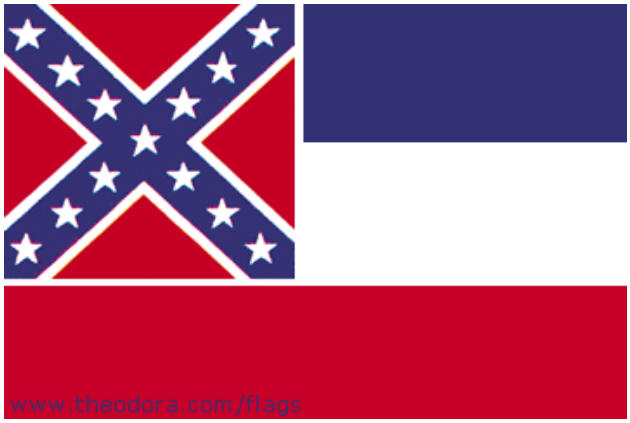
The state of Mississippi is rich in natural, architectural, and artistic beauty. It is home to the rolling hills in the northeast, the beautiful beaches of the Gulf Coast and some of the richest farmland in the world. It is also home to famous artists and musicians such as Walter Anderson, William Faulkner, Eudora Welty, John Grisham, and B.B. King. Cultural events are held throughout the state which showcase the rich cultural heritage here. Local cultural events include, but are not limited to: blueberry festivals, downtown festivals, parades, and Founder's Day celebrations.

Below are the different state symbols of Mississippi.

State Symbols

State Bird	Mockingbird
State Reptile	American Alligator
State Water Mammal	Bottlenosed Dolphin
State Fish	Largemouth or Black Bass
State Land Mammal	White Tailed Deer/Red Fox
State Wildflower	Coreopsis
State Butterfly	Spicebush Swallowtail
State Insect	Honeybee
State Fossil	Pre-Historic Whale
State Stone	Petrified Wood
State Waterfowl	Wood Duck
State Shell	Oyster Shell
State Beverage	Milk
State Toy	Teddy Bear
State Flower/Tree	Magnolia
State Soil	Natchez Silt Loam (Typic Eutrudepts)
State Dance	Square Dance
State Language	English
State Grand	Grand Opera House of Meridian
State Song	"Go Mississippi"

Source: Mississippi Official and Statistical Register 2004-2008



State Capitol

The Mississippi State Capitol is located in Jackson, Mississippi. Jackson, the capitol city, is home to the Governor, Lt. Governor, House of Representatives and the State Senate. The existing capitol building, one of three capitol facilities built, was completed in 1903. The first building was completed in 1822 and the second one in 1833. The Old Capitol building of 1833 served three roles. Those roles were state capitol from 1839 to 1903, state office building from 1917 to 1959, and state historical museum from 1961 to present day. The first building, completed in 1850, was constructed to help ensure that Jackson would indeed be the capital city. The present-day capitol building was designed by architect Theodore Link of St. Louis, Missouri. The architectural style is Beaux Arts. The focal point of the building is the 750 lights that illuminate four painted scenes and the rendition of a blind-folded lady which represents "Blind Justice." The four painted scenes represent two Native American Indians, a Spanish explorer and a Confederate general. An eagle perched atop the capitol dome is made of solid copper overlain with gold leaf. The Mississippi capitol is a designated landmark building and is listed on the National Register of Historic Places.

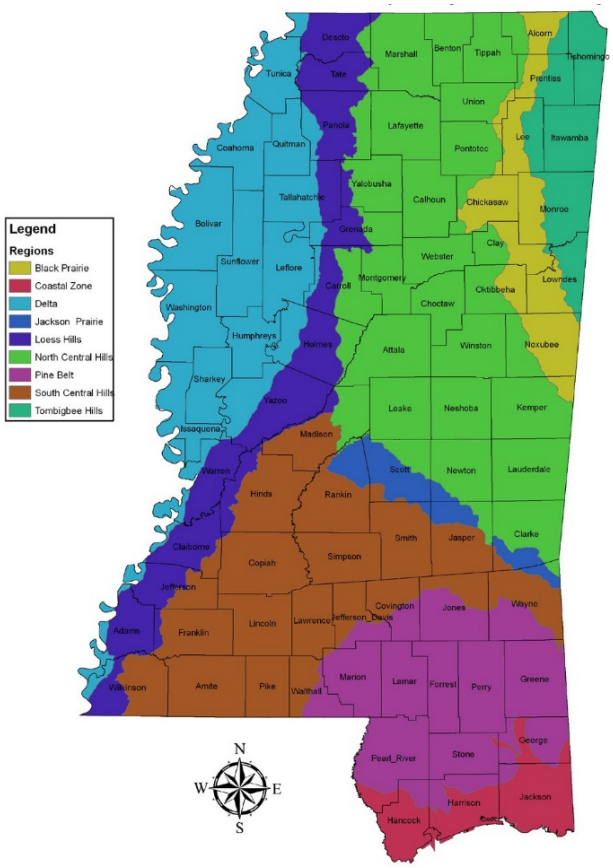
Source: Mississippi Department of Archives and History. http://www.mdah.state.ms.us/new_museum/history.html 2018; Mississippi Legislature. http://billstatus.ls.state.ms.us/htms/cap_info.htm

Geography

Mississippi is bordered by the states of Alabama, Tennessee, Louisiana, and Arkansas. A portion of the state boundary is delineated by the Mississippi River. This river is one of the largest water bodies in the continental United States. Other major water bodies within the state include the Pearl River, Big Black River, Yazoo River, Pascagoula River, and the Tombigbee River. An important fact about the State's geography is that lakes makes up 3 percent of the total area. The major lakes in Mississippi are Sardis Lake, Grenada Lake, Arkabutla Lake, and the Ross Barnett Reservoir.

The highest point in the state is Woodall Mountain in Tishomingo County. This landform has a total elevation of 806 feet. On the other hand, the lowest point in the state is the Gulf ofMexico, which is at sea level. The mean elevation for Mississippi is 300 feet. The state can be divided into nine physiographic regions- Black Prairie, Coastal Zone, Delta, Jackson Prairie, Loess Hills, North Central Hills, Pine Belt, South Central Hills, and Tombigbee Hills.

Figure 1.1.1
State of Mississippi Physiographic Regions



Black Prairies: this region extends from the northeastern corner of Noxubee County northward to Alcorn County and a small portion of Tishomingo County. The predominant soil type found in this region is clay. The topography in the Black Prairie region is flat.

Coastal Zone: this region covers portions of Pearl River, George, Hancock, Harrison, and Jackson counties. The predominant soil type in this region is acidic and sand with has areas of boggy soil high in organic content. Flat plains are the general topography.

Delta: this region covers the area of the state that borders the Mississippi River from a portion of DeSoto County down to the northeast corner of Wilkinson County. Flat plain is the general topography of the region. The Delta soil is characterized as mildly acidic to mildly alkaline.

Jackson Prairie: this region extends from portions of Wayne County to northern Rankin County. The predominant soil types in this region are both acidic and non-acidic. The topography is somewhat rolling with areas of ridges and valleys.

Loess Hills: this region extends from DeSoto County southward to Wilkinson County. The predominant soil type in this region is both acidic and non-acidic. This part of the state is also considered the brown loam region. The topography of this physiographic region is characterized by narrow ridges and steep-sided ravines.

North Central Hills: covering a large portion of Mississippi, this region extends from the northern portion of the state from Marshall County southward to northern Madison County then southwestward to Wayne County. The soils in this region are mostly acidic. The topography is characterized by both ridges and valleys.

Pine Belt: this region covers either all or portions of Walthall, Jefferson Davis, Jones, Covington, Lamar, Forrest, Perry, Greene, Pearl River, Stone, Wayne, and Harrison counties. The soil is acidic. The topography includes rolling hills as well as areas of steep-sided ridges and valleys. This region is also known for its abundance of hardwood trees.

South Central Hills: extending from southern Madison County to Wayne County and then southward to Wilkinson, Walthall, Amite, and Pike counties, the soil found here is primarily sandy loam. The topography includes rolling hills with broad valleys.

Tombigbee Hills: this region extends from Lowndes County northward to Tishomingo County. The soil is acidic and highly weathered. Topography in the Tombigbee Hills region is characterized by numerous streams, ravines and ridges, and contains the highest point in the state which is Woodall Mountain. The total height of this mountain is 806 feet.

Data Sources:

Mississippi State University Department of Geosciences – http://www.msstate.edu/dept/geosciences/faculty/brown/NWA_Journal/fig3.html Delta State University Department of Biology and Environmental Sciences – http://www.marshdoc.com/physiography/physiograph

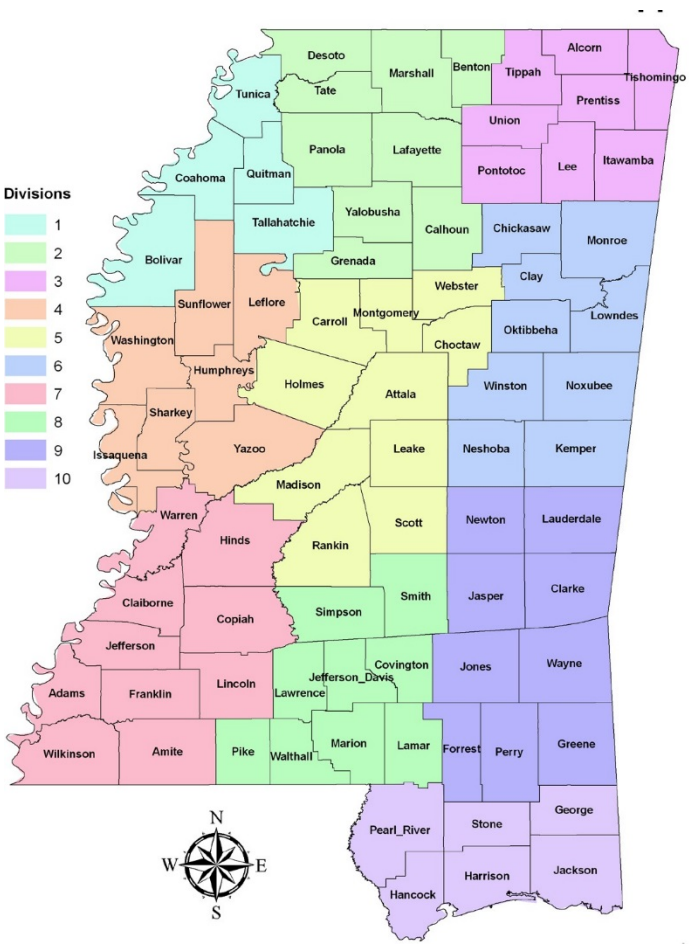
Climate

The State of Mississippi is located in the humid subtropical climate region of the United States, which is characterized by long, hot summers, temperate winters and rainfall that is evenly distributed throughout the year. The State is divided into 10 different climate zones: 1-Upper Delta; 2-North Central; 3-Northeast; 4-Lower Delta; 5-Central; 6-East Central; 7-Southwest; 8-South Central; 9-Southeast; and 10-Coastal. The normal mean annual temperatures range from 68 degrees along the coast to 62 degrees in the north. There have been occurrences where the temperature has dropped below 16 degrees and close to zero degrees in some areas. Mississippians have also routinely witnessed temperatures reaching 100 degrees in many areas. The record for the highest temperature was in Holly Springs, Miss., on July 29, 1930, when the temperature reached 115 degrees. The lowest temperature on record to date, minus 19 degrees, was set on January 30, 1966, in Corinth, Miss.

Northern portions of the state receive approximately fifty inches of rainfall annually, with that number increasing toward the south to approximately sixty-one inches per year on the Gulf Coast. Traceable amounts of snow and sleet are typical in the northernmost counties.

These northern counties have also experienced moderate and severe ice storms. A more detailed description of these occurrences can be found in Section 3.5.

Figure 1.1.2
Climate Divisions of Mississippi



Recreation

The State of Mississippi is home to over 22 state parks (Figure 1.1.3), which are easily accessible to the public. Each park offers a variety of recreational activities such as boating, wildlife watching, fishing, hiking, and swimming. It was estimated by a 2011 U.S. Fish and Wildlife Service Survey that approximately 1.4 million Mississippi residents and nonresidents participated in a wildlife-associated recreation with the State of Mississippi. Accordingly, the Bureau of Economic Analysis estimates that $611 million were spent on forestry, fishing, and related activities within Mississippi in 2007.

In a 2011 study by the U.S. Department of Commerce, almost $1 billion were contributed to the state economy as a result of recreational activities. The Mississippi Department of Wild- life, Fisheries and Parks oversees the state's parks and fisheries and operates 24 fishing lakes that span 6,044 acres. This agency is also responsible for 38 Wildlife Management Areas reserved for public hunting. In addition to the substantial amount of parks and wildlife related activities, many municipalities across the state provide and maintain parks for residents and visitors. Golf serves as the recreation of choice for residents as well as tourists and business travelers.

The state has more than 140 public and private golf courses located statewide. The location and climate of Mississippi make golf one of the more popular forms of recreation. Many PGA sponsored events have been held in the state and have attracted top-ranked professionals. There are many other forms of recreational opportunities that exist other than the traditional forms. Among these are: disc golf, paintball, skateboarding, and bicycling.

Figure 1.1.3
Mississippi State Parks and Destination

Data sources:
Mississippi Department of Wildlife, Fisheries and Parks – http://www.mdwfp.com 2013; Mississippi State University Extension Service – http://naturalresources.msstate.edu/ stats/index.html 2013; Mississippi Development Authority/Tourism Division – Golf, www. mapsofworld.com 2013, Mississippi – http://visitmississippi.org 2013

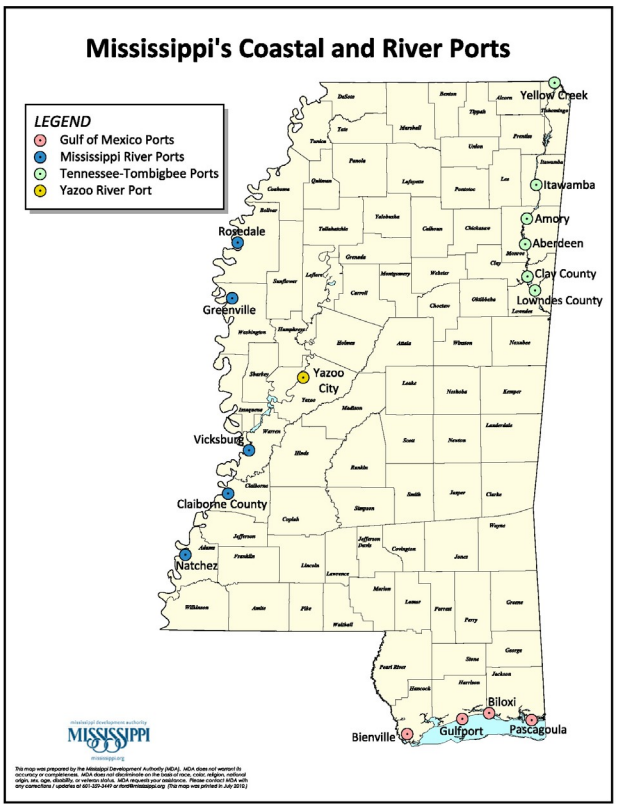
Transportation

Mississippi's highway network includes approximately 73,500 miles and more than 16,000 bridges under the jurisdiction of federal, state, and local governments. The state's highway network characteristics support the view of Mississippi as a rural state. The Mississippi Department of Transportation (MDOT) is the state agency responsible for the "higher order" highway miles (Interstates, Freeways, Other Principal Arterials), and facilitates general overview/collaboration on highway connectivity with ports, airports and railroads. The highway system typically handles more than 35 billion vehicle miles of travel annually and is ranked 28th in the nation. County-owned highways make up 72 per- cent of the state's highway network, while state-owned and city-owned highways are the balance at 15 and 12 percent respectively. The remaining one percent of roadways in Mississippi fall under federal jurisdiction. While higher order highways comprise fewer highway miles than rural roadways, they carry the bulk of Mississippi's traffic.

There are 16 water ports located in Mississippi (Figure 1.1.4). Of this total, two are controlled by the state. All others are privately owned and operated. The ports are located along the Mississippi River, near the Gulf of Mexico, and on the Tennessee-Tombigbee River. The ports contribute $1.4 billion to the State's economy and account for 3 percent of the Gross State product. The ports located in the state generate 34,000 direct and in- direct jobs that pay $765 million in wages and salaries.

Mississippi is home to 78 public-use airports. A large number of Mississippi's population live within one hour's drive of the seven airports which provide regularly scheduled passenger airline services. The remaining 71 public-use airports have a variety of purposes ranging from agricultural pesticide spraying to delivery services. The airport system accounts for $637 million of economic activity. It also supports 10,347 employees with salaries totaling $203.7 million.

Figure 1.1.4
Mississippi Ports



Source:

Mississippi Department of Transportation – http://www.gomdot.com/aero/plan.

htm 2011; Mississippi Department of Transportation – http://www.gomdot.com/localgov/planning/default.htm 2011, Mississippi Development Authority - http://www.mda.ms.us 2013

Population

The 2018 estimated population of Mississippi is 2,982,785. This number indicates a .95 percent increase from the 2000 figure of 2,848,666. The State of Mississippi is composed of 82 counties ranging in population from Issaquena, the smallest, with a total of 1,406 individuals to Hinds County, with 245,285. Based on the 2010 Census, the state averages 63.2 persons per square mile as compared to the United States with 87.4 persons per square mile. The counties that are most densely populated are DeSoto (224.3), Harrison (326.3) and Hinds (288.6).

The following is a breakdown of other population characteristics for the state:

- 37 cities have populations of 10,000 and above.
- 13 counties have populations of 50,000 and above.
- Four Metropolitan Areas, with the largest being the Memphis, Tenn., and DeSoto County Miss., that has a population of 1,135,614 and a population density of 377.7. This Metropolitan Statistical Area (MSA) ranked 43rd, which places it above Jacksonville, Fla., USA, and Tucson, AZ., USA. The next largest is Biloxi-Gulfport-Pascagoula USA with a population of 363,988 and a population density of 203.9.
- The median age is 35.5 years.
- 49.6 percent of the population is male.
- 51.4 percent of the population is female.
- 74.8 percent of the population is 18 years old or older. Of this total, 67.6 percent is 21 and over.
- The largest race class is White/Caucasian at 60.0 percent followed by African American/Black at 37.3.
- Per capita income for 2010 was $20,521.
- The poverty rate in 2010 was 17.6 percent. This is slightly higher than the national average of 14.3 percent.
- Average household size is 2.58 persons.

Mississippi is classified as a mostly rural state. Sixty-three percent of the state is classified rural as compared to 36.9 percent for urban. The definition of urban is those areas that are densely populated in and around large cities having a population over 50,000. It is also defined as those residential areas outside of the cities with a population of 2,500 or greater. As stated previously, most of the state is classified as rural. Rural is defined as those areas outside of the city with a population under 2,500. There is a total of 258 Census Designated Places (CDP) in the State of Mississippi. Of this total, 223 (86.4 percent) are considered rural. A CDP is a community or city that meets criteria set by Census.

In order of size and based on 2010 estimates by the U.S. Census, the populations of the top seven cities in Mississippi are:

- Jackson 173,514
- Gulfport* 67,793
- Biloxi* 44,054
- Hattiesburg 45,989
- Tupelo 34,546
- Meridian 41,148
- Southaven 48,482

In late August 2005, the worst natural disaster in United States history struck Mississippi. This disaster was Hurricane Katrina. It affected (and to date is still negatively affecting) the lives of many along the Gulf Coast region. At landfall, this Category 3 storm wiped out entire towns and communities. The densely populated cities of the Coast were turned into "ghost towns." The aforementioned figures show that two of the larger cities were located on the Mississippi Gulf Coast. According to a population report completed by CLARITAS in January 2006, the counties of Harrison, Hancock and Jackson lost a total population of 47,666. Since that initial impact, 27,295 or 57.26 percent has returned. While those three counties lost population due to the initial stages of Katrina, the counties of Pearl River, Stone, and George gained population. The total number of initial population impact for all three combined was 19,140.

Housing

The total number of housing units in Mississippi as based on 2011 American Community Survey estimates was 1,281,760. Of this total, 84.3 percent or 1,080,991 were occupied. The total number of vacant housing units was 200,769 or 15.7 percent. This can be seen in Figures 1.1.5 and 1.1.6.

Figure 1.1.5
Occupied Housing Units

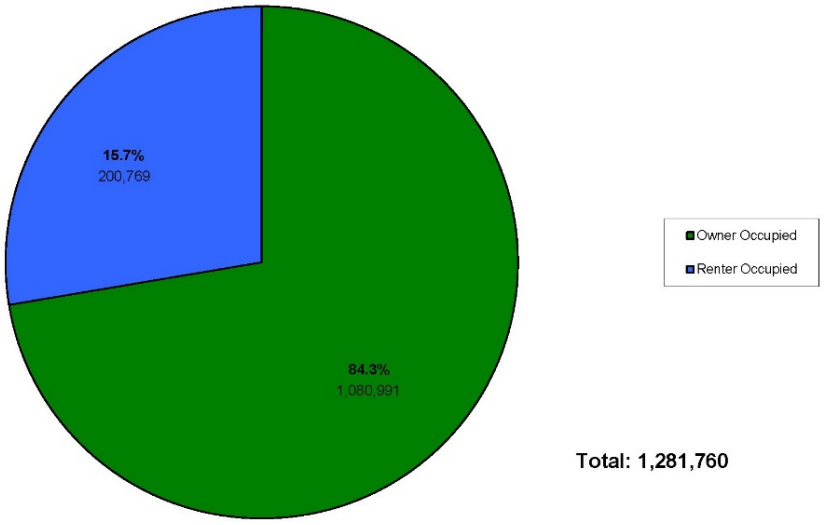
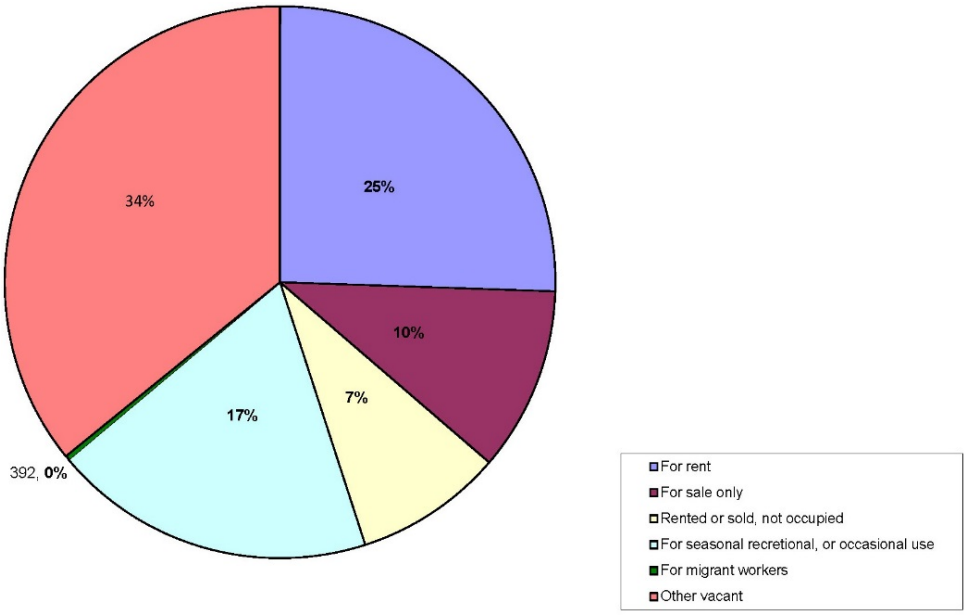


Figure 1.1.6
Vacant Housing by Type



According to the 2010 American Community Survey, the total number of occupied housing increased from 1,084,034 to 1,274,719. Of this total, 69.7 percent was classified as one unit detached while the second most common type was mobile home/other housing at 15.3 percent. It can be deduced from these numbers that most Mississippians live in single-family housing or in mobile home/other forms of housing. However, 3.3 percent live in those structures that are classified as having 10 or more apartments.

Figure 1.1.7
Housing Units (Occupied) by Year Built Type

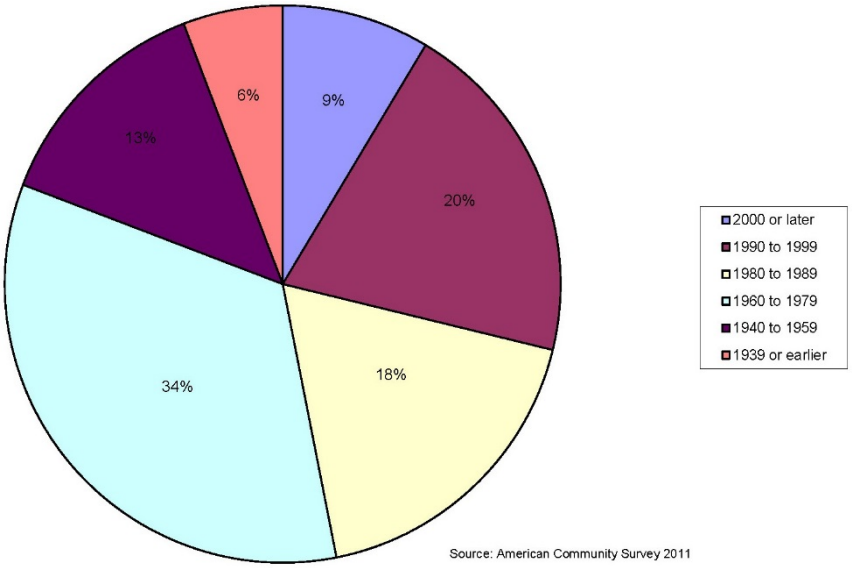
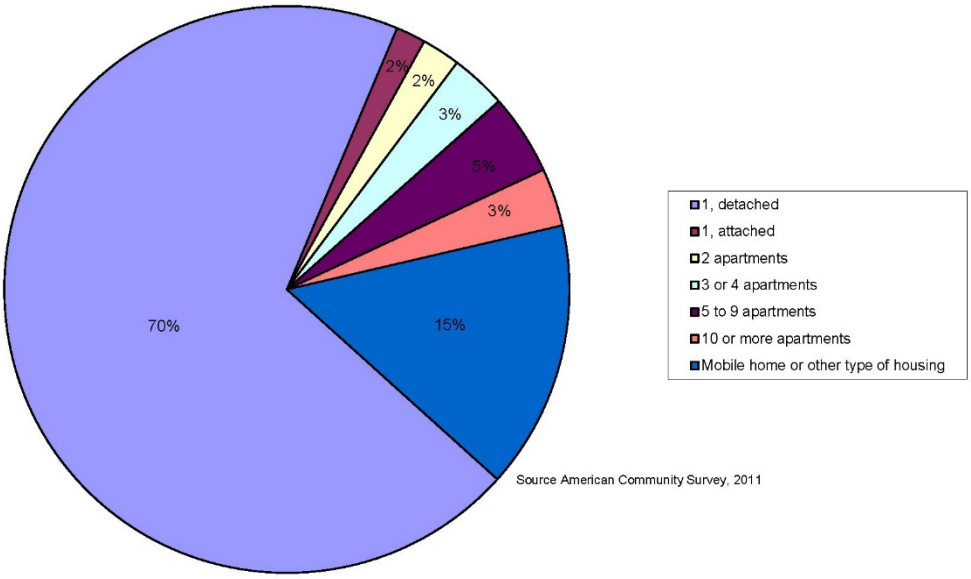
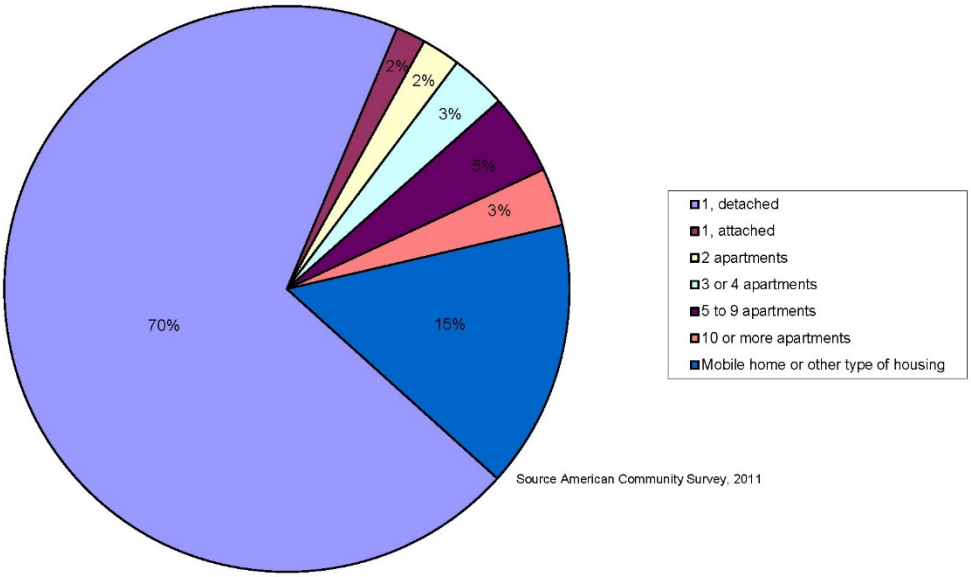


Figure 1.1.8
Renter Occupied



The majority of structures built took place between 1960 and 1979. This accounted for 33.9 percent of the total. This was followed by those built between the years of 1990 to 1999 at 20.2 percent. This shows that even though the housing stock tends to be older; newer homes are being built which signals progress and growth. Less than one percent of homes lacked plumbing facilities.

Figure 1.1.9
Housing Units (Occupied) by Structure Type



Economy

The State of Mississippi is home to many different industries. The industries range from agricultural based in the Delta to casino management on the Gulf Coast. The following is a list of the leading industries in the state:

Table 1.1.2

Industry Type	%	Industry Type	%
Accommodation and food services	6.9	Manufacturing	13.3
Agriculture, forestry, fishing and hunting	1.6	Other services (except public administration)	4.8
Arts, entertainment, and recreation	2.6	Professional, scientific and technical services	3.4
Construction	6.8	Public administration	5.4
Educational services	9.8	Retail trade	11.7
Finance, insurance, real estate and rental, and leasing	4.9	Transportation and warehousing and utilities	4.6
Health care and social assistance	14.7	Administrative support, waste management services	3.1
Information	1.3	Wholesale trade	2.6
Management of companies and enterprises	.04	Mining, quarrying, oil, and gas extraction	1.2

Source: Mississippi State Economy.www.bestplaces.net/economy/state/Mississippi, 2018

Table 1.1.2 above indicates that 13.3 percent of Mississippi's employment is through the manufacturing industry. Mississippi has large manufacturing plants such as Nissan North America, Huntington Ingalls Industries, Howard Industries and Cooper Tire and Rubber. These companies are also the leading employers in the state. Huntington Ingalls Industries has the largest number of employees at 12,500. It is followed closely by Nissan North America in Canton, MS which employs 6,000.

Toyota Motor Manufacturing, Mississippi, Inc. in Blue Springs, MS (located in the northeast section of the state) is the eighth North American vehicle assembly plant for Toyota. Production began in 2011. A total of 1,500 team members produce the Toyota Corolla.

Companies do not choose to locate in areas lacking skilled workforce. Mississippi offers industries a population of workers willing to be trained through various programs. According to the State Department of Education, the state of Mississippi in 2010 had a total of 24,739 high school graduates. In addition to that total, there were 25,179 graduates from both four year and community colleges. These students are equipped to meet the needs of manufacturing companies through adequate public education at the high school and college level.

Summary

The State of Mississippi is divided into many different regions, as determined by climate and physiography. These regions face different threat levels of hazards related to these criteria. The topography ranges from the low-lying areas of the Mississippi Delta to the coastline of the Mississippi Gulf Coast. The Gulf Coast (Coastal Zone) is threatened annually by hurricanes. One of the worst disasters in U.S. history occurred along the State's coastline in August 2005: Hurricane Katrina, which destroyed homes as well as entire communities. Many areas of the Delta lie near the Mississippi River, which creates ideal conditions for flooding after large amounts of rain. The state's climate is characterized by long, hot summers and temperate winters. While the amount of rainfall is typically evenly distributed, the long hot, summers have led to the occurrence of droughts in the past while during the winter season, ice storms have occurred in the northeast region of the state.

The threat of any major hazard could greatly affect many of the state's industries. Among these are, but not limited to: tourism (both gaming and culturally based), transportation (state's ports contribute $1.4 billion annually to economy) and manufacturing (13.3% of state's industries). In addition, the state's recreation industry would suffer due to a major hazard. There are over 21 state parks in the state and almost $1.1 billion dollars are contributed to the economy by these type activities. In the aftermath of Katrina, the tourism and transportation industries were greatly affected by road and bridge closures, extensive damage to casinos, the permanent closure of some state parks and other devastating impacts. The population of the state increased from 2,951,996 to 2,982,785. This marked an increase of .99 percent. As the population continues to grow, the threat to loss of life and property damage rises as well. It is for this and the aforementioned reasons, that this plan takes into account the efforts of local government and addresses all hazard-related issues and their lasting impacts to lives and the landscape.

1.2: Plan Adoption

44 CFR §201.4 (c)(6): The State mitigation strategy shall include the following elements:

A Plan Adoption Process. The plan must be formally adopted by the State prior to submittal to FEMA for final review and approval.

The State of Mississippi Standard Mitigation Plan meets the requirements of Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (commonly referred to as the Stafford Act - Public Law 93-288 as amended). Additionally, this plan meets the minimum planning requirements under 44 Code of Federal Regulations (CFR), Part 78 (Flood Mitigation Assistance).

It is intended that this plan also meet the requirements of the Disaster Mitigation Act of 2000 (DMA2K), Section 322. Section 322 of the Act requires that states, as a condition of receiving federal disaster recovery funds, have a mitigation plan in place that describes the planning process for identifying hazards, risks and vulnerabilities; identifying and prioritizes mitigation actions; encouraging the development of local mitigation; and providing technical support for these efforts. In addition, the Act also requires local and tribal governments to have mitigation plans.

The development and implementation of this strategy is authorized and/or required by the following state statutes:

Mississippi Emergency Management Law, Mississippi Code of 1972, Title 33-15, as amended.

Executive Order(s) by the Governor

The final draft of the State of Mississippi Standard Mitigation Plan was submitted to the Governor's Authorized Representative (GAR) for review and recommendation. From here it was sent to Governor Phil Bryant for adoption by the State of Mississippi under the executive powers of the Governor on July 2018. The Promulgation Statement issued by Governor Bryant is presented on the subsequent page.

PROMULGATION STATEMENT

Transmitted herewith is the updated *Mississippi Hazard Mitigation Plan,* as required under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted under Section 104 of the Disaster Mitigation Act of 2000 (Public Law 106-390).

This plan provides a significant opportunity to reduce Mississippi's disaster risk through the identification of hazards, an analysis of the risk, an assessment of vulnerability, and the recognition of strategies and specific mitigation activities that when implemented will eliminate or significantly reduce disaster losses.

Coupled with regional and community hazard mitigation plans, this plan serves as the mitigation platform in the emergency management framework of preparedness, response, recovery and mitigation.

This plan was developed in accordance with Federal hazard mitigation planning standards contained in 44 CFR 201.4. This plan will be updated as needed, but at least every five years, as required.

Therefore, by virtue of the authority vested in me, by the constitution of Mississippi and Title 33, Chapter 15, Mississippi Code of 1972, as amended. I hereby promulgate and issue the *Mississippi Hazard Mitigation Plan* as the official guidance for all concerned.

_____ _____

Phil Bryant
Governor

Date

1.3: Compliance with Federal Laws and Regulations

44 CFR §201.4(c)(7): The State mitigation strategy shall include the following elements:

Assurances. The plan must include assurances that the State will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with CFR 13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in CFR 13.11(d).

44 CFR

Through the development and enforcement of this plan, the State of Mississippi will comply with all provisions in 44 Code of Federal Regulations:

I. Part 7, Nondiscrimination in Federally Assisted Programs.
II. Part 9, Floodplain Management and Protection of Wetlands
III. Part 10, Environmental Considerations
IV. Part 13, Uniform Administrative Requirements for Grants and Cooperative Agreements to States and Local Governments.
V. Part 14, Reserved
VI. Part 17, Government-Wide Debarment and Suspension and Government-Wide Requirements of Drug-Free Workplace
VII. Part 18, New restrictions on lobbying
VIII. Part 201, Mitigation Planning
IX. Part 206, Federal Disaster Assistance
X. Subchapter B - Insurance and Mitigation
XI. Subchapter D - Disaster Assistance
XII. Subchapter F – Preparedness

Additionally, the laws listed below are provided as documentation that the State or any subsequent sub-grantee (recipients) that receive federal grant funds will comply with all applicable State and Federal statutes and regulations. The State will amend the plan whenever necessary to reflect changes in federal statutes and regulations or material changes in state law, organization, policy, or state agency operations.

The following provisions apply to the award of assistance:

Federal Law

I. Public Law 93-288, Disaster Relief Act of 1974, as amended by the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, Public Law 100-707 and further amended by Disaster Mitigation Act of 2000, Public Law 106-390.

II. Public Law 93-234, Flood Disaster Protection Act of 1973.

III. Public Law 103-181, Hazard Mitigation and Relocation Assistance Act of 1993.

IV. Public Law 98-502, Single Audit Act.

V. Public Law 81-920, Federal Civil Defense Act

VI. Title 31 CFR Part 205.6, Funding Techniques

Executive Orders

I. OMB Circular A-21, Cost Principles for Educational Institutions

II. OMB Circular A-87, Cost Principles for State and Local Governments

III. OMB Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.

IV. OMB Circular A-102, Uniform Administrative Requirements for Grants and Cooperative Agreements with State and Local Governments.

V. OMB Circular A-110, Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals, and other Non-Profit Organizations.

VI. OMB Circular A-122, Cost Principles for Non-Profit Organizations.

VII. OMB Circular A-133, Audits of Local Governments, and Non-Profit Organizations.

State Authorities

I. Mississippi Emergency Management Law, Mississippi Code of 1972, Title 33-15, as amended.

II. Other Applicable Mississippi laws refer to “Compendium of Legislation” Mississippi Administrative Plan, Volume I to Mississippi Emergency Management Plan

III. Executive Order(s) of the Governor

- E. O. 252, August 11, 1977; Relocation of State Government.
- E. O. 573, March 3, 1987; Mississippi Emergency Response Commission.
- E. O. 653, 1990, et. Seq.; Emergency Management Responsibilities.
- E. O. 985, 2007; Mississippi State Hazard Mitigation Council

2.0: The Planning Process

44CFR: §201.4(c) Plan Content. To be effective, the plan must include the following elements:

Description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated.

Mitigation Planning is . . .

Mitigation is any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event. Mitigation planning is a process for states and communities to identify policies, activities, and tools for implementing mitigation actions. The Mississippi Emergency Management Agency decided to continue with the following four basic steps or phases in updating its plan:

- Organization of resources;
- Assessment of risks;
- Development of a mitigation plan; and
- Implementation of the plan and monitoring progress.

Phase I: Organization of Resources

In 2007, the State of Mississippi made a firm commitment to identify and organize its resources through the Mississippi Hazard Mitigation Council. Established by Governor Haley Barbour under Executive Order 985, the Council has played a very major part in steering the State's mitigation strategy. The Council has served the people of Mississippi by providing a platform from which an integrated statewide plan could be developed to complete mitigation goals. The State continues to use this organization in the 2018 Hazard Mitigation Plan Update. The Council has in fact identified 2 more members since its conception. The members of the Council are further discussed in a later section of this document.

The Council is comprised of citizens who were jointly selected by MEMA's executive staff and Governor Barbour based upon the skills, knowledge, and abilities necessary for:

- forging partnerships from among a broad range of groups,
- integrating existing plans and planning efforts,
- identifying and articulating needs to state and federal officials, and
- providing continuity in statewide planning that seeks to achieve a common goal.

Governor Phil Bryant continues this commitment to hazard mitigation through the Mississippi Hazard Mitigation Council.

Phase II: Assessment of Risks

The State of Mississippi is diverse by nature and climate. From severe weather to wildfires and flooding to unstable dams, Mississippians have faced their share of disasters throughout the years. The plan developers began an assessment of risks by researching historical records and learning from past hazardous events. This history has been used to assist in the assessing of today's risks by using a Hazard Ranking Worksheet. From this process, the past documented events were profiled and vulnerabilities identified. The plan developers then projected estimated potential future losses.

The Hazard Ranking Worksheet operates like this: The probability of each hazard is determined by assigning a level, from one to four, based on the likelihood of occurrence from historical data. The total impact value includes the affected area, primary impact and secondary impact levels of each hazard. These levels are then multiplied by an importance factor to obtain a score for each category. The probability score is multiplied by the sum of the three impact categories to determine the total score for the hazard. Based on this total score, the hazards were then separated into four categories based on the hazard level they pose to the communities. Those four categories are:

- unlikely
- possible
- critical and
- highly likely

This backbone of information forms the bases for MEMA's mitigation plan and helps to shape it in an economically feasible and environmentally sound manner.

Phase III: Development of a Mitigation Plan

Each phase of MEMA's planning process in developing Mississippi's Mitigation Plan is documented within this report. Statewide hazard mitigation goals and objectives have been developed by the Hazard Mitigation Council and presented to stakeholders, partnering agencies, and the general public for review and comment. Details of this process are included within the next section.

In addition, state capabilities have been identified and assessments have been made concerning current effectiveness. Alterations to existing plans based on the state's capabilities have been identified and analyzed and, if found deserving, have been included within the 2018 Hazard Mitigation Plan Update. Finally, funding sources have been considered and where applicable, factored into the final document's operational procedures.

Phase IV: Implementation of the Plan and Monitoring Progress

Upon adoption of this plan, Mississippi's mitigation actions statewide will take on a more cohesive, stronger, and more easily recognized existence. Existing local and regional hazard mitigation plans will continue to move closer to statewide goals and objectives due to increased communications and understanding. Built in milestones for reviewing and tweaking the plan will help to ensure that stakeholders and the general public are afforded the opportunity for input. As the plan continually evolves, it will be altered to meet our ever-changing environment. And while this plan is a good start, it is in fact the beginning of a more unified and thus more effective and economically feasible strategy for saving lives and reducing future losses.

To help organize changes made from the 2013 to 2018 plan, a Table of Contents “Roadmap” for the 2013 to 2018 Update is provided in Appendix 7.2-A.

2.2: Coordination with Federal and State Agencies and Interested Groups in the Planning Process

44 CFR §201.4(b): Planning Process. An effective planning process is essential in developing and maintaining a good plan. The mitigation planning process should include coordination with other state agencies, appropriate federal agencies, and interested groups.

The State Hazard Mitigation Plan (the Plan) was prepared by the Mississippi Emergency Management Agency's (MEMA) Division of Mitigation Planning with assistance from numerous state agencies, organizations, and concerned citizens.

Early in the update process, multi-level involvement was achieved by engaging mitigation specialists from all areas of the state. MEMA chose this approach to achieve the most effective mitigation plan possible - one that works in tandem with municipal, local, state, and federal entities.

Hazard Mitigation Council

Governor Haley Barbour, being highly supportive of the State's mitigation strategies, executed Executive Order # 985, creating the Mississippi Hazard Mitigation Council. Mississippi's Hazard Mitigation Plan is a living document, and has been reviewed and updated in quarterly meetings held by the Hazard Mitigation Council since January 2007.

The Council is effective in guiding mitigation goals and objectives for the State of Mississippi. Appointees to the council were carefully selected to provide representation from key state and local agencies capable of contributing resources, implementing mitigation actions, and integrating mitigation planning efforts. It is anticipated that the Hazard Mitigation Council will remain intact and continue to strengthen communications and working relationships by coordinating mitigation efforts between all levels of governmental agencies, academia, tribal agencies, private non-profit organizations, and the private sector for years to come. This in turn bolsters development, supports on-going maintenance, and improves planning efforts. It is expected that the Council will remain intact indefinitely and that it will continue to assist in:

- creating a vision for addressing future needs
- accurately and quickly responding to economic and environmental changes
- regularly evaluating the success of the state hazard mitigation plan, and
- providing necessary resources whenever possible for updating or changing goals and addressing new laws and regulations

MEMA also established a well-rounded team of plan developers for the 2018 plan. Following the same format of the 2013 team, plan developers included state employees and a consulting agency to serve as plan developers for the 2018 Hazard Mitigation Plan. Through a series of workshops and meetings, many public entities have been involved in the planning process, and the mitigation actions of many stakeholders, emergency response organizations, and agencies have also been included in this plan. The State of Mississippi is therefore transitioning from many individualized mitigation strategies to a statewide planning effort.

Governor Barbour's executive order is presented on the following pages.

STATE OF MISSISSIPPI

Office of the Governor

EXECUTIVE ORDER NO. 985

MISSISSIPPI HAZARD MITIGATION COUNCIL

WHEREAS, there are significant opportunities to save lives and reduce future losses resulting from natural and human-caused hazards through hazard mitigation planning; and

WHEREAS, Public Law 106-390, known as the Disaster Mitigation Act of 2000 (DMA 2000), was signed into law by the President on October 10, 2000; and

WHEREAS, the DMA 2000 provides funding for disaster relief and recovery, and reinforces the importance of mitigation planning and disaster preparation; and

WHEREAS, the DMA 2000 establishes a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP) and is intended to facilitate cooperation between state and local authorities; and

WHEREAS, Section 322 of the DMA 2000 specifically addresses mitigation planning at the state and local level, identifies new requirements that allow HMGP funds to be used for planning activities, and increases the amount of HMGP funds available to states that have developed a comprehensive, enhanced mitigation plan prior to a disaster; and

WHEREAS, state governments have certain responsibilities for implementing Section 322 of the DMA 2000, including: preparing and submitting a standard or enhanced state mitigation plan; reviewing and updating the state mitigation plan every three years; providing technical assistance and training to local governments to assist them in applying for HMGP grants and in developing local mitigation plans; and reviewing and approving local plans if the state is designated as managing state and has an approved enhanced plan.

WHEREAS, the Enhanced Hazard Mitigation Plan can reduce or eliminate long-term risk to life and property from a hazard event; identify cost-effective and technically feasible mitigation measures that will reduce losses from future disasters in an environmentally sound manner; encourage long-term reduction of hazard vulnerability; build partnerships with sectors not previously involved; protect critical community facilities, reduce exposure to liability, minimize community disruption; facilitate funding priorities, especially following a disaster; and create more sustainable communities.

WHEREAS, establishing a Hazard Mitigation Council is in the best interest of the State of Mississippi;

NOW, THEREFORE, I, Haley Barbour, Governor of the State of Mississippi, by the authority vested in me by the Constitution and the Laws of this State, do hereby:

1. Direct that a Mississippi Hazard Mitigation Council ("Mitigation Council") be established and include representation from the following:

    a. Governor's Office;
    b. Mississippi Emergency Management Agency;
    c. Mississippi Department of Environmental Quality;
    d. Mississippi Department of Finance and Administration;
    e. Mississippi Department of Transportation;
    f. Mississippi Department of Public Safety;
    g. Mississippi Department of Marine Resources;
    h. Mississippi Levee Board;
    i. Mississippi Development Authority;
    j. Mississippi State Department of Health;
    k. Mississippi Department of Archives and History;
    l. Mississippi Municipal League;
    m. Mississippi Association of Supervisors;
    n. State Board for Community and Junior Colleges;
    o. Mississippi State Department of Education; and
    p. State Institutions of Higher Learning.

2. Declare that the Executive Director of MEMA shall serve as the Chairperson of the Mitigation Council.

3. Declare that MEMA's Executive Director may, as chairperson of the Mitigation Council, designate additional executive and non-executive branch personnel or quasi-governmental and non-governmental personnel to assist the Mitigation Council as needed for their expertise and counsel arises.

4. Declare that the Mitigation Council shall act as an advisory council in all matters related to Mississippi's Enhanced Hazard Mitigation Plan.

5. Require that the Mitigation Council review issues relating to the creation of Mississippi's Enhanced Hazard Mitigation Plan, as well as other mitigation efforts, as deemed appropriate by MEMA in cooperation with the Federal Emergency Management Agency (FEMA).

6. Direct that the Mitigation Council shall make recommendations for:

    a. An overall strategy for the adoption and use of Mississippi's Enhanced Hazard Mitigation Plan;
    b. Addressing potential technical, scientific, economic, security, privacy, and other issues related to the adoption of Mississippi's Enhanced Hazard Mitigation Plan;
    c. Identifying existing mitigation information resources, including funding sources, to support the development of Mississippi's Enhanced Hazard Mitigation Plan; and
    d. Supporting continuing, educational efforts to promote development of a population capable of being self-sustaining before, during and after a disaster event.

7. Direct all Executive branch departments, agencies, boards, and commissions and any other divisions of the Executive branch of state government, to fully cooperate with the Mitigation Council and provide staff support and any other assistance as requested.

8. Direct the Mitigation Council to meet periodically as needed to:

   a. Review Mississippi's Enhanced Hazard Mitigation Plan;
   b. Review statewide hazard mitigation goals and objectives; and
   c. Review priorities for categories of hazard mitigation projects.

9. Authorize the Mitigation Council to seek grants from government or private sources to achieve the goals and objectives set forth.

10. Deem that the Mitigation Council shall continue in existence until all of its objectives are achieved, unless otherwise directed by a future Executive Order.

IN TESTIMONY WHEREOF, I have hereunto set my hand and caused the Great Seal of the State of Mississippi to be affixed.

DONE at the Capitol in the City of Jackson, the 17th day of May, in the year of our Lord two thousand seven and of the Independence of the United States of America, the two hundred and thirty-first.

HALEY BARBOUR
GOVERNOR

BY THE GOVERNOR:

SECRETARY OF STATE

Members of the Hazard Mitigation Council and the agencies and/or associations they represent are indicated in table 2.2.1.

Table 2.2.1
Mississippi's Hazard Mitigation Council

Agency	Representative
Office of the Governor	Governor
Mississippi Emergency Management Agency (MEMA)	Executive Director
Mississippi Department of Environmental Quality (MDEQ)	Executive Director
Mississippi Department of Finance and Administration (DFA)	Executive Director
Mississippi Department of Transportation (MDOT)	Executive Director
Mississippi Department of Public Safety	Commissioner
Mississippi Department of Marine Resources (DMR)	Executive Director
Mississippi Levee Board	Executive Director
Mississippi Development Authority (MDA)	Executive Director
Mississippi State Department of Health	State Health Officer
Mississippi Department of Archives and History	Executive Director
State Board for Community and Junior Colleges	Executive Director
Mississippi State Department of Education	Executive Director
State Institutions of Higher Learning (IHL)	Executive Director
Mississippi Municipal League (MML)	Executive Director
Mississippi Association of Supervisors (MAS)	Executive Director
Mississippi Department of Human Services	Executive Director
Mississippi Forestry Commission	Executive Director

Team Approach

Alongside the Council, the planning team for the Mississippi 2018 Update consisted of Witt O'Brien's planners, GIS/HAZUS-MH specialist, data visualization specialist, MEMA Executive staff, and mitigation planners.

In this 2018 State Plan update, mitigation planners compiled the 34 FEMA approved local plans that cover the entire State of Mississippi and provided to the contractor. Results from 34 local mitigation plans, council meetings, and updated risk assessment were compiled to reflect natural hazard occurrences and risks.

On January 31, 2018, the kick-off/advisory committee meeting was held. Witt O'Brien and the Hazard Mitigation Council discussed the process of updating the State plan. A hazard identification exercise was conducted where hazards being profiled were ranked as well as a review of the process for HIRA and determination of hazard ranking methodology.

The Hazard Mitigation Council and Witt O'Brien convened for a second meeting on March 8, 2018 at 10:00 a.m. A hazard identification and risk assessment (HIRA) presentation was conducted by Witt O'Brien. MEMA Mitigation Planning Division issued the mission statement, goals, objectives, and state capabilities

from the 2013 plan for the Council to review for update. The Council determined that the mission statement would be updated and that one objective would be added to goal 1; however, the goals would remain the same for the 2018 Mitigation Plan Update.

Additionally, mitigation programs, table of mitigation actions, and funding sources were reviewed for update. Changes in state capabilities were reported. These reports are included in Section 4.2 of this document. From 2007 until now, members of the Council have continually updated project profiles and project information for their agencies over the 3 to 5-year period between plan updates. During the second meeting, March 8, 2018, the Council was issued the state plan survey, which addresses local capabilities and ways to be better prepared for and respond to natural disasters. The Council was asked to place the survey on their agency webpage to assist in getting responses from the general public.

Billy Patrick, Mitigation Planning Bureau Director, with Planners Carolyn McKinney and Frank Hill discusses updating project profiles during HM Council conference call 12/15/2017.

During plan development, experts from various private, state and local entities statewide, as well as representatives from the Federal Emergency Management Agency (FEMA), were given the opportunity to participate in the planning process to increase integration with ongoing state hazard mitigation planning efforts. MEMA solicited participation from industry associations and volunteer agencies, as well as mitigation planners and specialists representing all levels of governments and numerous specialized areas. Table 2.3.2.1 lists the organization representatives. A status report of 2013 mitigation actions and local mitigation action analysis was provided along with educational materials. The purpose was to stimulate open discussion for updating existing mitigation actions, identifying lead agencies that might take ownership of particular actions, prioritizing the actions, and then developing a draft strategy for maintaining identified actions.

Communication – The Key to a Cohesive Plan

An intranet site was created on MEMA's mitigation management site, MitigationMS.org for managing and updating information concerning mitigation planning activities. Participants (including the Hazard Mitigation Council, individuals with technical expertise, and the plan developers) that have mitigation projects can access and update their project profiles on this site. This has been a tremendous asset to the project managers and has continued throughout the 2018 Mississippi Hazard Mitigation Plan Update.

With the quarterly meetings and a Summary of the Hazard Mitigation Council Meetings going out to all members, Council Members, Project Managers and stakeholders were kept informed on State Plan Developments. The Hazard Mitigation Council has agreed that future meetings will be held semiannually.

MitigationMS.org - Table of Mitigation Actions

MitigationMS.org | Welcome, Billy Patrick [Settings | Help | Logout] Saferoom Application | HMGP Resources | Contact

My Home | Projects | Safe Rooms | Requests | Payments | Mitigation Plan | Reports

Table of Mitigation Actions

1) 1 - 7

Filter | Clear | Advanced | Export | New Project

#	Type	Strategy	Name	Agency	Cost	Funding	Completion	Priority
1	Dam Safety	Prevention	Permitting New Dams and Regulatory Compliance	MDEQ	$150,000.00	Budget	Annual	H
1	Flood	Prevention	Map Modernization: New Firm Adoption by Communities	MEMA	$20,000.00	CAP	2011	H
1	Tornado	Technical Assistance	Implement Wind Retrofit Projects	MEMA	$7,000.00	Budget	Annual	M
1	Earthquake	Technical Assistance	Review and Update HAZUS-MH Data Base	MEMA	$70,000.00	HMGP	2010	H
1	Wildfire	Prevention	Firewise Program Workshops	MFC	$100,000.00	USFS	Annual	H
2	Wildfire	Prevention	Community Wildfire Protection Plans	MFC	$240,000.00	USFS	Annual	H
2	Earthquake	Technical Assistance	HAZUS-MH Project Implementation for Local Initiatives	MEMA	$10,000,000.00	HMGP	2017	H
2	Winter Storm	Technical Assistance	Public Education and Outreach	MEMA	$7,000.00	Budget	Annual	H
2	Dam Safety	Prevention	Public Education and Outreach	MDEQ	$10,000.00	NDSP	Annual	H
2	Multi-Hazard	Outreach and Education	HMA Grant Application Training	MEMA	$7,000.00	Budget	Annual	H

MitigationMS.org - Project Profile/Progress Report

Project Profile/Progress Report

Filter | Clear | Advanced | Export

#	Subgrantee	Title	Project	Status	Step
2	MEMA	Project Profile Report #1	HMA Grant Application Tra...	Normal	2) Completed
15	MDFA	Project Profile Report #2	Complete/enhance inventor...	Normal	1) Applicant Submission
15	MDFA	Project Profile Report #3	Complete/enhance inventor...	Normal	1) Applicant Submission
15	MDFA	Project Profile Report #4	Complete/enhance inventor...	Normal	1) Applicant Submission
15	MDFA	Project Profile Report #5	Complete/enhance inventor...	Normal	1) Applicant Submission
15	MDFA	Project Profile Report #6	Complete/enhance inventor...	Normal	1) Applicant Submission
15	MDFA	Project Profile Report #7	Complete/enhance inventor...	Normal	1) Applicant Submission
32	MDFA	Project Profile Report #2	Coastal Retrofit Mississi...	Normal	1) Applicant Submission
32	MDFA	Project Profile Report #1	Coastal Retrofit Mississi...	Normal	3) Completed

Public Participation Outreach Efforts

Associations

Plan developers involved various hazard mitigation stakeholders in the planning process by attending various Mississippi based conferences and providing information and accepting comments for use in the development of the 2018 Hazard Mitigation Plan. Conferences attended and objectives of each are listed in Table 2.2.2.

Table 2.2.2
Public Outreach

Conference/Activity	Date/Location 2018	Purpose
MS Partners in Preparedness Conference	May 7-10 Biloxi, MS	Present purpose and need for updating MS's Hazard Mitigation Plan and invite participation through MEMA booth
MS Civil Defense Emergency Management Assoc.	May 8 Biloxi, MS	Present purpose and need for updating MS's Hazard Mitigation Plan and invite participation through MEMA booth
Association of Floodplain Managers of MS	May 22-May 24 Natchez, MS	Present purpose and need for updating MS's Hazard Mitigation Plan and invite participation through MEMA booth
Building Association of MS	June 3-8 Bay St. Louis, MS	Present purpose and need for updating MS's Hazard Mitigation Plan and invite participation through MEMA booth
MS Association of Supervisors	June 11-Present Jackson, MS	MEMA's Mitigation Survey is placed on the MAS website for outreach and feedback.
Mississippi Municipal League	June 15 – Present Jackson, MS	MEMA's Mitigation Survey is placed on the MML website for outreach and feedback.
Mississippi Emergency Management Agency	May 14 – Present Pearl, MS	Hazard Mitigation Plan placed on the MEMA Web-site for review and comment.

A survey designed to provide plan developers with information concerning hazard mitigation issues from the local perspective was made available at each conference. A copy of the survey is located in Appendix 7.2-C and the survey results are tabulated in section 4.3 of this report.

Another measurable result of open communication and outreach efforts with the above-mentioned associations was realization of written support of MEMA's efforts to develop a comprehensive statewide plan. The Public Works Association - Mississippi Chapter, the Mississippi Municipal League, and the Association of Floodplain Managers of Mississippi all adopted resolutions supporting the planning effort.

Business, Non-Profit and Professional Organizations

Because of the successes noted from reaching out to governmental associations, plan developers used the same strategy in 2018 to engage businesses, as well as non-profit and professional associations. Emails explaining the purpose and need of the mitigation plan and inviting participation in the process were sent to every business association listed for the State of Mississippi, as well as the 2018 president of Mississippi Voluntary Organizations Active in Disasters (VOAD), who in turn forwarded it statewide to his constituency.

By capitalizing on the name recognition and trust generated by business leaders who partnered with MEMA, the agency's message was received much more readily by the business community. Thus, readership and response to emailed information tended to be higher and educational benefits, as well as increased participation in plan development. Individuals within the business community were asked to participate by submitting comments to MEMA concerning the goals of the statewide comprehensive mitigation plan.

In addition to an increase in participation from the business community, MEMA also reached out to VOAD leaders of the state. Members of the Red Cross, the United Way and the Salvation Army were notified to review and comment on the goals and objectives of the updated plan.

Local, State, and Federal Agencies Engaged

While many of Mississippi's state agencies were invited to join the Mississippi Hazard Mitigation Council, others that typically had never been personally invited to develop mitigation planning strategies were sent letters from MEMA Executive Director Lee Smithson urging participation. It is hoped that this contact will strengthen understanding and future partnership opportunities.

In addition to open invitations to participate in the planning process, plan developers met with the following statewide agencies and or organizations to review their mitigation plans and coordinate state- wide activities. These outreach efforts included meetings with the following:

- Mississippi's Planning and Development Districts
- The Mississippi Department of Environmental Quality
- The United States Army Corps of Engineers
- The Center for Community Earthquake and Preparedness
- United States Geological Survey
- National Weather Service

Continuing the practice began in 2007, plan developers for the 2018 update sought to work more closely with federal agencies in the planning process. Input and guidance was particularly sought from the Federal Emergency Management Agency (FEMA) – Region IV employees. FEMA responded by directing plan developers to various written materials available through the internet and provided input through one-on-one conversations, e-mails and letters. A complete list of federal agencies that plan developers consulted is found in section 2.3, in Table 2.3.2.1.

Meeting with the Mississippi Band of Choctaw Indians

MEMA Planning Staff have met with representatives of the Mississippi Band of Choctaw Indians (the Tribe) in Choctaw, Miss., and in Pearl MS on several occasions to discuss mitigation projects. The Tribe now has its own FEMA approved hazard mitigation plan.

Currently, the Tribe has a statutory framework (known as Ordinance 50) that

- Establishes the emergency management team of Directors of the Fire Department, Police Department, the Health Department and facilities;
- provides equipment for facility buildings in each community designated as shelters (includes generators);
- significantly improves communications; and
- provides for a draft risk analysis.

Tribal mitigation activities resulting from review and evaluation of events during and after Hurricane Katrina are either in the works or completed. They include:

- increased training opportunities;
- increased purchases of emergency related equipment;
- improved 'on the ground' communications for effective contact of first responders;
- recent acquisition of communication equipment that has been installed in all faculty buildings (radios); and
- evaluation of policies for addressing staff burnout, which will likely be implemented.

Opportunity for Public to Comment

Individuals participated in the public involvement process via the internet. Information for review and comment were sent electronically for further dissemination statewide to the Mississippi Manufacturers Association, the Mississippi Department of Environmental Quality, the MS Department of Transportation, and the Mississippi Association of Supervisors, thus providing easy access for large segments of the population. Individuals that responded proved to be very interested and expressed a desire to participate in the current process as well as future planning efforts.

Other than educational information about hazard mitigation planning, the mitigation strategy mission statement developed jointly by the Hazard Mitigation Council and specialists statewide was made available. The mission statement listed proposed goals and action steps for hazard mitigation and was available for review and comment. The public was invited to rank the proposed goals to provide suggestions for new or amended action steps. Over 100 participated in this public involvement process. Information received is tallied on the subsequent page.

The second opportunity for the public to comment will be available prior to plan adoption as per FEMA requirement. Participants will be given the opportunity to comment and give feedback on the plan. Visitors will be invited to make suggestions and write questions on provided comment sheets. This type of public participation allows visitors to physically take part in the development process. Appendix 7.2-D contains a list of volunteer organizations and individuals who participated in the 2018 plan update.

Mission: To develop and maintain a disaster-resilient, sustainable Mississippi through perpetual planning and review of a comprehensive statewide mitigation strategy.

The percentage indicates the importance of the objective per response

		High	Medium	Low
Goal 1 – Minimize loss of life, injury, and damage to property, the economy, and the environment from natural hazards				
Objective 1.1	Protect critical facilities, infrastructure, and systems	100%	0%	0%
Objective 1.2	Reduce the number of at-risk and repetitive loss/SRL properties	86%	14%	0%
Objective 1.3	Reduce potential damage to future buildings and infrastructure	100%	0%	0%
Objective 1.4	Develop and maintain hazards-related research, modeling, data, and analysis to support program and project implementation	71%	29%	0%
Objective 1.5	Identify needs and appropriate projects from post disaster damage assessments	71%	14%	14%
Objective 1.6	Preserve, create, and restore natural systems to serve as natural mitigation functions	42%	14%	14%
Objective 1.7	Protect historic and cultural resources	71%	57%	0%
Objective 1.8	Provide state and local agencies with a statewide communications network with an Interoperable, highly reliable, fast access, public safety-grade communication system for use during events that threaten the health and welfare of the citizens of Mississippi.	43%	29%	0%
Objective 1.9	Promote State identified mitigation initiatives, such as saferooms, storm shelters, and severe weather warning systems.	57%	43%	14%
Goal 2 – Build and enhance local mitigation capabilities				
Objective 2.1	Support and provide guidance for local hazard mitigation planning and projects	57%	0%	42%
Objective 2.2	Encourage the adoption, improvement, and enforcement of local codes, ordinances, and land use planning	57%	42%	0%
Objective 2.3	Provide and promote technical assistance and training to local governments	71%	29%	0%
Objective 2.4	Identify and provide financial incentives and funding opportunities	71%	29%	0%
Goal 3 – Improve public education and awareness				
Objective 3.1	Develop and improve outreach programs and materials to increase awareness to the public and private sector about risk and mitigation in Mississippi	57%	14%	29%
Objective 3.2	Promote and utilize existing hazard mitigation education programs from state, federal and nonprofit sources	57%	0%	43%
Objective 3.3	Develop tailored outreach strategies for vulnerable populations, such as tourists, disabled persons, children and the elderly, non-English speakers, and low-income residents	57%	43%	0%
Goal 4 – Sustain and enhance a coordinated state mitigation program				
Objective 4.1	Strengthen coordination, communication, capabilities, and partnerships with levels of government, the private sector, and nonprofit organizations.	57%	14%	29%
Objective 4.2	Institutionalize hazard mitigation as integrated state policy	57%	42%	0%
Objective 4.3	Implement, monitor, and assess the effectiveness of the mitigation strategy and promote successes	57%	14%	29%

2.3: Integration with Other Planning Efforts, Programs and Initiatives

44 CFR §201.4(b): The Plan must discuss how the planning process was integrated to the extent possible with other ongoing state planning efforts, as well as other FEMA mitigation programs and initiatives.

As jurisdictions have realized a limited amount of resources, integration of programs, goals, and resources have become ever more necessary. From the initial 2004 Hazard Mitigation Plan to the 2007 Mitigation Plan until now, integration of programs and resources have significantly increased among local, state, and federal entities in the State of Mississippi. In addition to oversight of Hazard Mitigation Assistance, floodplain management, the Earthquake Program, and mitigation planning programs, MEMA follows and includes Mississippi Statutes in the hazard risk plans of the state departments of Public Safety, Development Authority, Transportation, Insurance, Corrections, Environmental Quality, Health, Human Services, Wildlife, Fisheries and Parks, the Office of Administration, Education, and the Public Service Commission. MEMA accomplishes many mitigation projects through collaboration. The Mississippi Development Authority partners with MEMA in joint funding of flood acquisition and drainage projects, and in storm shelter/saferoom projects. The Office of Geology in the Department of Environmental Quality and MEMA also partner in the NFIP Risk Map Program, while the Department of Transportation and MEMA partner in highway and bridge development to ensure the floodplain management component is addressed.

Multi-jurisdictional and local mitigation plans comprise another part of the program. As such, the development process for the state plan takes into consideration the mitigation goals and objectives identified therein. MEMA routinely works with numerous state and federal agencies on various issues, to include partnering with the Mississippi Development Authority; the American Red Cross for emergency sheltering; Department of Environmental Quality, Dam Safety Division on issues of high hazard dams; Mississippi Departments of Transportation and Public Safety on emergency evacuation issues; and the Mississippi Department of Homeland Security on all threats to the citizens of this state. MEMA extends an open-door policy to federal and state agencies, regional planning and development districts, and local governments to build stronger, more cohesive mitigation efforts whenever possible.

2.3.1 Integration of Local Plans

MEMA is the primary state coordinating agency for all local emergency operation plans and hazard mitigation plans. The Mitigation Planning Division has the primary responsibility of working with regional and local governments in developing, reviewing, and updating multi-jurisdictional and local hazard mitigation plans. The Preparedness Plans Bureau has the primary responsibility of working with local governments in developing, reviewing, and updating local emergency operation plans.

As part of the state mitigation planning initiative, multi-jurisdictional and local mitigation plans are being developed in conjunction with counties and regions. These multi-jurisdictional plans address the mitigation issues and initiatives for unincorporated and incorporated jurisdictions. This helps ensure as many jurisdictions as possible remain involved in the mitigation planning process. The local hazard mitigation Plan is normally a separate, stand-alone plan that represents a county or region. Any jurisdiction within a

county may prepare a mitigation plan specific to that jurisdiction and separate from the county or regional mitigation plan.

All 82 counties in the state have a Comprehensive Emergency Management Plan (CEMP) in place. These plans are scheduled for review and/or update by MEMA every five years. In addition, approximately 15 incorporated cities maintain separate CEMPs. These plans are included in the five-year MEMA review/ update process.

The local governments, the Mississippi Planning and Development Districts (PDD), and consultants are using the information contained in the State Hazard Mitigation Plan to develop multi-jurisdictional and local hazard mitigation plans. As the local hazard mitigation plans are developed, the information provided through those planning efforts will be available to MEMA for incorporation into the State Hazard Mitigation Plan. This cooperative effort contributes to the continuous improvement of all the plans as they are reviewed and updated every five years.

2.3.2 Integrating Planning Information with Other Mitigation Partners

MEMA's efforts to identify and engage mitigation partners continue to increase. New efforts include engaging traditional partners through unique public involvement outreach efforts. For example, to assist the Mississippi Hazard Mitigation Council, MEMA invited mitigation planners/specialists from local, state, and federal agencies, as well as the private sector, to participate in the State Hazard Mitigation Plan Update. Participants could go online and review and comment on the hazard mitigation plan. Table 2.3.2.1 lists those agencies/associations invited to participate in the development of the 2018 Standard Mitigation Plan.

Table 2.3.2.1

Name	Title	Organization
Tammie Ballard	President	Association of Floodplain Managers of Mississippi
Bill Carrigee	President	Building Officials Association of Mississippi
James M. Wilkinson	Director	Central United States Earthquake Consortium
Brandon Bolinski	Hurricane Program Manager, Region IV	Federal Emergency Management Agency
Jason Hunter	Floodplain Management and Insurance Branch Chief, Region IV	Federal Emergency Management Agency
Jesse Munoz	Mitigation Division Director, Region IV	Federal Emergency Management Agency
Jackie Bell	Chief Financial Officer	Federal Emergency Management Agency
Edwardine Marrone	RIV Acting Planning Lead	Federal Emergency Management Agency
Herbert Longenecker	Earthquake Program Manager, Region IV	Federal Emergency Management Agency,
Brian Adam	Director	Hancock County Emergency Management
Rupert Lacy	Deputy Director	Harrison County Emergency Management and Homeland Security Agency
Earl Etheridge	Director	Jackson County Emergency Management
David Dockery III	State Geologist and Director, Office of Geology	Mississippi Department of Environmental Quality

Steve Champlin	Geospatial Resources Division Director/Flood Mapping	Mississippi Department of Environmental Quality
Dusty Myers	Chief of the Dam Safety Division	Mississippi Department of Environmental Quality
Austin Cunningham	Hurricane Program Manager	Mississippi Emergency Management Agency
Stacy Ricks	NFIP State Coordinator	Mississippi Emergency Management Agency
George Humphreys	Hazard Mitigation Grants/Plans Bureau Director	Mississippi Emergency Management Agency
Susan Hardy	Earthquake Program Manager	Mississippi Emergency Management Agency
John Cox	Operations Bureau Director, Office of Response	Mississippi Emergency Management Agency
Bobby Storey	Emergency Management Director	DeSoto County
Dennis Dauterive	Director of Conservation Education/Public Outreach	Mississippi Forestry Commission
Stephen Wilkinson	Warning Coordinator Meteorologist, Weather Office	National Weather Service
Homer Wilkes	State Conservationist	Natural Resource Conservation Service
Trent Baldwin	Project Chief, P.E.	United States Geology Survey
Chris L. Mullen	Professional Engineer, Associate Professor, Department of Civil Engineering	University of Mississippi
Greg Easson	MS Mineral Resources Institute	University of Mississippi
K Van Wilson	Hydrologist, P.E.	US Army Corps of Engineers, Lower Mississippi-Gulf

MEMA's participation in the Mississippi Civil Defense/Emergency Management Association (MCDEMA) is another strong indication of the state's commitment to integrate statewide planning initiatives with local efforts. MCDEMA was originally organized by local Civil Defense Directors on May 21, 1961 to seek legislation and additional funding for local programs. Over the years, MCDEMA has continued to grow. A new initiative, which began in 2006, is a partnership between MEMA and MCDEMA to engage emergency management professionals in Alabama in the first Bi-State Hurricane Conference. The MS-AL Bi-State Hurricane Conference proved to be highly successful and had its second meeting in Mobile, Ala., in May 2008. Another meeting followed on April 27-29, 2009 at the MS Coast Civic Center (Coliseum) in Biloxi, MS. In 2010, the meeting was held in the River Room Conference Center in Flowood, MS on June 10-11. In 2012, the Hurricane Conference involved three states, MS, AL and Louisiana and was held on the MS Gulf Coast. The Central Gulf Coast Hurricane Conference was held June 23-24, 2015 in Mobile, Alabama with Mississippi and Alabama participating.

Today, MEMA and MCDEMA enjoy close working relationships which expand educational, communication, and partnership opportunities with concerned organizations at all levels of government. The association also actively promotes the sharing of information through training activities and meetings. This year, MCDEMA along with the State Department of Health, MS Emergency Management Agency, MS Hospital Association, Mississippi Department of Transportation, Mississippi Department of Environmental Quality, Department of Public Safety, Mississippi Office of Homeland Security, and the Mississippi Commission for Volunteer Services presented at the 'Partners in Preparedness Summit" 2018 at the Imperial Palace, Biloxi,

MS. This summit gave professionals involved with all aspects of emergency preparedness and response the opportunity to network with vendors and peers throughout the state. Attendance at this summit represents all areas of the emergency management and healthcare professions, state and local emergency management directors, public health officials, EMS, hospital, fire and law enforcement representatives, volunteer organizations, and local governmental agencies. Approximately 500+ participants attended.

Host agencies in the Partners in Preparedness Summit May 2018

Educational opportunities included (but were not limited to) sessions on the following:

- Incident Command System
- Advanced Casualty Management
- Developing Facility Emergency Ops Plans Based on Hazard Vulnerability Assmts.
- Statewide Emergency Response and the Possible Impacts
- Lessons learned: 2017 Hurricane Season
- NWS – 2018 Hurricane Season

The MCDEMA has proven to be very effective in reaching stated goals, and it is anticipated, the annual conferences will continue into the foreseeable future.

In addition to working with FEMA in all aspects of hazard mitigation projects and plans, MEMA has worked with many planners to integrate mitigation steps into projects and plans. The Corp of Engineers, Natural Resource Conservation Service, and Economic Development Administration partnered with Leflore County, MEMA, FEMA, the Mississippi Development Authority, Central Mississippi Planning and Development District and the Greenwood/Leflore Economic Development Association to develop a storm water drainage plan and project that saved the major industry in this region. This achievement is significant in that it employs over 700 citizens within a 12-county area.

Some 330 Mississippi communities participate in the National Flood Insurance Program (NFIP) and 32 participate in the Community Rating System (CRS). All of these floodplain management activities are supported by the Association of State Floodplain Managers, the Building Officials Association of Mississippi, and the AFMM. The USCOE assists the state and local communities in establishing base flood elevations in areas that have not been studied.

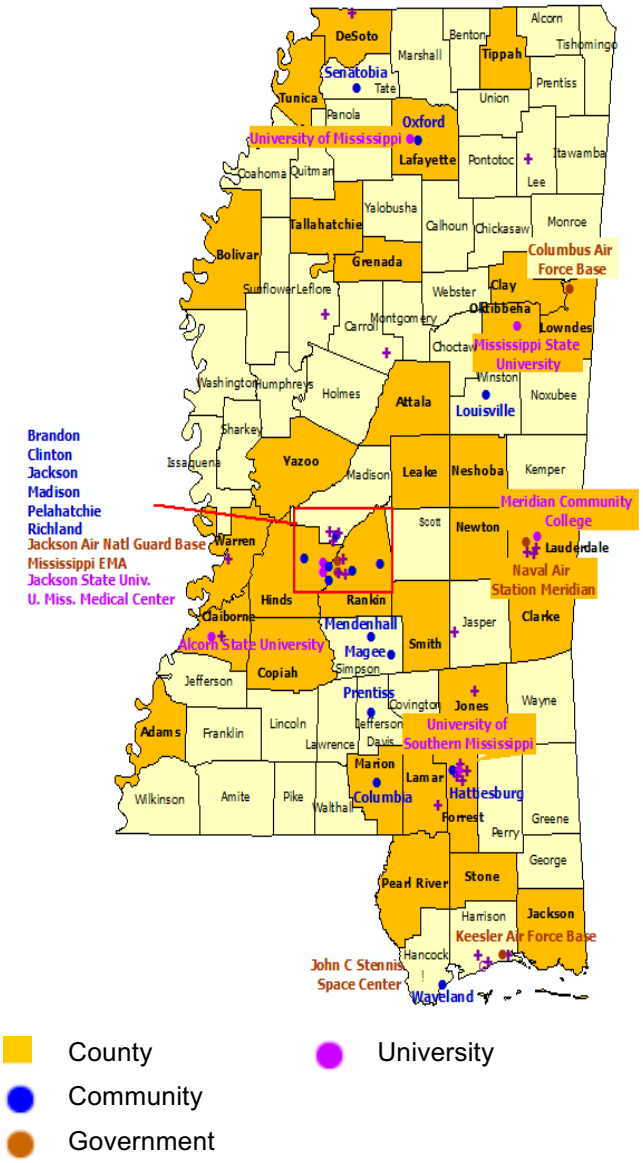
The Mississippi Development Authority's (MDA) Community Development Block Grant Program (CDBG) has complemented the MEMA buyout program by removing homes and businesses from flood hazard areas throughout the state. Many local communities are unable to provide the non-Federal cost share. By working together, MEMA and MDA are assisting local communities in addressing flood risk areas and improving housing stock. The Mississippi Department of Environmental Quality has worked with MEMA on endangered species and fish and wildlife management issues associated with flood buyouts and water management and conservation questions. The Mississippi Department of Archives and History works with MEMA concerning the National Environmental Policy Act as it relates to historic issues.

The Mississippi Department of Insurance supports MEMA in promoting flood and earthquake insurance, preparedness, response, and mitigation issues and plans. The Mississippi Department of Environmental Quality (MDEQ) has worked with MEMA on flood buyouts, hazardous material planning, earthquake mitigation, and dam safety plans and issues. The Mississippi Department of Transportation, the US Department of Transportation, and the Federal Highway Administration have worked with MEMA on flood buyouts, open space restriction issues, and earthquake planning and bridge retrofits. In addition to the state and federal transportation agencies, the US Geological Survey, the Central US Earthquake Consortium (CUSEC), MDEQ, the Mississippi Department of Insurance, the American Society of Civil Engineers (ASCE), the Mississippi Society of Professional Engineers, the University of Mississippi Center for Community Earthquake Preparedness, the University of Memphis Center for Earthquake Research and Information (CERI), and the Earthquake Engineering Research Institute, New Madrid Chapter, work with MEMA on earthquake mitigation, including retrofits, public education, soil mapping, and seismic studies.

StormReady Communities

The National Weather Service (NWS), Mississippi Civil Defense and Emergency Management Association (MCDEMA), and MEMA support the NWS StormReady Program in Mississippi with 31 counties, 15 communities, 7 universities, and 4 government sites, as well as the many mitigation measures included in that program and its plans (Figure 2.3.2.1). The State of Mississippi offered a safe room program called "A Safe Place to Go" encouraging homeowners to construct individual safe rooms at their residence. More than 6,200 safe rooms were installed. This program is no longer active due to funding availability. The State also provided funding for FEMA 361 and community safe rooms. MEMA has supported efforts to reduce injuries, fatalities and damages from severe weather events by funding weather radios to local schools and call-down systems to local governments for distribution to areas of high population concentrations such as schools, industries, and hospitals. MEMA's Statewide Coordinator has worked for years to educate local, state, and national voluntary organizations through the Disaster Recovery Partnership and Volunteer Organizations Active in Disaster (VOAD), concerning the importance of mitigation.

Figure 2.3.2.1
StormReady Communities



StormReady Counties	
Adams	Lauderdale
Attala	Leake
Bolivar	Lowndes
Claiborne	Marion
Clark	Neshoba
Clay	Newton
Copiah	Oktibbeha
Desoto	Pearl River
Forrest	Rankin
Grenada	Smith
Hinds	Stone
Jackson	Tallahatchie
Jones	Tippah
Lafayette	Tunica
Lamar	Warren
	Yazoo

StormReady Communities	
Brandon	Richland
Clinton	Senatobia
Columbia	Waveland
Hattiesburg	
Jackson	
Louisville	
Madison	
Magee	
Mendenhall	
Oxford	
Pelahatchie	
Prentiss	

StormReady Universities			
University of MS	Jackson State University	University of MS Med Center	University of Southern MS
Alcorn State University	Meridian Community College	Mississippi State University	

StormReady Government Sites			
John C. Stennis Space Center	Jackson Air National Guard Base	Naval Air Station Meridian	Mississippi Emergency Management Agency

2.3.3 Mitigation Programs and Measures

The following is a synopsis of the State, FEMA, and other program initiatives that are integrated into the Standard Mitigation Plan and will be utilized in the accomplishment of the strategies developed in this plan and local mitigation plans. The State will manage and administer FEMA funding in accordance with applicable Federal statutes and regulations. New programs and initiatives will be added to this ongoing list in subsequent updates in compliance with 44 CFR 13.11(d).

44 CFR 13.11(d): State Plans. Amendments. A state will amend a plan whenever necessary to reflect: (1) New or revised federal statutes or regulations or (2) a material change in any state law, organization, policy, or state agency operations. The state will obtain approval for the amendment and its effective date but need submit for approval only the amended portions of the plan.

Center for Community Earthquake Preparedness

During February of 1994, MEMA partnered with the Center for Community Earthquake Preparedness (CCEP) at the University of Mississippi to gain a more solid understanding of earthquake effects on structures. The final report, titled Evaluation of Earthquake Effects on Selected Structures and Utilities at the University of Mississippi: A Mitigation Model for Universities, was produced in October of 1999. This project was designed to determine responses of selected buildings and facilities to regional seismic activity at or near moment-magnitudes of four, six, and eight; identify potential mitigation that would minimize loss of lives during a regional seismic event; identify sites of potentially severe property damage resulting from a regional seismic event; increase the pool of technical experts capable of performing earthquake evaluations; establish general recommendations for earthquake hazards mitigation; and keep the issue of potential consequences of seismic activity before the public and the University of Mississippi administration. As a result of the partnership developed during this time, MEMA continues to work closely with CCEP to develop a profile on earthquakes in Mississippi, identifying the risk from regional earthquakes, assessing the vulnerability of regional earthquakes using HAZUS-MH, and identifying potential mitigation actions that could be implemented to mitigate the effects of earthquakes on the state. The partnership between MEMA and the CCEP will continue, and information from both entities will be mutually integrated to benefit the state's efforts to mitigate potential risks posed by the seismic hazards in Mississippi.

MEMA is also a participant in the New Madrid Seismic Zone Catastrophic Response Planning Project. Partners in this effort include the following:

- DHS/FEMA Headquarters (Response, Recovery, Mitigation, Private Sector, Critical Infrastructure, etc.)
- FEMA Regions IV, V, VI, VII
- Other federal agencies including USDOT, USGS, DHHS, DoD, and others
- CUSEC member states: AL, AR, IL, IN, KY, MS, MO, TN
- NORTHCOM
- Local governments

- Business, industry, and voluntary organizations
- Catastrophic planning personnel assigned to support each participating FEMA region and state
- MAE Center, Sandia National Lab, George Washington University (ICDRM)

The mission of the Project is to increase national readiness for a catastrophic earthquake in the New Madrid Seismic Zone (NMSZ). Specifically, this will be accomplished by developing a series of annexes or supplements to existing base plans for response and recovery to a series of major earthquakes in the NMSZ and integrating them into a single document with federal, regional, tribal, state, and local components. Additionally, the mission is to identify any issues that cannot be resolved based on current capabilities and to propose recommended courses of action for decision makers involved in the Project

Community Development Block Grants (CDBG)

Authorized to provide local match for the Hazard Mitigation Grant Program (HMGP), the Mississippi Development Authority is the grant recipient of the Community Development Block Grant (CDBG) funds on behalf of the State of Mississippi. The United States Congress allocated some $2 billion of CDBG funding for water, wastewater, electrical, homeowner grants, planning, and downtown revitalization. In some cases, CDBG funds can be used as part of the local share for HMGP, provided that the law does not preclude them.

The CDBG funds for homeowner grants were used to elevate homes that are now in new flood zones, as well as to upgrade homes to the new International Building Codes. Also, the funds will be used to buy-out property and thus hopefully change the use of the property from residential to green space and commercial uses.

Comprehensive Emergency Management Plans (CEMP)

The state and each county within the state (82 in all) to include the MS Band of Choctaw Indians have a Comprehensive Emergency Management Plan (CEMP). The plan serves as the operations and administrative guide for disaster preparedness, response, and recovery efforts. Select mitigation strategies such as employment of saferoom/storm shelters, evaluation and retrofitting of critical facilities, and public alert warning systems are a part of the CEMP.

The state plan and all county plans have been or are in the process of being updated by utilizing post-Katrina lessons learned, as well as incorporation of the guidelines contained in the National Response Framework.

Consolidated Plan for Housing and Community Development (CPHCD)

The Consolidated Plan for Housing and Community Development (CPHCD) is a requirement of the US Department of Housing and Urban Development (HUD) that consolidates the planning and application aspects of the Community Development Block Grant, Emergency Shelter Program, Home Investment Partnerships, and Housing Opportunities for Persons with AIDS formula programs. The CPHCD is a comprehensive planning document that identifies the state's overall needs for affordable and supportive housing and community development. In addition, the plan outlines a strategy to address those needs. The

CPHCD development process represents an opportunity to involve citizens and community groups in the process of assessing the state's overall housing and community development needs, establishing strategic priorities, and developing a plan to meet the state's identified housing and community development goals. The CPHCD is updated on a five-year cycle with action plans being developed annually. Identified hazard areas and information on vulnerable populations and structures identified within the mitigation plan will be integrated into the CPHCD to ensure that action plans developed to meet housing and community development needs are reflective of the mitigation goals identified within the mitigation plan.

Emergency Management Preparedness Grant (EMPG)

The EMPG provides funding for state and local emergency management programs to include the Natural Hazards Program and the State Hazard Mitigation Program. The EMPG is the backbone for funding local emergency management capability. Because of increased EMPG funding, all 82 counties now have active emergency management programs.

Forestry-Disaster Hazard Mitigation and Preparedness Plan (DHMPP)

The State of Mississippi Forestry Commission (MFC) has responsibilities for firefighting (ESF4) duties during and following a disaster. MFC completed its initial Disaster Hazard Mitigation and Preparedness Plan (DHMPP), and is in the process of updating it. This plan will continue to provide specific information on preparedness resources and activities as ESF4 relates to hurricanes and wildfires. Additionally, the plan will provide detailed information on mitigation activities MFC will undertake to reduce the level of vulnerability to wildfire for the State of Mississippi.

Federal Dam Safety Program

This FEMA program is administered/enforced by the Mississippi Department of Environmental Quality. Strategies for expanding dam safety are discussed in Section 4.4. Additional information on dam safety and relevant issues will be discussed in subsequent updates of the State of Mississippi's Standard Mitigation Plan.

Hazard Mitigation Assistance (HMA)

In 2008, the Federal Emergency Management Agency grouped together its grant programs and their requirements to form the Hazard Mitigation Assistance Program. HMA consist of the following programs:

- Hazard Mitigation Grant Program (HMPG)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)

This FEMA funded program serves as the main post-disaster mitigation utilized by the State of Mississippi. The following initiatives have been selected as high priority projects for current and future funding.

Retrofit of Critical Facilities – It is the intent of the Mitigation Bureau to assign a high priority to the retrofitting of critical facilities identified in state and local mitigation plans. Wind and flood events have

proven to have the highest history of damage, although earthquake vulnerability analysis has identified cost-effective measures for both structural and non-structural mitigation.

Planning – It has long been the policy of the Mitigation Bureau to assign funding priority to those communities that have identified eligible mitigation projects through a planning process. Therefore, the funding of mitigation plans is the top funding priority.

Saferooms – Extreme windstorms, such as tornados and hurricanes, pose a serious threat to buildings and their occupants in many areas of Mississippi. Even a structure built "to code," may not withstand extreme wind events. A shelter can be built in one of several places – beneath a concrete slab-on-grade foundation, or in an interior room on the first floor. To protect its occupants, an in-house shelter must be able to withstand the forces exerted by high winds and remain standing, even if the rest of the house is severely damaged. A saferoom or storm shelter is key to this plan's mitigation strategy to save lives.

Funds are available to the qualified homeowner from the HMGP administered by the Mitigation Bureau, through private lenders, and the Federal Housing Administration (FHA). Homeowners are requested to contact their local Emergency Management Agency for further information.

Repetitive Flood Loss Structures – These structures represent less than 4 percent of the insured structures in the state but have incurred over 25 percent of the total dollars paid on claims. A priority of the HMGP has been to identify these structures and fund cost-effective acquisition, elevation, localized drainage or relocation of the structures.

Public Alert and Warning System – A special initiative funded through a five percent set aside and the tornado mitigation initiative allows the state to fund warning systems on college and university campuses where large numbers of student and faculty reside. This program is coordinated with local emergency managers.

Expanded Mitigation Strategies Planning Grant Pilot Guidance - The HMGP Expanded Mitigation Strategies Planning Grant Pilot will provide funds for eligible HMGP Applicants for identifying and planning feasible mitigation projects, and incorporating those projects into their Local Mitigation Plans (LMPs). The mitigation planning process assists eligible Applicants in setting short and long-range mitigation goals and objectives.

Mitigation planning is a collaborative process whereby hazards affecting the community are identified, hazard vulnerability is assessed and analyzed, and consensus is reached on how to minimize or eliminate the effects of those hazards. Because LMPs are the foundation of a strong mitigation strategy, the Pilot will bridge the gap between mitigation planning strategies and the implementation of actual mitigation projects as part of the overall disaster recovery effort.

Pre-Disaster Mitigation-Competitive (PDM-C)

This FEMA program was authorized by the Disaster Mitigation Act of 2000, which amended the Stafford Act. PDM-C is a nationally competitive hazard mitigation program that is funded on an annual basis. States submit state level and community applications for funding of natural hazard mitigation measures. State and local governments are required to have an approved mitigation plan to receive funding under PDM-C.

Hazard Mitigation Technical Assistance Program (HMTAP)

The state has utilized Technical Assistance Task Orders to develop local and county plans, conduct regional workshops on Pre-Disaster Mitigation, publish a Mitigation Success Stories book, conduct community mitigation capability assessments to include community assistance visits and contacts, and to evaluate critical facilities in the wake of Tropical Storm Isadore and Hurricane Lili in September 2002. Significant to the development of this plan have been workshops at 10 Planning and Development Districts facilitated by an HMTAP Task Order, which is integral to the overall mitigation strategy for outreach and public involvement in the planning process.

National Flood Insurance Program (NFIP)

The US Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. The NFIP is a federal program that enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the federal government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new and substantially improved construction in floodplains, the federal government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and contents caused by floods.

The NFIP authorizes the Community Assistance Program (CAP), the Community Rating System (CRS), the Increased Cost of Compliance Insurance Program (ICC), and the Risk Map Program, all of which serve as mitigation incentives for reducing the cost of flood losses.

Community Assistance Program – State Support Services Element (CAP-SSSE)

The state's formal participation in the NFIP is through the FEMA funded Community Assistance Program (CAP). The CAP annual agreement provides partial funding for the state to establish and maintain an office responsible for providing NFIP technical assistance to state and local jurisdictions, for conducting NFIP compliance audits referred to as "Community Assistance Visits", and conduct training and public outreach/ education. The Governor has designated MEMA as the state coordinating agency for the CAP program. The MEMA Floodplain Management Bureau Director serves as the state NFIP Coordinator.

In Mississippi, the CAP is implemented through a five-year, long-term plan and a one-year action plan. These plans address NFIP compliance, public outreach/education, and mitigation of flood risk structures.

As of 4/3/2018, there were 330 local communities participating in the NFIP. Of those 330 communities, 32 also participate in the Community Rating System (CRS) program. The flood insurance policies found within these CRS communities equate to 61% of the policies within the state of Mississippi. Mitigation capability assessments have been conducted in these communities to ensure that local administrators are trained to become Certified Floodplain Managers (CFM).

Participating NFIP communities (with low to moderate flood risk) receive compliance visits every five years. Most of these communities have adopted the state model ordinance and community leaders/administrators have attended regional workshops.

The NFIP State Coordinator has developed a Local Flood Protection Ordinance Handbook, a Quick Guide, for local administrators and a model Flood Damage Prevention Ordinance that exceeds the FEMA standards for riverine and coastal communities. These tools are available in hardcopy and on the MEMA website. Statewide and regional NFIP workshops are conducted annually.

The Association of Floodplain Managers of Mississippi (AFMM) was established in 1999 and became a state chapter of the Association of State Floodplain Managers in 2001. The association currently has over 100 members and in 2004 hosted the annual national conference of the Association of State Floodplain Managers. Members of the AFMM attaining their certification are now assisting the state with training and "peer to peer" assistance to other communities.

Increased Cost of Compliance (ICC)

ICC coverage provides for the payment of an additional claim to help pay for the increased costs to comply with state or community floodplain management laws or ordinances after a flood in which a building has been declared substantially damaged or repetitively damaged. When an insured building is damaged by a flood and the community declares the building to be substantially or repetitively damaged, this triggers the requirement to comply with its community floodplain management ordinance, ICC will help pay for the cost to floodproof (non-residential buildings only), relocate, elevate or demolish a structure up to a maximum of $30,000. This coverage is in addition to the building coverage for the repair of actual physical damages from flood under the policy, but the total paid cannot exceed the maximum limit set by Congress for that type of building.

The maximum limit of $30,000 helps property owners insured under the NFIP to pay for a portion, or in some cases, all the costs of undertaking actions to protect homes and businesses from flood losses. In addition, an ICC claim payment can be used to complement and supplement funds under other mitigation programs such as the FMA and FEMA's HMGP, which assist communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings insured under the NFIP.

FEMA Risk Map Program

The Risk Map is the successor to FEMA's Map Modernization (Map Mod) program and expands the focus to include risk assessment, mitigation planning, and traditional hazard identification (flood mapping or DFIRM) activities. Risk MAP is meant to better inform communities as they make decisions related to reducing flood risk by implementing mitigation actions. Where Map Mod studies were county-wide based, Risk Map studies are based on HUC-8 basins and may include portions or all multiple counties and cities/towns. The initial 5-year Risk MAP program was funded for the years of FY2010 through FY2014. In addition to the traditional regulatory products (Flood Insurance Study (FIS), DFIRM, and DFIRM GIS Database), communities in a studied basin will receive new non-regulatory products which will include the following; Watershed Flood Risk Report, Watershed Risk Map, and Flood Risk GIS Database with changes since last FIRM data, Multi-Frequency Flood Depth Grids, Percent Annual Chance of Flooding data, percent chance of flooding over 30-Years and new HAZUS Annualized Risk data.

FEMA is working with federal, state, tribal, and local partners across the nation to identify flood risk and promote informed planning and development practices to help reduce that risk. Risk MAP provides high quality flood maps and information, tools to better assess the risk from flooding and planning and outreach support to communities to help them take action to reduce or mitigate flood risk. Each Risk MAP flood risk project is tailored to the needs of each community and may involve different products and services.

Homeland Security Plan

Findings from this plan were integrated with the Mississippi Emergency Operations Plan, with particular emphasis on human-caused hazards. The Homeland Security Plan development was closely coordinated with this Hazard Mitigation Plan.

Natural Hazards Program

Located in the Preparedness, Training, and Exercise Bureau of MEMA, the Natural Hazards Program Manager develops and coordinates the State Hurricane Program and the State Earthquake Program and coordinates the update of the Hurricane and Earthquake component of the plan.

Pre-Disaster Mitigation Planning Program (PDM-PL)

This FEMA program is being utilized to fund localities and Planning and Development Districts throughout the state to develop local and regional plans. Localities that have applied to bring their existing hazard mitigation plans into compliance with Sec. 322 standards may be funded based upon availability. These plans, when judged compliant, will be linked to Mississippi's Standard Hazard Mitigation Plan.

Pre-Disaster Mitigation Loans for Small Businesses

The Small Business Administration published a Final Rule on its Pre-Disaster Mitigation Loan Program in the Federal Register on October 7, 2002. After November 1, 2003, a business must be located in a community with a FEMA-approved mitigation plan to be eligible for this program. Eligible small businesses may borrow up to $50,000 each fiscal year at a fixed interest rate of four percent per year or less for mitigation measures approved in the loan request. Businesses proposing mitigation measures must be located in a Special Flood Hazard Area. A written certification from a local emergency management official is required as part of the loan application to satisfy this requirement. This program will coordinate with the State of Mississippi Standard Mitigation Plan to provide capital necessary to fund hazard mitigation projects.

State Emergency Response Commission

Mississippi Emergency Management Agency is designated by executive order to implement the Superfund Amendments and Reauthorization Act, Title III (Public Law 99-499). Personnel involved in this on- going planning effort coordinate Local Emergency Planning Commissions (LEPC) statewide. There is a particular emphasis on human-caused hazards as a result of the use or misuse of hazardous materials.

3.0: Risk Assessment

44 CFR §201.4(c)(2): A State Plan must include:

A risk assessment that provides the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments.

Overview of the Risk Assessment Process

Risk Assessment requires the collection and analysis of hazard-related data enabling state and local jurisdictions to identify and prioritize appropriate mitigation actions to reduce losses from potential hazards. Based on best available data, this section profiles natural and man-made hazards that could possibly affect the state, determines which jurisdictions and populations are most vulnerable, and estimates potential loss of state facilities.

This section of the plan was originally developed in 2004 with updates developed in 2007, 2010 and 2013. MEMA is the lead agency for the state in developing this plan and subsequent plan updates plus coordinates involvement from applicable state agency representatives through appointment to the State Hazard Mitigation Council (HMC).

The HMC thoroughly reviewed the identified hazards and their respective profiles. An appropriate amount of research conducted for each hazard and incorporated with the findings in the 2013 plan. Primary sources and methodologies used for this plan update are listed below:

- Declared Events: state and federal declared events obtained from www.fema.gov/disasters.
- National Climatic Data Center (NCDC): database maintained by the National Weather Service tracks natural hazard events with information about dates, locations and estimated damages. This database was improved since the 2010 plan and includes more categories of natural hazards. Data can be extracted statewide by county or zone - depending on the type of event at www.ncdc.noaa.gov/storm events.
- HAZUS-MH: FEMA's loss estimation software utilizes a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information.
- National Flood Insurance Program (NFIP): The NFIP eliminated many of the reports used in previous plans. For this plan update the NFIP Loss Statistics Report and the state of Mississippi repetitive flood claim and severe repetitive loss properties report dated February 2011 were used.

- Internet Research: The Internet and other online research tools used throughout this plan update.

- Local Mitigation Plans: Applicable data, including hazards identified as potential risks and rankings were summarized and tabulated throughout this section of the plan.

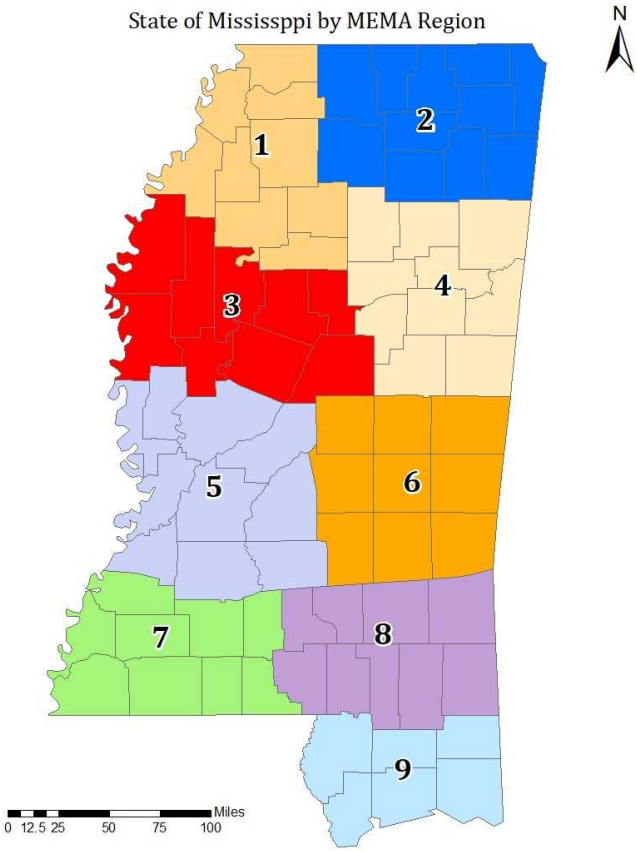
Identification of Critical Facilities and Infrastructure

The state of Mississippi is nearing completion of their effort to geocode all state-owned property. It is estimated this project will be completed in 2014. For this plan update, the estimated losses for state facilities and infrastructure will be based on the data presented in the 2010 plan.

Local Mitigation Strategy Integration

As of this plan update, a total of 104 local mitigation plans are approved. These plans were developed for single jurisdictions, counties, university/community colleges, and regional plans (multi-county). Each approved plan was considered and integrated as appropriate into this plan update.

MEMA will coordinate the update of local mitigation plans into regional plans based on MEMA's established regions. This change is to unify mitigation planning throughout the state to improve integration and utilize resources (financial and assets) more efficiently.



2018 Summary of Changes

Hazard data is presented, where appropriate, by MEMA Region. The state intends to make this information more usable to local jurisdictions as they update their plans to a level based on the nine MEMA Regions. HAZUS runs for floods are provided in the appendix of this plan and can be requested by jurisdictions to review and develop their tables and references within their plans as they deem appropriate. A brief summary of the changes/updates made to each hazard within this section is provided below.

3.1 Identifying Hazards - Added presidential declarations with individual assistance paid to date, updated the hazards identified in the approved local plans and introduced infrastructure interdependency vulnerabilities.

3.2 Profiling Hazards and Estimating Losses - Updated estimated losses and added explanation for HAZUS and flood mapping capabilities.

3.3 Tornado - Updated previous event history, incorporated property values and loss estimates from Mississippi Tax Commission, plus expanded narratives and damage impacts for recent events. Identified vulnerability to lapse in radar coverage and updated information regarding mobile/manufactured housing.

3.4 Dam/Levee Failure - Updated event history, inventory of dams, status of EAPs and changes in classifications. Added maps per MEMA districts.

3.5 Tropical Cyclone - Updated previous event history and state probabilistic and Katrina planning scenarios.

3.6 Flood - Updated event history and NFIP data.

3.7 Wild/Urban Fire - Updated information received from MFC with best available data. Added wildland fire maps.

3.8 Drought - Updated event history and added information on Keetch Byram Drought Index.

3.9 Winter Weather - Updated event history and expanded cold-weather related events and vulnerabilities.

3.10 Earthquake - Updated event history, effects on dams and incorporated HAZUS results.

3.11 Sea Level Rise/Climate Change - New section added to the plan as per FEMA requirements. It is up to the state to determine how they addressed it.

3.12 Cyberterrorism - Although a man-made hazard, could have potentially disastrous results if attacked.

3.13 Other Significant Hazards - Updated information for severe weather and coastal erosion.

3.14 Growth and Development Trends - Updated demographic information and added charts depicting from which states people are migrating.

3.15 Interdependency of Infrastructure - Updated section with the latest information.

Mitigation Recommendations

A number of recommendations came out of the 2013 plan as it was being developed. These recommendations continue to be relevant for this plan update as well.

Tornado

Constructing safe rooms in mobile/manufactured housing complexes should be further explored. Encouraging developers to include a community safe room could reduce injury or loss of life to residents.

Dam/Levee

Provide funding to complete a study of the potential impacts from a breach on the Pearl River levee system. This system protects the greatest number of people and assets in the state which could cause significant economic implications.

Explore impacts to failures in states that border Mississippi. As the state realized in 2010 with the ice/snow runoff from the northern states into the Mississippi River, what happens upstream can and will create significant damages to the levee systems in Mississippi. Furthermore, flooding caused by dam/levee failures in Mississippi and their potential impacts across state borders is also necessary - which was the case when the dam at Percy Quin overflowed into Louisiana.

Suitable data showing the location of all levees and their potential interaction of related river systems does not exist, largely due to regulatory oversight differences between certified and non-certified levee structures. This lack of data prohibits Mississippi from understanding the true potential of levee failures.

3.1: Identifying Hazards

44 CFR §201.4(c)(2)(i) - The State risk assessment shall include the following elements:

An overview of the type and location of all natural hazards that can affect the State

Introduction

Hazards identification is recognizing events threatening a particular planning area. An event becomes a hazard when it harms people, property or interferes with commerce and human activity. Such events would include, but are not limited to, hurricanes, floods, earthquakes, tornadoes and other hazards affecting populated areas. Natural hazards harming the state in the past are likely to happen in the future. Consequently, the process of identifying hazards includes determining whether or not the hazard occurred previously. Approaches to collecting historical hazard data include researching newspapers and other records, conducting a review of planning documents and reports in all relevant hazards subject areas, gathering hazard-related GIS data, and engaging in discussions with relevant experts throughout the state.

A variety of sources were used to determine the full range of potential hazards within the state of Mississippi, including internet research and a careful evaluation of approved local mitigation plans. Even though a particular hazard may not have occurred in recent history in the state, it is important to consider all hazards potentially affecting the planning area during the hazard identification stage.

Mississippi is vulnerable to a wide variety of natural and man-made hazards threatening life and property and is typically in the top ten of most vulnerable states in the nation due to risks from hurricanes, tornadoes and other hazards.

Table 3.1.1 outlines each major disaster declaration that Mississippi has received over the last decade. This establishes the vulnerability and historic occurrences of hazards with which Mississippi regularly deals with. This table also includes Individual Assistance (IA) statistics, accurate as of November 22, 2017.

Table 3.1.1
FEMA Major Disaster Declarations and Individual Assistance (IA) Funded Mississippi 2002 – 2017

Date	Disaster Type	Disaster Number	Amount of IA
November 22, 2017	Hurricane Nate	DR-4350	None
May 22, 2017	Severe Storms, Tornadoes, Straight-line Winds and Associated Flooding	DR-4314	None
January 25, 2017	Severe Storms, Tornadoes, Straight-line Winds and Associated Flooding	DR-4295	$3,314,757
March 25, 2016	Severe Storms, Tornadoes, and Flooding	DR-4268	$8,144,330

January 4, 2016	Severe Storms, Tornadoes, Straight-line Winds and Associated Flooding	DR-4248	$2,903,899
December 23, 2014	Severe Storms, Tornadoes, and Flooding	DR-4205	None
April 30, 2014	Severe Storms, Tornadoes, and Flooding	DR-4175	$5,899,175
February 13, 2013	Severe Storms, Tornadoes, and Flooding	DR-4101	$3,241,008
August 29, 2012	Hurricane Isaac	DR-4081	$17,667,440
May 11, 2011	Flooding	DR-1983	$13,724,525
April 29, 2011	Severe Storms, Tornadoes, Straight-line Winds and Associated Flooding	DR-1972	$10,730,970
May 14, 2010	Severe Storms, Tornadoes, and Flooding	DR-1916	$1,320,029
April 29, 2010	Severe Storms, Tornadoes, and Flooding	DR-1906	$4,302,971
May 12, 2009	Severe Storms, Tornadoes, and Flooding	DR-1837	None
September 22, 2008	Hurricane Gustav	DR-1794	$7,176,481
May 28, 2008	Severe Storms and Tornadoes	DR-1764	$549,481
May 8, 2008	Severe Storms and Flooding	DR-1753	$1,598,082
August 29, 2005	Hurricane Katrina	DR-1604	$1,296,454,555
July 10, 2005	Hurricane Dennis	DR-1594	None
September 15, 2004	Hurricane Ivan	DR-1550	$8,514,433
May 23, 2003	Severe Storms, Tornadoes, and High Winds	DR-1470	$740,552
April 24, 2003	Severe Storms, Tornadoes, and Flooding	DR-1459	$18,270,790
November 14, 2002	Severe Storms and Tornadoes	DR-1443	$2,028,549
October 1, 2002	Tropical Storm Isidore	DR-1436	None

Source: FEMA Disaster Declarations-Mississippi (2-20-18)

Hazard Identification Process

This section profiles the potential hazards posing the greatest threat to Mississippi. As part of the 2018 revision, a comprehensive list of hazards was compiled from the following sources that includes, but were not limited to:

- Review of the 2013 State of Mississippi Standard Mitigation Plan
- Review and assessment of historical data from the NCDC. FEMA Disaster Declarations, USGS, NFIP and various internet resources.
- Review of the local hazard mitigation plans

In addition to the sources above, hazard data and input were collected from direct communication with various agencies, discussions with consultant team's in-house experts, historical records and Internet searches

The screening process did not vary from the 2013 process. Working with the consultant, the HMC considered which hazards could realistically be addressed at the state level in terms of mitigation. The HMC still believes that many hazards are best addressed by the local mitigation plans. The HMC has not changed its position regarding the lack of a specific hazard profiled in this plan. Again, it does not mean the state will not provide adequate support to local jurisdictions in mitigating the effects of that hazard.

The HMC's position regarding hazard selection and profiling remains the same. Many of the hazards selected are related (*e.g.* flooding and tornadoes can develop during a coastal storm) because other hazards may result from a disaster event. In such instances, these hazards are not listed separately but concurrently.

Table 3.1.2 shows a summary of the hazard identification results for Mississippi, followed by the results of the hazards not included in this plan update. This table includes the hazard ranking and subsection where the hazard is addressed. Details of the hazard ranking and profiling process are provided following the identification tables.

Table 3.1.2
Summary of Hazards Selected

Hazard Type	Reasons for Inclusion	Section Reference
Flood	Much of the state of Mississippi is located within the 100- year floodplain. Flash floods and other flood events occur regularly during rainstorms due to terrain and hydrology of the state of Mississippi. There have been numerous Disaster Declarations as a result of flooding in Mississippi.	Section 3.6
Tornado	Tornadoes are common disasters in Mississippi, with the most active season being in March through May	Section 3.3

Tropical Cyclone	Hurricanes/tropical storms are common and devastating in Mississippi.	Section 3.5
Wildfire	The state of Mississippi experiences wildfires on a regular	Section 3.7
Earthquake	Significant research points to the possibility of damaging	Section 3.10
Extreme Winter Weather	There have been more than 47 damaging events between 1993 and 2009, with a reported $25 million in property damages and $5 billion in crop damages	Section 3.9
Drought	Research indicates the possibility of inadequate water supply as a result of prolonged drought conditions could impact the health of the population and jeopardize economic resources such as timber, livestock, and crops.	Section 3.8
Dam/Levee Failure	High hazard dams require Emergency Action Plans which include Inundation mapping.	Section 3.4
Severe Weather (heavy rain, thunderstorm, strong wind, hail and lightning)	Not typically a state-wide occurrence and best addressed in local plans.	Section 3.11
Coastal Erosion	Coastal erosion is primarily caused by hurricanes and coastal flooding, which are addressed in their respective sections.	Section 3.11
Climate Change/Sea Level Rise	Climate change/sea level rise is an evolving hazard that is largely caused by increased levels of atmospheric carbon dioxide which are address in their respective section.	
Cyberterrorism	Although a man-made hazard, but just as devastating is as any premeditated, politically, financially or maliciously motivated attack against informational systems which are addressed in their respective sections.	

Excluded Hazards

During the review of hazards included in the 2013 plan, the HMC determined they would not change the process or how the hazards were categorized. Therefore, the hazard profiled and not profiled will remain

the same in the 2018 plan update. Again, this decision was based on the belief they were not prevalent hazards within the state, and would pose little or no threat to the state as compared to the other hazards. Table 3.1.3 gives a brief description of those hazards and the reason for their exclusion.

Avalanche, landslide and volcano are recognized by FEMA as hazards prone to the U.S. but were not considered because they pose no threat to Mississippi.

Table 3.1.3
Summary of Hazards Excluded from Hazard Profiling

Hazard Type	Description	Reasons for Exclusion
Expansive soils	Expansive soils shrink when dry and swell when wet. This movement can exert enough pressure to crack sidewalks, driveways, basement floors, pipelines and even foundations.	Only 36% of local mitigation plans identified expansive soils as a hazard to be profiled. The state has concluded that it does not pose a significant state-level threat. The decision was also partially based on the fact that the impacts to state-owned or critical facilities would be little or none.
Extreme heat	Temperatures that hover 10 degrees or more or more above the average high temperature for the region and last for several weeks.	Only 24% of local mitigation plans identified extreme heat as a hazard to be profiled. While extreme heat can create emergencies in Mississippi, the state has concluded it does not pose a significant state-level threat. The decision was partially based on the impacts to state-owned or critical facilities would be little or none.
Liquefaction	Liquefaction occurs in saturated soils, that is, soils in which the space between individual particles is completely filled with water. This water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Prior to an earthquake, the water pressure is relatively low. However, earth- quake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other.	Soils in the state are mostly compact. Presents a minor threat. No significant historical record of this hazard in the region.

Land subsidence	Occurs when large amounts of ground water are withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rocks fall in on themselves.	Addressed in earthquake section.
Tsunamis	A tsunami is a series of ocean waves generated by sudden displacements in the sea floor, land- slides, or volcanic activity. In the deep ocean, the tsunami wave may only be a few inches high. The tsunami wave may come gently ashore or may increase in height to become a fast-moving wall of turbulent water several meters high.	MEMA participates on the National Tsunami Hazard Mitigation Program (NTHMP). There is no identified history of tsunamis in the Gulf. Mitigation would be similar to that for large hurricanes which are addressed.

Assessment of Local Mitigation Plans

The 2018 plan considers risks identified outside this process in order to be more aware of the hazards facing local jurisdictions. Chapter 5: Coordination of Local Mitigation Planning, covers in detail, hazards identified and addressed in the local plans. Generally, the hazards selected and profiled in this plan coincide well with the highest ranked local hazards.

MEMA Districts 1, 2, 3, 4, 5, 6 and 7 decided to create Multi-jurisdictional District Plans instead of moving forward with single jurisdictional plans. This review concluded the nine hazards of concern - flood, hurricane, wildfire, tornado, extreme winter weather, earthquake, drought, severe weather and dam/levee failure - are included in over 72% of the local plans. All counties are concerned about tornado and flood.; and for other hazards identified in local plans but not in the HMC ranking, a threshold was established. The HMC decided to continue with their decision from the prior plan update that if 45% or fewer of the local plans identified the hazard, it was deemed to pose no significant threat to the state. The results of the local hazard identification review are summarized in the table below.

A review of local plans revealed severe weather (thunderstorm, hail, lightning and high wind) was identified and addressed by 48% of the local plans. The HMC continues to hold the position that this hazard is best addressed at the local level and is addressed under Section 3.13 Non-Profiled Hazards. As with the 2013 plan, components of these hazards are addressed in the tropical cyclone and tornado sections of this plan as applicable. This plan update will do the same.

Drought was addressed in 75% of the local plans and included as a limited profiled hazard as it can have statewide impacts, but is best mitigated by local practices. Coastal erosion is included as a non-profiled hazard and determined to pose no significant statewide threat to Mississippi and little or no threat to state-owned or critical facilities.

Hazards identified and addressed in local plans, but not included in this plan, will receive the support of the state mitigation program. These hazards include but not limited to, sea level rise, salt water intrusion, tsunami and expanding soils. Many of the coastal communities are in the process of conducting studies to further understand globally and should continue to be explored by the state.

Natural Hazards	Percent of Plans Included	Natural Hazards	Percent of Plans Included
Flood	98%	Expansive Soils	67%
Tornado	100%	Extreme Heat	46%
Hurricane	54%	Storm Surge	5%
Thunderstorm/High Wind/Lightning	48%	Erosion/Coastal Erosion	46%
Wildfire	98%	Tropical Storm/Coastal Storm	36%
Severe Winter Storm/Extreme Cold/Ice Storms	1%	Land Subsidence	37%
Earthquake	94%	Tsunami	2%
Drought	75%	Sea Level Rise	0%
Dam/Levee Failure	62%		

Hazard Ranking

For the 2018 plan update, the HMC elected to use the same methodology adopted during the last plan update. Again, since the hazard ranking methodology was used in the majority of approved local mitigation plans, the HMC wanted to continue with a consistent methodology that is reflective of the statewide evaluation of hazards. The basis for the ranking methodology used in this plan update is presented in Table 3.1.4.

Table 3.1.4
Hazard Ranking Methodology

RISK CHARACTERISTIC (VULNERABILITY)		SCORE
AREA IMPACTED (The percentage of the state at risk to an impact from each hazard)	No area in the state directly impacted	0
	Less than 25% of the state impacted	1
	Less than 50% of the state impacted	2
	Less than 75% of the state impacted	3
	Over 75% of the state impacted	4
HEALTH AND SAFETY CONSEQUENCES (The health and safety consequences that can occur)	No health and safety impact	0
	Few injuries or illnesses	1
	Few fatalities but many injuries or illnesses	3
	Numerous fatalities	4
PROPERTY DAMAGE (The amount of property damage that can occur)	No property damage	0
	Few properties destroyed or damaged	1
	Few destroyed but many damaged	2
	Few damaged and many destroyed	3
	Many properties destroyed and damaged	4
ENVIRONMENTAL DAMAGE (The environmental damage that can occur)	Little or no environmental damage	0
	Resources damaged with short term recovery	1
	Resources damaged with long term recovery	2
	Resources destroyed beyond recovery	3
ECONOMIC DISRUPTION (The economic disruption that can occur)	No economic impact	0
	Low direct and/or indirect costs	1
	High direct and low indirect costs	2
	Low direct and high indirect costs	3
	High direct and high indirect costs	4
FUTURE OCCURENCE		**SCORE**
PROBABILITY OF FUTURE OCCURRENCE	Unknown but anticipate rare occurrence	1
	1 - 4 documented occurrences over last 10 years	2

(The probability of a future occurrence)	5 - 7 documented occurrences over last 10 years	3
	8 – 10 documented occurrences over last 10 years	4
	9a More than 10 occurrences over last 10 years	5

In keeping with the same process, the HMC studied each state-prone hazard and, based on historical data and information provided by the council members and planning team, considered the statewide implications each would present. Each risk characteristic – area impacted, health and safety consequences, property damage, environmental damage, and economic disruption – was assigned the same scoring value as dictated by the 2013 plan of 0-4, multiplied by a future occurrence value of 1-5 determining the overall risk level. The sum of each risk characteristic value was added together and multiplied by the probability of future occurrence to determine each hazard's total risk rating score. The formula is as follows: vulnerability x probability of occurrence = risk. Below is the definition of each risk level and their total rating score value.

Risk Level	Total Rating Score
Low	**0-15**
A hazard with a LOW RISK RATING is expected to have little to no impact upon the state. The hazard poses minimal health and safety consequences to the state's residences and is expected to cause little to no property damage. The occurrence of a hazard with a LOW RISK RATING is rare; however, due to other factors such as geographical location it is still possible for such a hazard to occur and even cause significant damage based upon the magnitude of the event.	
Moderate	**16-30**
A hazard with a MODERATE RISK RATING is expected to have a moderate impact upon the state. The hazard poses minor health and safety consequences with minor injuries expected and few to no fatalities. The hazard may cause some property injuries and few to no fatalities. The hazard may cause some property to be damaged or destroyed. The occurrence of a hazard with a MODERATE RISK RATING is likely at least once within the next 25 years.	
High	**31 or More**
A hazard with a HIGH RISK RATING is expected to have a significant impact upon the state. The hazard poses high health and safety consequences with numerous injuries and fatalities possible. The hazard may even cause some property to be damaged or destroyed. A hazard with a HIGH RISK RATING is expected to occur at least once within a 12 month period, but can occur multiple times within a year.	

Table 3.1.5 indicates the overall ranking established by the HMC using the method described above and followed by the definition of profiled, limited and non-profiled hazards. The completed worksheet is provided in Appendix 7.3.1-A.

Table 3.1.5
Hazard Ranking

2017 Hazards Selected	Total Vulnerability	Future Occurrence	Total Risk Value	Risk Level
Tornado	18	5	90	High
Dam/Levee Failure	11	5	55	High
Tropical Cyclone (Hurricane/Tropical Cyclone)	19	3	57	High
Flood	14	5	70	High
Wildfire	9	2	18	Moderate
Drought	10	2	20	Moderate
Extreme Winter Weather	11	3	33	Moderate
Earthquake	13	1	13	Low
Climate Change/Sea Level Rise	10	1	10	Low
Cyberterrorism	12	1	12	Low

Non-Profiled Hazards

The HMC chose again not to select and rank severe storms, because they do not typically cause a statewide impact, require a state response, and would be mitigated at the local level. During a review of the plan and with 48% of local jurisdictions indicating severe storms (thunderstorms, high wind, lightening and hail) were of significant concern, the state opted to expand the profile of this hazard under Section 3.13. In this section, a general discussion of vulnerability was added along with a history of events. Property damage, loss of life and injuries that can be expected statewide are addressed generally. It is not possible to specifically address expected losses to critical or state-owned facilities with the limited data available.

Beach/Coastal erosion is also included as a non-profiled hazard and determined to pose no significant statewide threat to Mississippi and little or no threat to state-owned or critical facilities.

Infrastructure Interdependency

Reliance upon built infrastructure in Mississippi is becoming increasingly important. Infrastructure elements such as roads, bridges, electrical grids, computer networks (the Internet), and similar components provide the economic and supply backbone upon which economic health and future growth rests. At best, failure of any one or all of these elements may result in substantial economic damage; and at worst, significant loss of life. Failure of one system (electrical) may cause cascading failures across multiple systems (water, wastewater, E911, etc.) with far reaching consequences (large fires raging out of control, disease). Complicating matters is the increasing fragility of infrastructure as components age, are threatened by severe weather and climate change, become terrorism targets, or simply fail due to an accident. Initial studies suggest failure of infrastructure in Mississippi due to aging is a significant concern. Collaborative data sharing across enterprises and exercises which investigate critical failure points and weaknesses in Mississippi's infrastructure systems is required.

3.2: Profiling Hazards

Hazard profiling involves describing the physical characteristics of past hazards such as magnitude, duration, frequency, and probability. This stage of the hazard mitigation planning process involves creating base maps of the state and collecting and mapping hazard event profile information obtained from various federal, state, and local government agencies. The extent to which hazards are profiled is dependent upon the availability of data. Some hazard profiles provide significantly more information than others based on the amount of prior research and data production identified. It is standard practice to use the best and most current available information. The HMC and consultant team obtained statewide maps and data from a variety of sources. The hazard data were mapped to determine the geographic extent of the hazards in the State. The level of risk associated with each hazard was estimated and assigned a risk level of high, medium or low (or variations thereof) depending on several factors that are unique to a particular hazard.

3.2.1: Identifying Assets and Assessing Vulnerability

44 CFR §201.4(c)(2)(ii) – The State risk assessment shall include the following elements:

An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State-owned critical or operated facilities located in the identified hazard areas shall also be addressed.

The third step of the risk assessment process is identifying assets throughout the state and projected to be affected by each hazard type. Assets include state-owned structures or critical facilities including hospitals, schools, and public infrastructure. An inventory of existing assets within the state was generated, mapped on a regional basis (Appendix 7.3.2-D-1 through D-14) to show their locations, and determination of vulnerability to each hazard type, where practicable

State-Owned Facilities - The Mississippi Department of Finance and Administration (MDFA) was tasked with compiling a comprehensive list of state-owned facilities as define as mitigation action Multi-Hazard-15 Inventory of State-Owned Facilities in the 2007 and 2010 plan. Funding was provided and the project was completed in 2016. Even though the project is complete, this plan update also utilized the best available data provided by HAZUS results, version 4.1 for Hurricanes and Earthquakes. Flood was run under 4.2 due to the release date that occurred in the middle of this planning process. This data is provided in Appendix 7.3.2-E and 7.3.2-F and includes an estimated number of facilities and the estimated replacement values. The majority of the data provided includes accurate physical locations for all properties.

The state of Mississippi developed the following definitions for Critical Facilities and Critical Infrastructure, with guidance from FEMA publication 386-2 and 42 U.S.C. 5195c. The intention of these definitions is toaid in the assessment of the vulnerability and operational necessity of facilities and systems within the state during the occurrence of a hazard event.

A Critical Facility is defined as any structure providing or houses critical services necessary to ensure the health and welfare of the population following a natural or man-made hazard event, including any facilities designated by local governments in their Hazard Mitigation Plan. Types of critical facilities are presented in detail in Appendix 7.3.2-A.

Critical Infrastructure is defined as systems so vital to the state of Mississippi the incapacity of those systems would have a debilitating impact on security, economics, public health, safety, or any combination of those factors, including any infrastructure designated by local governments in their Hazard Mitigation Plan. Types of critical infrastructure are presented in detail in Appendix 7.3.2-B.

One component of assets, Key Assets, is not identified and included in this plan. A Key Asset is defined as any system (private or publicly-owned), whether physical or virtual, that provides the state critical services and/or historic significance, whose destruction could cause large-scale injury, death or destruction of property and/or profoundly damage our state's prestige and confidence. Some of the key assets are also identified as a critical facility. Since the state has moved towards an all-hazards approach and man-made hazards are being included, key assets are necessary as these facilities could be prone to a man-made event and cause adverse implications to the state and local communities. Appendix 7.3.2-C provides the types of key assets that were identified for planning purposes.

These definitions were utilized to determine data collection criteria. All information included in the assessments of this plan is based on best-available data. The critical facilities, which were documented for this report, included all facilities listed as critical in existing local Hazard Mitigation Plans within the state. In accordance with the definition, available data was also collected for facilities that, in the event of a disaster: provide shelter and/or resources for displaced individuals, provide safe and reliable production or treatment of essential services, provide essential communication between emergency personnel and the general public, provide crucial public safety, serve as a central facility that houses officials providing leadership and guidance for essential community operations, provide primary health care, accommodate inter-modal transportation providing evacuation and/or distribution of supplies.

Assessing Vulnerabilities - An asset is vulnerable if it is susceptible to damage from a hazard. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. A vulnerability analysis can also predict the extent of injury and damage resulting from a hazard event of a certain intensity in an area. The vulnerability assessment identifies the effects of hazards by estimating the relative exposure of population, land development, and infrastructure to hazardous conditions, giving significant attention to critical and state-owned facilities. This includes consideration of the indirect effects of hazards, which can be much more widespread and more damaging than the direct effects. For example, the loss of commerce due to road closures for an amount of time could significantly outweigh the cost of repairing the road. The assessment helps set mitigation priorities by allowing the state and its local jurisdictions to focus attention on areas most likely to be damaged or most likely to require early emergency response during a hazard event.

3.2.2: Estimating Losses

> ***44 CFR 201.4(c)(2)(iii) – The State risk assessment shall include the following elements:***
>
> ***An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.***

For the identified hazards ranked the highest priority for concern by the HMC, losses were estimated for various hazard scenarios. For other identified hazards, where less data was available, a more simple, overall exposure analysis was conducted. Exposure analysis looks at the overall value of assets in the hazard area or ranked county, whereas loss estimation calculates anticipated losses from specific hazard scenarios (e.g. 100-year flood or Magnitude 7.7 Earthquake).

Summary of Losses

Each hazard identified for inclusion in this plan is presented in separate sections with full details regarding estimated damages sustained and future losses that might be realized based on various scenario approaches.

As a summary, provided below is a comparison of damages sustained to property and crops for hazards tracked through the National Climatic Data Center (NCDC). The tables below have been updated to reflect the general category of hazards prone to Mississippi and include the totals presented in the last plan to compare to the current totals.

Property Damage

Hazard Type	Total 2007-2009*	Total 2010-2012	2013	2014	2015	2016	2017	Total 2013 - 2017
Coastal Storms	$11,069,000	$12,260,000	None Reported	None Reported	None Reported	None Reported	$137,000	$137,000
Drought	None Reported	$500,000	None Reported	None Reported	None Reported	$1,740,000	None Reported	$1,740,000
Extreme Winter Weather	$1,320,000	$43,440,000	$540,000	$50,000	$61,000	None Reported	$2,125,000	$2,776,000
Flood/Heavy Rain	$31,718,000	$1,049,699,000	$4,204,000	$6,327,000	$2,528,000	$20,461,000	$13,248,000	$46,768,000
Severe Weather	None Reported	$41,991,050	$557,353,000	$2,705,000	$749,000	$1,347,000	$1,184,000	$563,338,000
Tornado	$124,717,000	$948,454,000	$42,287,000	$196,959,000	$13,865,000	$6,889,000	$30,150,000	$290,150,000

Source: NCDC and *2013 Plan totals

Crop Damage

Hazard Type	Total 2007-2009*	Total 2010-2012	2013	2014	2015	2016	2017	Total 2013 - 2017
Coastal Storms	None Reported	None Reported	None Reported	None Reported	None Reported	None Reported	None Reported	None Reported
Drought	None Reported	$27,200,000	None Reported	None Reported	None Reported	$1,740,000	None Reported	$1,740,000
Extreme Winter Weather	$1,320,000	$240,000	None Reported	None Reported	None Reported	None Reported	None Reported	None Reported
Flood/Heavy Rain	$6,805,000	$2,752,000	None Reported	None Reported	None Reported	None Reported	None Reported	None Reported
Severe Weather	None Reported	$1,013,500	None Reported	None Reported	None Reported	None Reported	None Reported	None Reported
Tornado	$6,897,000	$38,695,000	None Reported	$10,190,000	None Reported	None Reported	$4,210,000	$14,400,000

HAZUS-MH

Computer models to examine effects and consequences of disaster and crisis because alternative mechanisms for understanding may prove impossible to safely replicate in the field. Simulation models typically ingest tremendous quantities of data about pre-event conditions and then alter the data according to a set of rules driven by empirical relationships (a Category 3 storm will cause a storm surge of 15') or mechanistic components using detailed numeric solutions (winds of 120 mph will increase surface water speeds due to friction, wind friction water will pile up against a coast line as shoreline depth decreases, accumulation of water will cause a storm surge of 15'). Alterations in the data provide the user with results which may be misinterpreted. Thus, two basic factors affect the accuracy and value of modeling results: a) the quality of data used to initialize the model and b) the level of understanding and detail used to simulate processes affecting input data.

HAZUS-Multi Hazard (HAZUS-MH) is a suite of modeling software driven by geographic information systems software. HAZUS provides three levels of analysis based on the level of effort and expertise employed by the user (reference: http://www.fema.gov/HAZUS/HAZUS-multi-hazard-analysis-levels). Users can improve the accuracy of HAZUS loss estimates by furnishing more detailed data about their community or additional engineering expertise on the building inventory. The following describes the information and expertise needed for each level:

> Level 1: A basic estimate of earthquake, flood and hurricane wind losses is produced based on national databases and expert-based analysis parameters included in the HAZUS software. This is commonly referred to as an "out-of-the-box" or "default" loss estimate. FEMA's Basic HAZUS-MH course (E313) enables a user to run Level 1 loss estimation. There may be exceptions for what is considered Level 1 based on unique conditions for a specific study region. For example, if available in HAZUS-compatible format, soils maps can play a significant role in enhancing the quality of an earthquake loss estimate in a particular region.

Level 2: More accurate loss estimates are produced by including detailed information on local hazard conditions and/or by replacing the national default inventories with more accurate local inventories of buildings, essential facilities and other infrastructure. Although there is no standard way to perform a Level 2 study, priority should be given to information that better defines the hazard. Sensitivity studies guide the user in focusing time and resources on the type of information to improve the loss estimate for their study region. There are many professionals able to assist with a Level 2 analysis. These include geologists and hydrologists to improve hazard map data, GIS professionals to improve national default inventories, and engineers to improve the classifications of building types and vulnerabilities. Some background in loss estimation and experience in using HAZUS is normally required for a Level 2 analysis.

Level 3: These state-of-the-art loss estimates include all hazard and inventory improvements in a Level 2 study, plus expert adjustment of analysis parameters and use of advanced HAZUS capabilities, such as the Advanced Engineering Building Module (AEBM) and the Potable Water System Analysis Model (POWSAM). A Level 3 effort requires participation by earth scientists, structural engineers, land use planners and/or emergency managers to provide an accurate inventory and assessment of community vulnerability, as well as a high degree of expertise in HAZUS' architecture and file structure.

HAZUS model runs for Mississippi's State Hazard Mitigation Plan are typically conducted at Level 1, because each increasing level of modeling complexity requires substantial investments of time and effort. Basic Level 1 data input is derived from the 2000 Census and does not adequately reflect changes in population distribution, location of assets, and similar changes. Further, existing state-owned data sets, such as 2' or better resolution coastal elevation data, do not exist in a format easily consumed by HAZUS and is not used. Instead, the "canned" 30-m resolution National Elevation Dataset data are used. Significant time and effort are needed to combine and format local data for use by HAZUS. Thus, while HAZUS is an excellent modeling tool, re-running it every three years without improving the input baseline data simply churns out inaccurate and little changed results. In computer modeling terms, "garbage-in equals garbage-out".

This plan update strongly recommends an ongoing modeling effort with baseline data sets consistently updated throughout the hazard planning and mitigation process. Running of models such as HAZUS should be separated from the funding of the State Hazard Mitigation Plan and performed in-house on an ongoing basis. This would allow the most current and accurate modeling efforts to be updated to the plan without restricting efforts because of the relatively limited time period and funding levels associated with this plan.

Flood Mapping

HAZUS and similar models rely predominantly upon FEMA D-FIRM and emerging RiskMap products for flood planning. As noted, Mississippi is heavily vested in updating and modernizing the flood mapping program. However, newer data sets which further improve flood estimates than those used to support the D-FIRM program are available for many areas of the state and may be manipulated beyond the HAZUS modeling system.

The general process used is to create a regional digital elevation model from like resolution datasets. In this instance, the traditional 30-m National Elevation Dataset is replaced with a 2' resolution LIDAR data set

to indicate bare-earth elevations. This base elevation data set is loaded and viewed in a capable 3D application such as ESRI's ArcScene.

Potential flood elevations are based on the current sea state as measured above Mean Sea Level (MSL) and initially depicted by constructing a flat plane representative of the area of interest as shown in the illustration below. The plane is assigned an elevation equal to that of mean sea level.

The blue area in Figure 3.2.1 depicts the area of interest for potential storm surge modeling along coastal Mississippi using Hurricane Katrina data. Hurricane Katrina produced the highest storm surge ever recorded on the U.S. coast--an astonishing 27.8 feet at Pass Christian, Mississippi. This bested the previous U.S. record of 22.8 feet, which also occurred at Pass Christian, during 1969's Hurricane Camille. According to the NHC Katrina final report, Hurricane Katrina brought a surge of 24 - 28 feet to a 20-mile stretch of Mississippi coast. The full 90 miles of coastline from eastern Louisiana to Alabama received a storm surge characteristic of a Category 3 hurricane. The colossal damage that resulted has been documented by blogger Margie Kieper during a series of blog posts that ran in the summer of 2006. The contents are reproduced here and consist of an introduction explaining why the surge was so large, and 16 parts exploring the damage done to each stretch of the Gulf Coast ravaged by Hurricane Katrina in 2005.

Figure 3.2.1
Storm Surge Map

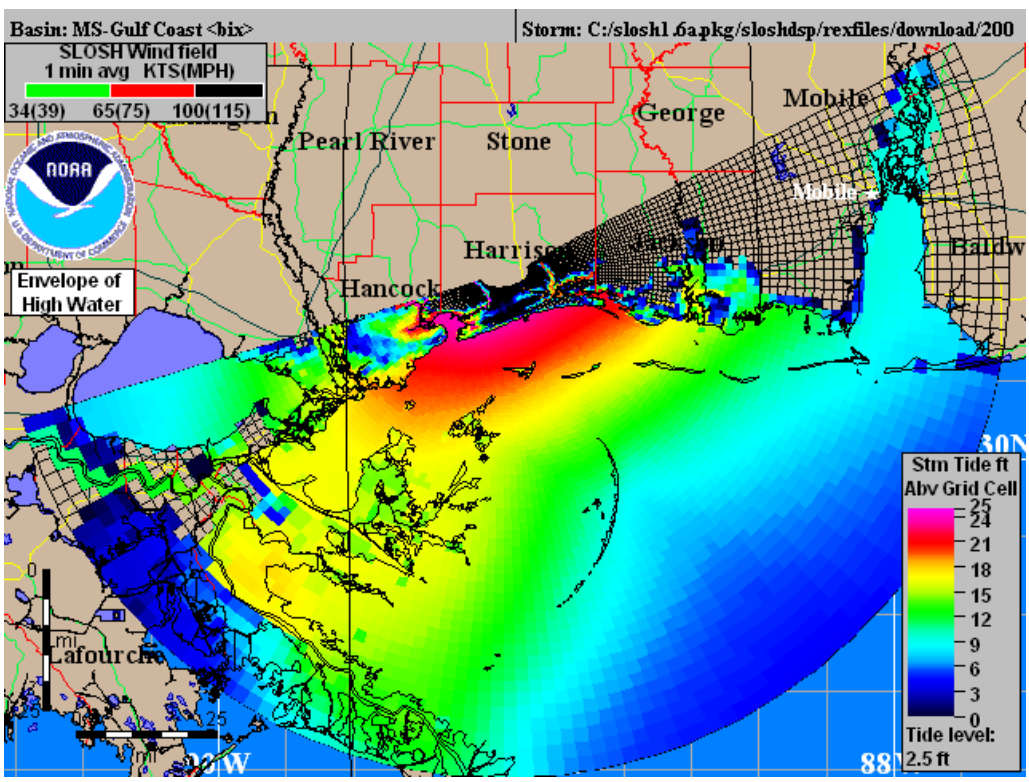
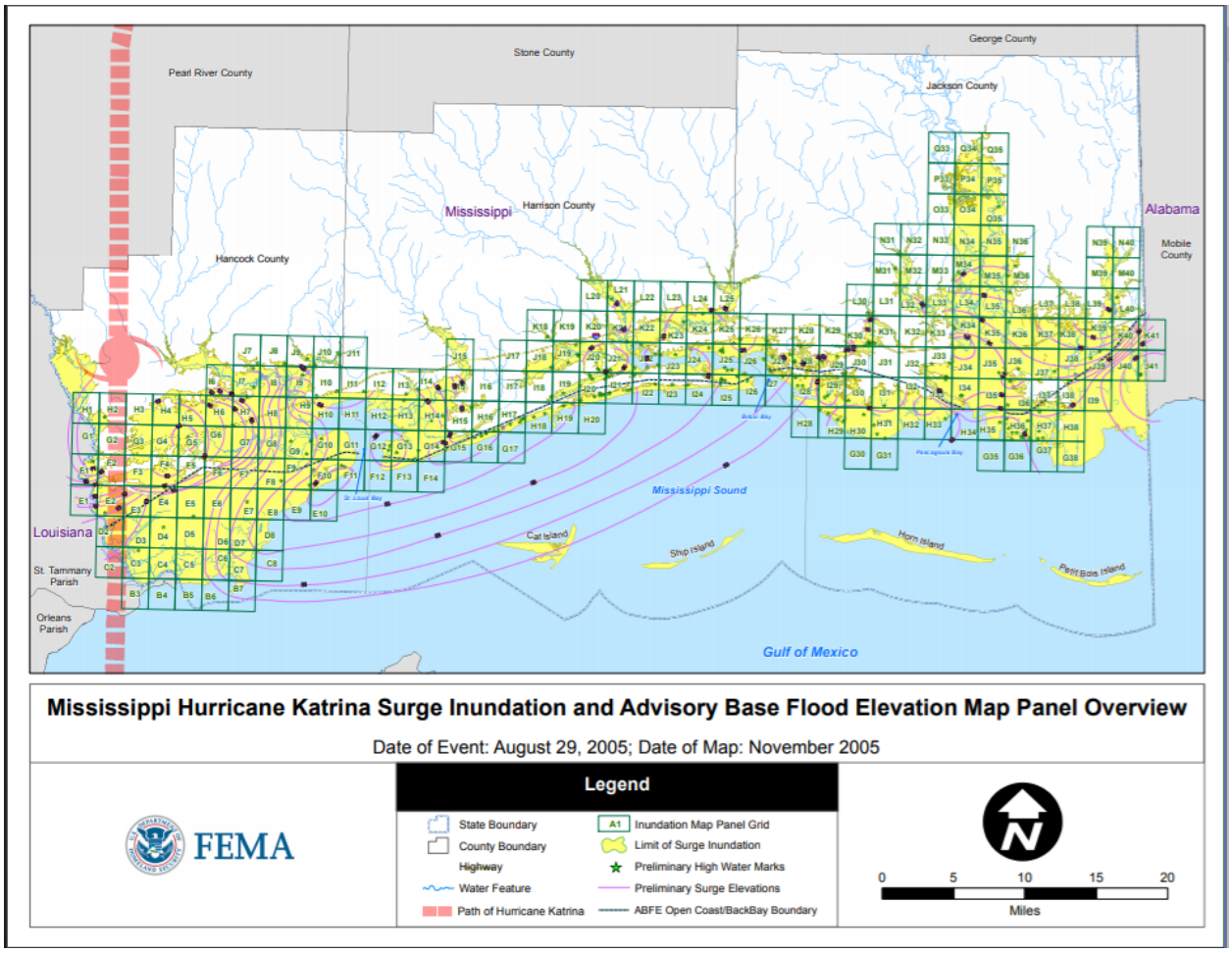


Figure 3.2.1 contains a SLOSH module for Hurricane Katrina of 2005. This image does not show the height above mean sea level of the surge, but rather how high the surge was above the surface.

The plane is initially intersected in 3D space with the baseline elevation model. The intersection is compared with accepted shoreline locations thereby validating the basic modeling approach. The plane is then elevated in 1' increments and the resulting intersection recorded for each potential flood elevation. This is illustrated in Figure 3.2.3 using Katrina's maximum inundation depth plus 20' to simulate extreme circumstances. The net result is a series of lines and polygons depicting locations likely to flood.

While more sophisticated modeling tools are available, they are not typically suitable for use with large areas, they require extensive technical training and additional high-resolution data sets such as soil models and velocity of the flood waters. The approach described herein is lightweight, errs on the side of caution, and is a solid, alternative published methodology which provides easy to interpret results as shown in Figure 3.2.4.

Figure 3.2.2
Katrina's Maximum Inundation



3.3: Tornado Risk Assessment

Hazard Description

Tornadoes are nature's most violent storms. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. A tornado appears as a rotating, funnel-shaped cloud extending from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long. Every state is at some risk from this hazard. Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasion- ally, tornadoes develop so rapidly that little, if any, advance warning is possible. Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Tornadoes generally occur near the trailing edge of a thunderstorm. It is not uncommon to see clear, sunlit skies behind a tornado.

Most of the Earth's tornadoes touch down in the hotbed known as Tornado Alley, bordered by the Dakotas to the north, the Gulf Coast to the south, the Rocky Mountains to the west and the Appalachian Mountains to the east. Tornadoes in some areas have become so common that tour guides often charge thousands of dollars to lead groups on weeklong tornado-watching tours.

Southeast of Tornado Alley is Dixie Alley, home to the deadliest tornadoes. Dixie Alley spreads from the Lower Mississippi Valley to the Upper Tennessee Valley, including Arkansas, Mississippi, Louisiana, Alabama, Georgia and the Florida panhandle.

Quick facts about tornadoes:

- They may strike quickly, with little or no warning.
- They may appear nearly transparent until dust and debris are picked up or a cloud forms in the funnel.
- The average tornado moves southwest to northeast, but tornadoes have been known to move in any direction.
- The average forward speed of a tornado is 30 mph, but may vary from stationary to 70 mph.
- Tornadoes can accompany tropical storms and hurricanes as they move onto land.
- Waterspouts are tornadoes formed over water.
- Tornadoes are most frequently reported east of the Rocky Mountains during spring and summer months.
- Peak tornado season in the southern states is March through May; in the northern states, it is late spring through early summer.
- Tornadoes are most likely to occur between 3 pm and 9 pm, but can occur at any time.

The most common and practical way to determine the strength of a tornado is to look at the damage it caused. From the damage, we can estimate the wind speeds. Prior to February 2007, the Fujita Scale was used to measure tornado severity (Table 3.3.1).

Tornadoes are also rated based on their wind speeds. An average tornado has maximum wind speeds of about 112 mph or less, measures around 250 feet in width and travels approximately one mile before unraveling. Some chart toppers have had 300 mph winds - almost twice that of 1992's devastating Hurricane Andrew. The hurricane was a Category 5 storm, the highest hurricane rating.

Table 3.3.1
Fujita Scale

F-Scale Number	Intensity Phrase	Wind SpF5eed	F-Scale Number	Intensity Phrase	Wind Speed
F0	Gale tornado	42 – 72 mph	F3	Severe tornado	158 – 206 mph
F1	Moderate tornado	73 – 112 mph	F4	Devastating tornado	207 – 260 mph
F2	Significant tornado	113 – 157 mph	F5	Inconceivable tornado	261 – 318 mph

Source: NOAA

The Enhanced Fujita Scale, or EF Scale (Table 3.3.2), was implemented by the National Weather Service in 2007 to rate tornadoes in a more consistent and accurate manner. The EF-Scale takes into account more variables than the original Fujita Scale (F-Scale) when assigning a wind speed rating to a tornado, incorporating 28 damage indicators such as building type, structures and trees. For each damage indicator, there are 8 degrees of damage ranging from the beginning of visible damage to complete destruction of the damage indicator. The original F-scale did not take these details into account.

Table 3.3.2
Enhanced Fujita Scale

Enhanced Fujita Category	Wind Speed (mph)	Potential Damage
EFO	65-85	**Light damage.** Peels surface off some roofs; some dam- age to gutters or siding; branches broken off trees; shallow- rooted trees pushed over.
EF1	86-110	**Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	**Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the

		ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	**Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	**Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible

Source: NOAA

Hazard Profile

The hazard profile for tornadoes in Mississippi was updated from the previous approved plan of 2013 to include current statistics regarding tornado activity.

According to the Storm Prediction Center, an average of 1,224 tornadoes touch down per year across the United States. The top 10 states for tornadoes as of the most recent (1991-2015) average are represented in the table below:

Top 10 Tornado States

State	No. of Tornadoes	Ranking
Texas	146.7	1
Kansas	92.4	2
Oklahoma	65.4	2
Florida	54.6	3
Nebraska	54.6	4
Illinois	54	5
Colorado	49.5	6
Iowa	49.2	7
Alabama	47.1	8
Missouri	46.7	9
Mississippi	45.1	10

Source: NOAA

During the years 1950 to 2017, Mississippi has had 2,554 tornadoes, accounting for 503 fatalities and 6,717 injuries. This averages less than one fatality per tornado, but more than two injuries during each event.

The fewest tornadoes recorded during one year in Mississippi were five in 1964. The greatest number of tornadoes in Mississippi recorded by the National Weather Service was 136 in 2011.

Tornadoes are not as easily spotted in Mississippi as they are in the Midwest where flat land and few trees make tornadoes more visible. Densely populated counties and communities throughout Mississippi tend to record more sightings of tornadoes than rural and less populated areas. It should be noted tornadoes are often associated with severe weather events such as thunderstorms. Due to the climate conditions in Mississippi, tornadoes can occur in every month of the year, but have a greater frequency during the period of February through May and November, typically during the change of seasons.

Education and Outreach

The state of Mississippi declared November as Tornado Awareness Month. This is done as part of the state's effort to educate the public on tornado safety. In addition, a statewide test of the tornado warning system is conducted in February in conjunction with Severe Weather Awareness Week. The purpose is to encourage schools, government agencies and businesses throughout the state to test their tornado emergency procedures.

Maximum Tornado Threat

A review of past tornado occurrences reveals Hinds and Rankin Counties continues to have the most recorded tornadoes from 1950 – 2017. The counties with the most recorded tornadoes are demonstrated in the table below.

Top 10 Tornado Counties

Counties	No. of Tornadoes	Ranking
Hinds	87	1
Rankin	74	2
Harrison	70	3
Jones	66	4
Jackson	57	5
Madison	55	6
Simpson	53	7
Bolivar	50	8
Hancock	50	8
Copiah	48	9
Warren	48	9
Pearl River	48	9
Newton	44	10

Damage caused by an EF-4 tornado that occurred in the Hattiesburg (Forrest County) area on Sunday, Feb. 10, 2013, impacting multiple facilities on the University of Southern Mississippi (USM) campus.

Aerial view from Marsh Hall
Source: USM

Elam Arms Dormitory
Source: USM

Shafer Center for Crisis Intervention
Source: USM

Jazz Station
Source: USM

Picture taken by Eric Roberts, courtesy of NWS
Laurel (Jones County) - December 2014

Picture taken by Teresa Mergens, courtesy of NWS
Columbia (Marion County) - December 2014

Picture taken by Haskel Burns, courtesy of NWS
Columbia (Marion County) - December 2014

Picture taken by John Carter, courtesy of NWS
Heidelberg (Jasper County) - December 2014

Picture taken by: Tom Malmay, Malmay & Associates
Near Holly Springs (Marshall County) - December 2015

More Precise Tornado Warnings

Tornado and severe thunderstorm warnings have not changed much in the passing decades. However, a research program is looking to improve lead time and the precision of warnings. An overhaul of the nation's weather warning process, including tornado warnings, currently in development aims to provide more precise warnings with increased lead time to help decision makers and the general public respond accordingly.

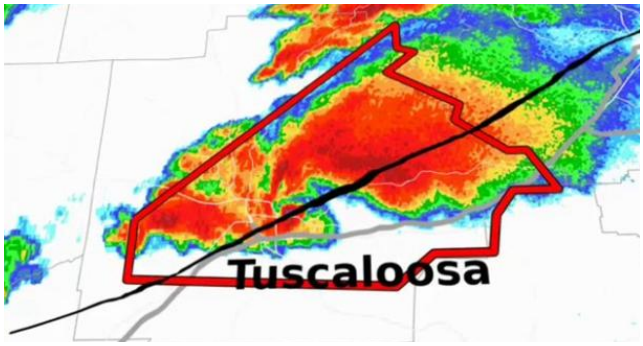
The Forecasting a Continuum of Environmental Threats (FACET) program at NOAA's National Severe Storms Laboratory in Norman, Oklahoma, seeks to provide forecasters a continuously-updating threat grid to supplement the current warning polygons. The current warning process has not changed much since the 1960s, with the exception of subtle tweaks including the use of bullet statements in text to more clearly highlight potential impacts (including the use of tornado and flash flood emergencies) and the use of storm polygons instead of whole counties.

When one only hears the warning, that part of a county or city is in a warning and those located in that area should take shelter immediately. The general graphical depiction of a warning is a polygon. If your location is in that polygon, taking shelter is highly recommended. If not, it is not a threat, at least not yet. However, false alarm challenges with tornado warnings is always an issue due to the limitations of Doppler radar detecting rotation near the ground, among other reasons.

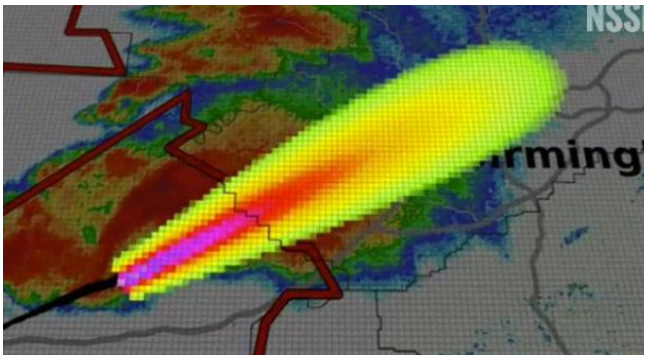
This paradigm of warnings, together with dual-polarization of Doppler radar, severe storm research and a more dense network of spotters has led to an average lead time of 13 minutes for tornado warnings. However, tornado warning polygons will always be larger than any actual tornado tracks due to uncertainty in the track of the parent thunderstorm when a warning is issued. Consider the infamous Tuscaloosa, Alabama, EF4 tornado during the April 27, 2011, super outbreak. While this warning

technically was correct as a tornado was confirmed within the warned area and it likely saved lives, the fact remains, the large majority of the tornado-warned area was not hit by the tornado. No one will complain about being over warned outside of the massive tornado's path. However, the question then becomes whether those same folks will take shelter the next time.

FACET seeks to provide a more precise probability threat map of a severe weather event, such as a tornado. This threat map, known as PHI or probabilistic hazard information, can ingest both conventional current data such as radar, satellite and surface observations, as well as any high-resolution models, and can be adjusted in real-time by the forecaster. The PHI map more tightly represents the area of greatest threat, within the larger tornado warning.



Tornado warning (red polygon) and actual track (black line) of the Tuscaloosa, Alabama, EF4 tornado of April 27, 2011.
Source: National Severe Storms Laboratory



Example of what a probability threat map from FACETs would look like for the April27, 2011, Tuscaloosa, Alabama tornado. In this case, the dark red, and purple contours of the plume indicate the greatest likelihood of a tornado.
Source: National Severe Storms Laboratory

Perhaps most importantly, this map could update as frequently as every minute, giving advanced alert downstream of the conventional tornado-warned area. FACET envisions the PHI maps and data could be used, for example, to prompt a "tornado threat increasing" alert when the PHI threat plume is pushing toward your area but not yet close enough for a tornado warning, which would provide valuable extra lead time.

The benefits of more precise, accurate warnings with increased lead time are immense. However, this can only happen if the warnings are heeded. This is where the important component of social and behavioral science plays a role. FACET envisions the PHI maps and data could be used, for example, to prompt a "tornado threat increasing" alert when the PHI threat plume is pushing toward your area, but not yet close enough for a tornado warning, which would provide valuable extra lead time.

Incidentally, the PHI concept is not simply for tornado warnings. While the current focus is on hazards associated with thunderstorms such as tornadoes, hail, lightning and flash flooding, this concept can also be extended to other hazardous weather, including winter weather.

It will be several years before these probability threat maps accompany standard warnings issued from the National Weather Service. However, some aspects of FACETs/PHI will be rolled out at NOAA's Storm Prediction Center and the Weather Prediction Center in 2018. Implementation in local National Weather Service forecast offices and private meteorological companies look to come online sometime in 2021.

dependent on National Weather Service requirements, it is uncertain whether these PHI-based warnings will completely replace the current polygon warnings.

Location/Past Occurrences

Mississippi is no stranger to tornado/severe weather threats and has had 29 Presidentially declared events since 1953 as shown in Table 3.3.3. Brief descriptions of the events that occurred over the past ten years and summaries from the NCDC and FEMA on the impacts to people and property, plus the public assistance dollars obligated is provided in the summaries following the table.

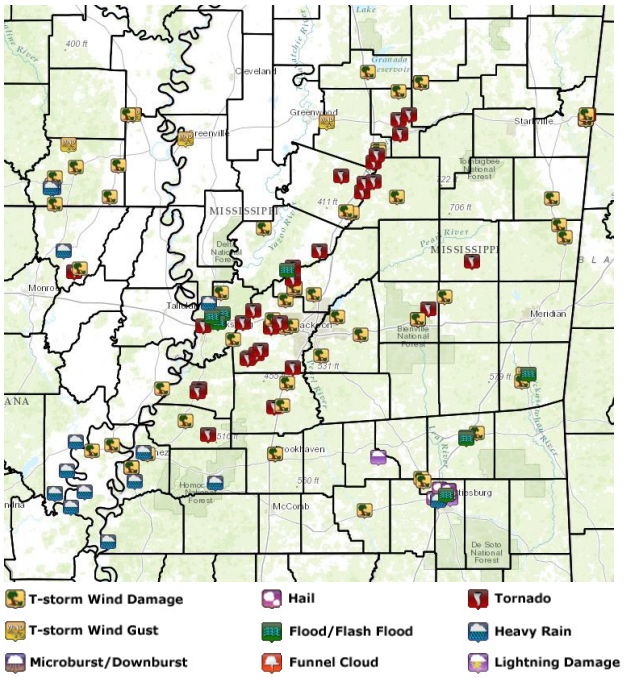
Table 3.3.3
Presidential Disaster Declarations - Tornado/Severe Weather

Declaration Number	Incident Period	No. of Counties Affected	Date of Major Declaration
DR-4314	April 30, 2017	9	May 22, 2017
DR-4295	January 20 – 21, 2017	4	January 25, 2017
DR-4248	December 23 – 28, 2015	12	January 4, 2016
DR-4205	December 23 – 24, 2014	1	January 7, 2015
DR-4175	April 28 – May 3, 2014	13	April 30, 2014
DR-4101	February 10 - 22, 2013	6	February 13, 2013
DR-1972	April 15 - 28, 2011	37	April 29, 2011
DR-1916	May 1 - 2, 2010	8	May 14, 2010
DR-1906	April 23 - 24, 2010	7	April 29, 2010
DR-1837	March 25 - 28, 2009	11	May 12, 2009
DR-1764	April 4, 2008	1	May 28, 2008
DR-1470	May 5 - 8, 2003	9	May 23, 2003
DR-1459	April 6 - 25, 2003	14	April 24, 2003
DR-1443	November 10 - 11, 2002	3	November 14, 2002
DR-1398	November 24 - December 17, 2001	17	December 7, 2001
DR-1360	February 16 - March 15, 2001	23	February 23, 2001

DR-1051	May 8 - 17, 1995	4	May 12, 1995
DR-968	November 21 - 22, 1992	9	November 25, 1992
DR-967	October 10, 1992	1	October 17, 1992
DR-939	March 9 - 10, 1992	4	March 20, 1992
DR-906	April 26 - May 31, 1991	32	May 17, 1991

Source: FEMA Disaster Declarations-Mississippi

DR - 4314 - April 30, 2017



During the early morning hours of April 30th, a squall line of severe thunderstorms developed across central Louisiana and pushed eastward across the National Weather Service Jackson, MS forecast area. The line intensified as it approached the Mississippi River and evolved into a Quasi-Linear Convective System (QLCS). Numerous tornadoes (29) developed along the line, with the most prolific damage occurring along the track of a large mesovortex which tracked from Claiborne County through western Hinds/Madison, eastern Yazoo, eastern Holmes, southeastern Carroll, Montgomery, and northwestern Webster counties.

This region is no stranger to tornadoes, squall lines or tornado outbreaks. However, what occurred Sunday morning, April 30th, was quite rare. Here is a general explanation of a very complex situation. As the squall line of storms was taking shape across central Louisiana, a mesoscale convective vortex (MCV) began to develop. This feature is on a smaller scale than traditional low pressure areas and usually ranges in diameter between 20 to 50 miles. This particular MCV developed as a large cluster of storms merged with the evolving squall line. Intensifying downdrafts caused bowing segments in the line to surge out. Due to the strong ambient wind shear in place, strong updrafts along the bowing line became oriented more favorably with the underlying wind shear. As this occurred, smaller scale circulations quickly developed. These circulations are called meso-vortices and are the features responsible for producing the tornadoes our region experienced. A feedback mechanism began at this point and the larger “parent” MCV was able to be maintained as it continued to modify the environment driving stronger wind shear which in turn supported strong and multiple quickly developing meso-vortices as the system moved northeast. This all combined to support and maintain an efficient tornado producing feature rarely seen. While hard to describe and visualize, this larger vortex was essentially on the ground and was generating smaller vortices

that were rotating around the parent circulation. The end result was substantially wide tornado paths, numerous tornadoes, and additional wind damage away from the tornadic vortices.

For a historical perspective, this event ranks as 4th on the number of tornadoes (29) produced across the forecast area. Also of note, other similar efficient tornado producing MCVs are quite hard to identify. Most recent are two that occurred during the early morning squall line from April 27, 2011. One was in central Mississippi (very near the recent impacted area), and the other in northern Alabama. There are likely other instances of these systems in the past, but these likely occurred before Doppler Radar which is a tremendous tool in identifying the smaller scale meso-vortices and how the data aids the damage survey process.

In addition, strong straight line winds occurred in some areas. A 71 mph wind gust was recorded at the Greenwood-Leflore Airport. Flash flooding was also reported in some areas including Vicksburg, Bentonia, Hattiesburg, and Laurel.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 9** • **Deaths: 1** • **Injuries: 0** • **Estimated Property Damage: $15,510,000**	$14,859,529.38	$12,693,708.75	$2,104,623.63

DR - 4295 - January 20-21, 2017

Two rounds of severe weather impacted the ArkLaMiss region - one beginning shortly after midnight on early Saturday morning and continuing through shortly before daybreak and a second beginning during the evening hours and continuing until just before midnight Saturday night. During the early morning event, areas south of I-20 in Mississippi were impacted. Most notably, an EF-3 tornado tracked through Lamar and Forrest counties, killing four people in Hattiesburg and injuring over 50 others. In addition. Trees and powerlines were downed and large hail was reported in other areas across south Mississippi. Heavy rainfall resulted in flash flooding in parts of Forrest, Marion, Jones, and Jefferson counties. The evening event impacted a larger proportion of the area. An EF-2 tornado occurred in Lauderdale County near the Lauderdale community, injuring one. An EF-1 tornado occurred in Morehouse Parish tracking between Mer Rouge and Bonita. Also, a brief EF-0 tornado occurred near

Petal, Miss Source: MS Army National Guard, Pfc. Christopher Shannon

Hamburg in Ashley County. Wind damage was reported across parts of southeast Arkansas, southwest Mississippi, and east Mississippi. Meanwhile, large hail fell from central Louisiana through central and south Mississippi. Hail as large as 3.5" in diameter fell in Catahoula Parish.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 4** • **Deaths: 4** • **Injuries: 58** • **Estimated Property Damage: $9,635,000**	$8,910,037.31	$6,802,467.91	$2,107,569.40

DR - 4248 - December 23-28, 2015

Much above normal temperatures, with some record warmth, and high amounts of moisture in the region led to an active period of weather throughout the month of December. With such warm and moist conditions in place, many upper disturbances and strong frontal systems sparked severe thunderstorms and tornadoes to develop across the region in December, with the strongest and most widespread tornado event in north Mississippi on December 23rd.

Prentiss County Source: National Weather Service

December 23, 2015 - This tornado touched down about a mile east of US Highway 61 and moved northeast, downing trees and power lines along the path. Damage in Bolivar County was rated EF-1 but the tornado continued into Coahoma County producing more significant damage farther northeast resulting in the EF-3 rating.

December 25, 2015 - A chicken house was damaged with a tin roof partially torn off along with trees downed. This damage occurred along County Road 529. Residents witnessed the tornado move through the area.

December 28, 2015 - This brief tornado touched down 2.5 miles southwest of Seminary and tracked to the northeast before crossing Seminary Sumrall Road where it destroyed a barn and snapped some trees. As it crossed the Road a shed was destroyed and more trees were uprooted and snapped. The tornado then crossed Tower Road and shortly after caused severe damage to a carport that fell on a vehicle. The tornado then crossed Seminary Mike Conner Road where it uprooted some trees. The tornado continued northeast and right before crossing Highway 49, several trailers were blown onto the highway and a fireworks stand was destroyed. Numerous trees were snapped in the area as the tornado crossed the highway. The tornado continued on the ground crossing Evergreen Church Road and Ray Harvey Road

where it snapped more trees. In this area it produced severe roof damage to a home and snapped trees. The tornado then crossed watts Road where large limbs were downed and trampoline was destroyed. The tornado lifted soon after crossing Watts Road north of Seminary.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	Emergency Work (Categories A-B)	Permanent Work (Categories C-G)
• **No of Counties Affected: 12** • **Deaths: 11** • **Injuries: 64** • **Estimated Property Damage: $12,031,000**	$5,548,643.40	$2,488,560.26	$3,060,083.14

DR - 4205 - December 23 - 24, 2014

During the afternoon of Dec 23rd, just enough ingredients came together to support numerous severe storms ahead of a cold front. Across the Lower Mississippi River Valley, peak heating contributed to decent instability in the developing warm sector in advance of the front. Sufficient low level wind shear and strong winds aloft were also in place as a decent upper low was located to our north. This helped to support organized thunderstorm activity along with quite a few supercell storms.

A long lived, persistent, storm tracked across the southeastern counties (near Columbia, Mississippi to Sumrall and Laurel to Heidelberg, Mississippi line) and produced multiple tornadoes. Widespread damage occurred in southern Columbia, near Sumrall and near Laurel and areas in Marion, Jones and Clarke counties. Sadly, five confirmed fatalities occurred, with three near Columbia in Marion County and two near Laurel in Jones County. Severe storms moved out of the region by late afternoon to early Tuesday evening. The front continued to track through the area through the evening of December 23rd.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	Emergency Work (Categories A-B)	Permanent Work (Categories C-G)
• **No of Counties Affected: 1** • **Deaths: 5** • **Injuries: 50** • **Estimated Property Damage: $27,233,000**	$2,966,616.03	$1,659,926.12	$1,270,103.91

DR - 4175 - April 28 - May 3, 2014

A powerful spring storm system brought a multi-day severe weather outbreak across a large portion of the country during the April 27-30 timeframe. This outbreak started across the Central Plains on the 27th and slowly migrated eastward over the following two days. A large tornado outbreak occurred across the Lower MS River & TN River Valleys on the 28th. The event was capped on the 30th with additional severe weather and a historic flash flooding/heavy rain event along the AL, FL gulf coast where rainfall totals peaked between 15-25 inches.

Winston County / Source: WLBT

Across the NWS Jackson, MS forecast area, the tornado outbreak on the 28th was the main event. This event was driven by a classic severe weather pattern with a strong fast moving jet stream and a deep surface cyclone over the central plains. These features helped to produce strong wind shear in the atmosphere which in turn combined with rich gulf moisture and setup a volatile atmospheric mix. Multiple supercell thunderstorms developed during the afternoon/evening and produced many instances of damaging wind and large hail along with multiple tornadoes. The most devastating tornado was the EF-4 which tore a path across NE Leake, the corners of Attala/Neshoba counties, and through the heart of Winston County where the city of Louisville was especially hard hit. This tornado was on ground for 34.3 miles and resulted in 10 fatalities and many injuries (official total unknown at this time). Other hard hit counties were Lowndes, Rankin, Hinds, Scott, Newton, Montgomery, Warren and Jones. Each of these counties experienced at least one tornado, some multiple tornadoes. Overall, 21 tornadoes have been confirmed across the forecast area. Of these tornadoes, 3 were rated EF-3, 3 rated EF-2, 12 rated EF1 and 2 rated EF-0. Below is a table that has more specific information on each tornado.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 13** • **Deaths: 11** • **Injuries: 145** • **Estimated Property Damage: $157,059,000**	$89,845,050.69	$21,767,778.80	$68,077,271.89

DR - 4101 - February 10 - 22, 2013

During the morning hours of Sunday, February 10, 2013, a line of severe thunderstorms moved into southeast Arkansas, northeast Louisiana, and central Mississippi, downing trees and power lines and destroying a barn near Silver City in Humphreys County. An approaching cold front, an unusually high amount of wind shear, and sufficient instability resulted in the severe weather outbreak.

As the storms continued to push eastward through the early afternoon, the cold front began to stall, and the entire weather system slowed down. To the south and east of the line of storms, several supercell thunderstorms developed in the more unstable air mass over south Mississippi, with many of the storms exhibiting strong rotation on radar. Shortly after 4 pm, a tornado developed over southwest Marion County near the Pickwick community and tracked across the county into far western Lamar County before lifting.

The same storm that produced this tornado continued eastward across northern Lamar County, producing a large tornado that touched down west of Oak Grove, with EF-4 winds estimated at 170 mph, and tracked through the very populated West Hattiesburg area. Emergency management reported 51 homes destroyed and 170 with major damage in Lamar County.

The tornado continued into Forrest County, tracking through the cities of Hattiesburg and Petal before ending in northwestern Perry County. Considerable damage occurred along the path of this storm before impacting the southeast corner of the University of Southern Mississippi campus. Numerous buildings were damaged in this area including several campus buildings and a large church. In Forrest County, emergency management reported 133 homes destroyed, 207 sustained major damage, and 63 injuries suffered. Scattered severe storms continued to affect the Pine Belt area through the remainder of Sunday evening and into the early morning hours of Monday, February 11, before finally moving out of the area.

In addition to severe winds, flash flooding was a major issue in several areas. From the 10th through the early morning hours of the 11th, heavy rainfall occurred over parts of southeast Mississippi, with five to seven inches of rain fall and flash flooding reported in the area. Rainfall amounts of up to 3 1/2 inches occurred in the Jackson metro area, leading to considerable flash flooding. Quick rises occurred on several streams in the city of Jackson.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 8** • **Deaths: 0** • **Injuries: 74** • **Estimated Property Damage: $39,315,000.00**	$4,451,913.70	$3,014,539.56	$1,437,374.14

DR - 1972 - April 15 - 28, 2011

A historic outbreak of tornadoes across Arkansas, Louisiana, and Mississippi began late on Tuesday, April 26th continuing into the early morning hours of Wednesday, April 27th. The event ramped up again during the early afternoon of April 27th continuing into the early evening. The activity on April 26th began as supercell thunderstorms producing large hail and tornadoes across northeast Texas and portions of Arkansas before evolving into a squall line as it moved east.

This line of storms evolved through many stages as it moved across several states before dissipating. It produced wind damage as it pushed east and was responsible for 23 of the 32 tornadoes that occurred across the three-state area during this event. Of those 23, 12 were rated as strong (EF2, EF3) tornadoes and had fairly long tracks.

Wednesday morning the atmosphere once again became increasingly favorable for producing additional severe storms by early afternoon. The driving force for the activity Wednesday afternoon was a potent low-pressure area at the surface that intensified during the day. The winds in the mid level atmosphere increased to 80-100 mph, causing the low level winds to become stronger. The wind shear caused by the turning of the winds from southerly near the surface to westerly aloft was at rare levels for late April over the Deep South.

In addition, an abundance of low level moisture returned to the area. Sunny skies during the morning interacted with the high levels of moisture, eventually leading to a very unstable air mass by early afternoon. The result was an extremely rare mix of instability and wind shear. These ingredients, along with lift from a potent upper disturbance, ultimately led to the historic tornado outbreak of April 27, 2011.

By early afternoon, several supercell thunderstorms were developing across central and eastern Mississippi. These storms grew to supercell size and began producing tornadoes. The first tornado of the after- noon started in Neshoba County on the north side of Philadelphia. This tornado ended up producing EF-5 damage and tracked for 29 miles across Neshoba, Kemper, Winston and Noxubee Counties - decimating the Town of Smithville.

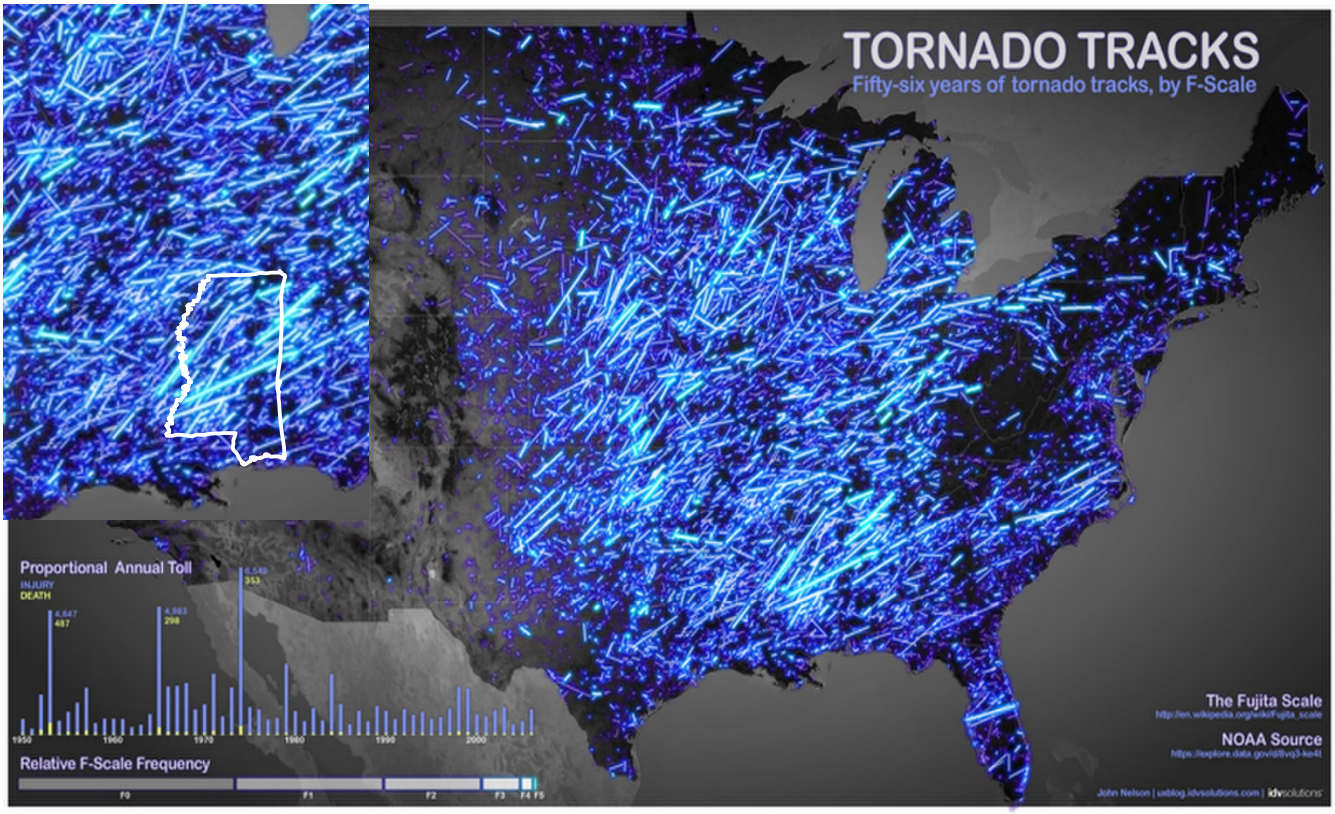
Through the rest of the afternoon multiple tornadoes developed, stemming from multiple supercell storms. Nearly all of the storms produced tornadoes, many of them significant with long tracks. Another violent tornado impacting the Jackson forecast area occurred across Smith, Jasper, and Clarke Counties continuing into Alabama with a total path length of 124 miles across both states.

Loss of life during this historic event was staggering. Unfortunately, 321 people lost their lives, making this the second deadliest tornado outbreak in U.S. history. The March 18, 1925 Tri-State tornado outbreak was the first with 747 fatalities. This system produced the first EF-5 tornado in Mississippi since the Candlestick Park tornado on May 3, 1966, and marks the first time since statistics have been kept that two EF-5

tornadoes have been recorded on the same day in Mississippi, with the tornado in Smithville also rated as EF-5. Four tornadoes had path lengths over 100 miles across the southern states during this event, and all four of these were rated either EF-4 or EF-5.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 47** • **Deaths: 32** • **Injuries: 170** • **Estimated Property Damage: $56,461,000**	$22,811,869.44	$11,648,398.71	$11,163,470.73

Figure 3.3.1a
Recorded Tornado Events 1950 to 2017

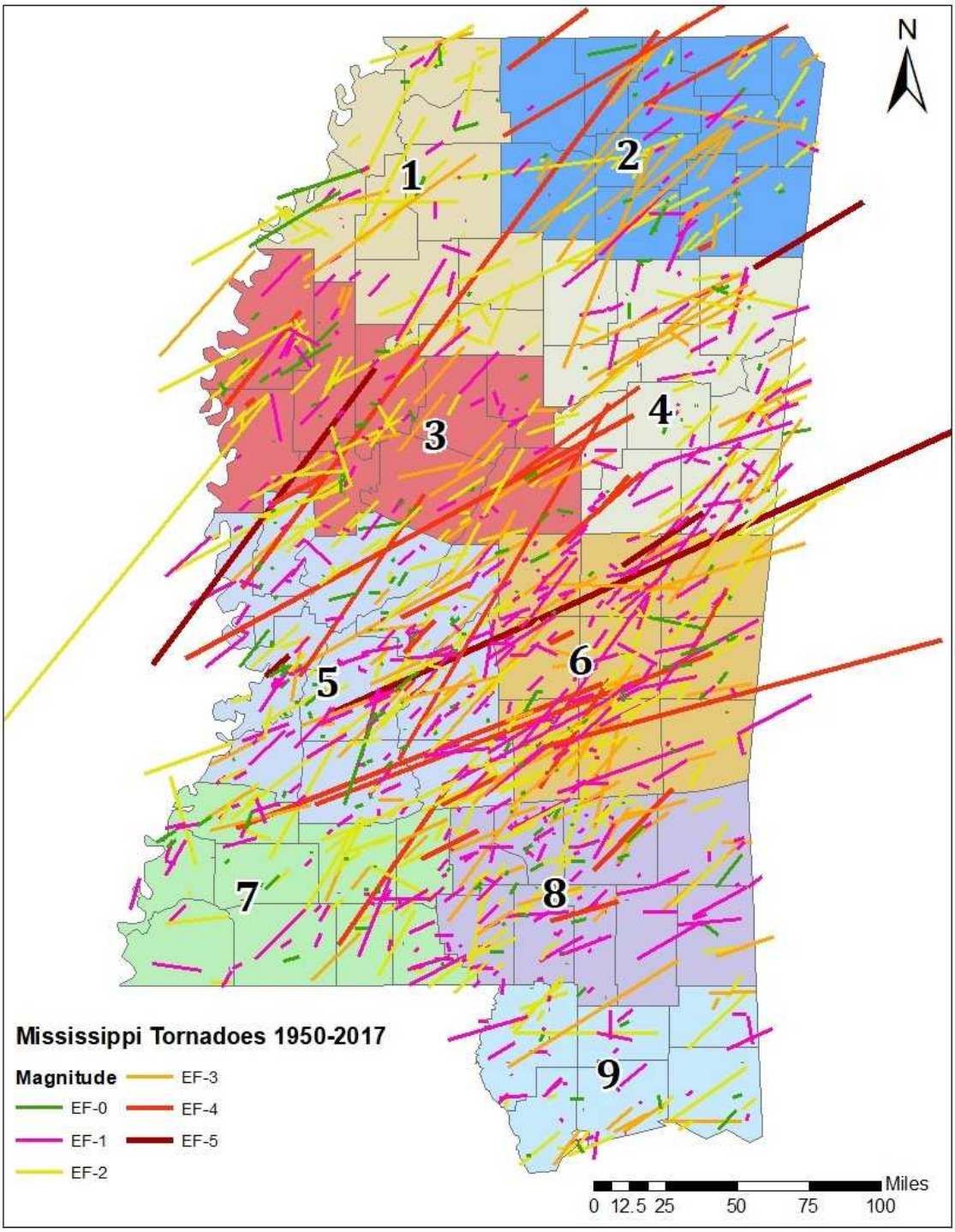


Probability of Future Tornado Events

The National Weather Service in Jackson, is no more closer to scientifically establishing a probability of future events in any one county or area. Tornadoes remain to random and unpredictable in nature. They will and have occurred in all of Mississippi's 82 counties at any point. The recorded period shows an average of 38 tornado events per year throughout the state of Mississippi.

This assertion remains the same from the 2013 plan update. Past occurrences continue to indicate more densely populated counties, such as Harrison, Hinds, Jackson, Jones, Rankin and Smith have experienced a greater number of tornadoes. Based solely on historical data, the counties with the greatest number of past occurrences are those with the greatest perceived risk of reoccurrence.

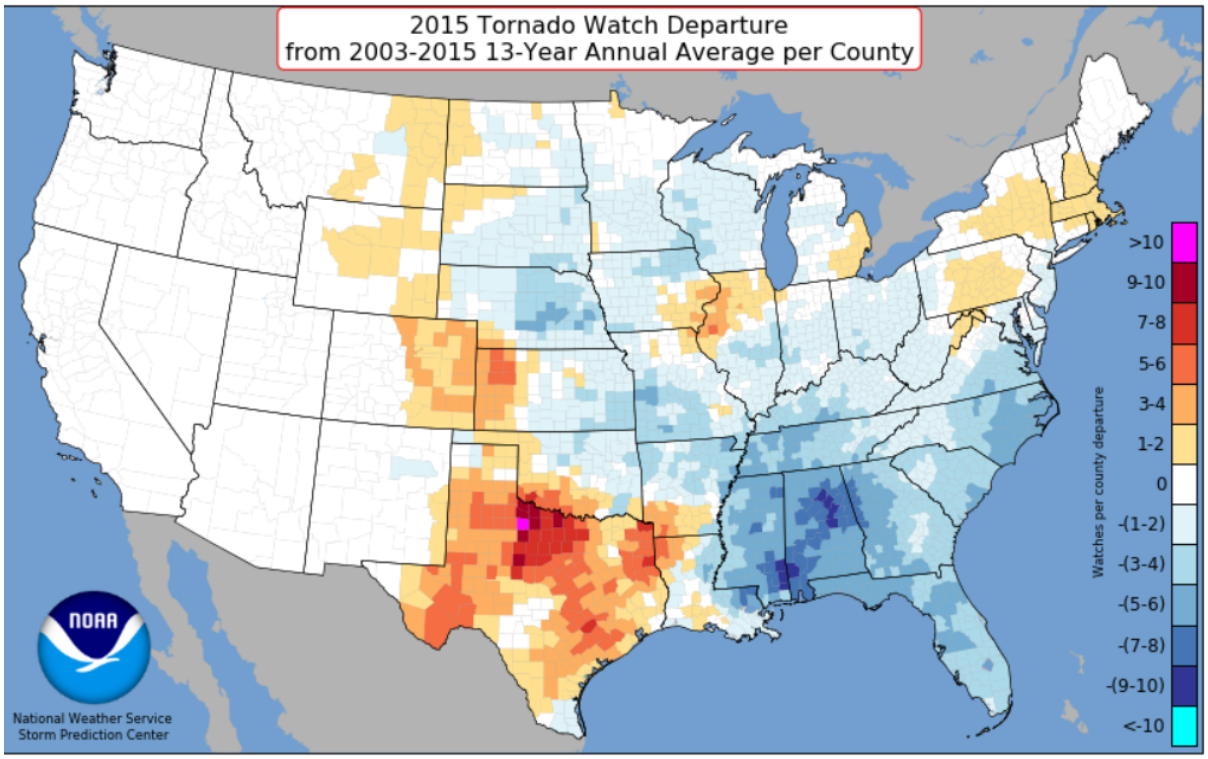
Figure 3.3.1b
Recorded Tornado Events 1950 to 2017



Tornado Watches

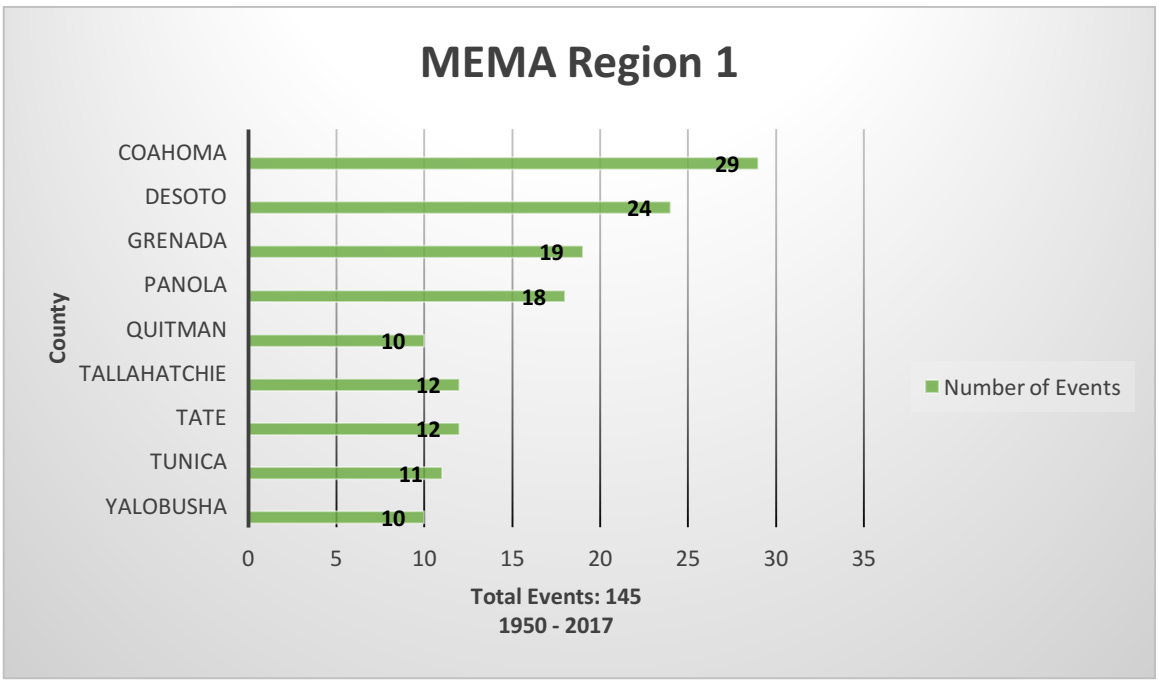
Figure 3.3.2. below further demonstrates Mississippi's vulnerability to potential tornado outbreaks. This graphic shows from 1993 - 2012 the watches per county departure range from -5 to 6.

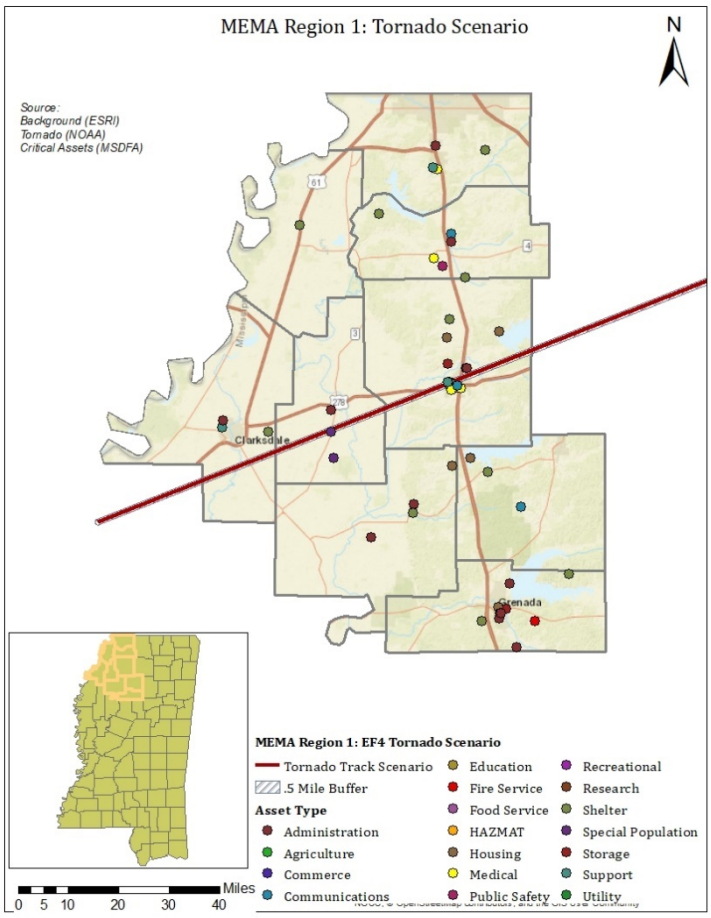
Figure 3.3.2
Tornado Watches 2003 - 2015

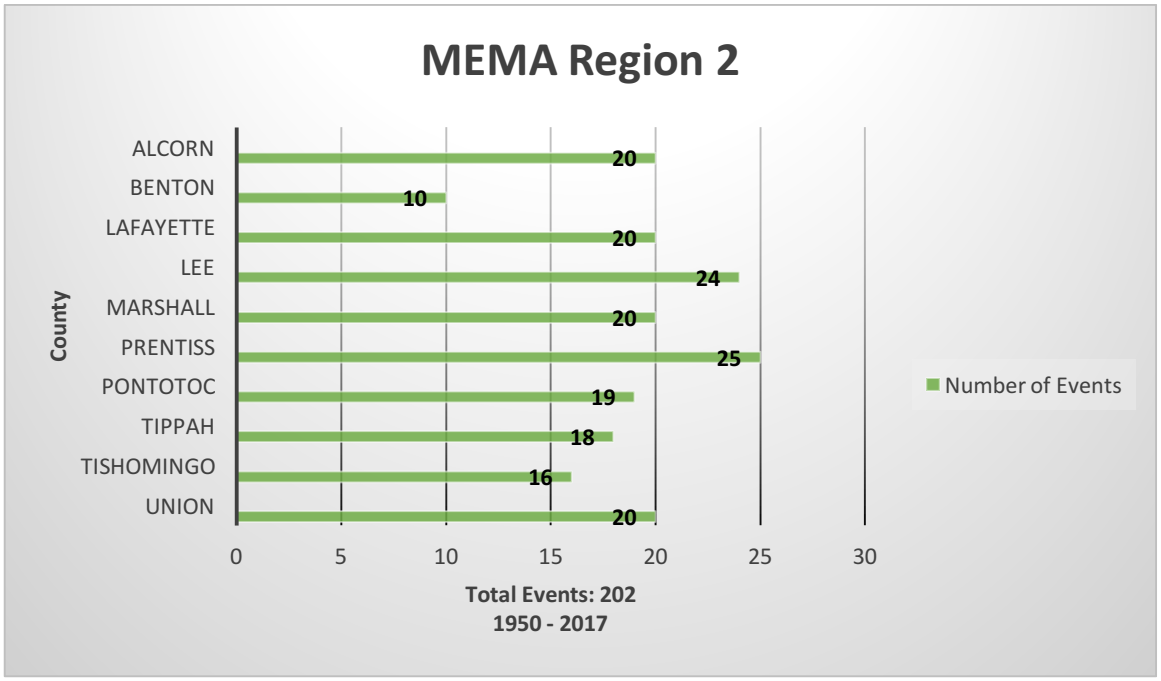


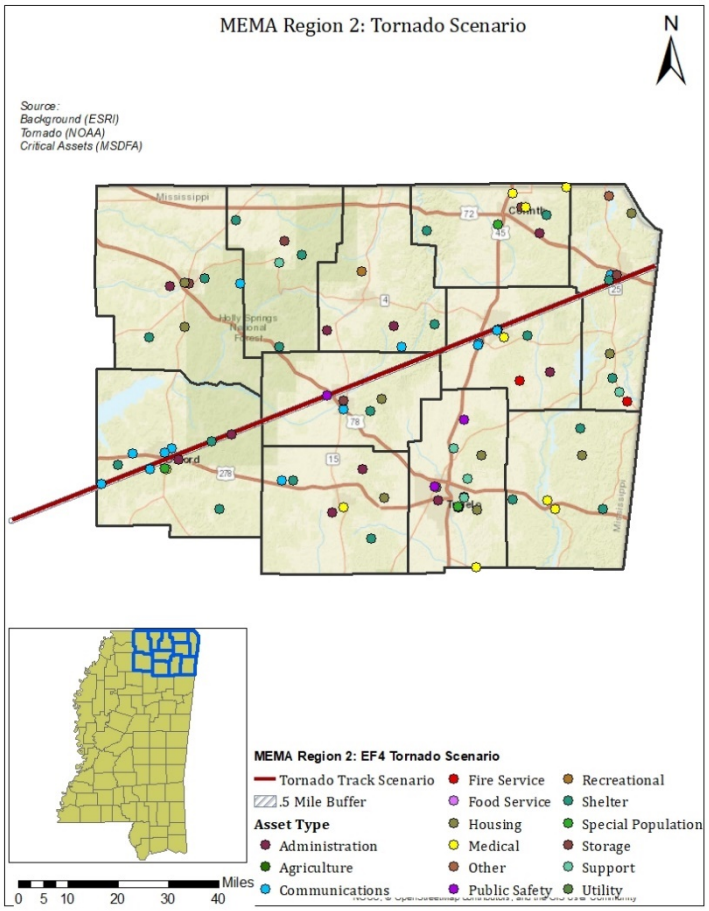
Events Per Region

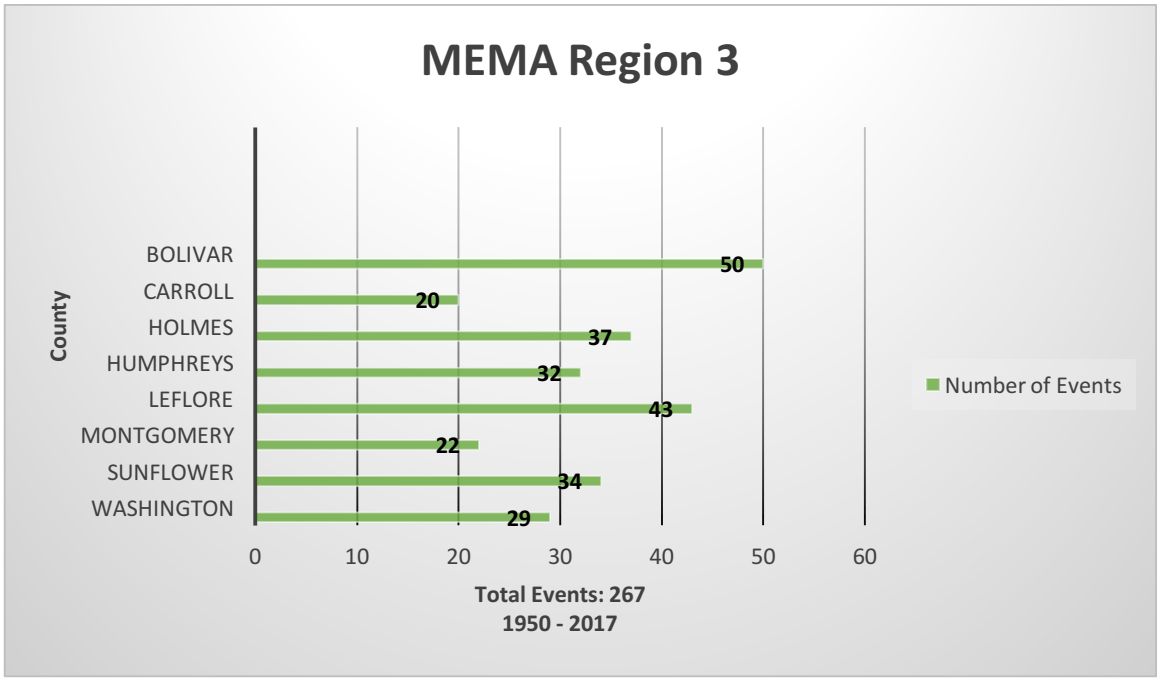
The following pages contains graphs depicting the tornado events that have occurred in each MEMA Region. Each graph is accompanied with a regional map. An existing tornado track from the 1969 F4 just south of Jackson that killed more than 30 people was used. The historic track was shifted to intersect with critical assets typically near the center of each region. A half mile buffer was added to the centerline of the track to encompass more of the anticipated damage swath. The resulting swath was analyzed with critical assets that intersect with the swath to produce the tabular data sheets.

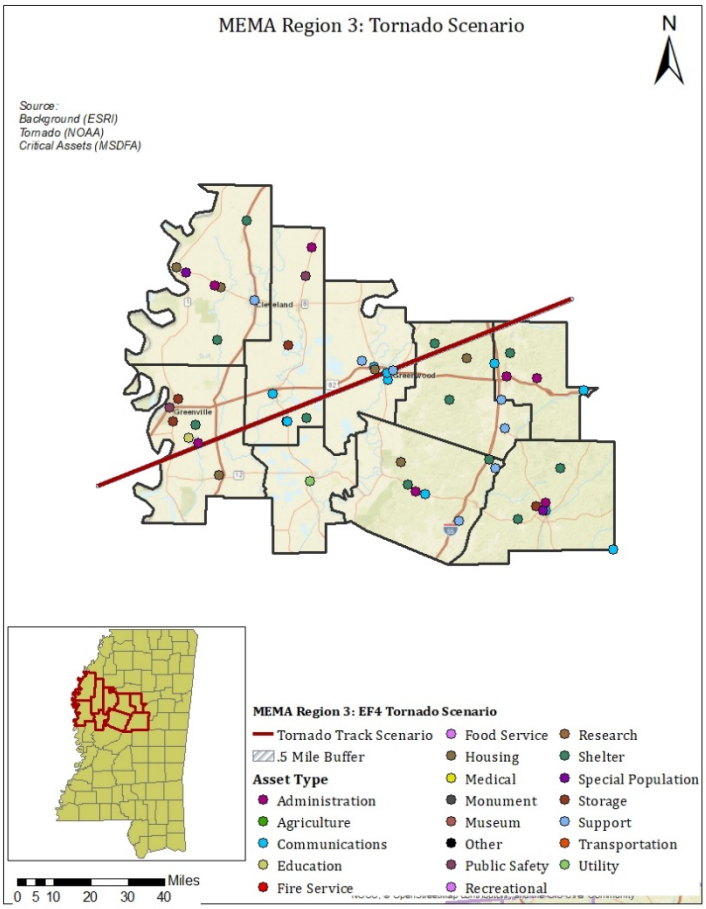

MEMA Region 1
County
COAHOMA
DESOTO
GRENADA
PANOLA
QUITMAN
TALLAHATCHIE
TATE
TUNICA
YALOBUSHA
29
24
19
18
10
12
12
11
10
0
5
10
15
20
25
30
35
Number of Events
Total Events: 145
1950 - 2017

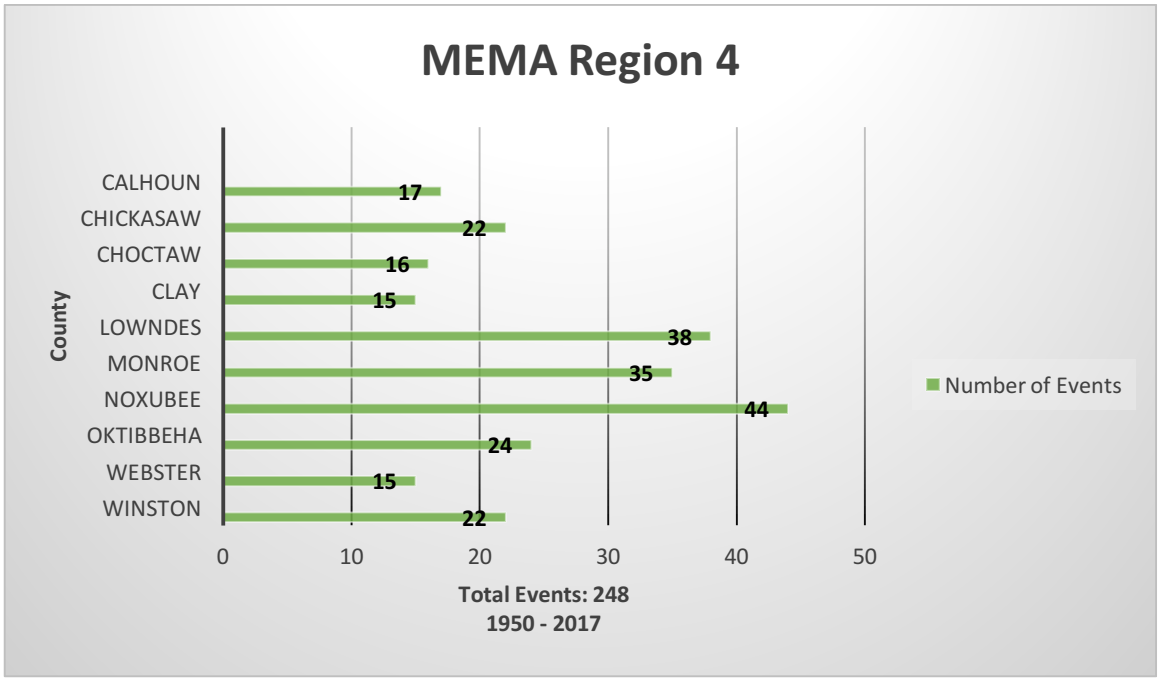

MEMA Region 1: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
Clarksdale
Grenada
MEMA Region 1: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Agriculture
Commerce
Communications
Education
Fire Service
Food Service
HAZMAT
Housing
Medical
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40

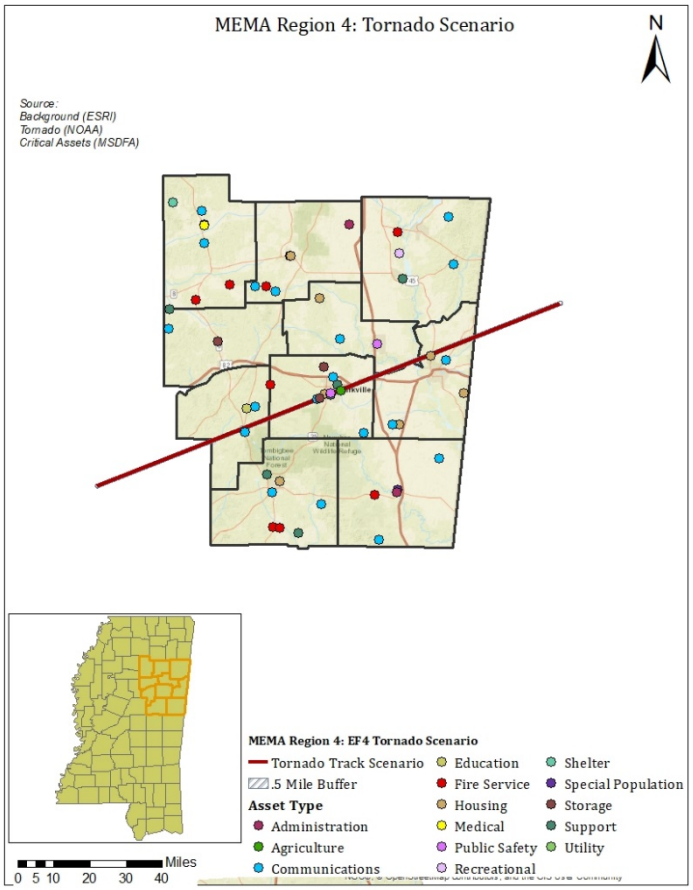

MEMA Region 2
County
ALCORN
BENTON
LAFAYETTE
LEE
MARSHALL
PRENTISS
PONTOTOC
TIPPAH
TISHOMINGO
UNION
20
10
20
24
20
25
19
18
16
20
0
5
10
15
20
25
30
Number of Events
Total Events: 202
1950 - 2017

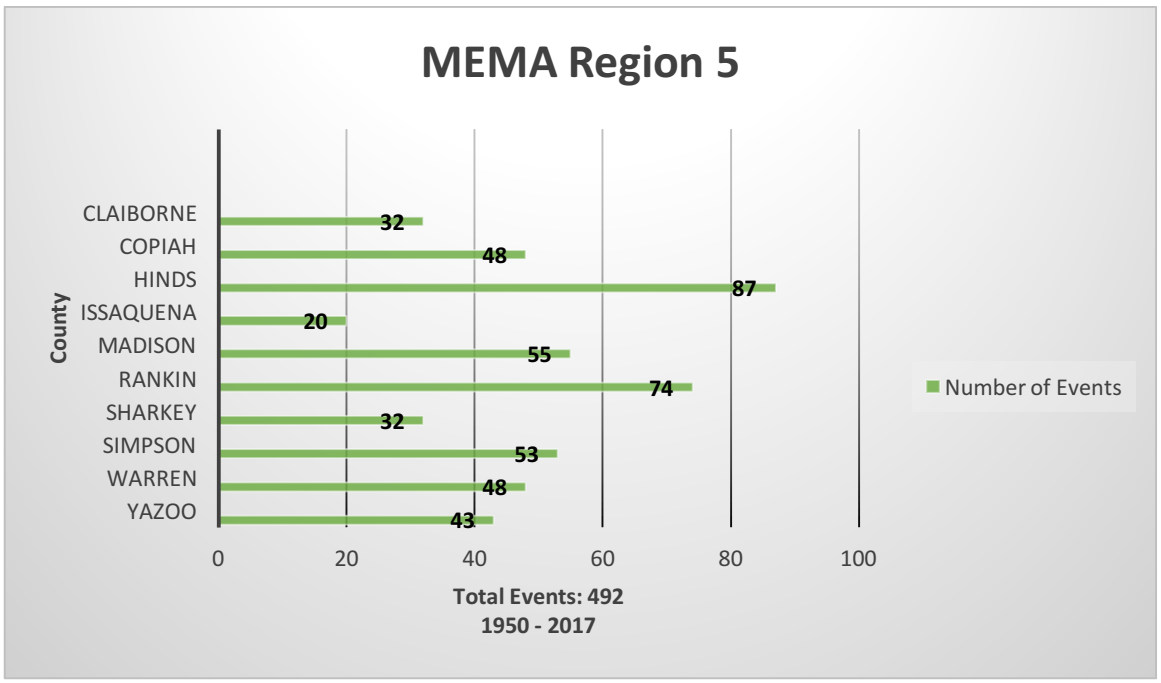

MEMA Region 2: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
MEMA Region 2: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Agriculture
Communications
Fire Service
Food Service
Housing
Medical
Other
Public Safety
Recreational
Shelter
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40

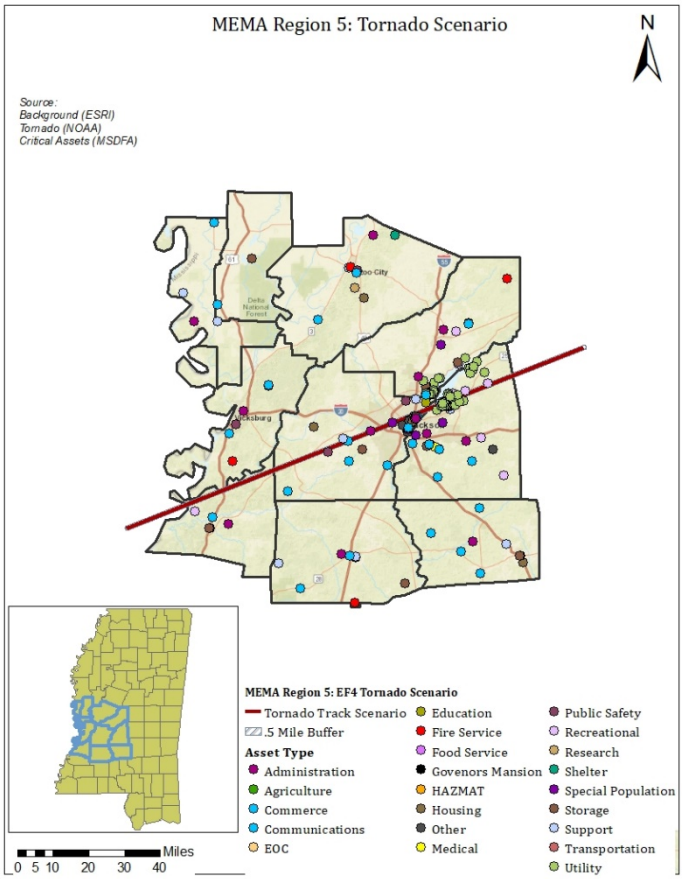

MEMA Region 3
County
BOLIVAR
CARROLL
HOLMES
HUMPHREYS
LEFLORE
MONTGOMERY
SUNFLOWER
WASHINGTON
50
20
37
32
43
22
34
29
0
10
20
30
40
50
60
Number of Events
Total Events: 267
1950 - 2017

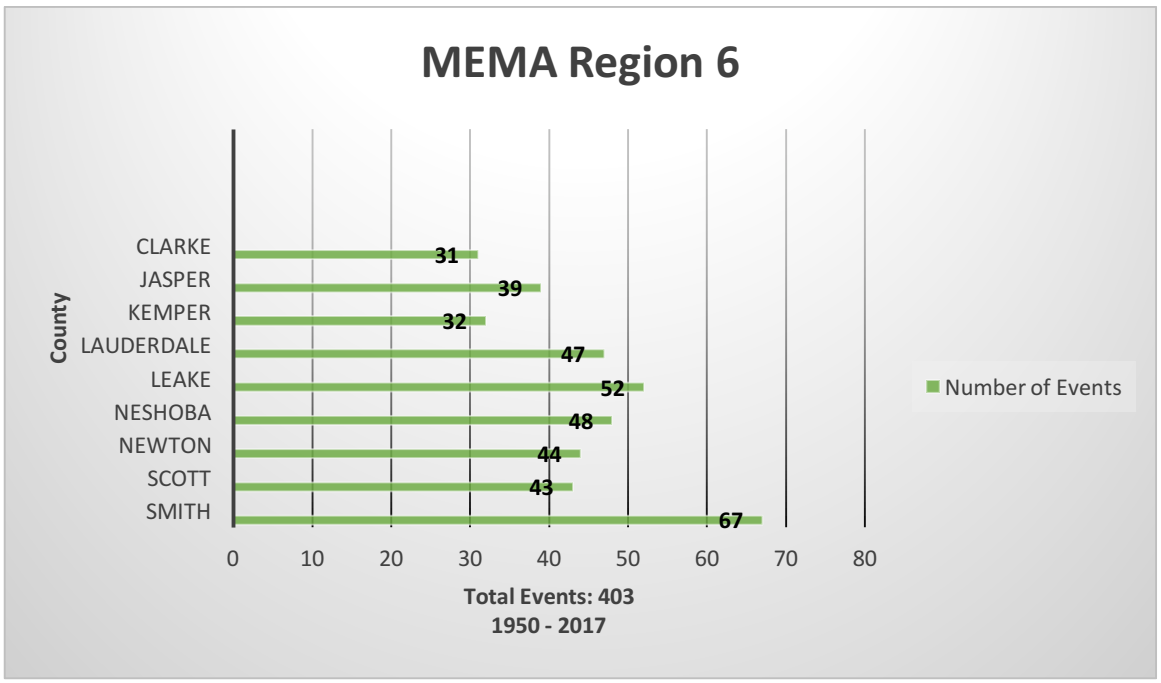

MEMA Region 3: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
Greenville
Cleveland
Greenwood
MEMA Region 3: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Agriculture
Communications
Education
Fire Service
Food Service
Housing
Medical
Monument
Museum
Other
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Transportation
Utility
Miles
0 5 10 20 30 40

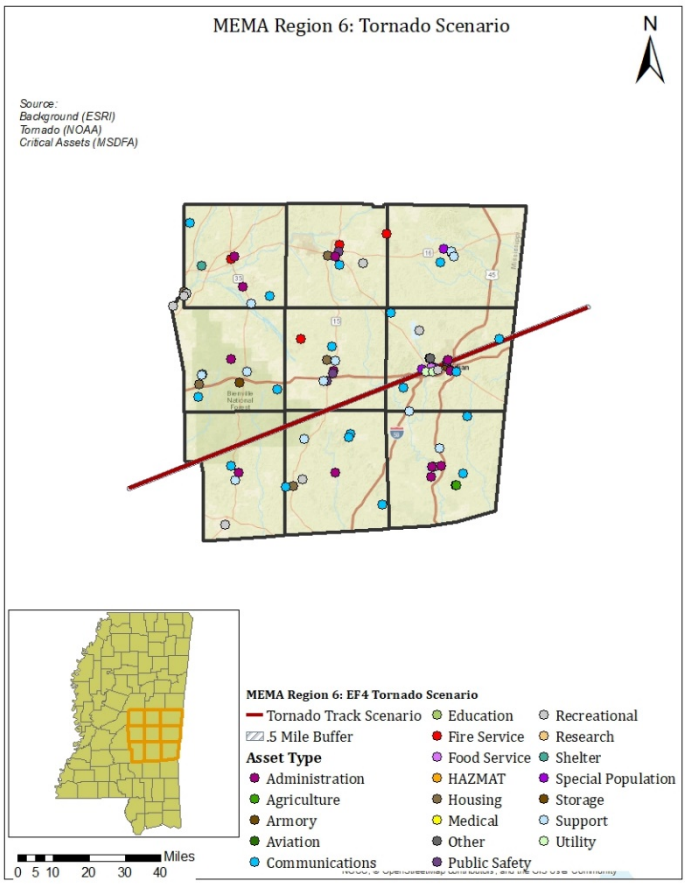

MEMA Region 4
County
CALHOUN
CHICKASAW
CHOCTAW
CLAY
LOWNDES
MONROE
NOXUBEE
OKTIBBEHA
WEBSTER
WINSTON
17
22
16
15
38
35
44
24
15
22
0
10
20
30
40
50
Number of Events
Total Events: 248
1950 - 2017

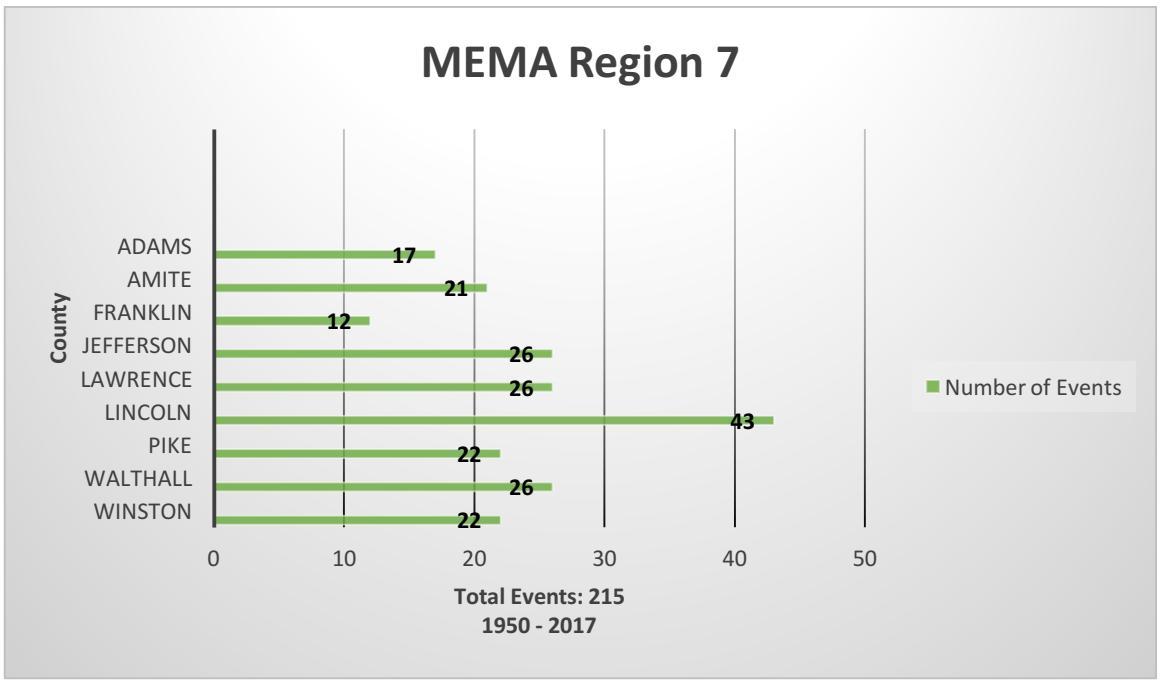

MEMA Region 4: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
MEMA Region 4: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Agriculture
Communications
Education
Fire Service
Housing
Medical
Public Safety
Recreational
Shelter
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40

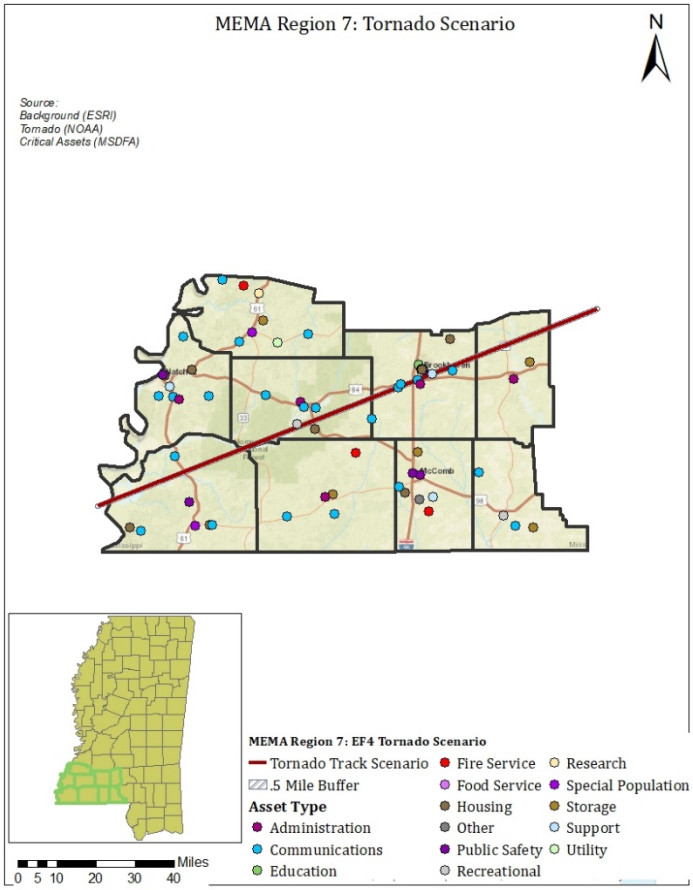

MEMA Region 5
County
CLAIBORNE
COPIAH
HINDS
ISSAQUENA
MADISON
RANKIN
SHARKEY
SIMPSON
WARREN
YAZOO
32
48
87
20
55
74
32
53
48
43
0
20
40
60
80
100
Total Events: 492
1950 - 2017
Number of Events

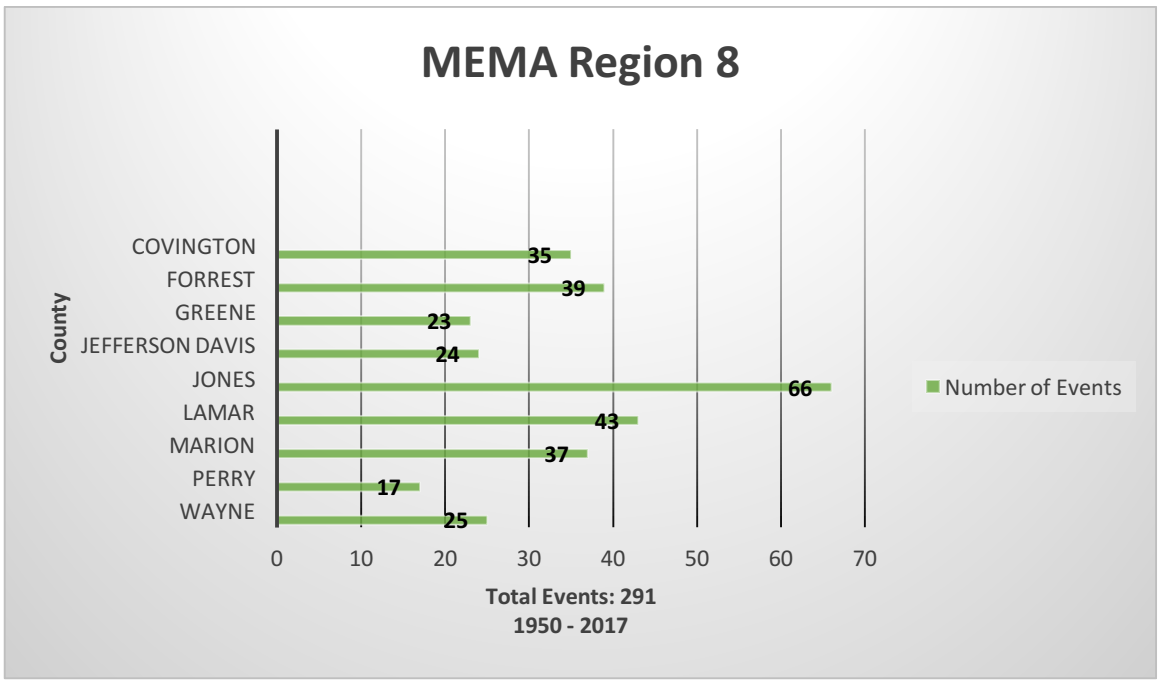

MEMA Region 5: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
MEMA Region 5: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Agriculture
Commerce
Communications
EOC
Education
Fire Service
Food Service
Governors Mansion
HAZMAT
Housing
Other
Medical
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Transportation
Utility
Miles
0 5 10 20 30 40

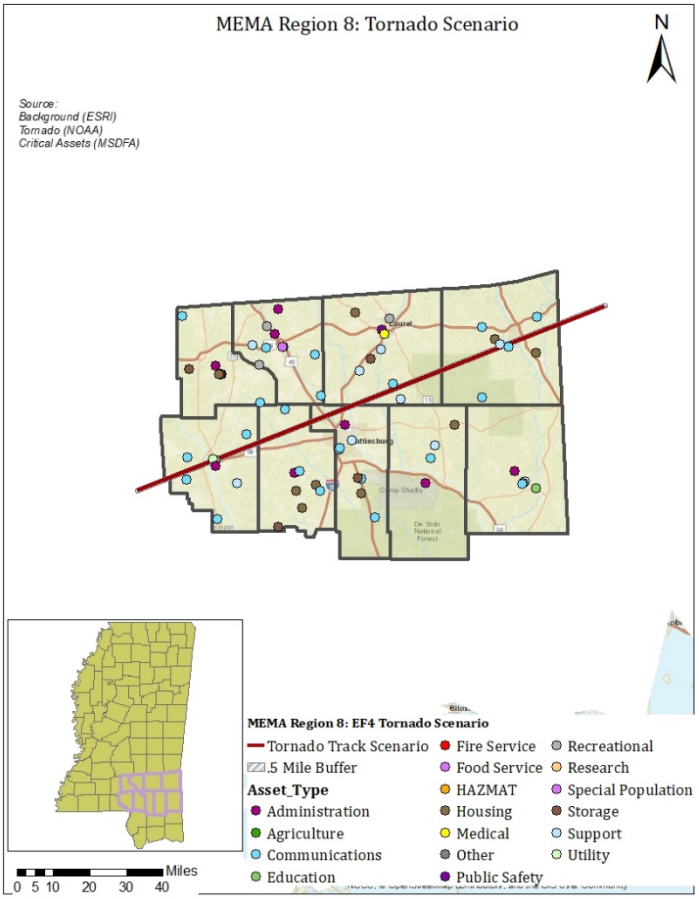

MEMA Region 6
County
CLARKE
JASPER
KEMPER
LAUDERDALE
LEAKE
NESHOBA
NEWTON
SCOTT
SMITH
31
39
32
47
52
48
44
43
67
0
10
20
30
40
50
60
70
80
Total Events: 403
1950 - 2017
Number of Events

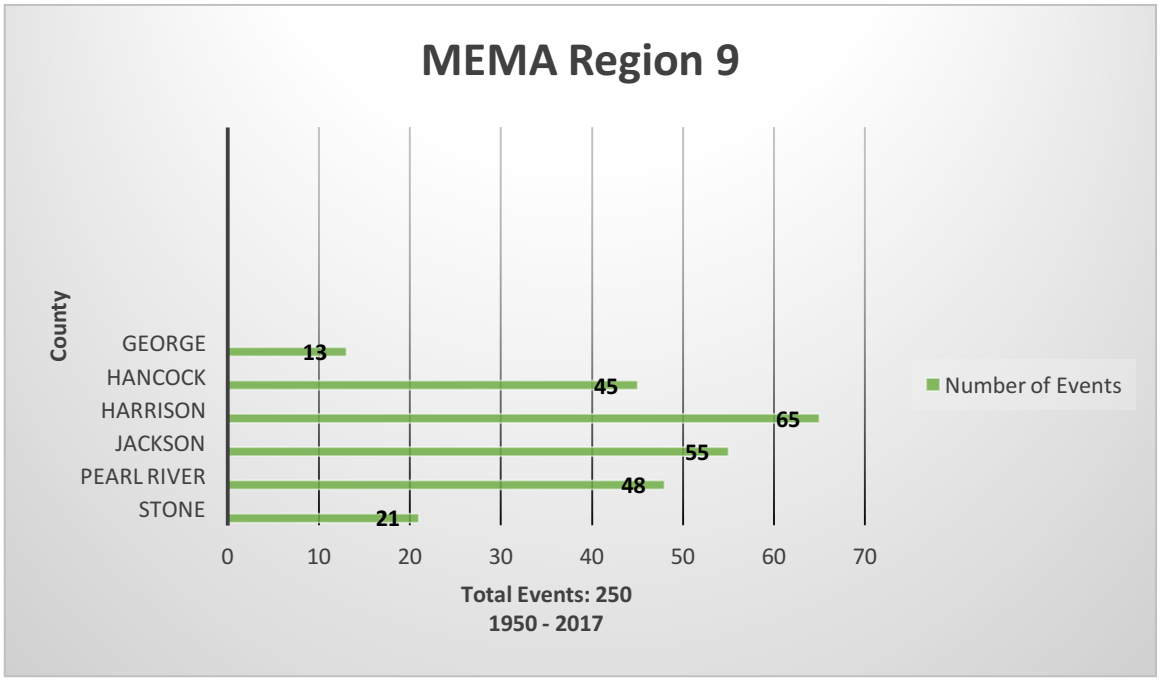

MEMA Region 6: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
MEMA Region 6: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Agriculture
Armory
Aviation
Communications
Education
Fire Service
Food Service
HAZMAT
Housing
Medical
Other
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40

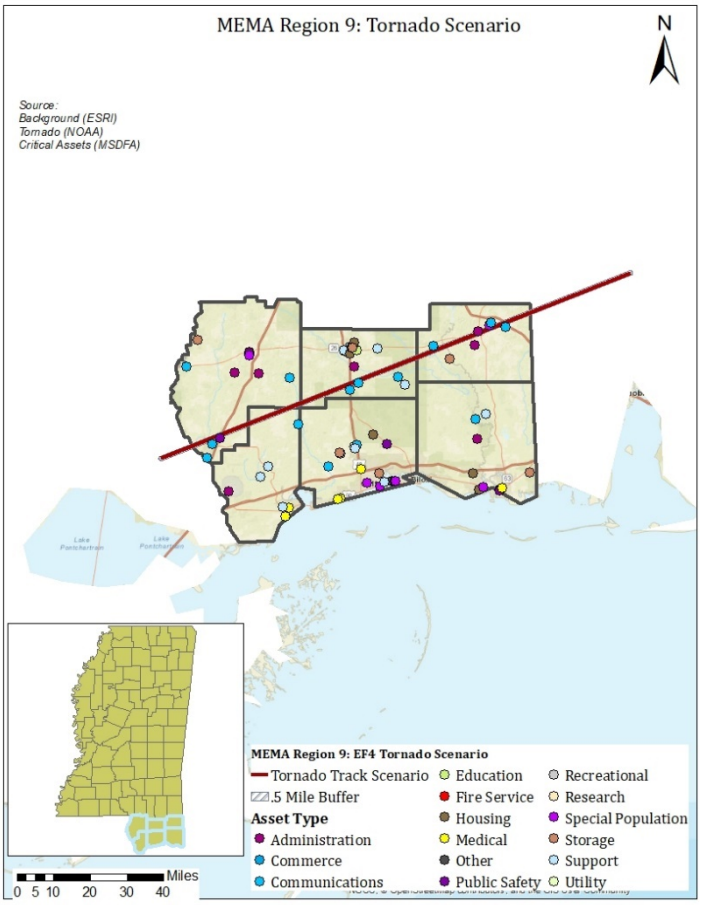

MEMA Region 7
County
ADAMS
AMITE
FRANKLIN
JEFFERSON
LAWRENCE
LINCOLN
PIKE
WALTHALL
WINSTON
17
21
12
26
26
43
22
26
22
0
10
20
30
40
50
Number of Events
Total Events: 215
1950 - 2017


MEMA Region 7: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
McComb
MEMA Region 7: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Communications
Education
Fire Service
Food Service
Housing
Other
Public Safety
Recreational
Research
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40


MEMA Region 8
County
COVINGTON
FORREST
GREENE
JEFFERSON DAVIS
JONES
LAMAR
MARION
PERRY
WAYNE
35
39
23
24
66
43
37
17
25
0
10
20
30
40
50
60
70
Number of Events
Total Events: 291
1950 - 2017


MEMA Region 8: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
MEMA Region 8: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset_Type
Administration
Agriculture
Communications
Education
Fire Service
Food Service
HAZMAT
Housing
Medical
Other
Public Safety
Recreational
Research
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40


MEMA Region 9
County
GEORGE
HANCOCK
HARRISON
JACKSON
PEARL RIVER
STONE
13
45
65
55
48
21
0
10
20
30
40
50
60
70
Number of Events
Total Events: 250
1950 - 2017


MEMA Region 9: Tornado Scenario
N
Source:
Background (ESRI)
Tornado (NOAA)
Critical Assets (MSDFA)
MEMA Region 9: EF4 Tornado Scenario
Tornado Track Scenario
.5 Mile Buffer
Asset Type
Administration
Commerce
Communications
Education
Fire Service
Housing
Medical
Other
Public Safety
Recreational
Research
Special Population
Storage
Support
Utility
Miles
0 5 10 20 30 40

Assessing Vulnerability of People to Tornadoes

Any person working in a building or living in a dwelling is vulnerable to the wrath of a tornado. According to a study at Michigan State University, there are roughly 9 million mobile homes in the United States. The United States averages well over 1,000 tornadoes per year. The risk of fatalities is greater in mobile homes, which may be the only viable housing option for some people. A Northern Illinois University study entitled, “Nightime Tornadoes are Worst Nightmare”, has indicated that 45% of all fatalities during tornadoes occur in mobile homes, compared to 26% in traditional site-built houses

Again, mobile/manufactured homes are particularly vulnerable and as shown in Table 3.3.4 these structures are a substantial percentage of housing throughout the state. Without appropriate warning or access to a tornado shelter, they can rapidly become involved in a life- threatening situation.

People who outside of the siren warning area and with little access conventional communications such as telephones, as well as those that do not have a NOAA weather radio are also at risk. People with special needs and/or home-bound due to medical problems are especially vulnerable. Those who are reliant on medical care such as insulin and oxygen are likely dependent on electricity and ventilation systems. This makes them especially vulnerable to tornadoes in the event they cause a disruption in electrical service. Patients in nursing homes and hospitals and patients in need of home health care are particularly vulnerable to loss of power and disruption in public services resulting from a tornado event.

Inadequate individual warning and inadequate shelter during an event contribute to the number of fatalities resulting from any given tornado. Often due to mobility problems or inability to hear or understand warnings, the very young, the elderly, and the handicapped are especially vulnerable to tornadoes. It is imperative institutions housing these individuals develop a severe weather action plan and conduct frequent drills

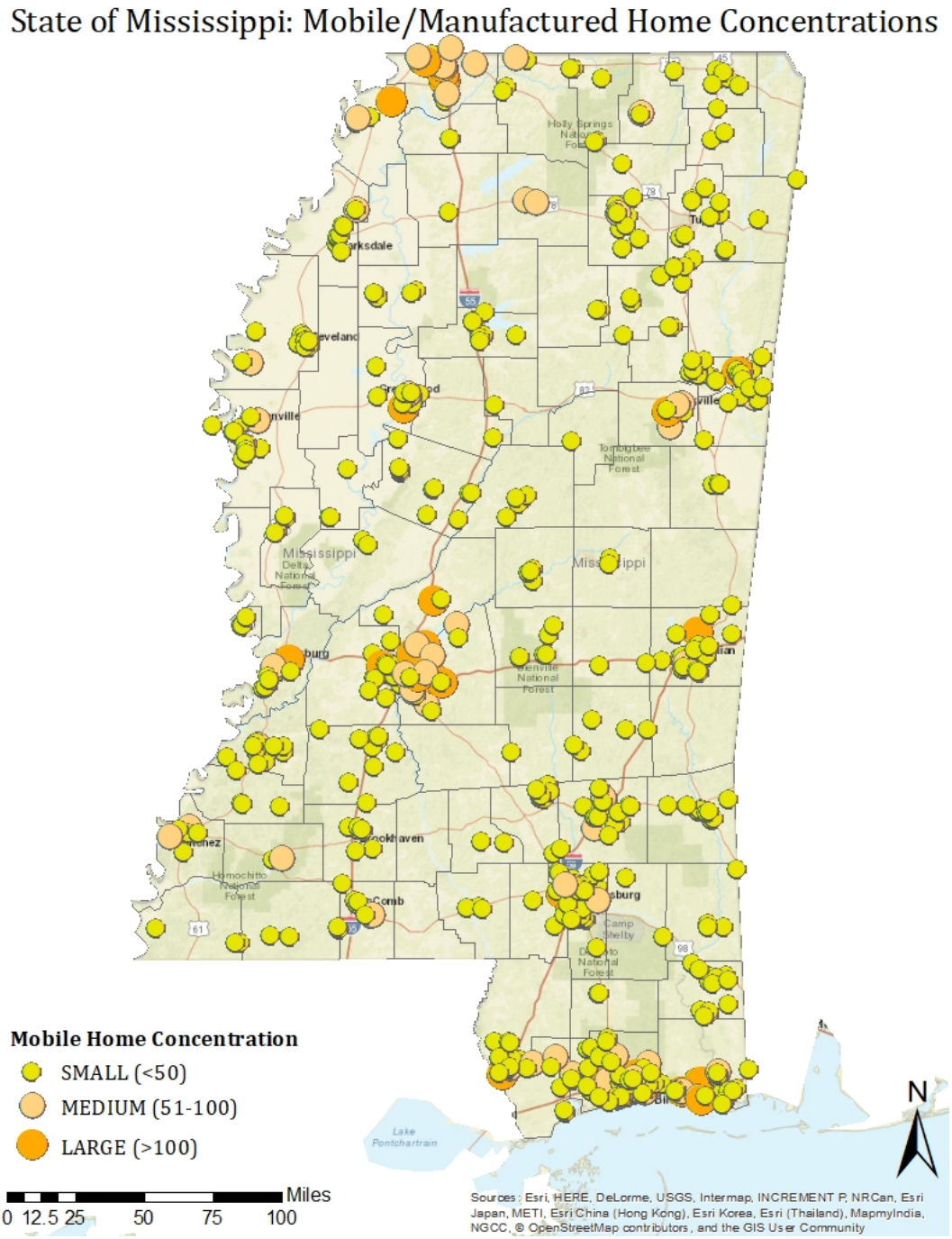
Table 3.3.4
Mobile/Manufactured Housing

County	Number of Mobile/ Manufactured Housing	Percentage of Total Housing		County	Number of Mobile/ Manufactured Housing	Percentage of Total Housing
MEMA Region 1 – 16,195						
Coahoma	1,057	9.8%		Tallahatchie	1,292	23.3%
DeSoto	2,971	4.6%		Tate	2,425	21.7%
Grenada	1,602	15.7%		Tunica	593	12.3%
Panola	4,044	27.4%		Yalobusha	1,767	27.7%
Quitman	444	12.4%				
MEMA Region 2 – 27,777						
Alcorn	2,479	14.5%		Pontotoc	3,232	25.7%
Benton	1,124	26.7%		Prentiss	2,128	19.2%
Itawamba	2,245	22.1%		Tippah	2,297	18.9%
Lafayette	2,594	10.8%		Tishomingo	1,945	22.3%
Lee	3,994	11.0%		Union	2,611	
Marshall	3,128	20.8%				
MEMA Region 3 – 11,604						
Attala	1,871	14.5%		Leflore	1,106	8.4%
Bolivar	1,537	26.7%		Montgomery	832	15.3%
Carroll	1,067	22.1%		Sunflower	470	4.8%
Holmes	2,518	10.8%		Washington	1,798	8.3%
Humphreys	405	11.0%				
MEMA Region 4 – 18,808						
Calhoun	1,368	19.7%		Monroe	3,615	22.0%
Chickasaw	1,958	26.1%		Noxubee	1,727	33.5%
Choctaw	728	17.5%		Oktibbeha	2,253	10.5%
Clay	1,448	15.7%		Webster	972	20.2%
Lowndes	3,106	11.5%		Winston	1,633	18.6%
MEMA Region 5 – 28,132						
Claiborne	1,512	35.8%		Rankin	7,739	13.3%
Copiah	3,271	26.9%		Sharkey	430	20.3%
Hinds	4,289	4.1%		Simpson	3,051	25.5%
Issaquena	152	27.4%		Warren	3,377	15.4%
Madison	2,080	5.1%		Yazoo	2,231	22.2%

Clarke	2,270	28.8%		Neshoba	2,431	19.7%
Jasper	2,549	31.0%		Newton	1,910	20.4%
Kemper	1,046	22.1%		Scott	3,471	30.2%
Lauderdale	4,866	13.9%		Smith	1,918	26.4%
Leake	2,297	24.4%				
MEMA Region 7 – 19,891						
Adams	1,704	11.6%		Lincoln	4,195	27.5%
Amite	1,928	29.1%		Pike	4,430	24.7%
Franklin	1,153	27.7%		Walthall	2,031	28.5%
Jefferson	1,265	34.4%		Wilkinson	1,772	35.1%
Lawrence	1,413	23.4%				
MEMA Region 8 – 23,521						
Covington	2,109	11.6%		Lamar	2,307	9.5%
Forrest	3,071	29.1%		Marion	2,882	24.3%
Greene	1,082	27.7%		Perry	1,938	35.1%
Jefferson Davis	1,567	34.4%		Wayne	2,865	31.1%
Jones	5,700	23.4%				
MEMA Region 9 – 24,622						
George	2,163	23.1%		Jackson	5,348	8.7%
Hancock	2,987	12.6%		Pearl River	4,734	19.3%
Harrison	7,783	8.7%		Stone	1,607	22.2%
Total Mobile/Manufactured Housing Mississippi						**193,308**

Source: U. S. Census Bureau: 2000 Census and Selected Housing Characteristics 2012-2016 American Community Survey 5-Year Estimates

Figure 3.3.3
Mobile/Manufactured Housing



Loss of Life

The strong winds of a tornado can rip just about anything off the ground including trees, vehicles, and even houses. The second damaging effect of tornadoes is from the debris that the storm picks up. People have been buried alive by houses or mud picked up and then dropped by a tornado. Smaller objects become damaging projectiles when thrown by tornadoes.

To date, this information has remained the same. The deadliest tornado occurred in Vicksburg on March 2, 1966, with 58 fatalities. The Delta Region was struck on February 21, 1971, with 118 fatalities (known as the Delta Outbreak). At this point, 2005 had the most recorded tornadoes when 120 hit the state of Mississippi

Vulnerability to Natural Resources

Trees and decorative vegetation are all subject to damage from tornadoes. The force of a tornado is powerful enough to uproot trees and vegetation and deposit the debris in standing water, resulting in a polluted drinking water supply. Tornadoes also have the ability to cause animals to migrate prematurely.

Streams can become clogged with wind-blown debris and downed trees, causing flooding and resulting in a slow recovery. Habitat for local wildlife may become destroyed, resulting in a reduction of species. If debris is not removed from the forest floor, it can become fuel for a wildfire.

Local Plan Integration Summary

Below is a summary of the risk classification identified in the individual local mitigation plans, which includes all corresponding municipalities and Disaster Resistant University Plans by MEMA Region:

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1	--	--	1	6	--	--	1
2	--	1	1	7	--	--	1
3	--	1	1	8	--	--	4
4	--	--	2	9	--	--	1
5	--	--	17*				

*Note- two additional plans in Region 5 ranked tornado as "yes" only and are not included in the above table.

Assessing Vulnerability by Jurisdiction Methodology and Potential Losses

The previous plans assessed each county's vulnerability to tornado events by utilizing a rating system devised to establish four ratings based on the following factors: number of past tornado occurrences, total valuation of private property in each county, population density of each county, and past tornado damage values. Each of these ratings were summed up to determine an overall vulnerability rating for each county relative to the other counties.

As with the 2013 plan update, the 2018 plan update is using the same methodology. Four factors are used, but they are not being classified into groupings to assess a value. The value for each category is presented in Table 3.2.5 by MEMA Region.

The four factors are described in detail below with a summary of the results.

1. **Prior Events** - As previously suggested, the total number of tornadoes reported is probably dependent upon population density and weather radar coverage. For the purposes of this plan, it is reasonable to assume the overall frequency of tornadoes does not vary significantly across the state by any means other than seasonality – southern portions of Mississippi appear to experience a higher number of tornadoes during the spring severe weather season whereas the northern portions experience their peak in the fall severe weather season.

   Summary of Prior Events: The number of events by county, per region is provided in graph form on pages 3:92 - 3:100 and in Table 3.3.5 on pages 3:107 - 3:111 by MEMA Region. All counties are considered at high risk.

2. **Private Property Values** - To relatively compare the amount of assets vulnerable to loss by tornado damage in each county, the state of Mississippi turned to assessment data from the Mississippi Tax Com- mission. The values were obtained from the "Mississippi State Tax Commission Annual Report Fiscal Year Ending June 30, 2016."

   The Annual Report provides private property assessments in two categories. These are "Real Property" and "Personal Property." The "Real Property" assessment represents the true value of all taxable land and improvements thereto including residential, commercial and industrial property. The "Personal Property" assessment represents the value of the following: business inventories; furniture, fixtures, machinery and equipment for non-residential property; mobile homes and automobiles. To determine the Total Valuation of Property for each county, the "True Value" from the "Personal Property" assessment was added to the "True Value" from the "Real Property" assessment. This total private property valuation dollar value in itself is an indicator of the total value of each county's property (tangible assets).

   Summary of Private Property Values: The Total Property Valuation ranged from $143,595,723 in Issaquena County to $13,812,440,934 in Harrison County.

3. **Tornado Damage Values** - Total damages of past tornadoes was determined to be an important factor in assessing vulnerability. The National Weather Service database listed past events plus provided damage estimates from those events. These damage estimates were presented in approximations.

   Summary of Tornado Damage Values: Lawrence County still leads in greatest loss with $504,289,000 in damages (2011-2017). The least amount of damage was in Stone County with $660,050 in damages. At the last plan update, Smith County had the least amount of damages per dollar amount. Smith County is currently as approximately $50,000,000 in damages.

Table 3.3.5
Tornado Damage Assessment

MEMA Region 1				
County	**Event**	**Total of Value of Property** (2016 Tax Commission)	**Reported Property Damage (NCDC) 1950 – 2018** (Approximations from site)	**Percent of Property Damage**
Coahoma	29	$1,007,458,991	$33,761,000	3.35%
DeSoto	24	$12,475,875,540	$44,648,000	3.58%
Grenada	19	$1,375,804,642	$1,768,000	0.13%
Panola	18	$1,708,022,135	$29,369,000	1.72%
Quitman	10	$288,633,934	$31,159,000	1.08%
Tallahatchie	18	$703,845,311	$32,002,000	0.45%
Tate	12	$1,243,521,770	$780,300	0.06%
Tunica	11	$1,480,716,504	$3,607,000	0.24%
Yalobusha	10	$571,843,941	$25,685,000	0.45%
Totals	**151**	**$20,855,722,768**	**$202,779,300**	

MEMA Region 2				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Alcorn	20	$1,643,659,265	$4,056,000	0.25%
Benton	10	$477,336,736	$3,526,000	0.07%
Itawamba	13	$992,580,078	$4,126,000	0.04%
Lafayette	20	$4,348,103,412	$62,068,000	1.43%
Lee	24	$6,765,092,049	$22,006,000	0.33%
Marshall	20	$2,023,383,364	$5,666,000	0.28%
Pontotoc	19	$1,056,134,861	$30,101,000	2.85%
Prentiss	25	$983,469,246	$3,983,000	0.04%
Tippah	18	$919,227,879	$4,111,000	0.04%
Tishomingo	16	$1,204,081,030	$2,925,000	0.24%
Union	20	$1,940,333,798	$27,348,000	1.41%
Totals	**205**	**$22,353,401,718**	**$169,916,000**	

MEMA Region 3				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Atalla	36	$722,206,923	$94,228,000	1.30%
Bolivar	50	$2,043,324,562	$17,212,000	0.84%
Carroll	20	$544,262,661	$3,870,000	0.07%
Holmes	37	$616,184,963	$69,419,000	1.13%
Humphreys	32	$368,177,168	$10,688,000	0.29%
Leflore	43	$1,639,305,774	$33,721,000	2.06%
Montgomery	22	$431,514,148	$7,442,000	0.20%
Sunflower	34	$1,192,777,363	$7,525,000	0.63%
Washington	29	$2,347,211,318	$10,953,000	0.47%
Totals	**303**	**$9,904,964,880**	**$255,058,000**	

MEMA Region 4				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Calhoun	17	$663,392,234	$970,010	0.01%
Chickasaw	22	$645,723,585	$7,790,000	0.12%
Choctaw	16	$1,895,663,331	$119,415,000	6.30%
Clay	15	$951,785,243	$4,306,000	0.05%
Lowndes	38	$6,702,763,658	$75,223,000	1.12%
Monroe	35	$2,050,241,361	$12,122,000	0.60%
Noxubee	36	$415,775,069	$6,423,000	0.15%
Oktibbeha	24	$2,720,651,555	$7,258,000	0.27%
Webster	15	$468,716,910	$6,825,000	0.15%
Winston	22	$813,391,943	$122,152,000	1.50%
Totals	**240**	**$17,328,104,889**	**$362,484,010**	

MEMA Region 5				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Claiborne	32	$360,234,501	$26,844,000	0.75%
Copiah	48	$1,128,041,573	$10,555,000	0.94%
Hinds	87	$11,949,237,413	$92,701,000	7.76%
Issaquena	20	$143,595,723	$3,765,000	0.30%
Madison	55	$11,505,788,910	$45,737,000	3.98%
Rankin	74	$10,958,465,853	$143,927,000	13.13%
Sharkey	32	$263,377,963	$28,284,000	1.07%
Simpson	53	$1,349,677,391	$27,446,000	2.03%
Warren	48	$3,601,457,620	$32,270,000	0.90%
Yazoo	43	$1,260,391,724	$147,846,000	11.73%
Totals	**492**	**$38,918,811,051**	**$559,375,000**	

MEMA Region 6				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Clarke	31	$815,018,920	$27,254,000	0.33%
Jasper	39	$965,621,992	$40,477,000	0.42%
Kemper	32	$411,462,319	$42,985,000	1.04%
Lauderdale	47	$4,206,780,767	$17,747,000	0.42%
Leake	52	$793,096,450	$65,721,000	0.83%
Neshoba	48	$1,226,377,511	$2,069,000	0.20%
Newton	44	$840,363,450	$19,720,000	0.23%
Scott	43	$1,261,988,972	$9,362,000	0.74%
Smith	67	$3,578,179,107	$50,977,000	1.42%
Totals	**403**	**$14,098,889,488**	**$276,312,000**	

MEMA Region 7				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Adams	17	$1,789,743,060	$6,006,000	0.34%
Amite	21	$722,206,923	$2,047,000	0.03%
Franklin	12	$357,331,223	$3,775,000	0.11%
Jefferson	26	$324,790,094	$2,785,000	0.09%
Lawrence	26	$830,701,582	$504,289,000	60.71%
Lincoln	43	$1,798,471,747	$10,621,000	0.60%
Pike	22	$1,948,601,296	$29,078,000	1.50%
Walthall	26	$564,836,621	$2,288,000	0.04%
Wilkinson	11	$409,048,884	$1,153,000	0.03%
Totals	**204**	**$8,745,731,430**	**$562,042,000**	

MEMA Region 8				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
Covington	35	$953,519,490	$10,555,000	1.1%
Forrest	39	$4,215,660,367	$44,721,000	1.06%
Greene	23	$567,356,719	$15,432,000	0.27%
Jefferson Davis	24	$431,170,885	$3,826,000	0.09%
Jones	66	$3,379,100,357	$71,897,000	2.13%
Lamar	43	$3,788,935,003	$24,279,000	0.64%
Marion	37	$1,049,746,033	$28,876,000	2.75%
Perry	17	$534,520,330	$1,088,000	0.02%
Wayne	25	$2,035,360,396	$27,593,000	1.36%
Totals	**309**	**$16,955,369,580**	**$228,267,000**	

MEMA Region 9				
County	Event	Total of Value of Property (2016 Tax Commission)	Reported Property Damage (NCDC) 1950 – 2018 (Approximations from site)	Percent of Property Damage
George	13	$898,104,563	$1,552,000	.02%
Hancock	45	$3,844,208,848	$27,087,000	.7%
Harrison	65	$13,812,440,934	$63,203,000	.46%
Jackson	55	$12,382,944,852	$2,933,000	.2%
Pearl River	48	$2,689,806,893	$5,260,000	.2%
Stone	21	$740,879,991	$660,050	.09%
Totals	**247**	**$34,368,386,081u**	**$100,695,050**	

Impacts of Mitigation

Warning Sirens

The Mississippi Emergency Management Agency partnered with the Federal Emergency Management Agency to improve tornado warning capabilities through participation in a storm siren grant program. This program required localities to provide minimum matching funds, document a proposed site and the effective range and population to be warned should the project be funded, and assume responsibility for future maintenance of a funded system.

Safe Rooms

The state of Mississippi also offered a safe room program - “A Safe Place to Go” encouraging homeowners to construct individual safe rooms at their residence providing protection to their families. More than 6,200 safe rooms were installed statewide thanks to this initiative. This program is no longer active as funding is unavailable.

The state also provided funding for FEMA 361 and Community Safe Rooms. With advanced notice, these safe rooms could be opened for those persons who may be in harm’s way; including but not limited to those in mobile homes/manufactured housing.

3.4: Dam/Levee Failure Risk Assessment

Hazard Description

A dam is any artificial barrier constructed to impound or divert water, waste- water, liquid borne materials or solids that may flow if saturated. All structures necessary to maintain the water level in an impoundment or to divert a stream from its course will be considered one dam.

A levee is an artificial embankment alongside a river. The main purpose of an artificial levee is to prevent flooding of the adjoining countryside; however, they also confine the flow of the river resulting in higher and faster water flow.

Dam Categories

The Surface Water and Dam Safety Divisions of the Office of Land and Water Resources, Mississippi Department of Environmental Quality (MDEQ) develop regulations on Dam Safety for the state. Dams are categorized according to what lies downstream, as well as the expected impact of dam failure. The following is taken from regulations for dams in Mississippi that will describe the statutory dam categories:

Low Hazard (Category III, or Class A) - A class of dam in which failure would at the most, result in damage to agricultural land, farm buildings (excluding residences), or minor roads. Without exception, all low hazard dams in Mississippi are earthen dams; some are considered to be properly engineered structures.

High Hazard (Category I, or Class C) - Dam failure may cause loss of life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads. Dams con- structed in residential, commercial, or industrial areas are classified as high hazard dams unless other- wise classified on a case-by-case business. For example, dams constructed where there is potential for development receive a high hazard classification. The term “High Hazard” does not speak to the quality of the structure, but rather the potential for a resultant death or exposure to property damage down- stream in case of a failure. A dam can be as small as six feet in height, but if a homeowner lives within a reasonable distance of the structure, he would be considered vulnerable.

A high hazard dam is a class of dam in which failure may cause loss of life, serious damage to residential, industrial, or commercial buildings; or damage to, or disruption of, important public utilities or transportation facilities such as major highways or railroads. Dams proposed for construction in established or proposed residential, commercial, or industrial areas, and that meet the statutory thresholds for regulation, will be assigned this classification unless the applicant provides convincing evidence to the contrary.

Significant Hazard (Category II, or Class B) - A class of dam in which failure poses no threat to life, but which may cause significant damage to main roads, minor roads, or cause interruption of service of public utilities.

Hazard Profile

The hazard profile for dam failure in Mississippi includes current statistics regarding dam/levee failures and safety regulations that have been adopted by the State. According to the Mississippi Department of Environmental Quality - Dam Safety Division, there are 3,833 dams in Mississippi, of which 328 are classified as either high or significant hazard class (Figure 3.4.1).

Dams have a design lifetime. Unlike U.S. Army Corps of Engineers dams, private dams are all too likely to go without periodic maintenance essential to minimize failure. In spite of a five-year inspection period for high hazard dams, problems such as trees growing in the structure resulting in piping, animals using the dam structure for burrowing, and the appearance of sand boils can contribute to dam failure.

Catastrophic dam failure is characterized by the sudden, rapid, and uncontrolled release of impounded water produced by either overtopping or a break in the dam due to natural causes or human intervention. Lesser degrees of failure tend to lead up to or increase the risk of catastrophic failure. Management of such lesser degrees of failure normally can be accomplished if action is taken early and quickly.

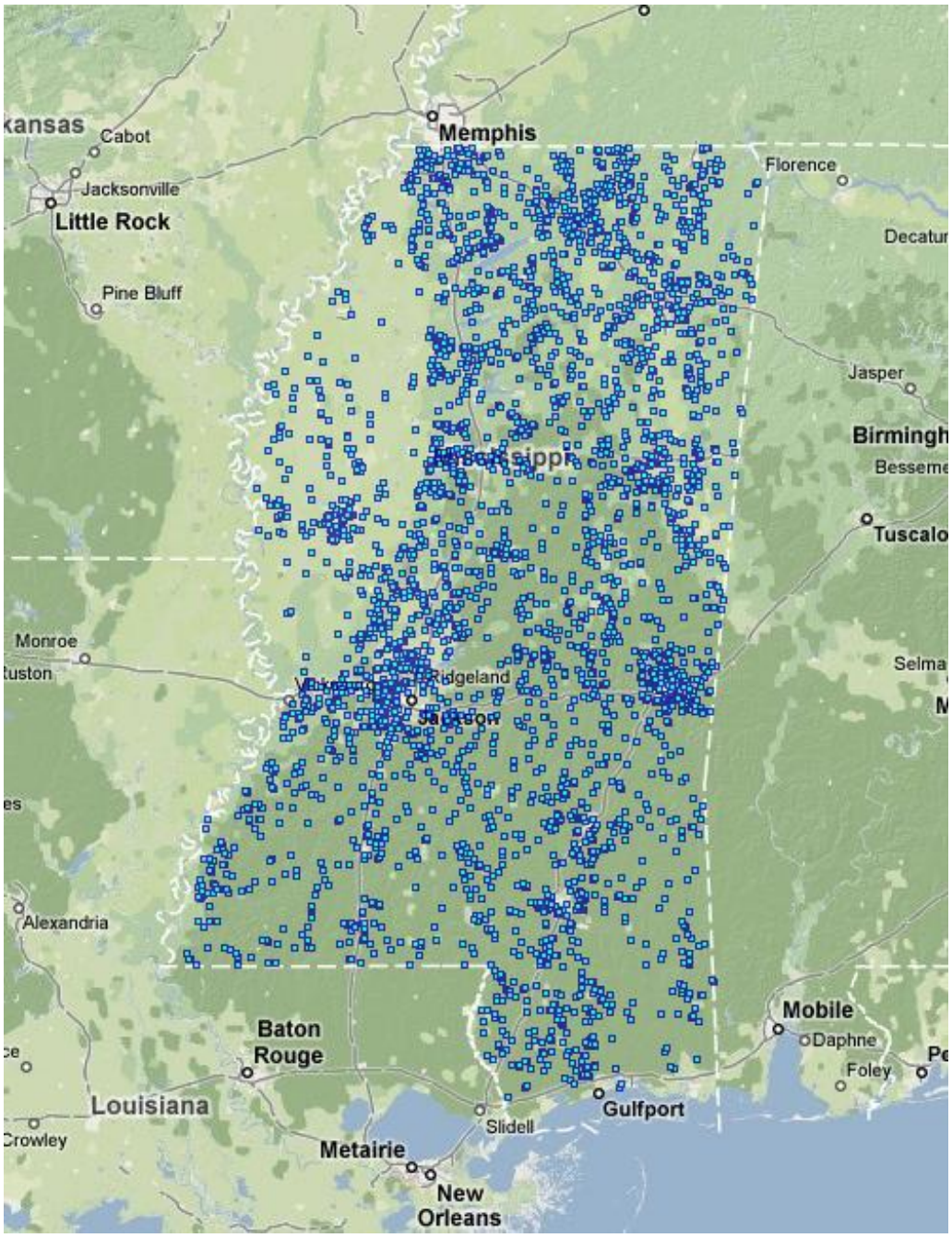
Mississippi's dam safety program should ensure the safety of public and private dams arising from the extraordinary public safety risks posed by unsafe dams, the false sense of security that often arises from the presence of an upstream dam (no matter its function), and the tendency of localities and private landowners to want to develop areas that seem protected but in reality could be inundated if a dam fails or is breached.

Emergency Action Plans

Section 51-3-39 of the Mississippi Code of 1972 charges dam owners with responsibility for maintaining and operating their dams in a safe condition. Dam Safety Regulations adopted by the Mississippi Commission on Environmental Quality in 2004 require all owners of High Hazard and Significant Hazard Dams to have their dams inspected by a registered professional engineer before March 2006. Additionally, the owners were required to prepare an Emergency Action Plan (EAP) for submission to MDEQ. Significant Hazard dams that may interrupt some roads or public utility services are also required to have EAPs in place.

The MDEQ Office of Land and Water Resources, Division of Dam Safety administers the state's dam safety program. This office conducts comprehensive file reviews and current hazard evaluation of all dams on their inventory. The Division's list of dams can be found in Appendix 7.3.4-A. This list includes dams consisting of at least 50 acres of surface drainage area. Any size dam can be determined to be "High Hazard".

Figure 3.4.1
Mississippi Dams



Source: MDEQ Dam Safety Division

Changes in Dam Classifications from 2018 Plan

The Dam Safety Division of MDEQ has been actively reviewing the hazard class ratings for dams throughout the state. Since the 2013 plan, over 3,389 were reclassified and are identified in the dam inventory provided in Appendix 7.3.4-A.

Table 3.4.1.shows dams which has a hazard class that has moved to high. Since 2013, 131 dams' classification was moved high. Table 3.4.1a will show those dams initially with high classifications that were subsequently moved to low.

Table 3.4.1
2018 Dam Hazard Class Changes to High

State ID	County	Dam Name	2013 Plan Hazard Class	2018 Plan Hazard Class
MS02789	Attala	Kenneth Lowe Lake Dam	L	H
MS06167	Attala	Albin Pond Dam	N/A	H
MS00939	Benton	Oaklimeter Creek Watershed Structure Lt-8-17 Dam	L	H
MS03282	Calhoun	Otoucalofa Creek Y-15-1 Dam	L	H
MS03285	Calhoun	Otoucalofa Creek Y-15-4 Dam	L	H
MS01050	Carroll	Abiaca Watershed Structure Y-34-13 Dam	L	H
MS01606	Carroll	Pelucia Watershed Structure Y-33a-14 Dam	L	H
MS01616	Carroll	Abotlapoota Ws Str Y-34-15 Dam	L	H
MS01623	Carroll	Abiaca Watershed Structure Y-34-29 Dam	L	H
MS02799	Choctaw	Upper Yockanookany Ws Str No 3 Dam	L	H
MS00546	Covington	Dry Creek Watershed Structure 3 Dam	L	H
MS01509	Desoto	J B Lyon Pond Dam	L	H
MS01584	Desoto	Fox Lake Dam	L	H
MS02292	Desoto	Short Fork Pond Dam	L	H
MS03004	Desoto	Mcingvale Lake Dam	L	H
MS03347	Desoto	Blue Springs Lake A Dam	L	H
MS03864	Desoto	Megan Drive Lake Dam	N/A	H
MS03868	Desoto	Hilderbrant Lake Dam	N/A	H
MS00211	Forrest	Lynn Cartlage Lake Dam	L	H
MS03221	Forrest	Lake B Dam	L	H
MS03852	Forrest	Lakeland Drive Lake Dam	N/A	H
MS05145	Grenada	Southlakes Pond Dam	N/A	H
MS01713	Hinds	J C Gladney Lake Dam	L	H
MS01714	Hinds	Muse Lake Dam	L	H
MS01717	Hinds	Dennery Pond Dam	L	H
MS01722	Hinds	Nadia Lake Subdivision Dam	L	H
MS01742	Hinds	Jones Lake Ms01742 Dam	L	H
MS01745	Hinds	Cooks Lake Dam	L	H
MS01758	Hinds	Lazy C Club Lake Dam	L	H
MS01774	Hinds	Raymond Lake Dam	L	H
MS01785	Hinds	Collin Lake Dam	L	H
MS01798	Hinds	T D Buford Pond Dam	L	H
MS02164	Hinds	Friday Lake Dam	L	H

MS02754	Hinds	Walter Vinson Lake Dam	L	H
MS02896	Hinds	Multip Manor Lake Dam	L	H
MS03093	Hinds	Mcgee Lake Dam	L	H
MS05362	Hinds	MS05362 Lake Dam	N/A	H
MS05363	Hinds	MS05363 Lake Dam	N/A	H
MS05365	Hinds	MS05365 Lake Dam	N/A	H
MS05421	Hinds	Regency Estates Lake Dam	N/A	H
MS05422	Hinds	MS05422 Lake Dam	N/A	H
MS05433	Hinds	MS05433 Lake Dam	N/A	H
MS05525	Hinds	MS05525 Lake Dam	N/A	H
MS00108	Holmes	Tackett Watershed Structure 9 Dam	L	H
MS02313	Holmes	Flood Water Retarding Structure Site 35	L	H
MS02854	Jackson	Black Creek Cooling Water Dam	L	H
MS02827	Jasper	Big Creek Watershed Structure 13 Dam	L	H
MS03039	Jasper	Heritage Lake Dam	S	H
MS01149	Jones	Lake Hatten Dam	L	H
MS01170	Jones	Lake Ivell Dam	L	H
MS03861	Jones	Roberts Lake Dam	N/A	H
MS06161	Jones	Flowers Lake Dam	N/A	H
MS01641	Kemper	Shammack Creek Watershed Structure 3 Dam	L	H
MS01230	Lafayette	Avant Lake Dam	L	H
MS01235	Lafayette	East And West Goose Str R-9-1 Dam	L	H
MS01236	Lafayette	East And West Goose Str R-9-2 Dam	L	H
MS01237	Lafayette	Upper Yocona Watershed Structure Y-14-01 Dam	L	H
MS03104	Lafayette	Lake Tara Dam	L	H
MS03398	Lafayette	Otoucalofa Creek Structure Y-15b-8 Dam	L	H
MS03628	Lafayette	Spring Lake Dam	S	H
MS06090	Lafayette	Reagan Lake Dam	N/A	H
MS06100	Lafayette	Big Jones Lake Dam	N/A	H
MS06103	Lafayette	Brown Lake Dam	N/A	H
MS00712	Lamar	Little Black Creek Water Park Dam	L	H
MS02731	Lamar	W J Morris Pond Dam	L	H
MS05382	Lamar	Woodville Trace Lake Dam	N/A	H
MS02616	Lauderdale	Memorial Park Cemetery Pond Dam	L	H
MS02620	Lauderdale	C W Downer Pond Dam	L	H
MS05625	Lauderdale	MS05625 Lake Dam	N/A	H
MS05763	Lauderdale	Fair Oaks Lake Dam	N/A	H
MS05765	Lauderdale	MS05765 Lake Dam	N/A	H
MS05766	Lauderdale	MS05766 Lake Dam	N/A	H
MS05901	Lauderdale	MS05901 Lake Dam	N/A	H
MS01646	Lee	Town Creek Watershed Dam #9	N/A	H
MS04503	Lee	Shook Lake Dam	N/A	H
MS02260	Madison	Arrington Lake Dam	S	H
MS02274	Madison	Lake Cavalier Dam	S	H
MS02880	Madison	Sulphur Springs Lake Dam	L	H
MS03151	Madison	Camden Lake Dam	L	H
MS03323	Madison	Cherry Hill Plantation Lake Dam	H	L
MS03662	Madison	Scott Lake Dam	L	H
MS03819	Madison	Houston Primos Dam	S	H

MS04308	Madison	MS04308 Lake Dam	N/A	H
MS05730	Madison	MS05730 Lake Dam	N/A	H
MS05836	Madison	MS05836 Lake Dam	N/A	H
MS05904	Madison	MS05904 Lake Dam	N/A	H
MS05907	Madison	Twelve Oaks Trace Dam	N/A	H
MS06006	Madison	MS06006 Lake Dam	N/A	H
MS06046	Madison	MS06046 Lake Dam	N/A	H
MS06156	Madison	The Pond Dam	N/A	H
MS06169	Madison	Lake Katherine Dam	N/A	H
MS02160	Montgomery	Winona Country Club Lake Dam	L	H
MS03802	Montgomery	E & E Ranch Lake Dam	L	H
MS02442	Neshoba	Lake Pushmataha	L	H
MS00755	Noxubee	Land O Lakes Dam	L	H
MS03994	Pearl River	Go Go Road Lake Dam	N/A	H
MS02174	Perry	Sportsman Lake Dam	L	H
MS03859	Pike	C. V. Glennis Lake Dam	N/A	H
MS00674	Pontotoc	Town Creek Watershed Structure 26a Dam	L	H
MS01267	Rankin	Busick Lake Dam	L	H
MS01285	Rankin	Renno Sportsman Lake Dam	L	H
MS01298	Rankin	Loflin Lake Dam	L	H
MS01300	Rankin	Crawley Lake Dam	L	H
MS01305	Rankin	Piney Woods Lake Dam	L	H
MS03300	Rankin	Taylor Lake Dam	L	H
MS03465	Rankin	Shumaker Lake Dam	N/A	H
MS05356	Rankin	MS05356 Lake Dam	N/A	H
MS05446	Rankin	MS05446 Lake Dam	N/A	H
MS05532	Rankin	Easthaven Lake Dam	N/A	H
MS05632	Rankin	Etheridge Dam	N/A	H
MS05663	Rankin	MS05663 Lake Dam	N/A	H
MS06173	Rankin	Piney Woods Lake #2 Dam	N/A	H
MS00874	Scott	Hines Lake Dam	L	H
MS06164	Simpson	McCoy Lake Dam	N/A	H
MS03063	Smith	Big Creek Watershed Structure 15 Dam	L	H
MS03917	Stone	Pine Burr Country Club Lake Dam	N/A	H
MS03980	Stone	MS03980 Lake Dam	N/A	H
MS01683	Tallahatchie	Ascalmore Structure Y-17a-01 Dam	L	H
MS01684	Tallahatchie	Ascalmore Structure Y-17a-02 Dam	S	H
MS01140	Tate	Southfork Lake Dam	L	H
MS03368	Tate	Simpson Lake Dam	L	H
MS00620	Tippah	Muddy Creek Watershed Structure 24a Dam	L	H
MS01887	Tippah	Upper Tippah Watershed Structure Lt-6-17 Dam	L	H
MS00153	Warren	Lake Hilda	L	H
MS00154	Warren	Lake Linda	L	H
MS02757	Warren	Leroy George Lake Dam	L	H
MS02757	Warren	Leroy George Lake Dam	L	H
MS06170	Warren	Tidwell Dam	N/A	H
MS00189	Winston	Lake Tiak O Khata	N/A	H
MS01949	Yazoo	Bentonia Watershed Structure 7 Dam	L	H

Source: MDEQ Dam Safety Division

Table 3.4.1a
2018 Dam Hazard Class Changes from High

State ID	County	Dam Name	2013 Plan Hazard Class	2018 Plan Hazard Class
MS00434	Adams	Mrs Roland Stacy Lake Dam	H	L
MS00053	Bolivar	Delta Steam Electric Station Dam	H	L
MS01049	Carroll	Abiaca Watershed Structure Y-34-12 Dam	H	L
MS01067	Carroll	Big Sand Watershed Structure Y-32-19 Dam	H	L
MS02659	Desoto	Horse Farm Dam	H	L
MS03336	Desoto	Cedar Grove - East Lake Dam	H	L
MS03337	Desoto	Cedar Grove - West Lake Dam	H	L
MS03717	Desoto	Grays Creek Lake #1 Dam	H	L
MS00219	Harrison	Riverline Lake Dam	H	L
MS02765	Jasper	Blacks Dam	H	S
MS01254	Lafayette	Coon Creek Lake Dam	H	L
MS03615	Lafayette	Crown Pointe Dam	H	L
MS03323	Madison	Cherry Hill Plantation Lake Dam	H	L
MS02036	Noxubee	Don Good Lake Dam	H	L
MS03592	Rankin	Mikell Lake Dam	H	L

Source: MDEQ Dam Safety Division

Mississippi Floodplain Management

Mississippi has 5.2 million acres of high-risk flood zones, not counting the areas protected by certified levees. Mississippi has approximately 665 miles of major levees, which are generally located in the western border counties. All levees are constructed to provide a specific level of protection, such as the year or 500-year flood. The 500-year flood level plus the additional freeboard height is considered a minimum protection standard for levees protecting urban areas. If a flood occurs that exceeds that design, the levee will be overtopped or otherwise fail from saturation, leakage, etc. When this happens, the results are catastrophic. The threat of earthquakes also increases the risk of areas protected by levees.

Dam Failure vs Dam Incident

By definition and by action, dam failure leads to an uncontrolled release of the reservoir. The results can be catastrophic.

Dam incidents are events of engineering and safety interest that provide insight into the structural and functional integrity of dam systems and their operation. An incident does not result in failure, but often failure is adverted by intervention. Since 2010, there have been 26 recorded incidents. There were 16 incidents at high or significant hazard dams, with three of those not being on the inventory at the time of the incident. At least eight incidents occurred at low hazard dams. At the time of the incident, two were not on the inventory.

Past Occurrences - Incidents

Robinhood #4 Dam Incident

Incident occurred on January 3, 2017 in Rankin County. Piping was caused by animals burrowing in the embankment.

Trace State Park Dam Incident

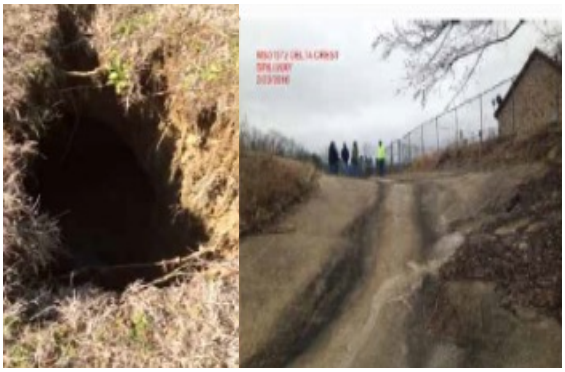
Incident occurred on November 26, 2016 in Pontotoc County. Major slide of working surface occurred.

Shahkoka Lake Dam Incident

Incident occurred on March 10, 2016 in DeSoto County. The incident is a result of sliding on the downstream slope.

Piney Woods Lake Dam Incident

Incident occurred on February 15, 2016 in Rankin County. Unfortunately this incident was a result of overtopping.



Delta Crest Lake Dam Incident

Incident occurred on February 1, 2016 in DeSoto County. This was a result of severe erosion under the primary spillway slab..

Oktibbeha County Lake Dam Incident

Incident occurred on January 29, 2016 as a result of a major slide on the upstream slope.

Truman Robert #1 Dam Incident

Incident occurred on November 20, 2015 in Forrest County. The incident occurred due to a failure of the CMP primary spillway.

Albritton Lake Dam Incident

Incident occurred on January 21, 2015 in Pearl River County. Failure of the abandoned CMP primary spillway is the cause of the incident.

McCoy Lake Dam Incident

Incident occurred on April 15, 2014 in Simpson County. A slope failure incident led the owner to attempt a controlled breach.

Maximum Dam Failure Threat

The maximum threat to citizens of Mississippi from dam failure will not originate from state or privately-owned dams, but from federal flood control structures such as the United States Corps of Engineers' Arkabutla, Sardis, Grenada, or Enid reservoirs. Simultaneous failure of these structures could occur due to an earthquake in the New Madrid Seismic Zone. It is also important to note that extensive flooding from states upstream that feed into the Mississippi River could also contribute to major flooding due to levee breaches. However, a scenario of a failure at Lake Arkabutla Dam is provided in the vulnerability assessment section.

When a dam has been designated as a High Hazard Dam Failure, Dam Safety Regulation, Title II: Part 7, Chapter 3, requires all owners of High Hazard and Significant Hazard Dams to have their dams inspected by a registered professional engineer at recurring intervals to be set by the division. All High Hazard dams must also have an Emergency Action Plan (EAP). EAPs may also be required for some Significant Hazard Dams. Guidelines for the inspections and for the preparation of the EAPs can be accessed from the links located on MDEQ's website.

Past Occurrences – Dam Failure

Since 2013, MDEQ Dam Safety Division has recorded 41 breaches. Table 3.4.2 shows all breaches that have occurred since 1982. It is important to note that some failures may not have been detected and reported.

Table 3.4.2
Dam Failures 1982 – 2017

Date	County	Structure Name	Cause of Failure
June 2017	Wayne	Lirette Lake Dam	Unknown.
June 2017	Jones	Flowers Lake Dam	The primary spillway conduit which was made of 8' diameter fuel tanks partially collapsed and water exited the pipe and eroded the center of the embankment above the conduit
June 2017	Jones	Flowers Lake Dam	The primary spillway conduit which was made of 8' diameter fuel tanks partially collapsed and water exited the pipe and eroded the center of the embankment above the conduit
May 2017	Lamar	Gumpond Road Dam	Seepage/piping through animal burrows
May 2017	Pearl River	Catfish Lake Dam	Overtopping
May 2017	Smith	Vowell Lake Dam	Slide occurs in the center of the crest and downstream slope
April 2017	Forrest	Sharra Lake Dam	Partial failure of concrete chute spillway
January 2017	Franklin	Gayle Evans Lake Dam	Spillway erosion
March 2016	Smith	Vowell Lake Dam	Piping around the primary spillway pvc and a slide that formed on the downstream slope of the dam
March 2016	Winston	Lake Tiak O Khata Dam	New area of seepage/piping
March 2016	Hinds	Regency Estates Lake Dam	During heavy rains, the reservoir filled to top of dam and began eroding around the siphon pipe causing significant damage
March 2016	Marion	Regency Estates Lake Dam	During heavy rains, the reservoir filled to top of dam and began eroding around the siphon pipe causing significant damage
February 2016	Rankin	Piney Woods Lake Dam	Overtopping cause large slide on the downstream slope at an area between the left abutment and the middle of the dam.
February 2016	Desoto	Delta Crest Subdivision Lake Dam	Piping/severe erosion under the primary spillway
January 2016	Oktibbeha	Oktibbeha County Lake Dam	Slide on the upstream slope near the right abutment
January 2016	Jones	Lonesome Pines Lake Dam	Piping approximately half way down downstream slope
December 2015	Itawamba	Biddle Lake Dam	Overtopping
November 2015	Forrest	Truman Roberts Number 1 Dam	Failure of primary spillway conduit (corrugated metal pipe)

November 2015	Hinds	Latham Pond Dam	Overtopping of a breach section constructed by the owner
July 2015	Pontotoc	Trace State Park Lake Dam	Major slide on the downstream slope just to the left of the outlet
May 2015	Monroe	Clark Lake Dam	Erosion around the primary spillway culvert in the left abutment(refer to picture taken in the file)
March 2015	Tate	Senatobia Lake Subdivision Dam	Failure of the primary spillway (cmp) that was previously filled with concrete
June 2014	Webster	Savannah Lake Dam	Through piping that began to headcut
April 2014	Warren	Silver Creek Dam	Headcut back through the earthen spillway during a large rain event
April 2014	Scott	Whiteway Farms Dam	Severe seepage through dam that will eventually lead to failure if the seepage areas are not repaired. At the time of inspection, seepage was estimated at 20-30 gpm but it did not appear that piping was occuring.
March 2014	Hancock	St Regis Paper Company Lake Dam	The area received 3-5" of rainfall which led to activation of the spillway with large flows that started a series of headcuts in the spillway channel.
October 2013	Lamar	Lake Serene North	Piping under the spilllway slab. Further investigation is taking place.
May 2013	Forrest	Noi	Corrosion and piping around riser and conduit
May 2013	Jackson	Spring Lake Dam	Owner attempted to rebuild dam. Construction breached during heavy rain
January 2013	Adams	Robbins Lake Dam	Dam overtopped after a large rain event. Crest of dam was damaged and a large hole scoured out along the edge of the crest.
January 2013	Desoto	MF Harris Pond Dam	Seepage caused by trees and animal burrows
December 2012	Madison	Madison Baptist Fellowship Dam	Seepage due to animal burrows
August 2012	Pike	Percy Quinn	Large slides developed with seepage. Did not lead to uncontrolled release of pool.
August 2012	Wayne	Unknown	Failure around conduit. Exact cause unknown.
August 2012	Pearl River	Portie Dam	Heavy rains from Hurricane Isaac caused the dam to overtop and significant water backed up onto owners property. A slide occurred near the center of the dam. A superficial crack formed on the dam.
August 2012	Pike	Percy Quinn	Large slides developed with seepage. Did not lead to uncontrolled release of pool.
August 2012	Lamar	Lake Serene Southeast Dam	Large slide on downstream face of dam. Did not lead to uncontrolled release of pool.

January 2010	Jones	Lake Getaway	A plane of weak clay, failure to mix layers well during construction and poor maintenance
April 2005	Hinds	Dennery Lake	Seepage, piping, biological growth caused section near center of dam to erode away
2005	Desoto	Allen Subdivision Lake	Animal penetration, causing dam to breach
June 2004	Hinds	Lake Dockery	Animal penetration. Dam failed near center. Controlled breach continued at the failed section
2004	Lamar	Bennett York	Dam owner attempted to lower water level by controlled breach but lost control
May / June 2004	Hinds	Lake Dockery	Piping
April 2004	Pearl River	Dove Lake	Piping
March 2004	Lamar	Big Bay Lake	Piping
February 2004	Yazoo	Dr. Freeman Lake	Piping
February 2004	Simpson	Peacock Lake	Overtopping
September 2003	Warren	Lake Forrest	Piping
July 2003	Lamar	Emmit Graves	Piping
May 2003	Lauderdale	Wild Duck Lake	Piping
April 2003	Lauderdale	Lake Evelyn	Piping
January 2003	Madison	Andover South	Piping
December 2002	Lafayette	Royal Oaks	Piping
October 2002	Harrison	Windy Hills Lake	Piping along primary spillway conduit
September 2002	Madison	Andover South	Piping
September 2002	Pike	Lake Dixie Springs	Overtopping
August 2002	Lauderdale	State Hospital Lake	Poor overall condition
July 2002	Lafayette	Horseshoe Lake	Massive slides, erosion on downstream slope, leading to dam breach
April 2002	Carroll	Billups Dam	Piping
March 2002	Lauderdale	Lake Tom Bailey	Deterioration for primary concrete spillway
February 2002	Panola	Unnamed Dam	Piping along primary spillway leading to dam breached
January 2002	Lauderdale	John Kasper Lake	Excessive seepage leading to dam breach
July 2001	Lamar	Bridgefield	Massive slides on downstream face leading to dam breach
May 2001	Madison	Francis Calloway	Piping leading to dam being breached
May 2001	Madison	Robinson Springs	Overtopping
March 2001	Lamar	West Lake First Addition	Piping leading to dam being breached
January 2001	Hinds	Turtle Lake	Piping leading to dam being breached
September 2000	Warren	Lake Haven	Animal penetration
April 2000	Hinds	Whites Lake	Piping/Breached
May 1995	Lauderdale	Vise Lake Dam	Sand boils - problem with longevity of dam
January 1995	Panola	Lake Village Dam	Spillway Failure
November 1994	Hinds	Spring Lake	Spillway Failure
April 1994	Desoto	Strickland Lake	Breached by Regulators
July 1993	Jones	Indian Springs Lake	Breached
December 1991	Benton	Porter Creek	Breached
June 1989	Leflore	Abiaca Creek	Breached
April 1984	Hinds	Lakeview Lake	Breached

April 1984	Hinds	Lake Larue	Breached by Design
March 1984	Lauderdale	Dalewood Shores	Minor Breach
March 1984	Panola	Pine Lake	Breached
March 1984	Forrest	Burketts Creek	Breached
March 1984	Forrest	West Lake	Overtopped
March 1984	Rankin	Ross Barnett Reservoir	Sandbags on Levee
May 1983	Hinds	Jackson County Club	Breached
May 1983	Leake	State Highway 35	Overtopped
April 1983	Leflore	Pelucia Bayou	Breached
April 1983	Pearl River	Anchor Lake	Breached
April 1983	Adams	Robins Lake	Breached
April 1983	Hancock	Boy Scout Camp	Breached
April 1983	Lamar	Lake Serene	Spillway Out
December 1982	Leflore	Pelucia Bayou	Overtopped

Source: MDEQ Dam Safety Division

Dam Failures

MF Harris Dam Failure

Failure occurred on January 10, 2013 in DeSoto County. Seepage caused by trees and animal burrows.

Silver Creek Dam Failure

Failure occurred on April 6, 2014 in Warren County. Headcut back through the earthen spillway during a large rain event.

Truman Roberts Number 1 Dam Failure

Failure occurred on November 20, 2015 2013 in Forrest County. Failure of primary spillway conduit (corrugated metal pipe).

Gayle Evans Lake Dam Failure

Failure occurred January 19, 2017 in Franklin County. Failure occurred due to spillway erosion.

Flowers Lake Dam Failure

Failure occurred on June 6, 2017 in Jones County. The primary spillway conduit which was made of 8' diameter fuel tanks partially collapsed and water exited the pipe and eroded the center of the embankment above the conduit.

Probability of Future Dam Failure Events

In each state plan update, probability of dam failure was considered high due to reduced inspection capabilities within state government, and a series of dam failures, indicated a period of frequent failures could be expected. As noted in the previous plan update of 2013, MDEQ continued to improve compliance with dam regulations with increased inspections.

While the structural weakness of a dam is apparent from outside observation, sudden dam failure that occurs during normal operations, with the water level at full supply and the water released causing the largest change in flows is called a sunny day failure. It may be caused by foundation failure, earthquakes, or another such event. This scenario normally refers to internal erosion (piping) failure. There are ways to evaluate imminent failure of a structure, but these do not always provide the information needed to foretell future events. State policies that have been promulgated to provide for a periodic inspection period require five-year inspections for “high hazard” dams.

Levee Failures

The Great Flood of 1927 unleashed a spring season of catastrophic events along the banks of the Mississippi River. The flooding was a result of persistent heavy rainfall across the Central U.S. starting in August 1926 and continuing through the spring of 1927. As the weather system stalled over the Midwestern states, untold amounts of water descended on the Upper Mississippi River region. The region’s expanding tributaries caused the Mississippi River to overflow in eleven states from Illinois to Louisiana. That same system brought heavy rainfall to the Yazoo-Mississippi Delta, an alluvial plain located in northwest Mississippi.

After several months of heavy rain, the Mighty Mississippi reached unprecedented levels, causing a levee to break in Illinois on April 16th. A few days later, on April 21st, the levee in Mounds Landing, MS gave out.

This levee lay below the junction with the Arkansas River and approximately 12 miles north of Greenville, Mississippi. Greenville was flooded the next day. The break was so severe, the amount of water it allowed through covered nearly 1 million acres with 10 feet of water in just 10 days. Before long, the swelling waters caused the entire levee system along the Mississippi River to collapse. The Mississippi Delta received some of the worst damage, with water as high as 30 feet in some areas. It was two months before the flood waters subsided. Figure 3.4.2 on the following page is a map that shows the areas inundated with floodwaters. The map also shows the levee breaks all along the Mississippi. It was not until August 1927 that the last of the floodwaters had flowed into the Gulf of Mexico.

This devastating 1927 flood caused the loss of more than 246 lives; drowned out hundreds of cities, towns, and villages; drove 700,000 people from their homes, rendering them objects of charity dependent upon the Red Cross and other agencies; inundated 1,800 square miles; destroyed 1.5 million farm animals; caused losses amounting to many hundreds of millions of dollars; suspended interstate freight and passenger traffic; prevented telegraph and telephone communication; delayed the United States postal service; and paralyzed industry and commerce. The flood of 1927 was the catalyst that began the great migration of African Americans to northern states, with the majority relocating to Chicago, IL.

As a result of this disaster to the valley, the Federal Congress on May 15, 1928 passed a general flood control act, wherein the government assumed the cost of all construction and for the first time enunciated the policy of the Federal Government assuming the construction of levees necessary for the protection of the valley.

After the waters receded, some two months later, property damage was estimated at $350 million dollars, equivalent to approximately $5 billion dollars today. Economic losses were estimated at $1 billion (1927 dollars), which was equivalent to almost one-third of the federal budget at that time.

Some examples of levee failures along the Mississippi River prior to the General Flood Control Act of 1928 are recounted by Walter Sillers below:

- In 1882, the entire line of levee in Bolivar County, about 85 miles, seemed to snap in a hundred places in one night, during a terrible storm on the night of February 28th, and the whole county was under water.

- A section of the levee a mile long caved into the river just south of the town of Prentiss in 1865, and other levees, north and south, in Bolivar County, either caved in or broke; and as the stage of water was high for that day, a disastrous overflow swept over the country, drowning stock, sweeping away fences, destroying crops, and carrying destruction and disaster in its wake.

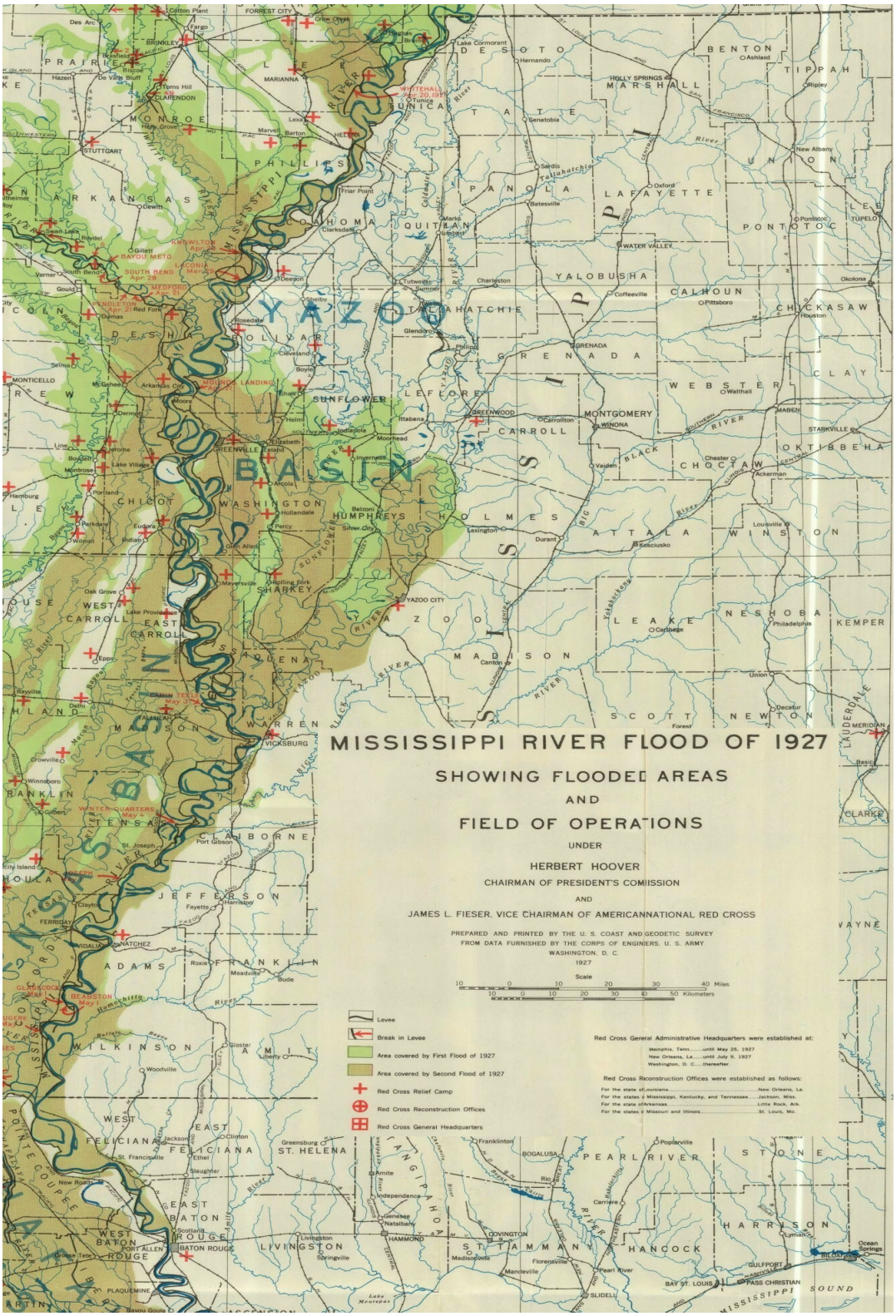
- A private levee along Lake Vermillion from Lake Beulah to Neblett's Landing was adopted as a part of the main levee system, in lieu of the abandoned levee. In spite of all the work and care given to the levee proper, there were many breaks in it – 1867, 1882, 1874, and 1897. A break occurred in the Catfish Point Levee in 1890, causing the entire Point with its improved plantations to be thrown outside the levee and abandoned. The most disastrous of all was in 1912 in which the water was the highest on record and caused a disastrous break in the levee four miles below Beulah.

- In 1922, the closure of the Cypress Creek levees on the Arkansas side of the Mississippi River raised the flood line to the extent that carries the water over the top of the Mississippi Levees from Kentucky Ridge to Mound Landing, causing a desperate struggle and a vast expenditure of money to top it off and hold it against the increased flood line of the river.

- In 1926, Bolivar County was operating under the second Flood Control Act of 1923, under which act all the levee boards contributed one-third of the cost of construction of the levees and maintained the works after they were constructed.

- The Mississippi River Flood of 1927 was the nation's greatest natural disaster. The National Safety Council estimated deaths in the Yazoo-Mississippi Delta alone at 1,000. In Mississippi it directly affected an estimated population of 185,495. A total of 41,673 homes were flooded; 21,836 buildings were destroyed; 62,089 buildings were damaged; and 2,836 work animals, 6,873 cattle, 31,740 hogs, and 266,786 poultry were drowned. An entire crop year was lost. A major result of the 1927 flood, which had an impact in eleven states, was the National Flood Control Act of 1928 passed by the U. S. Congress.

Figure 3.4.2


MISSISSIPPI RIVER FLOOD OF 1927
SHOWING FLOODED AREAS
AND
FIELD OF OPERATIONS
UNDER
HERBERT HOOVER
CHAIRMAN OF PRESIDENT'S COMISSION
AND
JAMES L. FIESER, VICE CHAIRMAN OF AMERICANNATIONAL RED CROSS
PREPARED AND PRINTED BY THE U. S. COAST AND GEODETIC SURVEY
FROM DATA FURNISHED BY THE CORPS OF ENGINEERS, U. S. ARMY
WASHINGTON, D. C.
1927
Scale
Miles
Kilometers
Levee
Break in Levee
Area covered by First Flood of 1927
Area covered by Second Flood of 1927
Red Cross Relief Camp
Red Cross Reconstruction Offices
Red Cross General Headquarters
Red Cross General Administrative Headquarters were established at:
Memphis, Tenn. ..... until May 25, 1927
New Orleans, La. ..... until July 9, 1927
Washington, D. C. ..... thereafter.
Red Cross Reconstruction Offices were established as follows:
For the state of Louisiana ..... New Orleans, La.
For the states of Mississippi, Kentucky, and Tennessee ..... Jackson, Miss.
For the state of Arkansas ..... Little Rock, Ark.
For the states of Missouri and Illinois ..... St. Louis, Mo.
YAZOO BASIN
MISSISSIPPI
ARKANSAS
LOUISIANA
VICKSBURG
YAZOO CITY
MERIDIAN
ST. HELENA
BOGALUSA
BILOXI
GULFPORT
BAY ST. LOUIS
PASS CHRISTIAN
MISSISSIPPI SOUND

Greenville, MS (Washington Co.) – April 30, 1927

Cary (Sharkey Co.) – May 1, 1927

Downtown Greenville, MS (Washington Co.) – April 30, 1927

Egremont (Sharkey Co.) – May 2, 1927

Onward (Sharkey Co.) – May 2, 1927

Source: National Museum of African American History and Culture

Valley Park (Issaquena) – May 2, 1927

Assessing Vulnerability Dam Failure

Life and property are always vulnerable to dam and levee failures throughout Mississippi. Loss of life is the primary concern in assessing vulnerability to dam and levee failure. For this reason, a dam is considered high hazard if only one life is at-risk to inundation in the event of a failure. Residential homes as well as public buildings and infrastructure are vulnerable to damage if formerly-impounded waters are released due to dam or levee failure. In many cases a dam or levee failure results in property damage that may not be returned to pre-incident levels.

Each year, there are a number of dam failures in Mississippi and probably an equal number of dams that are breached under controlled conditions to avoid the possibility of a sudden failure. Some dam failures in the state have caused significant property damage. However, it is important to note that there have been no fatalities in Mississippi attributable to a dam failure.

Damages from Flooding as a Result of Dam Failure

Damages due to flooding will have an effect on crops and trees. The destructive force of water can destroy homes and businesses otherwise able to withstand wind and weather.

Vulnerability of People

Homes built within the footprint of a “low hazard” dam suddenly may change the dam’s status to “high hazard” and unknowingly place homeowners and their families at risk. The design lifetime of an earthen dam is about 50 years. Often, the owner is not able to conduct routine site inspections of the dam and may not detect warning signs of an eminent failure that might impact downstream properties.

When water is released from a dam failure, its course and destination can become unpredictable. The National Weather Service will issue a Flash Flood Warning in the event of a dam failure. Drivers attempting to cross roads without benefit of a bridge or culvert may be caught in a flash flood with no hope of recovery. The MDEQ Dam Safety Division is not aware of any deaths directly attributable to dam failure. An indirect death occurred when a driver ignored a warning sign and drove into a ravine created by a dam failure from Tropical Storm Isidore a full six months earlier.

Vulnerability of Natural Resources

Water that is impounded loses its dissolved oxygen. When a dam empties into a watercourse, fish in the watercourse suffocate and die as a result of a lack of biologically dissolved oxygen. Silt is often at the bottom of a dam impoundment and will enable water-borne bacteria and microbes to grow in an environment free of the cleansing action of sunlight. Mining operations utilize dams to impound tailings and may include processed water, process chemicals, and portions of un-recovered minerals, all of which are toxic to aquatic and human life. This does not imply that dams are a hazard to people and to the environment, but water-borne minerals and water without aeration need to remain impounded behind a dam.

Assessing Vulnerability by County

All dams must be considered, regardless of hazard class. Any residential structure built in an inundation area of a dam may ultimately provide justification to change the dam's classification. Information obtained for the 2018 update continues to reveal that 59 of Mississippi's 82 counties contain high or significant hazard dams. Again, this number has not changed from the 2013 plan. To date, there are approximately 5,695 dams in the State of Mississippi. To date, there are still over 1,000 dams that have not been added to the inventory. The break down of hazard types is as follows:

Overall inventory of Dams	
High Hazard Dams	306
Significant Hazard Dams	50
Unclassified Hazard Dams	3.103
Low Hazard Dams	2,236
Total	**5,695**

A county summary by MEMA Region is provided in Table 3.4.3 and Table 3.4.4. lists the top ten counties in total number of dams. An overall analysis of the dam inventory shows that between 2013 and 2017 approximately 1,264 dams have had a change in status. This means that for some districts, dams were either added to the inventory, removed from the inventory or placed in categories outside of Significant, High, and Low. The table below depicts the differences from the 2013 plan update versus the 2018 plan update.

Total Number of Dams per District		
District	**2013**	**2018**
1	380	452
2	578	559
3	414	263
4	471	462
5	705	876
6	510	434
7	215	166
8	347	320
9	214	482
Total	**3,834**	**4,014**

Table 3.4.3
Dam Inventory by County/MEMA Region

County	Significant	High	Low	Total	County	Significant	High	Low	Total
MEMA Region 1					MEMA Region 2				
Coahoma	-	-	2	2	Alcorn	-	1	27	28
DeSoto	1	21	112	134	Benton	-	4	62	66
Grenada	-	3	32	35	Itawamba	-	-	30	30
Panola	1	9	95	105	Lafayette	1	14	94	109
Quitman	-	-	1	1	Lee	-	14	66	80
Tallahatchie	2	10	32	44	Marshall	-	-	79	79
Tate	1	4	65	70	Pontotoc	1	7	42	50
Tunica	-	-	1	1	Prentiss	-	3	13	16
Yalobusha	3	7	50	60	Tippah	3	4	50	57
					Tishomingo	-	2	4	6
					Union	1	4	33	38

County	Significant	High	Low	Total	County	Significant	High	Low	Total
MEMA Region 3					MEMA Region 4				
Atalla	1	2	44	47	Calhoun	-	4	52	56
Bolivar	-	-	14	14	Chickasaw	2	1	65	68
Carroll	4	23	86	113	Choctaw	-	4	5	9
Holmes	1	5	39	45	Clay	-	-	40	40
Humphreys	-	-	4	4	Lowndes	-	2	49	51
Leflore	-	-	-	-	Monroe	1	-	52	53
Montgomery	-	2	22	24	Noxubee	2	-	32	34
Sunflower	-	-	12	12	Oktibbeha	1	1	73	75
Washington	-	-	3	3	Webster	-	1	21	31
					Winston	-	1	44	45

County	Significant	High	Low	Total	County	Significant	High	Low	Total
MEMA Region 5					MEMA Region 6				
Claiborne	-	1	20	21	Clarke	-	-	59	59
Copiah	-	4	26	30	Jasper	1	3	21	25
Hinds	3	34	183	220	Kemper	1	3	42	46
Madison	10	30	208	248	Lauderdale	2	32	87	121
Rankin	2	30	94	126	Leake	2	-	18	20
Simpson	-	2	32	34	Neshoba	1	2	56	59
Warren	1	7	28	38	Newton	1	3	51	55
Yazoo	2	4	153	159	Scott	1	2	29	32
					Smith	-	3	14	17

County	Significant	High	Low	Total	County	Significant	High	Low	Total
MEMA Region 7					MEMA Region 8				
Adams	-	5	33	38	Covington	1	1	5	7
Amite	-	-	15	15	Forrest	1	7	68	76
Franklin	-	1	11	12	Greene	2	-	26	28
Jefferson	-	-	18	18	Jefferson Davis	-	2	20	22
Lawrence	-	-	10	10	Jones	-	6	21	27
Lincoln	-	1	13	14	Lamar	-	14	84	98
Pike	-	3	21	24	Marion	-	2	12	14
Walthall	-	-	6	6	Perry	-	-	20	20
Wilkinson	-	-	29	29	Wayne	-	-	28	28

County	Significant	High	Low	Total	County	Significant	High	Low	Total
MEMA Region 9									
George	1	-	18	19	Jackson	-	1	37	38
Hancock	-	1	56	57	Pearl River	1	3	207	211
Harrison	-	1	63	64	Stone	-	3	90	93

Source: MDEQ Dam Safety Division

Table 3.4.5
Top Ten Counties in Number of Dams

County	Significant	High	Low	Total
Carroll	4	23	86	113
DeSoto	1	21	112	134
Hinds	3	34	183	220
Lafayette	1	14	94	109
Lauderdale	2	32	87	121
Madison	10	30	208	248
Panola	1	9	95	105
Pearl River	1	3	207	211
Rankin	2	30	94	126
Yazoo	2	4	153	159

Source: MDEQ Dam Safety Division

When assessing the categories of the dams, in addition to the standard Significant, High, and Low, there are Unsatisfactory, Further Investigation Needed (FIN), and Scheduled for Inspection (SFI). FIN means that the dams were unclassified and needs additional analysis or field check. The designation of SFI means the dams needs to be further inspected after an assessment was conducted. U signifies that the dam is unclassified. There were a group of dams under MSDEQ purview that unfortunately failed from 2012 – 2017. Outside engineers were hired to conduct assessment reports for inspections. Table 3.4.6 shows the U, FIN and the SFI numbers.

Table 3.4.6
Dam Inventory by County/MEMA Region

County	FIN	SFI	U	Total	County	FIN	SFI	U	Total
MEMA Region 1					MEMA Region 2				
Coahoma	-	-	-	-	Alcorn	8	-	-	8
DeSoto	51	-	-	51	Benton	-	-	16	16
Grenada	22	-	-	22	Itawamba	1	-	24	25
Panola	23	-	1	24	Lafayette	35	-	4	39
Quitman	-	-	-	-	Lee	21`	-	38	59
Tallahatchie	2	-	1	3	Marshall	14	-	-	14
Tate	8	-	-	8	Pontotoc	-	-	53	53
Tunica	-	-	-	-	Prentiss	6	-	7	13
Yalobusha	13	-	3	16	Tippah	5	-	10	15
					Tishomingo	1	-	-	1
					Union	-	-	44	44

County	FIN	SFI	U	Total	County	FIN	SFI	U	Total
MEMA Region 3					MEMA Region 4				
Atalla	1	-	6	7	Calhoun	-	-	37	37
Bolivar	-	-	-	-	Chickasaw	2	-	30	32
Carroll	5	-	-	5	Choctaw	-	-	13	13
Holmes	9	2	2	13	Clay	9	-	26	35
Humphreys	-	-	-	-	Lowndes	5	-	37	42
Leflore	-	-	1	1	Monroe	24	-	25	49
Montgomery	2	-	2	4	Noxubee	-	-	54	54
Sunflower	-	-	-	-	Oktibbeha	-	-	83	83
Washington	-	-	-	-	Webster	-	-	8	8
					Winston	5	-	32	37

County	FIN	SFI	U	Total	County	FIN	SFI	U	Total
MEMA Region 5					MEMA Region 6				
Claiborne	-	1	20	21	Clarke	9	-	15	24
Copiah	1	-	3	4	Jasper	2	-	20	22
Hinds	3	-	126	129	Kemper	1	-	34	35
Madison	10	-	48	58	Lauderdale	4	4	98	106
Rankin	19	2	49	70	Leake	2	-	6	8
Simpson	7	2	12	21	Neshoba	11	-	45	56
Warren	4	1	11	16	Newton	5	-	34	39
Yazoo	17	1	1	19	Scott	1	-	9	10
					Smith	-	-	10	10

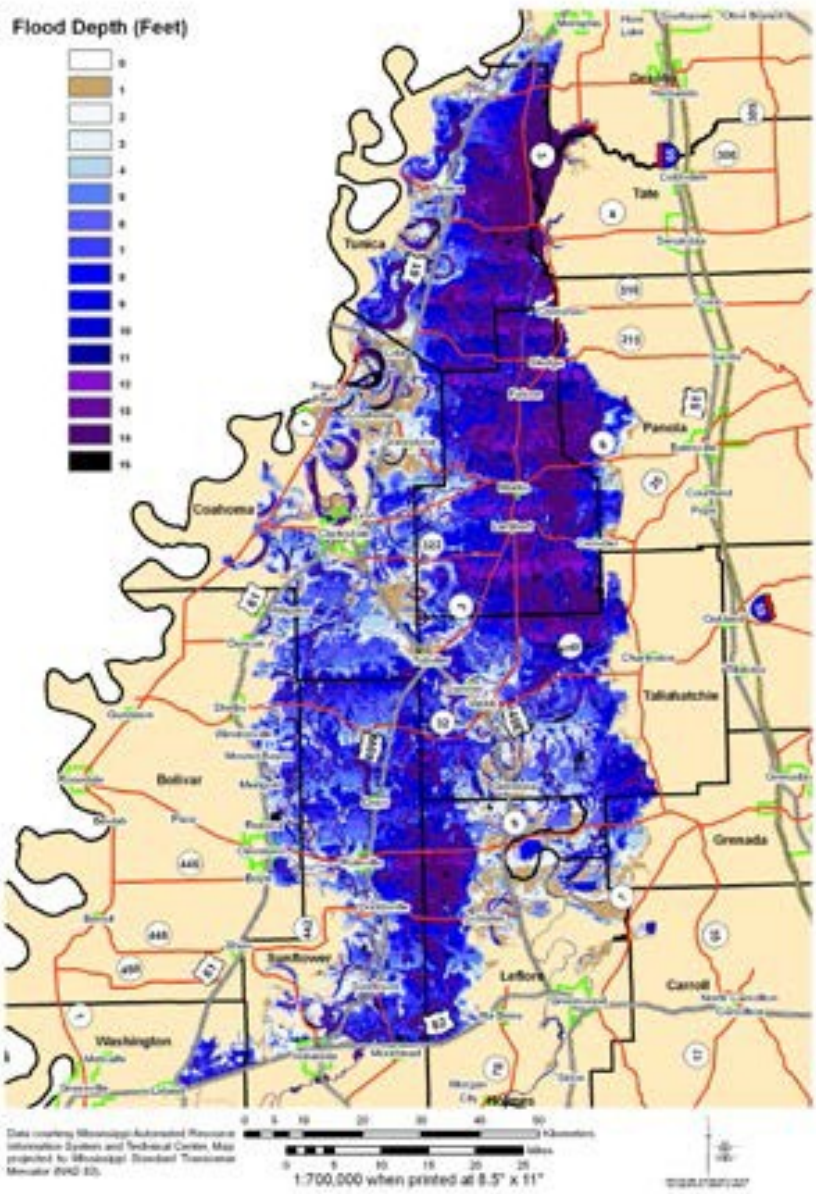
County	FIN	SFI	U	Total	County	FIN	SFI	U	Total
MEMA Region 7					**MEMA Region 8**				
Adams	2	-	1	3	Covington	-	-	15	15
Amite	2	-	-	2	Forrest	12	2	2	16
Franklin	4	-	-	4	Greene	2	-	-	2
Jefferson	-	-	-	-	Jefferson Davis	3	-	3	6
Lawrence	2	-	-	-	Jones	2	-	40	42
Lincoln	-	-	-	-	Lamar	21	1	2	24
Pike	6	-	-	6	Marion	7	-	1	8
Walthall	2	-	-	2	Perry	5	-	-	5
Wilkinson	1	-	-	1	Wayne	-	-	-	-

County	FIN	SFI	U	Total	County	FIN	SFI	U	Total
MEMA Region 9									
George	4	-	-	4	Jackson	1	-	-	1
Hancock	2	-	-	2	Pearl River	37	-	2	39
Harrison	3	-	-	3	Stone	2	-	-	2

Lake Arkabutla Dam Failure Scenario

To assess dam failure, a multi-county scenario was developed. The scenario remains the same from the previous plans (2010 and 2013). The failure of Lake Arkabutla Dam failure is still considered the worst case scenario. The Lake Arkabutla Dam failure scenario indicates that water from a dam failure originating in Desoto County and ending in Leflore County would take 45 days to travel to the Sunflower River and would involve insurmountable damages to private and public properties. Because the movement of water would be slowed in its journey to the Sunflower River, there would be sufficient warning to people downstream to enable evacuation. Although it may be difficult to predict in specifics, it is estimated that deaths could be in the hundreds because of the length of time water would continue to block roads and access. The disruption to business and the costs of recovery would range in the billions of dollars. Figure 3.4.3 depicts flooding that could be expected as a result of a Lake Arkabutla Dam Failure.

Figure 3.4.3
Lake Arkabutla Dam Failure Scenario



Local Plan Risk Assessment Summary

Below is a summary of the risk classification in the individual local mitigation plans by MEMA Region.

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1	-	-	-	6	-	9	-
2	-	-	-	7	9	-	-
3	8	1		8	-	-	-
4	-	-	-	9	6	-	-
5	16	31	-				

3.5: Tropical Cyclone Risk Assessment

Hazard Description

Tropical Cyclones are naturally occurring events that produce damaging high winds, generate dangerous storm surge flooding, cause pounding storm surf, spawn tornadoes, and produce torrential rainfall that can cause inland flooding.

The Atlantic hurricane season begins June 1 and ends on November 30, but hurricanes have developed outside of the designated season. Mississippi has been subject to winter and spring extra-tropical storms driving higher than normal tides from southerly and southeasterly winds. The Mississippi Coast has also experienced tropical depressions and tropical storms which have caused higher than normal tides, storm surge and gusting winds.

FEMA defines coastal storms as causing "increases in tidal elevations (called storm surge), wind speed and erosion, caused by both extra-tropical events and tropical cyclones." FEMA defines hurricanes as "tropical cyclones characterized by thunderstorms and defined wind circulation." These winds "blow in a large spiral around a calm center called the eye."

The following terms are used to describe tropical storms / hurricanes:

Tropical Wave: A trough or cyclonic curvature maximum in the trade-wind easterlies. The wave may reach maximum amplitude in the lower middle troposphere.

Tropical Depression: A tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1-minute average) is 33 kt (38 mph or 62 km/hr) or less.

Tropical Storm: A tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 34 kt (39 mph or 63 km/hr) to 63 kt (73 mph or 118 km/hr).

Hurricane: A tropical cyclone in which the maximum sustained surface wind (using the U.S. 1-minute average) is 64 kt (74 mph or 119 km/hr) or more.

Hurricane wind intensity is measured with the Saffir-Simpson Scale based on a 1-5 rating of a hurricane's sustained wind speed at the time of measurement. This is used to give an estimate of the potential property damage expected along the coast from a hurricane landfall. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures. Wind speed is the determining factor in the scale. All winds are described using the U.S. 1-minute average. Previously, storm surge was described by the Saffir-Simpson Scale, but is no longer included.

The following excerpt from the National Hurricane Center explains revised definition of the Saffir-Simpson Hurricane Scale and the separation of storm surge from storm category followed by an explanation of the need to revise the new range of wind speeds:

Earlier versions of the Saffir-Simpson Hurricane Scale incorporated central pressure and storm surge as components of the categories. The central pressure was used during the 1970s and 1980s as a proxy for the winds as accurate wind speed intensity measurements from aircraft reconnaissance were not routinely available for hurricanes until 1990. Storm surge was also quantified by category in the earliest published versions of the scale dating back to 1972. However, hurricane size (extent of hurricane- force winds), local bathymetry (depth of near-shore waters), topography, the hurricane's forward speed and angle to the coast also affect the surge that is produced. For example, the very large Hurricane Ike (with hurricane force winds extending as much as 125 mi from the center) in 2008 made landfall in Texas as a Category 2 hurricane and had peak storm surge values of about 20 ft. In contrast, tiny Hurricane Charley (with hurricane force winds extending at most 25 mi from the center) struck Florida in 2004 as a Category 4 hurricane and produced a peak storm surge of only about 7 ft. These storm surge values were substantially outside of the ranges suggested in the original scale. Thus, to help reduce public confusion about the impacts associated with the various hurricane categories as well as to provide a more scientifically defensible scale, the storm surge ranges, flooding impact and central pressure statements are removed from the Saffir-Simpson Hurricane Scale and only peak winds are employed in this revised version.

The Saffir-Simpson Hurricane Wind Scale (SSHWS) has undergone a minor modification for 2012 in order to resolve awkwardness associated with conversions among the various units used for wind speed in advisory products. The change broadens the Category 4 wind speed range by one mile per hour (mph) at each end of the range, yielding a new range of 130-156 mph. This change does not alter the category assignments of any storms in the historical record, nor will it change the category assignments for future storms.

Table 3.5.1 depicts the revised Saffir-Simpson Scale by category, associated wind speeds and expected damages from a particular event.

Table 3.5.1
Saffir-Simpson Hurricane Wind Scale

Category	Previous Range	New Range	Effects of Land
One	74-95 mph	No change	**Very dangerous winds will produce some damage:** Well- constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days
Two	96-110 mph	No change	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
Three	111-130 mph	111-129 mph	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
Four	131-155 mph	130-156 mph	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks or months.
Five	Greater than 155 mph	Greater than 157mph	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center, Revised 2012

Storm Surge

Hazard Description

The National Hurricane Center defines storm surge as an abnormal rise of water generated by a storm over and above the predicted astronomical tides. Storm surge should not be confused with storm tide, which is defined as the water level rise due to the combination of storm surge and the astronomical tide. The rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides reaching up to 20 feet or more in some cases (Figure 3.5.1).

Storm surge is produced by water being pushed toward the shore by the force of the winds moving cyclonically around the storm. The impact on surge of the low pressure associated with intense storms is minimal in comparison to the water being forced toward the shore by the wind.

The maximum potential storm surge for a particular location depends on a number of different factors. Storm surge is a very complex phenomenon because it is sensitive to the slightest changes in storm intensity, forward speed, size (radius of maximum winds-RMW), angle of approach to the coast, central pressure (minimal contribution in comparison to the wind), and the shape and characteristics of coastal features, such as bays and estuaries (Figure 3.5.2).

Other factors impacting storm surge are the width and slope of the continental shelf. A shallow slope will potentially produce a greater storm surge than a steep shelf. For example, a Category 4 storm hitting the Louisiana coastline, which has a very wide and shallow continental shelf, may produce a 20-foot storm surge; while, the same hurricane in a place like Miami Beach, Florida, with the continental shelf dropping off very quickly, might see an 8 or 9-foot surge.

Figure 3.5.1
Storm Surge vs. Storm Tide
(Source: NHC)

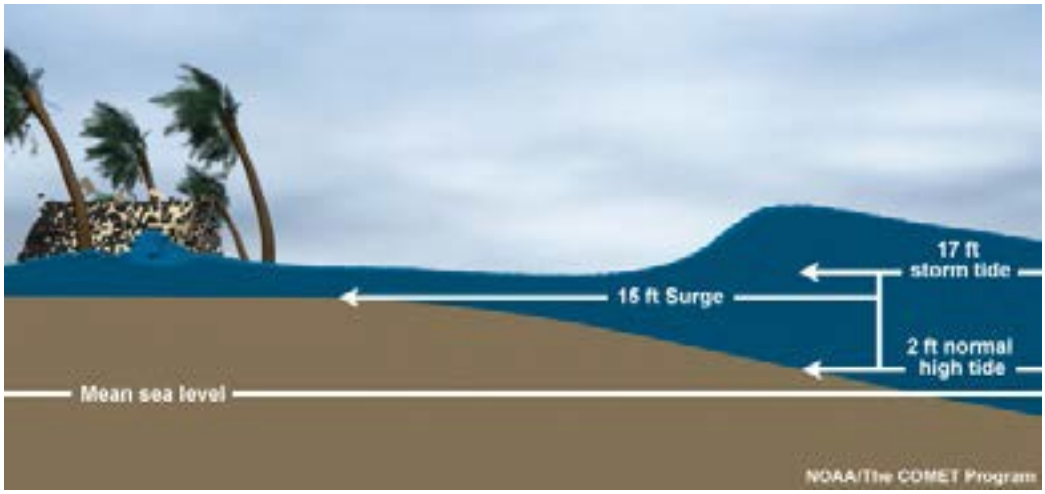
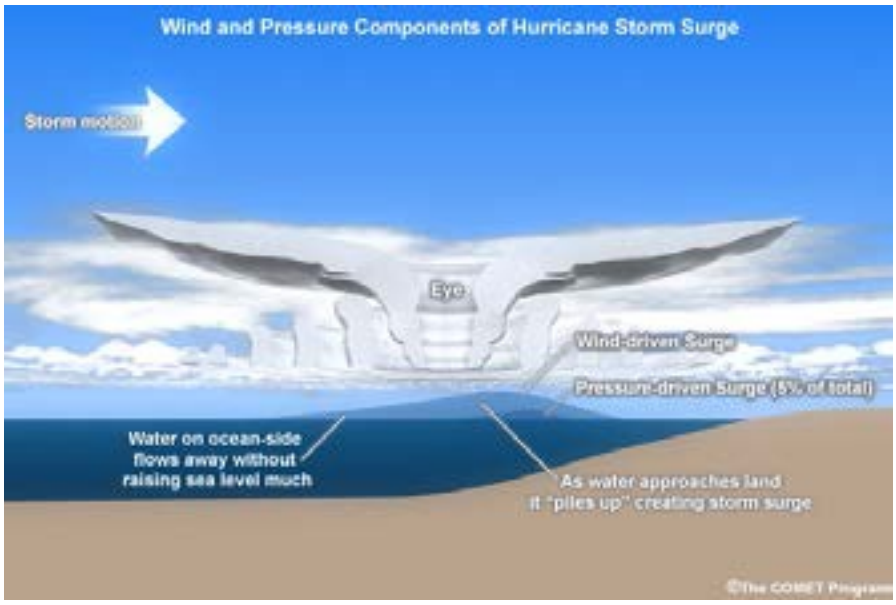


Figure 3.5.2
Wind and Pressure Components of Hurricane Storm Surge
(Source: NHC)



Hazard Profile

Location

The Gulf Coast of Mississippi is located in a high-hazard area for hurricanes and storm surge, and is one of the more densely populated areas of the state. According to the 2010 U.S. Census, over 370,702 residents reside in the coastal counties of Hancock, Harrison, and Jackson. The second-tier of counties is comprised of George, Pearl River, and Stone. These counties, located immediately upland from the coastal counties, had a combined population of 96,198 in 2010. The combined total population of all six counties was 466,900. The effects of Hurricane Katrina, which made landfall in August 2005, caused drastic population shifts as people sought shelter in non-coastal areas. As housing was built and employment centers and schools were rebuilt many residents returned to their homes. In 2008, the estimated population of these six counties was 422,785, a net gain of 44,115 has been realized.

The three coastal counties are potentially at very high risk from the direct impact of a hurricane or tropical storm. Residents of the three upland counties are at high risk from strong winds, rain damage, flooding, severe storms, and tornadoes generated from the hurricane.

Storm surge is potentially the most devastating factor associated with hurricanes. Within the boundaries of the first-tier counties, properties adjacent to areas affected by tides, particularly areas south of U.S. Highway 90, are the most susceptible to damage from storm surge with heavy flooding as the most common result. In extreme cases, such as Hurricanes Camille and Katrina, the incoming wall of water and wind could destroy well-built buildings along the immediate coastline.

Hurricanes also significantly impact the medium-risk Gulf Coast counties of Clarke, Covington, Forrest, Greene, Jasper, Jefferson Davis, Jones, Lamar, Lauderdale, Marion, Perry, Pike, Rankin, Simpson, Smith, Walthall, and Wayne counties. Each of these counties can all receive the effects of high winds, rain damage, severe storms, and flooding. Hurricane effects have also impacted, with less severity, the low risk counties of other further inland counties.

Hurricanes that move northeast across the Louisiana Delta or move inland between Mobile, Alabama and Panama City, Florida, usually are less damaging because these storms are located on the “weak side” of the storm. Even if a hurricane/tropical storm does not make landfall, the Mississippi Gulf Coast can suffer the damaging effects of high tide, rain, and wind from hurricanes/tropical storms that move in from the Gulf of Mexico.

Shelter Requirements

The state of Mississippi has implemented a statewide sheltering program to build FEMA 361 community saferooms to house displaced households or those seeking shelter from impending storms. Below is a summary of the progress made to date on the construction and capacity of these saferooms which will assist in evaluating the expected shelter requirements set forth in the scenarios presented in this plan

update. Note, the number of facilities and capacity for the 361 safe rooms include 32 facilities that are currently under construction to house approximately 21,245 persons.

Mississippi Safe Room Program

Safe Room Type	County	No. of Facilities	Est. Capacity
Individual	Statewide	10,918	28,824
FEMA 361	Adams, Copiah, Desoto, Forrest, George, Hancock, Harrison, Jackson, Jones, Lafayette, Lamar, Lauderdale, Lincoln, Monroe, Neshoba, Pearl River, Pike, Rankin, Stone, Tate, Tunica, and Wayne	72	52,337
Community	Attala, Calhoun, Chickasaw, Holmes, Itawamba, Lafayette, Lamar, Lauderdale, Lee, Leflore, Lowndes, Madison, Monroe, Panola, Pontotoc, Prentiss, Smith, Tallahatchie, Tippah, Union, Wayne, Winston, and Yalobusha	183	Undetermined

Education and Outreach

Hurricane Preparedness Week occurs the last week in May of each year. For more information on hurricane awareness call the MEMA Public Information number (866-519-6362) between 8 a.m. and 5 p.m. weekdays.

The state also participates in state, regional, and national hurricane and all-preparedness conferences. During these conferences, public and private agencies have an opportunity to receive educational and training to further their efforts in preparing for and responding to future events.

Past Occurrences

Since 1965 Mississippi has been struck by 17 hurricanes and 18 tropical storms/depressions. Tables 3.5.2 and 3.5.3 reflects the history of hurricanes and tropical storms/depressions from 1965 to 2017 in Mississippi followed by storm surge events in Table 3.5.4. Figures 3.5.3 to 3.5.5 are also provided by category to show the tracks of these storms as they entered the Gulf of Mexico.

Table 3.5.2
Hurricane/Tropical Storm Events
Presidential Disaster Declarations – Mississippi

Event/Declaration Number	Incident Period	Number of Counties Affected	Major Declaration Declared
Hurricane Nate DR-4350	October 6 - 10, 2017	5	November 22, 2017
Hurricane Isaac DR-4081	August 26 - September 11, 2012	49	August 20, 2012
Hurricane Isaac DR-4081	August 28 - September 8, 2008	22	September 22, 2008
Hurricane Katrina DR-1604	August 29 - October 14, 2005	82	August 29, 2005
Hurricane Dennis DR-1594	July 10 - 15, 2005	41	July 10, 2005
Hurricane Ivan DR-1550	September 13-20, 2004	44	September 15, 2004
Tropical Storm Isidore DR-1436	September 23 - October 6, 2002	10	October 1, 2002
Tropical Storm Allison DR-1382	June 6 - 13, 2001	8	June 21, 2001
Hurricane Georges DR-1251	September 25 - October 5, 1998	13	October 1, 1998
Hurricane Elena DR-741	August 29 - September 4, 1985	4	September 4, 1985
Hurricane Frederic DR-599	September 13, 1979	13	September 13, 1979
Hurricane Camille DR-271	August 18, 1969	20	August 18, 1969
Hurricane Betsy DR-210	September 25, 1965	No County Information	September 25, 1965

Table 3.5.3
Hurricane/Tropical Storm Events
Presidential Disaster Declarations – Mississippi

Incident Name	Event Date	County(s) Affected	Deaths	Injuries	Property Damage
Tropical Storm Isaac	8/28/2012	Adams, Amite, Claiborne, Copiah, Covington, Forrest, Franklin, Hancock, Harrison, Hinds, Issaquena, Jackson, Jefferson, Jefferson Davis, Jones, La- mar, Lawrence, Lincoln, Marion, Pearl River, Pike, Rankin, Simpson, Smith, Walthall, Wilkinson and Warren	1	2	$7,375,000
Tropical Storm Lee	9/2/2011	Amite, Hancock, Harrison, Jackson, Pearl River, Pike and	0	0	$55,000

		Wilkinson			
Tropical Storm Ida	11/9/2009	Forrest, Hancock, Harrison and Pearl River	0	0	$0
Tropical Storm Ike	9/11/2008	Hancock, Harrison, and Jackson	0	0	$0
Tropical Storm Gustav	9/2/2008	Adams, Claiborne, Copiah, Forrest, Franklin, Jefferson, Jefferson Davis, Lamar, Lawrence, Lincoln and Marion	0	0	$5,850,000
Tropical Depression Rita	9/25/2005	Coahoma and Tunica	0	0	$10,000
Hurricane Rita	9/24/2005	Adams, Bolivar, Carroll, Claiborne, Copiah, Franklin, Hinds, Holmes, Humphreys, Issaquena, Jefferson, Jefferson Davis, Lawrence, Leflore, Lincoln, Madison, Marion, Rankin, Sharkey, Simpson, Sunflower, Warren, Washington, and Yazoo	0	0	$485,000
Tropical Depression Dennis	7/11/2005	Calhoun, Chickasaw, Itawamba, Lee, and Union	0	0	$35,000
Hurricane Cindy	7/5/2005	Hancock, Harrison, Jackson, and Pearl River	0	0	$9,000,000
Tropical Storm Cindy	7/5/2005	Forrest, George, Greene, Lamar, and Stone	0	0	$200,000
Tropical Storm Arlene	6/10/2005	Clarke, Clay, Hancock, Harrison, Jackson, Kemper, Lauderdale, Lowndes, Noxubee, and Oktibbhea	0	0	$445,000
Tropical Storm Matthew	10/9/2004	Hancock, Harrison and Jackson	0	0	$20,000
Tropical Storm Ivan	9/16/2004	Chickasaw, Itawamba, Lee, and Monroe	1	0	$30,000
Tropical Storm Bill	6/30/2003	Clarke, Covington, Forrest, Hancock, Harrison, Jackson, Jasper, Jefferson Davis, Jones, Kemper, Lamar, Lauderdale, Marion, Newton, Pearl River, and Smith	0	0	$1,200,000
Hurricane Lili	10/3/2002	Adams, Amite, Attala, Carroll, Covington, Hancock, Harrison, Hinds, Jackson, Jasper, Leake, Leflore, Madison, Pearl River, Pike, Scott, Smith, Walthall,	0	0	$13,900,000

		Warren, Washington, Wilkinson, and Yazoo			
Tropical Storm Hanna	9/14/2002	Hancock, Harrison, and Jackson	0	0	$0
Tropical Storm Bertha	8/4/2002	Hancock, Harrison, and Jackson	0	0	$50,000
Tropical Storm Hermine	9/19/1998	Hancock, Harrison, Jackson, and Pearl River	0	0	$85,000
Tropical Storm Earl	9/2/1998	Hancock, Harrison, and Jackson	0	0	$0
Hurricane Danny	7/17/1997	Hancock, Harrison, and Jackson	0	0	$0
Hurricane Opal	10/4/1995	Hancock, Harrison, and Jackson	0	1	$75,000
Hurricane Erin	8/20/1995	Greene, Perry, and Wayne	0	0	$100,000

Source: NCDC

Table 3.5.4
Storm Surge History

Date	County	Property Damage ($)	Date	County	Property Damage ($)
6/20/2017	Jackson	$0	8/29/2005	Hancock	$3,380,000,000
	Harrison	$0		Harrison	$5,630,000,000
	Hancock	$0		Jackson	$2,250,000,000
10/7/2017	Jackson	$0	7/5/2005	Hancock	$500,000
	Harrison	$0		Harrison	$300,000
	Hancock	$0		Jackson	$200,000
8/28/2012	Jackson	$600,000	10/9/2004	Hancock	$15,000
	Harrison	$2,100,000		Harrison	$15,000
	Hancock	$2,100,000	9/15/2004	Harrison	$400,000
9/2/2011	Jackson	$10,000		Jackson	$1,200,000
	Harrison	$10,000		Hancock	$400,000
	Hancock	$10,000	6/30/2003	Jackson	$250,000
9/11/2008	Jackson	$0		Hancock	$500,000
	Harrison	$0		Harrison	$250,000
	Hancock	$0	10/13/2001	Hancock	$0
9/1/2008	Jackson	$1,250,000	2/15/1998	Harrison	$250,000
	Harrison	$750,000		Hancock	$500,000
	Hancock	$500,000		Jackson	$250,000
Total Estimated Property Damage			**$11,272,000,000**		

Figure 3.5.3
Category 1 and 2 Historical Hurricanes
1852-2017

Source: www.csc.noaa.gov/hurricanes

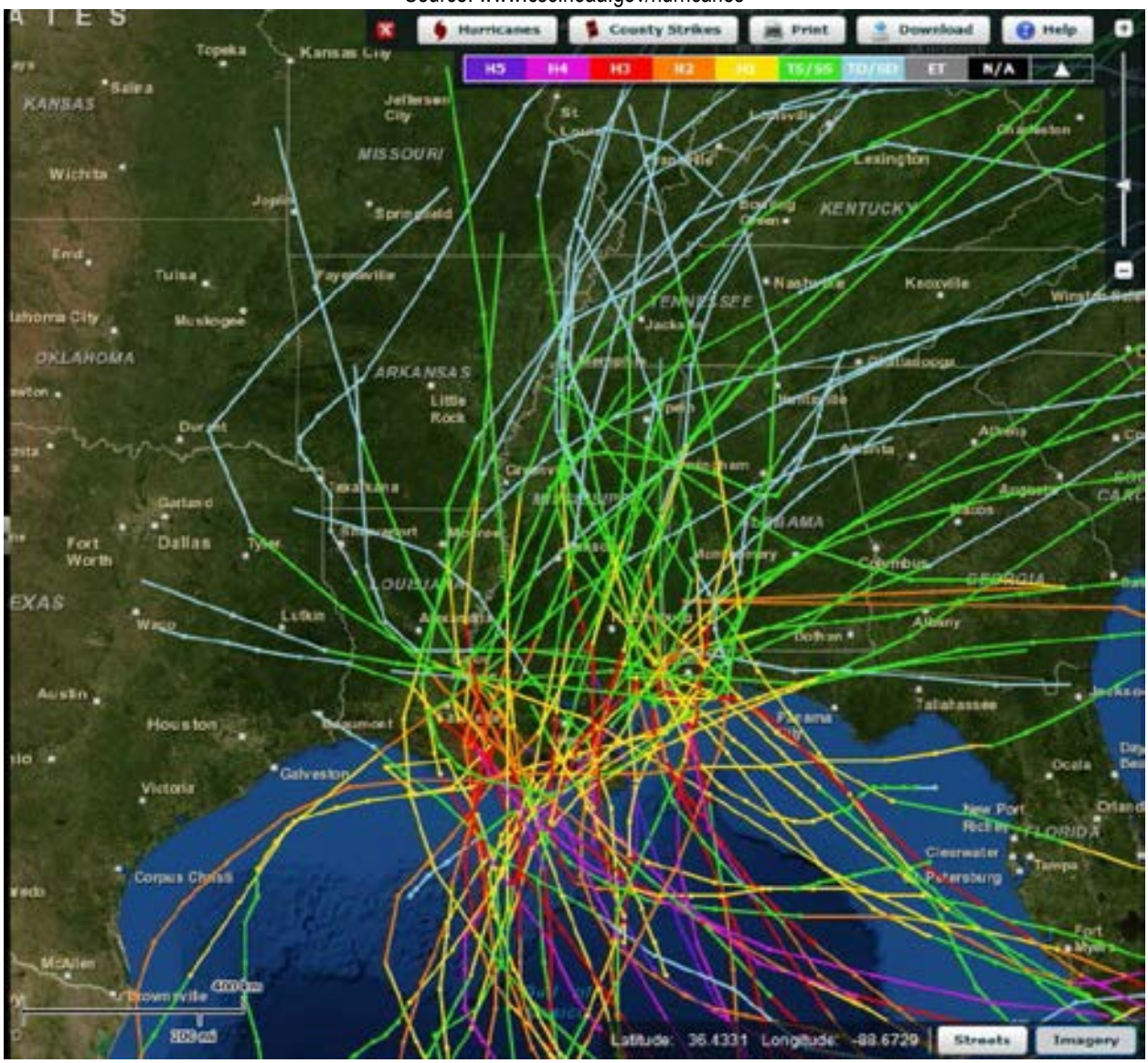


Figure 3.5.4
Category 3, 4 and 2 Historical Hurricanes
1852-2017

Source: www.csc.noaa.gov/hurricanes

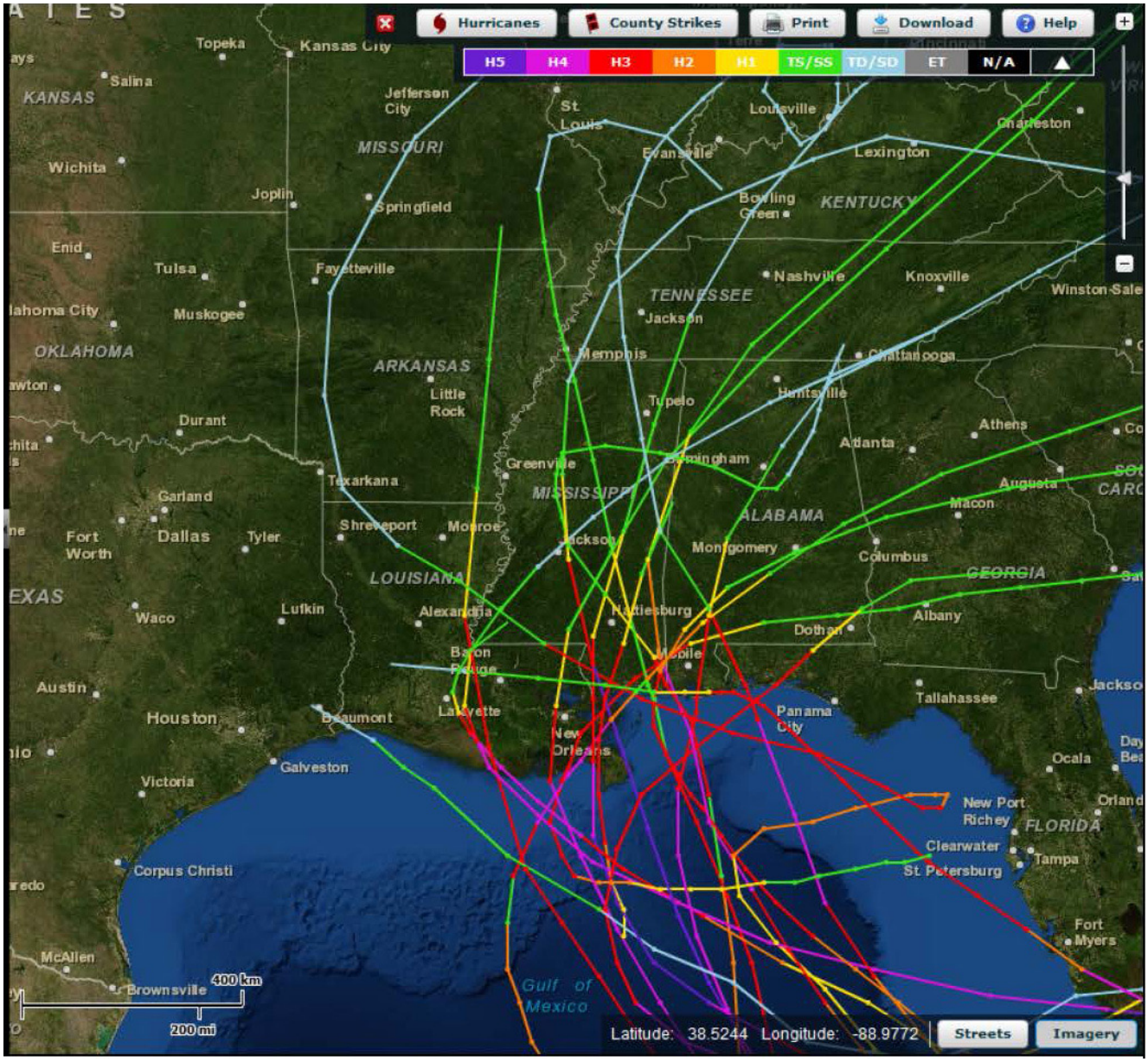
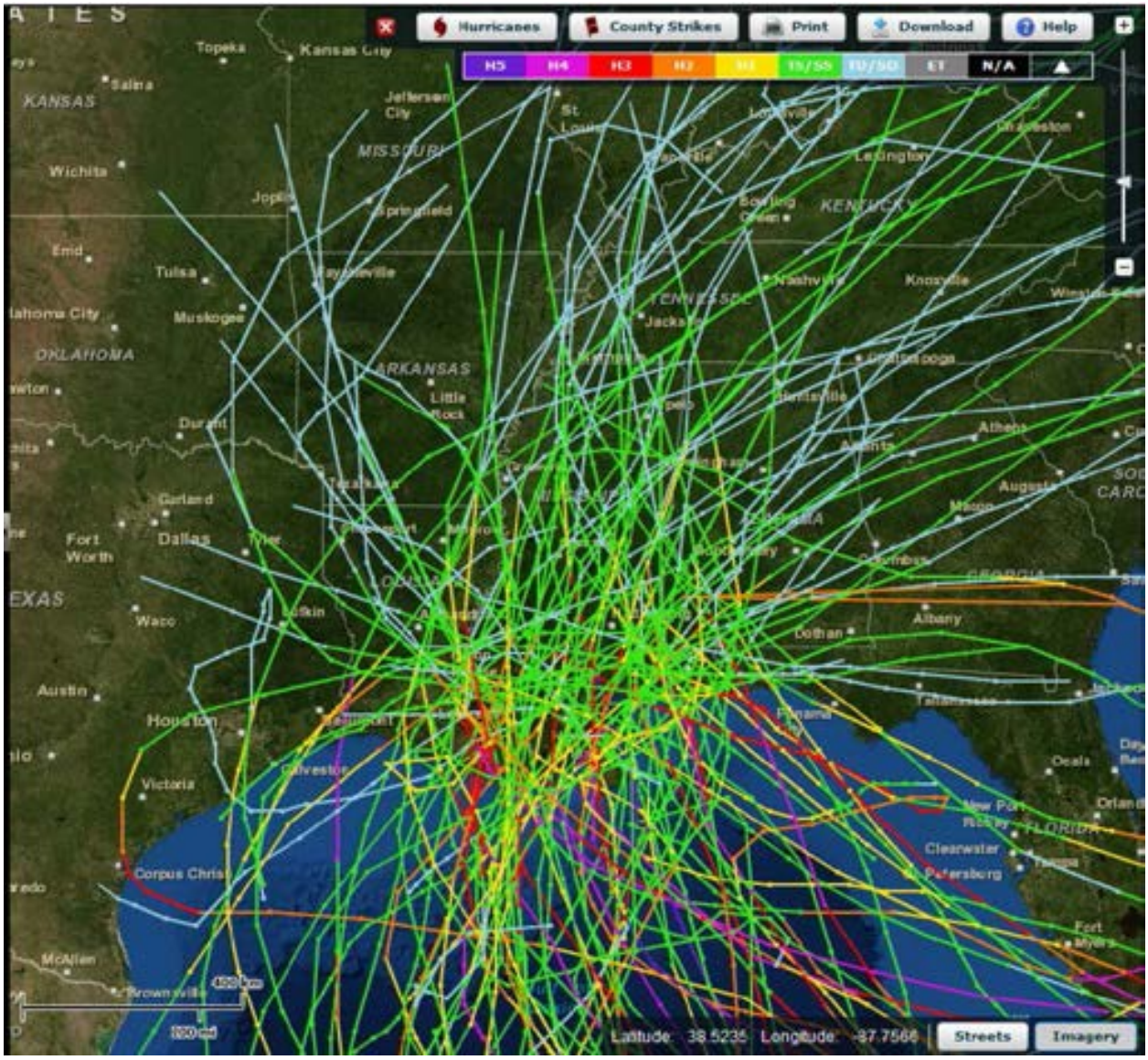


Figure 3.5.5
Historical Tropical Storms
1852-2017
Source: www.csc.noaa.gov/hurricanes



Summaries of the Presidentially declared disaster events that have occurred over the past ten years is provided below. The summaries also include data from the NCEI and FEMA on the impacts to people and property and the public assistance dollars obligated.

November 22, 2017 – Hurricane Nate

Hurricane Nate originated in the Western Caribbean and was an unusually fast-moving storm, which caused widespread destruction and casualties in Central America. Hurricane Nate moved through the Yucatan Channel and into the Gulf of Mexico on October 7, 2017. The next day, Hurricane Nate made landfall near the mouth of the Mississippi River in Louisiana. After crossing the marshland of the delta, Hurricane Nate made its second U.S. landfall in Biloxi, Mississippi. Hurricane Nate caused storm surge along the coastline, as well as rip currents, hurricane force winds, and beach erosion.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 6** • **Deaths: 0** • **Injuries: 0** • **Estimated Property Damage: $125,000**	$986,297	Not Available	Not Available

Source: NCDC and FEMA

Satellite image of Hurricane Nate

August 28, 2012 – Hurricane Isaac

Hurricane Isaac entered the Gulf of Mexico as a tropical storm on August 26, 2012 moving northwest after crossing Haiti, Cuba, and the Florida Straits. Isaac moved slowly north northwest over the eastern Gulf. Isaac strengthened into a hurricane on the morning of the 28th when it was 75 miles south southeast of the mouth of the Mississippi River. Isaac made landfall in Plaquemines Parish as a Category 1 Hurricane near Southwest Pass of the Mississippi River on the evening of the 28th. A second landfall occurred near Port Fourchon the following morning. The storm weakened to a tropical storm on the afternoon of the 29th about 50 miles west southwest of New Orleans, and weakened further to a tropical depression on the afternoon of the 30th near Monroe, Louisiana.

Even though Isaac was of hurricane status from near the mouth of the Mississippi River into southeast Louisiana, only tropical storm force winds were recorded on land areas of Mississippi. The maximum sustained wind in south Mississippi was 46 knots or 53 mph measured at the Gulfport- Biloxi-Airport during the early afternoon of August 29th. A portable weather station (Weatherflow Inc) near Gulfport measured a 48-knot gust, or 55 mph, late on the morning of August 29. Maximum wind gust of 58 knots or 67 mph was recorded at the NOAA NOS Bay Waveland station and also at Gulfport (Weatherflow Inc) late on the morning of Aug 29. The long duration of tropical storm force winds downed some trees and power lines across the region.

The minimum sea level pressure measured from a land station was 995.9 mb the NOAA-NOS station at Bay-Waveland station during the early morning of Aug 29th. A storm tide ranged from approximately 5 feet in Jackson County to nearly 10 feet in Hancock County closer to Isaac's center. These values are approximately 3 to 8 feet above normal astronomical values. Storm surge flooding impacts were greatest in Hancock County. Persistent rain bands affected south Mississippi, especially the coastal sections produced heavy rainfall over a three-day period. 10 to 20 inches of rainfall was common across the region. A co-operative observer near Pascagoula recorded the maximum reading of 22.20 inches of rain. Heavy rainfall produced both flash flooding and later moderate-to-major river flooding. Records crests were observed on the Wolf River near Landon (August 31) and Gulfport (September 1), and the East Hobolochitto River near Caesar (August 31). Storm surge and high tides restricted outflow of the rivers near the coast and lakes exacerbating flooding of low lying areas along rivers and bayous near the coast as they emptied into the Gulf. There were two weak tornadoes documented that occurred along Mississippi coast which resulted in generally minor property damage.

Overall, impacts from Isaac resulted in millions of dollars in damages in south Mississippi and one direct fatality. Much of the damage in the coastal counties of Hancock, Harrison, and Jackson was related to storm surge on the coast, flash flooding, or river flooding. The chart below provides a summary of the reported impacts to people and property damage from NCEI and the dollars obligated to date for public assistance through FEMA.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	Emergency Work (Categories A-B)	Permanent Work (Categories C-G)
• No of Counties Affected: 49 • Deaths: 1 • Injuries: 2 • Estimated Property Damage: $7,375,000	$37,002,798	$23,061,498	$13,941,300

Source: NCDC and FEMA

Satellite image of Hurricane Isaac

September 1, 2008 – Hurricane Gustav

Hurricane Gustav made landfall as a Category 2 hurricane near Cocodrie, LA during the morning of September 1, 2008. Gustav continued to move northwest and weakened to a Category 1 storm over south central Louisiana later that day. The highest wind gust recorded in south Mississippi was 74 mph at the Gulfport-Biloxi International Airport while the highest sustained wind of 54 mph was recorded at the Waveland Yacht Club. No official wind observations were available in far southwest Mississippi; however, hurricane force wind gusts may have occurred. Rainfall varied considerably ranging from around 4 to 10 inches. Gustav produced mainly light wind damage across coastal Mississippi, although more significant and concentrated damage occurred in southwest Mississippi closer to the track of center of the storm. Widespread power outages occurred in southern Mississippi.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 22** • **Deaths: 0** • **Injuries: 0** • **Estimated Property Damage: $19,370,000**	$33,702,564	$19,932,178	$12,657,491

Source: NCDC and FEMA

Satellite image of Hurricane Gustav

August 28, 2005 – Hurricane Katrina

Hurricane Katrina was one of the most destructive hurricanes on record to impact the coast of the United States. It was one the worst natural disasters in the history of the U.S., resulting in catastrophic damage and numerous casualties along the Mississippi coast. Damage and casualties resulting from Hurricane Katrina extended as far east as Alabama and the panhandle of Florida. Post-event analysis by the National Hurricane Center indicates that Katrina weakened slightly before making landfall as a strong Category 3 storm in initial landfall in lower Plaquemines Parish. The storm continued on a north-northeast track with the center passing about 40 miles southeast of New Orleans with a second landfall occurring near the Louisiana and Mississippi border as a Category 3 storm with maximum sustained winds estimated at 121 mph. Katrina continued to weaken as it moved north-northeast across Mississippi during the day but remained at hurricane strength 100 miles inland.

Damage across coastal Mississippi was catastrophic. The storm surge associated with Hurricane Katrina approached or exceeded the surge associated with Hurricane Camille (1969) and impacted a much more extensive area. Almost total destruction was observed along the immediate coast in Hancock and Harrison Counties with storm surge damage extending north along bays and bayous to Interstate 10. Thousands of homes and businesses were destroyed by the storm surge. Hurricane-force winds also caused damage to roofs, power lines, signage, downed trees, and some windows were broken by wind and wind-driven debris in areas away from storm surge flooding, wind damage was widespread with fallen trees taking a heavy toll on houses and power lines. Excluding losses covered by the National Flood Insurance Program (NFIP), insured property losses in Mississippi were estimated at $9.8 billion dollars. Uninsured and insured losses combined were estimated to exceed $100 billion dollars across the Gulf Coast.

Satellite image of Hurricane Katrina

The NECI reports that tide gauges were destroyed by Hurricane Katrina; therefore, storm surge was determined by post storm high water marks. It was estimated that the storm surge along Harrison County was between 19 and 25 feet, 23 feet was recorded at the Hancock County EOC operations area in Waveland, and the high-water mark measured on the Jackson County EOC building in Pascagoula was 16.1 feet. Storm total rainfall amounts generally ranged from 10 to 16 inches across coastal and south Mississippi with much lower amounts observed over southwest Mississippi. The highest observed storm total rainfall was 11 inches at Stennis Space Center and near Picayune.

With all 82 counties eventually being included in the Presidential Disaster Declaration, the impacts of Hurricane Katrina, both direct and indirect, continue to be felt today, and have resulted in significant challenges facing our citizens, local governments and the state. Never before have we experienced the total destruction of communities and cities. Virtually every element of society that makes a community - homes, business, schools, places of worship, healthcare and government were destroyed in Bay St. Louis, Waveland, Pass Christian, and Long Beach.

The challenges of rebuilding these communities that experienced total loss of their tax base and sales tax revenues continue today. Affordable housing and total rebuilding of infrastructure continue to strain resources available to many local governments. Cities and counties throughout the state wrestle with increased population as a result of evacuees who have decided not to return to areas of Louisiana and the Mississippi Gulf Coast, straining availability of affordable housing, inadequate infrastructure, and the ability of local governments to provide basic services.

To help understand the total effects of this catastrophic event, a storm surge and HAZUS final wind field figures are presented as Figures 3.5.6 and 3.5.7.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 82** • **Deaths: 238** • **Injuries: Undetermined** • **Estimated Property Damage: $80,000,000,000**	$3,237,615,391	$1,170,007,750	$1,885,105,865

Source: NCDC and FEMA

Figure 3.5.6
Hurricane Katrina Storm Surge Map

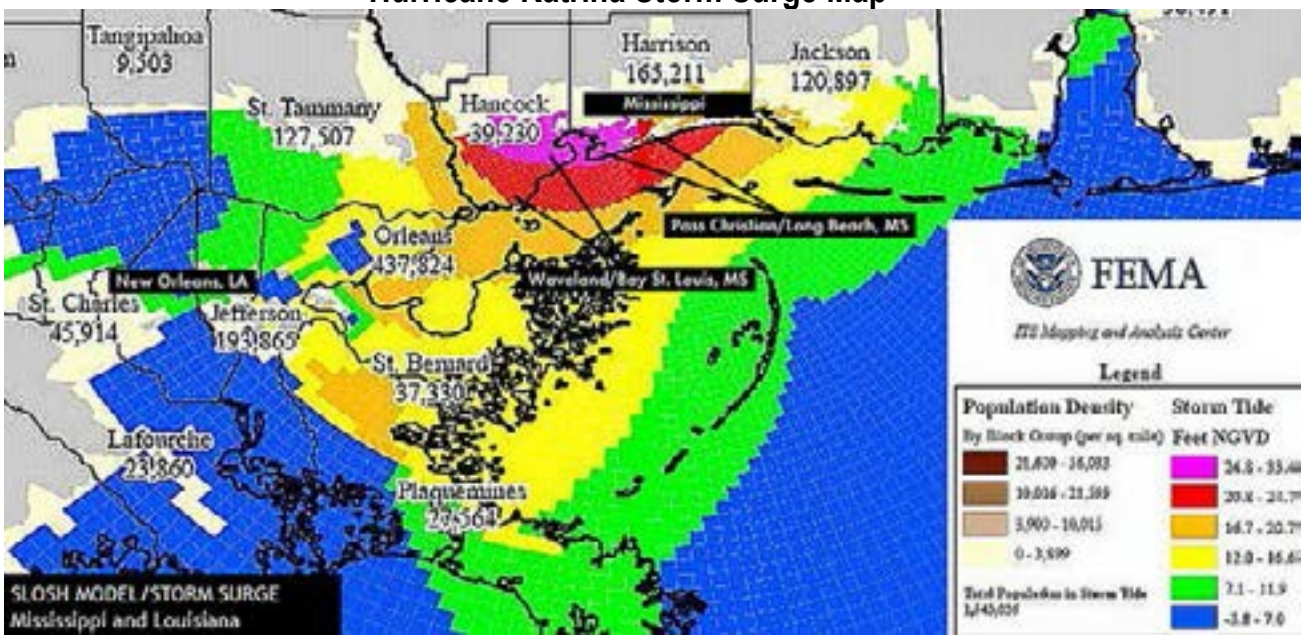
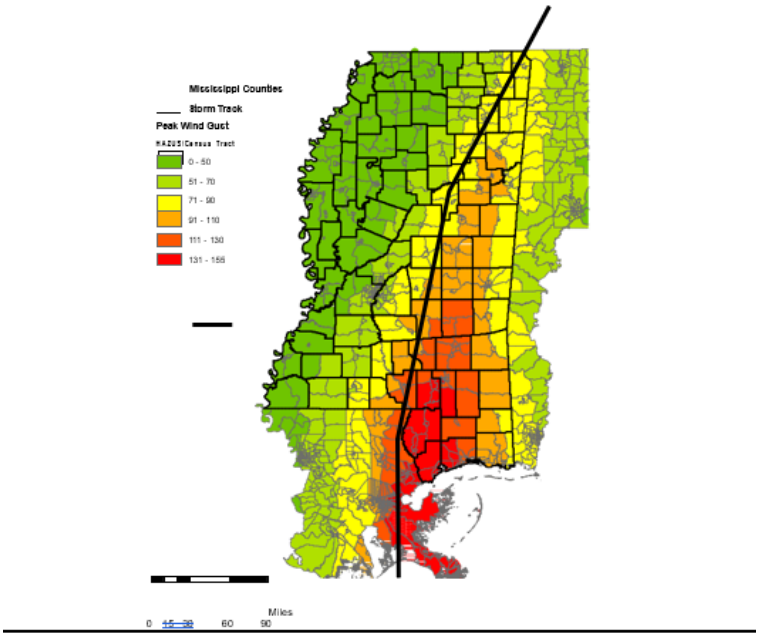


Figure 3.5.7
Hurricane Katrina Peak Gust by Census Track
HAZUS and Wind Field



July 10, 2005 – Hurricane Dennis

Hurricane Dennis entered the Gulf of Mexico as a hurricane. After crossing over Cuba, the hurricane moved into the central Gulf of Mexico and strengthened to a Category 4 hurricane on July 10th. Hurricane Dennis weakened to a Category 3 hurricane prior to making landfall along the western Florida panhandle. The Mississippi Gulf Coast felt some tropical weather from Hurricane Dennis. The highest wind gusts over land in Mississippi were reported at Keesler Air Force Base at 46 mph. The highest wind gusts over water adjacent to Mississippi was 52 mph from a buoy located 22 miles south-southeast of Biloxi. Rainfall on the Mississippi Gulf Coast was reported to be less than 2 inches. The lowest reported pressure on the Mississippi Gulf Coast was 994.2 mb, and the highest reported tide was 4 feet MMSL at Waveland (NCEI: Event Details). Harrison County received public assistance under a Presidential Disaster Declaration.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 41** • **Deaths: 0** • **Injuries: 0** • **Estimated Property Damage: $2,550,000**	$1,707,563	$1,735,639	$0

Source: NCDC and FEMA

Satellite image of Hurricane Dennis

September 16, 2004 – Hurricane Ivan

Hurricane Ivan made landfall near Gulf Shores, Alabama as a Category 3 hurricane during the morning of September 16, 2004. The storm caused extensive damage in Coastal Alabama and Florida. Harrison and Hancock Counties experienced tropical storm force winds. A wind gust of 78 mph was captured at Point Cadet in Biloxi. The lowest pressure reported on the Mississippi Gulf Coast was 975.6 mb at the Jackson County Emergency Operations Center. Keesler Air Force Base captured a low pressure of 982.9 mb about two hours later. The highest storm surge on the Mississippi Gulf Coast was at the mouth of the Pascagoula River and was 3.72 ft NGVD. A Presidential Disaster Declaration was made, providing individual assistance to residents of Harrison County and public assistance to local governments in Harrison County.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 44** • **Deaths: 1** • **Injuries: 0** • **Estimated Property Damage: $9,720,000**	$14,403,026	$10,113,755	$4,289,274

Source: NCDC and FEMA

Satellite image of Hurricane Ivan

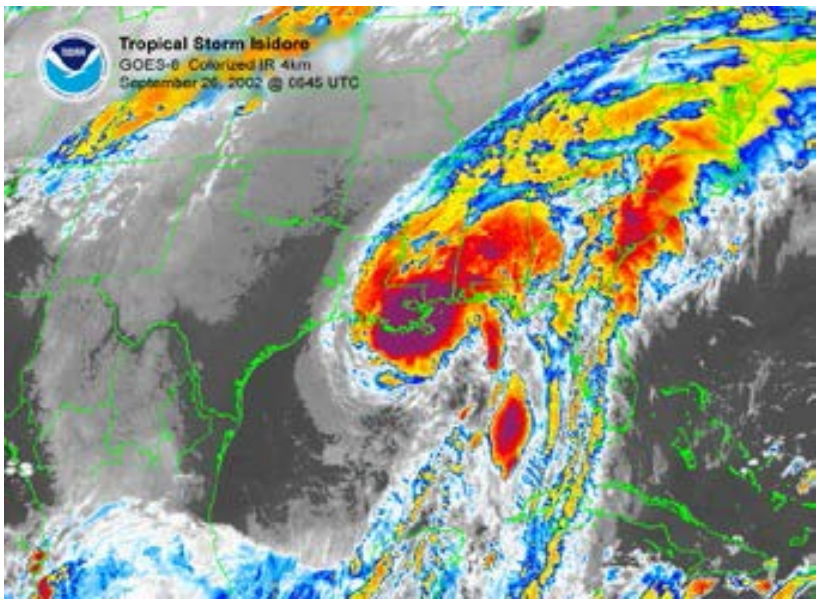
September 26, 2002 – Tropical Storm Isidore

Tropical Storm Isidore made landfall near Grand Isle, LA during the early morning of September 26, 2002. The tropical storm moved north across southeast Louisiana and by the evening was located in central Mississippi, where it was downgraded to a tropical depression. Tropical Storm Isidore had a large circulation with tropical storm force winds extending several hundred miles from its center. Tide levels were generally 4 to 7 feet above normal, with locally higher levels, across much of coastal Mississippi. Significant beach erosion occurred along the coast and on the barrier islands. The maximum storm surge reading on the Mississippi Coast was 7.61 feet NGVD at the Corps of Engineers tide gage at Gulfport Harbor, and 6.86 feet NGVD in Biloxi Bay at Point Cadet. There were two fatalities on the Mississippi Coast related to the tropical storm; one direct and another indirect. Rainfall amounts associated with Isidore were generally 5 to 8 inches and resulted in some river flooding and flash flooding. Approximately 2,500 homes in Hancock County, 1,400 homes in Harrison County were flooded, primarily as the result of storm surge, with river flooding and flash flooding causing some of the flood damage.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 10** • **Deaths: 1** • **Injuries: 0** • **Estimated Property Damage: $25,500,000**	$6,784,617	$999,661	$5,784,956

Source: NCDC and FEMA

Satellite image of Tropical Storm Isidore



Probability of Hurricane Future Events

Researchers have studied the probability of a tropical cyclone landfall and guest calculations for 17 regions from Brownsville, Texas to Eastport, Maine. A web page that displays this information has been created as a joint project between the Tropical Meteorology Project at Colorado State University, Fort Collins, Colorado, and the GeoGraphics Laboratory at Bridgewater State College, Bridgewater, MA. (http://landfalldisplay.geolabvirtualmaps.com).

According to the researchers, information obtained indicates that the 2018 Atlantic hurricane season will be somewhat more active than the 2017 season predictions. Increases are shown below for winds greater than 40 mph to 115 mph:

- Probability of Tropical Storm Force (>= 40 mph) Wind Gusts - Increase of 1.08%
- Probability of Hurricane Force (>=75 mph Wind Gusts - Increase of 1.08%
- Probability of Intense Hurricane-Force (>= 115 mph) Wind Gusts - Increase of 1.08%

Overall Mississippi is expected to have a 13.9% probability of hurricane impact(s) and 6.0% chance for a major hurricane impact. Tables 3.5.5 and 3.5.6 break down the probability by coastal county for 2018 and for the next 50-year period.

Table 3.5.5
2018 Hurricane Landfall Probability

Probability	George	Hancock	Harrison	Jackson	Pearl River	Stone
Probability of 1 or more named storms making landfall	5.4%	4.5%	6.0%	6.6%	5.6%	5.3%
Probability of 1 or more named hurricanes making landfall	2.7%	2.3%	3.0%	3.3%	2.8%	2.7%
Probability of 1 or more intense hurricanes making landfall	1.2%	1.0%	1.3%	1.5%	1.3%	1.2%
Probability of tropical storm force (>= 40 mph) wind gusts	40.5%	40.5%	40.5%	40.5%	40.5%	40.5%
Probability of hurricane force (>=75 mph) wind gusts	13%	13%	13%	13%	13%	13%

Probability of intense hurricane force (>= 115 mph) wind gusts	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Source: http://landfalldisplay.geolabvirtualmaps.com/

Table 3.5.6
50 Year Hurricane Landfall Probability

Probability	George	Hancock	Harrison	Jackson	Pearl River	Stone
Probability of 1 or more named storms making landfall	88%	82.7%	90.3%	92.5%	88.6%	87.4%
Probability of 1 or more named hurricanes making landfall	64.2%	57.3%	67.6%	71.4%	65%	63.4%
Probability of 1 or more intense hurricanes making landfall	36.9%	31.8%	39.7%	42.9%	37.6%	36.3%
Probability of tropical storm force (>= 40 mph) wind gusts	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Probability of hurricane force (>=75 mph) wind gusts	99.6%	99.6%	99.6%	99.6%	99.6%	99.6%

Probability of intense hurricane force (>= 115 mph) wind gusts	82.3%	82.3%	82.3%	82.3%	82.3%	82.3%

Source: http://landfalldisplay.geolabvirtualmaps.com/

Assessing Vulnerability

In assessing Mississippi's vulnerability to damage and loss of life from hurricanes and tropical storms, at the top of the list is loss of life and property due to flooding. Mississippi's citizens are vulnerable to hurricanes. The very young, the elderly and the handicapped are especially vulnerable to harm from hurricanes. Not only are resident's homes vulnerable to hurricanes, but also public buildings, infrastructure and natural resources are all subject to damage. In some cases, the damage to natural resources cannot be restored to pre-incident levels.

Damages from Flooding Due to Hurricanes

Torrential rains from hurricanes and tropical storms can produce extensive urban and riverine flooding. Winds from these storms located offshore can drive ocean water up the mouth of a river, compounding the severity of inland overbank flooding.

In addition to the combined destructive forces of wind, rain, and lightning, hurricanes can cause a "surge" in the ocean, which can raise the sea level as high as 25 feet or more in the strongest hurricanes. This "storm surge" also can have the opposite effect, in that the sea level can be lowered to below mean sea level at the backside of a hurricane. This phenomenon causes more destruction as storm surge waters are sucked back out to sea. For more information on flood-related losses from hurricanes see the flood section of the risk assessment.

Vulnerability of People to Hurricanes

For those who are unable to evacuate for medical reasons, there should be provision to take care of special-needs patients and those in hospitals and nursing homes. Many of these patients are either oxygen-dependent, insulin-dependent, or in need of intensive medical care. There is a need to provide ongoing treatment for these vulnerable citizens, either on the coast or by air evacuation to upland hospitals. The stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

According to U.S. Census Bureau 2008-2010 American Community Survey, there were 7,073 non-institutionalized persons residing in Hancock County in 2010 with a certain disability. There were 27,210 in Harrison County and 21,398 in Jackson County. The types of disabilities include: hearing, vision, cognitive, ambulatory, self-care, and/or independent living difficulties. Together these counties accounted for a total of 55,681 persons with disabilities who could possibly be in need of help to survive the effects of a hurricane.

Total population vulnerability in the high-risk counties has decreased somewhat post for Jackson and Harrison Counties and a slight increase for Hancock County. Table 3.5.7 compares 2000 and 2010 populations. This area is still in a state of flux in terms of its population as the recovery from Katrina is ongoing. See the discussion in growth and development trends in Section 3.14 for more detail on the population shifts as a result of Katrina.

Table 3.5.7
Vulnerable Populations in High Risk Counties Updated

County	City	2000 Population	2010 Population
Jackson	Pascagoula	26,200	22,392

	Moss Point	15,851	13,704
	Gautier	11,681	18,572
	Ocean Springs	17,255	17,442
	Jackson County (Unincorporated Area)	60,433	58,584
Jackson County Totals		**131,420**	**130,694**
Harrison	Biloxi	50,644	44,054
	Gulfport	71,127	67,793
	Pass Christian	6,579	4,613
	D'Iberville	7,608	9,486
	Long Beach	17,320	14,792
Harrison County Totals		**189,598**	**187,105**
Hancock	Bay St. Louis	50,644	44,054
	Waveland	71,127	67,793
	Jackson County (Unincorporated Area)	6,579	4,613
Hancock County Totals		**42,967**	**43,929**

Source: Based on 2000 and 2010 U.S. Census Bureau figures. Total population includes cities and unincorporated areas

The need for a speedy evacuation by Gulf Coast residents in their personally-owned vehicles has been expedited, utilizing the National Weather Service's storm surge model Sea, Lake, and Overland Surges from Hurricanes or SLOSH. Modelers examined the population density of each coastal county, the capability of evacuation roads to handle evacuees, and the topography (which areas would flood first in the event of a hurricane) to establish evacuation zones. These zones identify who should leave and in what order based on which areas are most vulnerable to storm surge. This assignment of evacuation zones enables local residents to assess their own vulnerability to a hurricane, given their location. Local officials can then call for an evacuation of the particular zone when the opportunity presents itself.

The model, developed in 2000, has been effectively implemented in an evacuation of people in their vehicles. If used in a timely basis, given sufficient warning, this SLOSH model is effective in saving lives in the Gulf Coast counties of Hancock, Harrison, and Jackson.

The Mississippi Department of Transportation's (MDOT) Statewide Traffic Management Center (TMC) provides coordination and timely management of all traffic conditions. In addition to keeping citizens safer and more informed during routine travel, the TMC improves better emergency event coordination and incident management than in previous years.

The TMC has enhanced MDOT's ability to respond to traffic-flow impediments resulting from adverse weather, debris in the roadway and the presence of hazardous materials. MDOT utilizes 260 traffic cameras located throughout the state to accomplish this. Once an incident is detected, the operations staff initiates an appropriate response by coordinating closely with other state and local agencies and disseminating real- time information to emergency responders and the public. In addition, the TMC has helped staff to establish close working relationships with similar TMC's in Border States to more efficiently coordinate regional responses as needed.

When the Traffic Engineering Desk at Mississippi Emergency Management Agency (MEMA) is operational, the TMC is capable of relaying incident information to contribute to MEMA's situational awareness. A similar

working relationship exists with state and local law enforcement agencies to address any impediments to the flow of traffic during emergencies, especially during evacuation events.

Contraflow is the practice of turning traffic flow in one direction on controlled-access routes during times

of emergency evacuation. It was first implemented in Mississippi during Hurricane Katrina. The purpose of contraflow in Mississippi is to quickly and efficiently assist the state of Louisiana in evacuating the greater New Orleans area by reversing southbound lanes of I-55 and I-59 to northbound flow. Contraflow is only implemented when requested by Louisiana and approved by the Governor of Mississippi. After Hurricane Katrina, MDOT's post-disaster evaluation results indicated that changes should be made to contraflow in to improve operations. The primary improvement included extending the termination point of I-59 contraflow to just south of Hattiesburg. During Hurricane Katrina, I-59 contraflow in Mississippi extended from the Mississippi/Louisiana state line to just south of Poplarville. Contraflow for I-55 began in Louisiana and extended into Mississippi to just south of Brookhaven. An evacuation and contraflow maps with primary and alternate evacuation routes is provided in Appendix 7.3.5-A.

Loss of Life from Hurricanes

In general, loss of life and property due to high winds is confined to the coastal area. This loss of life is due to wind-borne glass, building materials, and limbs and shrubs. Upland losses can be attributed to rain damage and flooding as well as tornadoes. Flooded road crossings in upland and coastal areas seem to involve a greater loss of life to people in automobiles.

Most deaths due to hurricanes are flood-related. Both coastal and inland flooding is a common occurrence with hurricanes and tropical storms. The death toll from Mississippi hurricanes amounts to 391 persons. This includes 238 persons who died in Hurricane Katrina, 152 who died in Hurricane Camille, and two who died upland in Hurricane Georges. Ninety percent of the deaths in hurricanes involve water-related or flooding deaths. The remaining deaths are due to the impacts of wind and wind-borne projectiles.

Effective warnings, and timely evacuation from coastal areas inundated by storm surge have shown a dramatic reduction in deaths. Evacuation ensures that nobody remains present in the hazard area.

Vulnerability of Natural Resources to Hurricanes

Natural resources, particularly beaches, are devastated by hurricanes. The erosion of the coastline is considerable due to the impact of wind, waves, and debris in a hurricane event. Beaches need to be replenished with appropriate materials to reduce erosion. Storm surge and subsequent erosion of the shoreline leads to the loss of property. The Barrier Islands - Cat, Horn, Petit Bois, and Ship - protecting the Mississippi Gulf Coast have seen damage from earlier events and are projected to disappear within years.

Inland rivers and lakes can become clogged with wind-blown debris and trees, thus slowing recovery from

a hurricane. Obstructions, if not removed, can become a cause for flooding.

Trees that are blown down to the forest floor quickly become a target for infestation from insects that may spread to healthy trees. Water quality may suffer due to unwanted debris and vegetation blown in from a hurricane. Potential debris from fallen trees affected by hurricanes and tornadoes that often accompany them, can create wildfires when the area dries sufficiently to allow for burning through lightning or

intervention by mankind. The Mississippi State Forestry Commission is quick to ensure, through proactive cutting and prescribed burns, that fallen trees and debris will not become fuel for a wildfire.

According to research conducted the U.S.G.S - Historical Changes in the Mississippi-Alabama Barrier-Island Chain and the Roles of Extreme Storms, Sea Level and Human Activities (Robert A. Morton), the islands off the coast of Mississippi are seeing a decline in land mass. These islands provide not only storm protection but also have a high social value for their recreational offerings.

Figures 3.5.8 to 3.5.11 are provided to show the location of the barrier islands and the changes in their land mass between 1847 to 2007.

Figure 3.5.8
Mississippi Barrier Islands

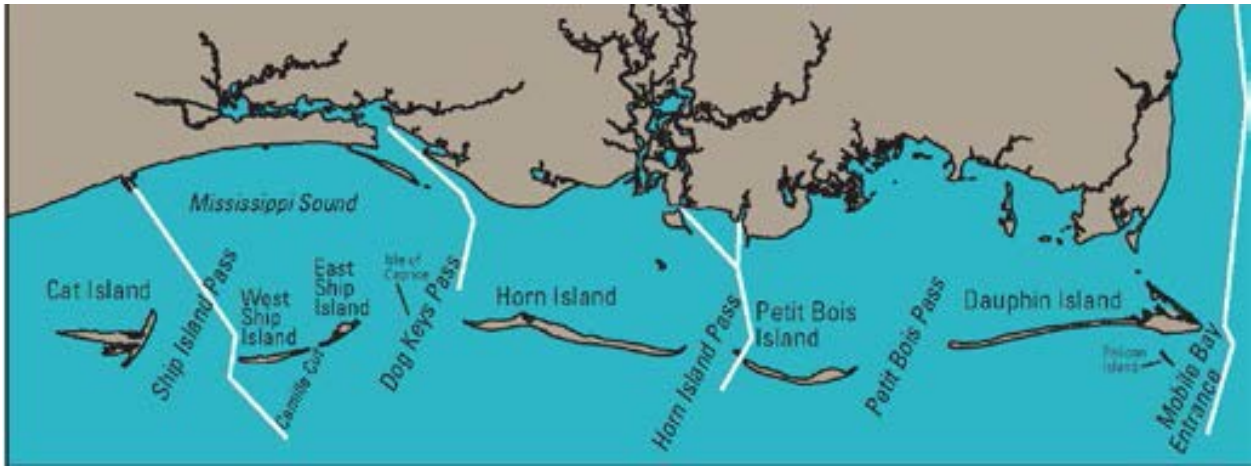


Figure 3.5.9
Historical Land-Loss Trends

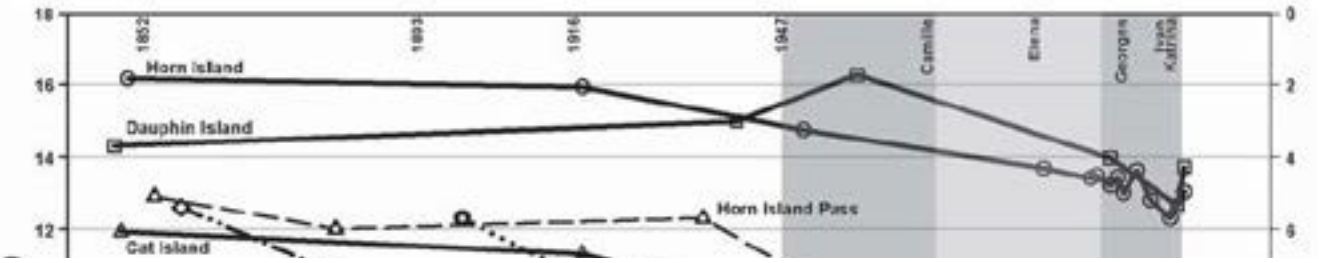
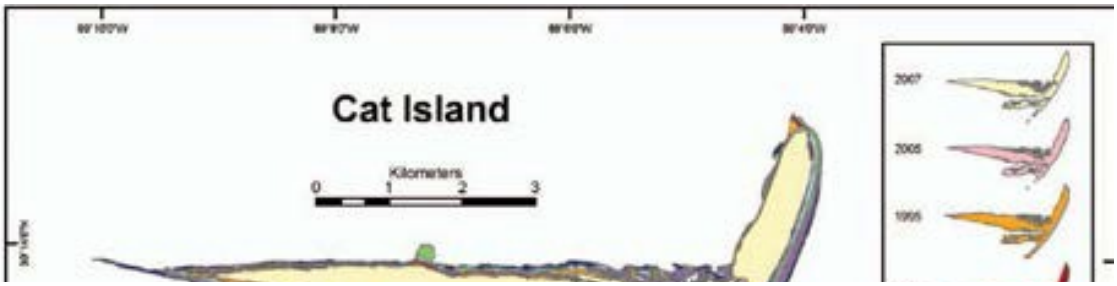


Figure 3.5.10
Historical Land-Loss Trends



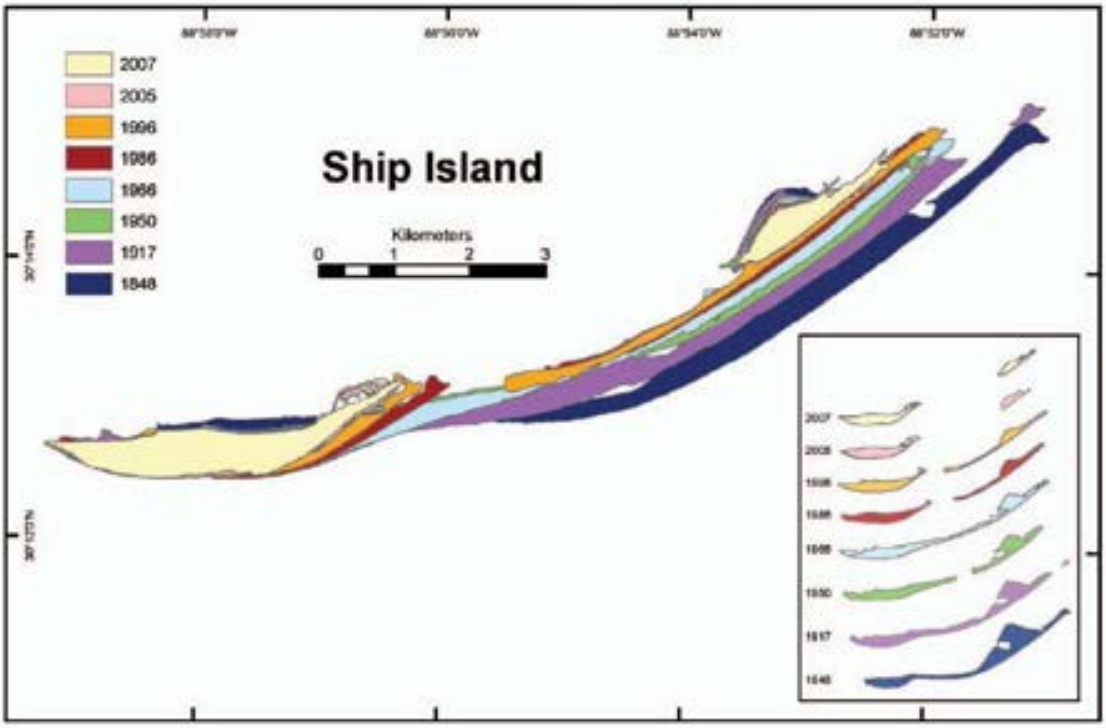
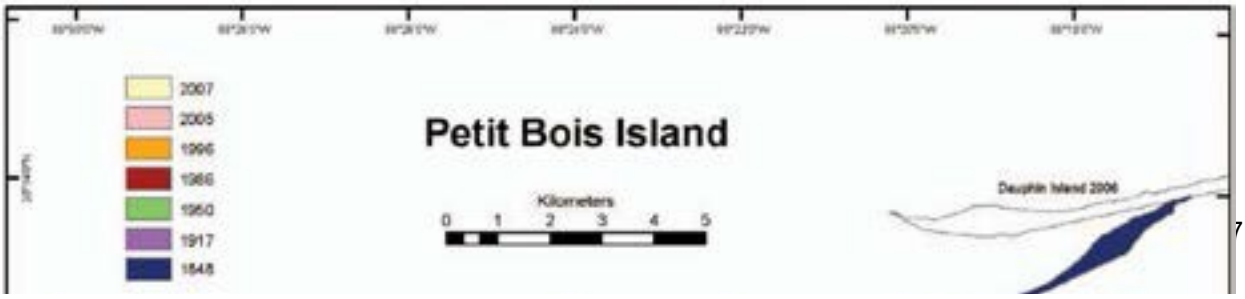
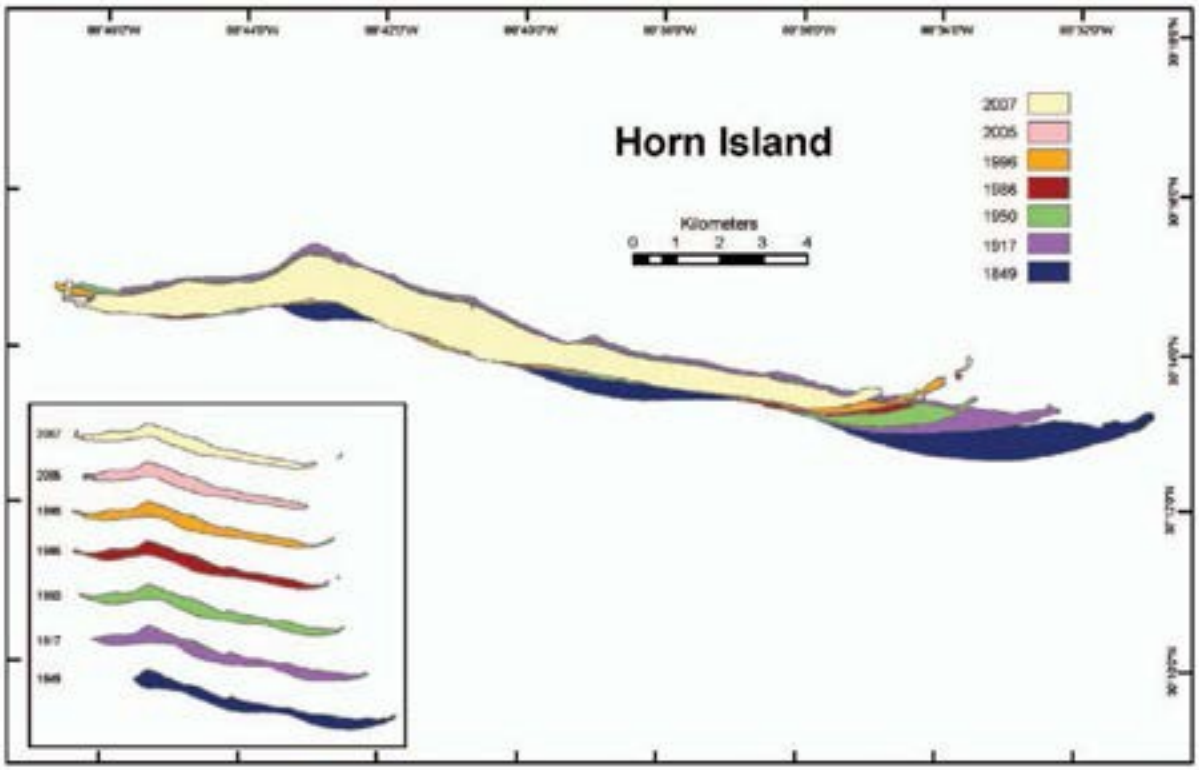


Figure 3.5.11
Petit Bois and Horn Islands





Vulnerability of Private Improvements to Hurricanes

Homes, businesses, and manufactured homes are especially vulnerable to the effects of a hurricane and the winds, rain, and tornadoes generated by a hurricane. The effects of storm surge can flatten a house.

Although hurricane winds can exert tremendous pressure against homes, a large fraction of hurricane damage is not from the wind itself, but from airborne missiles such as tree limbs and branches, signs and

sign posts, roof tiles, metal siding and other pieces of buildings, including entire roofs in major storms. This wind-borne debris penetrates doors and windows, and allows the force of the wind to act against interior walls and ceilings not designed to withstand such forces, thus blowing the building apart.

Local Plan Risk Assessment Summary

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1	1	-		6	-	-	1
2	1	-		7	-	-	1
3	1	-		8	-	2	1
4	-	1	1	9	-	-	1
5	-	19	1				

Assessing Vulnerability by Jurisdiction

Mississippi has had 13 declared hurricane/tropical storm disaster declarations. Table 3.5.7 provides information on the coastal and inland counties that have been declared in previous hurricanes/tropical storm events in order to establish frequency and vulnerability to hurricane/tropical storm damage. In Camille and Katrina, for example, central Mississippi counties as well as coastal counties received damage. These incidents cover the period 1969 to 2017, a 48-year period. The counties are sorted with those with the greatest number of declarations listed first to the least.

Table 3.5.8
Counties Declared in Hurricane/Tropical Storm Events

County	Camille DR-271	Frederic DR-599	Elena DR-741	Georges DR-1251	T.S. Allison DR-1382	T.S. Isidore DR-1436	Ivan DR-1550	Dennis DR-1594	Katrina DR-1604	Gustav DR-11794	Isaac DR-4081	Nate DR-4350
Hancock	X	X	X	X	X	X	X	X	X	X	X	X
Harrison	X	X	X	X	X	X	X	X	X	X	X	X
Jackson	X	X	X	X	X	X	X	X	X	X	X	X
Pearl River	X	X	X	X	X	X	X	X	X	X	X	
George	X	X		X	X	X	X	X	X	X	X	X
Forrest	X	X		X			X	X	X	X	X	
Greene	X	X		X		X	X	X	X		X	X
Jones	X	X		X	X		X	X	X		X	
Stone	X	X				X	X	X	X	X	X	X
Lamar	X			X	X		X	X	X		X	
Perry	X	X		X			X	X	X		X	
Wayne	X	X		X			X	X	X		X	
Covington	X	X					X	X	X		X	
Jefferson Davis				X			X	X	X	X	X	
Marion	X			X			X		X	X	X	
Pike					X	X	X		X	X	X	
Amite						X	X		X	X	X	
Clarke		X					X	X	X		X	
Copiah						X	X		X	X	X	
Jasper	X						X	X	X		X	
Lauderdale	X						X	X	X		X	
Rankin	X						X	X	X		X	
Simpson	X						X	X	X		X	
Smith	X						X	X	X		X	
Walthall	X						X		X	X	X	
Adams	X						X		X	X	X	
Claiborne							X		X	X	X	
Franklin							X		X	X	X	
Hinds							X	X	X		X	
Jefferson							X		X	X	X	
Kemper							X	X	X		X	
Lawrence							X		X	X	X	
Lincoln							X		X	X	X	
Neshoba							X	X	X		X	
Newton							X	X	X		X	
Noxubee							X	X	X		X	
Scott							X	X	X		X	
Wilkinson							X		X	X	X	
Winston							X	X	X		X	
Attala								X	X		X	
Clay							X	X	X			
Lowndes							X	X	X			
Leake								X	X		X	
Madison								X	X		X	
Monroe							X	X	X			
Oktibbeha							X	X	X			
Warren							X		X		X	
Calhoun								X	X			
Carroll								X	X		X	
Chickasaw									X		X	
Choctaw									X		X	
Grenada									X		X	
Holmes									X		X	
Issaquena									X	X		
Itawamba								X	X			

County	Camille DR-271	Frederic DR-599	Elena DR-741	Georges DR-1251	T.S. Allison DR-1382	T.S. Isidore DR-1436	Ivan DR-1550	Dennis DR-1594	Katrina DR-1604	Gustav DR-11794	Isaac DR-4081	Nate DR-4350
Lee								X	X			
Montgomery									X		X	
Pontotoc								X	X			
Washington									X	X		
Webster								X	X			
Yazoo									X		X	
Alcorn									X			
Benton									X			
Bolivar									X			
Coahoma									X			
Desoto									X			
Humphreys									X			
Lafayette									X			
Leflore									X			
Marshall									X			
MS Choctaw Indian Reservation											X	
Panola									X			
Prentiss									X			
Quitman									X			
Sharkey									X			
Sunflower									X			
Tallahatchie									X			
Tate									X			
Tippah									X			
Tishomingo									X			
Tunica									X			
Union									X			
Yalobusha									X			
Hurricane Betsy, 1965, is not included as historical data is not available.												

Assessing Vulnerability by Jurisdiction Methodology/HAZUS-MH Modeling

HAZUS-MH hurricane loss modeling capabilities were used to quantify expected losses to the state and differentiate vulnerability by region. HAZUS-MH can model specific hypothetical or historical scenarios and probabilistic scenarios. Scenario results represent the expected damage from a single hurricane event, while probabilistic scenario results represent the range of probable losses estimated from a 1,000-year simulation of expected hurricane activity. The direct economic loss results for a probabilistic analysis include annualized loss estimates. Annualized losses are the total losses summed over the entire simulation period divided by 1,000 years.

As noted in the previous information on location of past hurricanes and tropical storms, Mississippi's highest risk of impact is in the coastal counties of Jackson, Hancock, and Harrison. As demonstrated by past events, the impact diminishes as storms move inland, but as witnessed with Katrina, even inland counties can experience damage from hurricanes. Katrina's storm track served as the pattern for the 2018 deterministic scenario.

State Probabilistic Scenario

To identify potential losses from a hurricane event, a probabilistic scenario was developed from HAZUS-MH. This analysis evaluates the statistical likelihood that a specific event will occur and what losses and consequences will result. Provided in tables below are the estimated average yearly losses (annualized losses) and the expected distribution of losses (return period). Appendix 7.3.5-B contains the detailed HAZUS reports.

Table 3.5.9
Summary Impacts by Building Occupancy Type – 100-year Return

Occupancy	Exposure	Percentage of Total
Residential	$210,772,463	75.14%
Commercial	$ 43,001,230	15.33%
Industrial	$ 11,641,553	4.15%
Agriculture	$ 1,383,000	0.49%
Religious	$ 7,032,841	2.51%
Government	$ 2,358,594	0.84%
Education	$ 4,328,839	1.54%
Totals	**$280,518,520**	**100%**

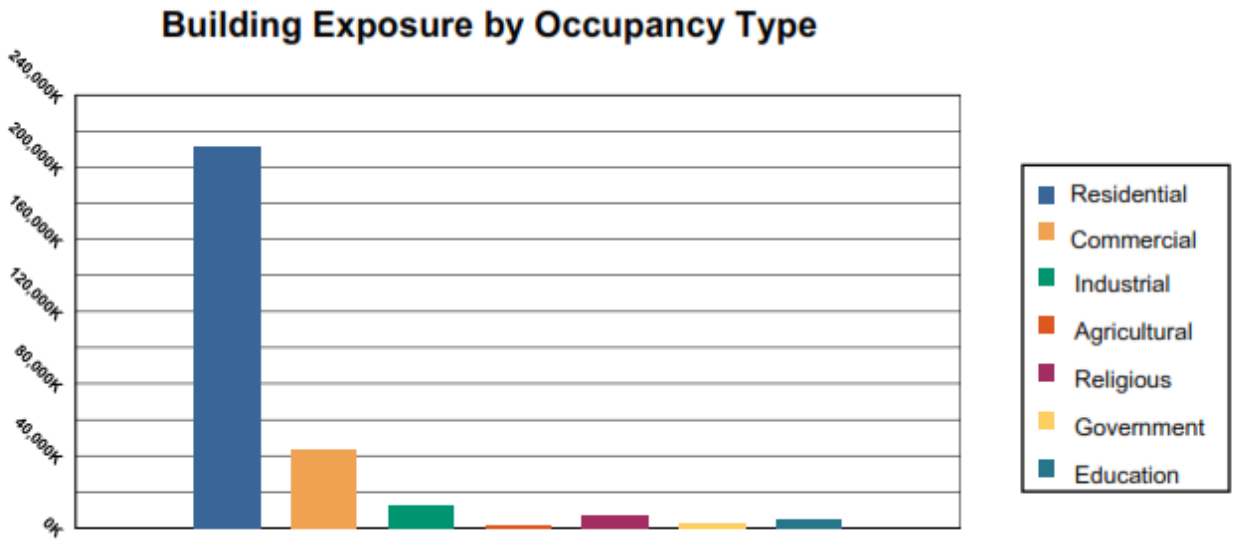
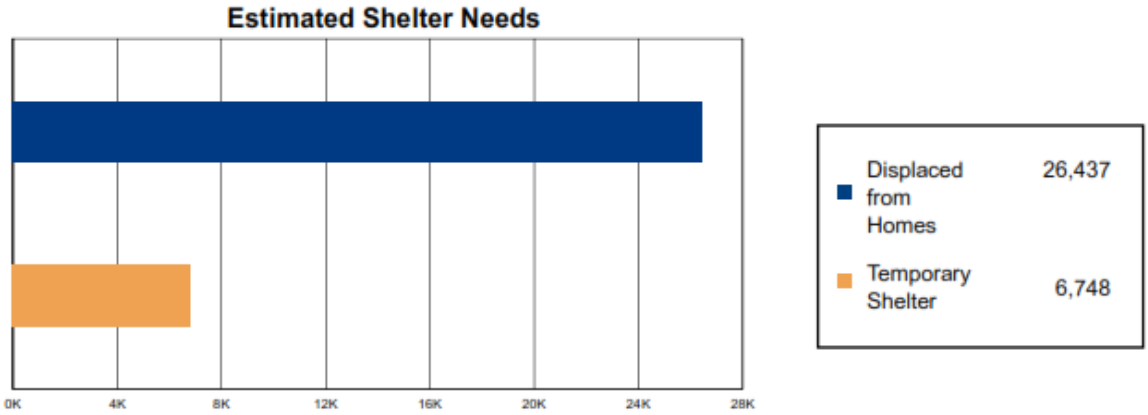


Table 3.5.10
Expected Number of Buildings Damaged by Occupancy – 100-year Event

Occupancy	None	Minor	Moderate	Severe	Destruction

Residential	5,139	41	47	80	32
Commercial	61,225	1,072	1,176	1,459	96
Industrial	2,463	37	41	67	1
Agriculture	2,929	40	45	78	1
Religious	15,390	230	237	407	15
Government	8,670	117	128	201	7
Education	1,071,652	23,678	18,646	13,512	12,854
Totals	**1,167,468**	**25,214**	**20,320**	**15,803**	**13,006**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the estimated amount of people that may require temporary sheltering. The model estimates 26,437 households to be displaced due to the hurricane. Of these, 6,748 people will seek temporary shelter in public shelters.



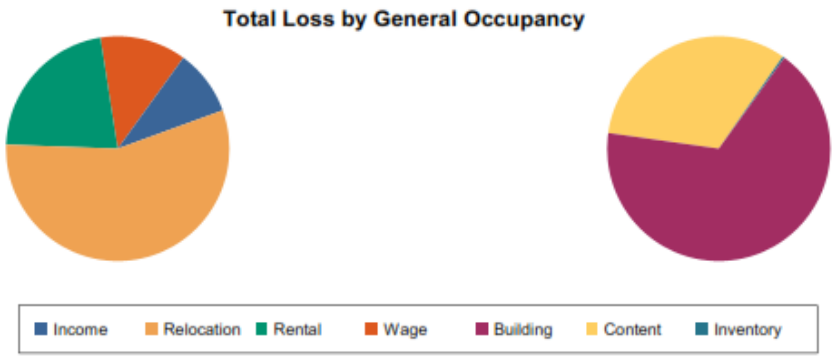
Building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The businesses interruption losses are the losses associated the inability to operate a business because the damage sustained during the hurricane. Business interruption losses also include temporary living expenses for those people displaced from their homes because of a hurricane.

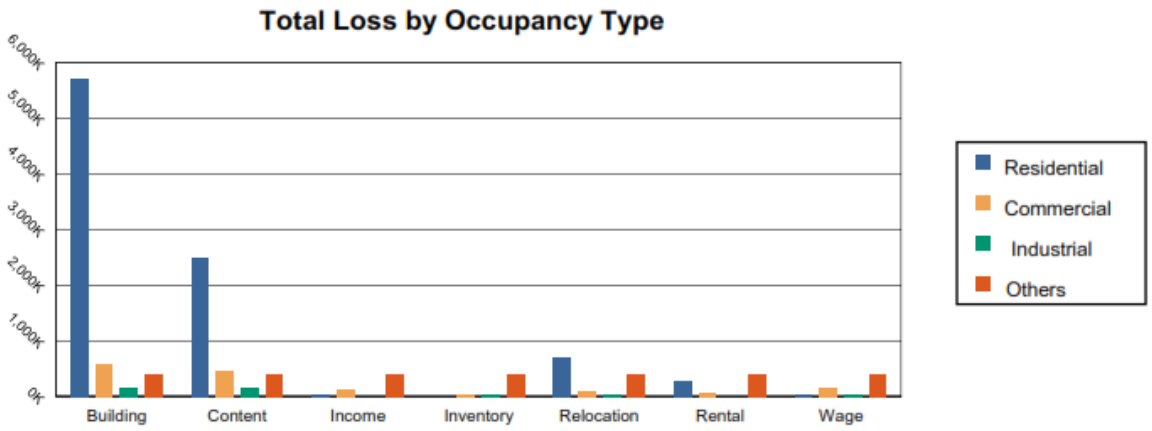
HAZUS estimates the total property damage losses at $11,318,000. Three percent of the estimated losses were related to the business interruption. The largest loss was sustained by residential occupancies which made up over 81% of the total loss.

Table 3.5.11
Building Related Economic Loss Estimates: 100-year Event

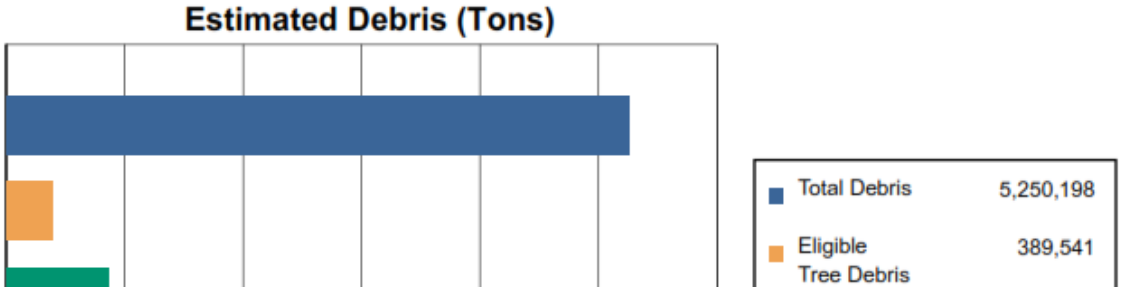
Occupancy	Property Damage	Business Interruption Loss	Total
Residential	$8,173,663	$993,814	$9,167,477
Commercial	$329,989	$397,982	$1,421,005
Industrial	$329,989	$20,048	$350,038

Others	$321,839	$57,799	$379,639
Totals	**$9,848,515**	**$1,469,644**	**$11,318,160**





HAZUS estimated the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: brick/wood, reinforced concrete/steel, eligible tree debris, and other tree debris. The model estimates that a total of 5,250,918 tons of debris will be generated. Of the total amount, 3,957,811 tons (75%) is other tree debris. Of the remaining, brick/wood comprises of 67% of the total, reinforced concrete/steel comprises of 3%, and the remainder is comprised of eligible tree debris.



Peak Windspeed Forecast

Figure 3.5.12 illustrates the frequency of anticipated peak sustained wind speeds associated tropical cyclones making landfall in Mississippi. These data were derived us HAZUS-MH probability estimates.

Figure 3.5.12
Peak Windspeed Forecast: 100-year Event

Hurricane Katrina Scenario (500 Year Event)

HAZUS General Description

This scenario is based on 47,705.34 square miles and contains 605 census tracts. There are over 1,046,000 households with a total population of 2,844,658 people (2000 Census Bureua data). An estimated 1,282,000 buildings are included in this scenario with a total replacement value (excluding contents) of $159,417,000 (2006 dollars). Approximately 92% of the buildings (and 72% of the building value) are associated with residential housing. Appendix 7.3.5-C contains the detailed HAZUS reports for all 82 counties.

General Building Stock

HAZUS estimates that there are 1,282,365 buildings included in this scenario which have an aggregate total replacement value of $159,417,000 (2006 dollars). Table 3.5.12 presents the relative distribution of the value with respect to the general occupancies for all 82 counties followed by the expected damages by occupancy in Table 3.5.13.

Table 3.5.12
Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Total
Residential	$ 114,980,081	72.1%
Commercial	$427,348,654	17.2%
Industrial	$ 7,456,047	4.7%
Agricultural	$ 898,946	.06%
Religious	$ 4,652,775	2.9%
Government	$ 1,527,107	1.0%
Education	$ 2,553,782	1.6%
Total	**$159,417,392**	**100.0%**

HAZUS estimates that about 34,770 buildings will be at least moderately damaged. This is over 3% of the total number of buildings in the state. There are an estimated 1,792 buildings that will be completely destroyed.

Table 3.5.13
Expected Building Damage by Occupancy

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	5,232	91.83	225	3.94	136	2.39	89	1.56	15	0.27
Commercial	55,971	89.68	3,270	5.96	2,169	3.47	545	0.87	9	0.01
Education	2,030	91.58	111	4.99	59	2.64	17	0.79	0	0.00
Government	2,629	92.71	126	4.45	62	2.19	18	0.64	0	0.00
Industrial	14,647	90.22	947	5.83	488	3.01	150	0.92	3	0.02

Residential	1,069,831	90.28	84,384	7.12	25,535	2.15	3,491	0.29	1,764	0.15
Total	**1,157,666**		**89,929**		**28,621**		**4,356**		**1,792**	

Essential Facility Damage

In this scenario, the state had 111 hospitals with 17,989 hospital beds available for use. The day of the hurricane the number of beds was reduced to 3,064 beds (73%). After one week, 80% of the beds will be in service with 89% operational after 30 days. Table 3.5.15 presents the expected damage to essential facilities statewide.

Table 3.5.14
Expected Damage to Essential Facilities

Classification	Total	Number of Facilities		
		Probability of at Least Moderate Damage >50%	Probability of Complete Damage >50%	Expected Loss of Use < 1 Day
EOC's	37	0	0	37
Fire Stations	399	0	0	399
Hospitals	111	38	8	85
Police Stations	368	0	0	368
Schools	1,288	38	0	1,014

Shelter Requirements

It is estimated that 5,486 households could be displaced due to the scenario of a Katrina-like event. Of these, 1,520 people (out of a total population of 2,844,658) will seek temporary shelter in public saferooms. Table 3.5.15 provides an individual county detail for MEMA Regions 9, and 8; county totals are given for Region 7, 6, and 5 with no shelter requirements indicated for Regions 1-4.

Table 3.5.15
Shelter Requirements by MEMA Region

MEMA Region/County		No. of Displaced Households	No. of People Needing Shelter
9	George	22	6
	Hancock	510	135
	Harrison	3,339	918
	Jackson	292	72

	Pearl River	263	71
	Stone	108	30
Total Region 9		**4,534**	**1,232**
8	Covington	17	6
	Forrest	500	163
	Greene	6	2
	Jefferson Davis	8	3
	Jones	76	23
	Lamar	228	58
	Marion	44	13
	Perry	34	10
	Wayne	3	0
Total Region 8		916	278
County Total Region 7		8	3
County Total Region 6		27	7
County Total Region 5		1	0

Building-Related Losses

The following building-related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with the inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were $3,139,000 with 3% of the estimated losses related to business interruption. By far, the largest loss was sustained by the residential occupancies which made up over 81% of the total loss. A summary of the statewide impact of the losses associated with the building damage is provided below followed by Table 3.5.17 which provides detail county data for MEMA Regions 6-9.

Table 3.5.16
Statewide Building-Related Economic Loss Estimates
(thousands of dollars)

Property Damage					
Area	Residential	Commercial	Industrial	Others	Total
Building	$1,646,525	$205,475	$25,778	$40,066	$1,917,844

Content	$573,726	$109,495	$15,960	$18,897	$718,077
Inventory	0	$2,416	$3,655	$558	$6,630
Subtotal	**$2,220,250**	**$317,387**	**$45,393**	**$59,521**	**$2,641,5522**
Business Interruption Loss					
Income	$3,955	$26,365	$453	$2,724	$33,497
Relocation	$212,726	$55,033	$2,955	$11,588	$282,303
Rental	$99,385	$25,054	$429	$1,171	$126,039
Wage	$9,322	$30,528	$745	$13,861	$54,457
Subtotal	**$325,388**	**$136,980**	**$4,583**	**$29,344**	**$496,295**
Total Losses	**$2,545,639**	**$454,367**	**$49,976**	**$88,865**	**$3,138,847**

Table 3.5.17
MEMA Region/County Building-Related Economic Loss Estimates

MEMA Region/	County	Total Property Damage	Total Business Interruption	Total Losses
9	George	21,167	2,592	23,759
	Hancock	237,561	47,245	284,807
	Harrison	1,339,646	287,667	1,627,312
	Jackson	211,836	29,376	1,627,312
	Pearl River	140,822	25,456	166,277
	Stone	47,659	9,552	57,212
8	Covington	15,365	1,996	17,361
	Forrest	205,234	42,356	247,589
	Greene	6,751	611	7,363
	Jefferson Davis	6,597	544	7,143
	Jones	61,853	9,519	71,371
	Lamar	111,468	21,618	133,085
	Marion	29,969	5,262	20,061
	Perry	17,498	2,562	20,061
	Wayne	7,661	569	8,230
7	Adams	87	0	87
	Amite	1,048	0	1,048
	Franklin	361	0	361
	Jefferson	67	0	67
	Lawrence	5,233	250	5,482
	Lincoln	4,475	86	4,561
	Pike	10,220	913	11,132
	Walthall	7,448	1,000	8,448
	Wilkinson	91	0	91
6	Clarke	6,280	351	6,631
	Jasper	7,188	549	7,737
	Kemper	2,674	125	2,799

MEMA Region/	County	Total Property Damage	Total Business Interruption	Total Losses
	Lauderdale	33,733	2,914	36,647
	Leake	1,869	1	1,870
	Neshoba	5,177	330	5,507
	Newton	6,008	343	6,350
	Scott	4,231	247	4,479
	Smith	7,890	339	8,230
5	Simpson	8,297	505	8,802
	Claiborne	47	0	47
	Copiah	2,280	12	2,293
	Hinds	11,774	9	11,784
	Isaquena	0	0	0
	Madison	3,752	2	3,754
	Rankin	12,307	118	12,425
	Sharkey	0	0	0
	Warren	24	0	24
	Yazoo	19	9	19
4	County Totals	30,924	1,259	32,193
3	County Totals	726	0	726
2	County Totals	8,199	3	8,201
1	County Totals	33	0	33

Debris Generation

HAZUS estimates that 12,098,123 tons of debris will be generated from this Katrina scenario. Of the total amount, 10,979,123 tons (91%) is other tree debris. The remaining 1,119,000 tons includes 33% of brick/ wood and the remainder being eligible tree debris. A summary of the statewide impact of debris being generated by this scenario is provided below followed by Table 3.5.18 with county-specific data for MEMA Regions 6-9 with county totals for Regions 2-5 (Region 1 did not report any debris generation).

Statewide Summary of Debris Generation (in tons)				
Brick, Wood and Other	Reinforced Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
369,224	1,963	747,813	10,979,123	12,098,123

Table 3.5.18
MEMA Region/County Debris Generation

		Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	
9	George	3,022	3	14,894	340,564	358,483
	Hancock	34,941	268	57,758	584,794	677,761
	Harrison	177,734	1,236	146,861	800,204	1,126,035
	Jackson	30,5711	84	58,891	494,667	583,707
	Pearl River	20,936	127	56,891	889,281	967,235
	Stone	7,337	52	31,254	685,186	723,829
County Region 9 Totals		**274,541**	**1,770**	**366,043**	**3,794,696**	**4,437,050**
8	Covington	2,589	2	14,311	257,730	274,632
	Forrest	34,778	100	54,230	569,558	658,666
	Greene	1,046	0	12,453	350,928	364,427
	Jefferson Davis	1,102	0	8,408	201,782	211,292
	Jones	10,191	5	32,042	451,469	493,708
	Lamar	17,378	77	44,388	608,394	670,237
	Marion	5,210	5	21,052	430,211	456,478
	Perry	2,872	3	25,330	727,625	755,830
	Wayne	945	0	11,637	340,081	352,663
County Region 8 Totals		**76,111**	**192**	**223,851**	**3,937,778**	**4,237,933**
7	Adams	0	0	0	0	0
	Amite	37	0	1,450	46,894	48,381
	Franklin	5	0	544	17,599	18,148
	Jefferson	0	0	0	0	0
	Lawrence	535	0	5,795	155,733	162,063
	Lincoln	400	0	3,566	72,680	76,646
	Pike	1,354	0	7,534	111,876	120,764
	Walthall	1,415	1	8,590	192,624	202,630
	Wilkinson	0	0	285	9,219	9,504
County Region 7 Totals		**3,746**	**1**	**27,764**	**606,625**	**638,136**
6	Clarke	694	0	10,009	255,369	266,072
	Jasper	950	0	11,260	292,087	304,297
	Kemper	251	0	6,707	216,857	223,815

		Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	
	Lauderdale	4,476	0	20,645	268,414	293,535
	Leake	92	0	1,478	38,999	40,569
	Neshoba	455	0	4,330	91,059	95,844
	Newton	687	0	5,888	144,566	151,141
	Scott	379	0	3,765	94,916	99,060
	Smith	825	0	9,490	255,305	265,620
County Region 6 Totals		**8,809**	**0**	**73,572**	**1,657,572**	**1,739,953**
5	**County Totals**	**2,479**	**0**	**21,802**	**311,702**	**335,983**
4	**County Totals**	**3,135**	**0**	**25,385**	**524,149**	**552,669**
3	**County Totals**	**19**	**0**	**978**	**28,025**	**29,022**
2	**County Totals**	**384**	**0**	**8,415**	**118,578**	**127,377**

Assessing Vulnerability of State Facilities/Estimating Potential Losses

Methodology for Assessing Vulnerability of State Facilities

The methodology and HAZUS runs for assessing vulnerability of state facilities was updated for the 2018 plan. State plan developers used the HAZUS-MH Level 1 scenario to assess the vulnerability of State-owned critical or operated facilities located in hurricane-hazard areas.

The HAZUS-MH scenario provided damage states and loss estimates for government buildings. As stated in the section on Critical Facilities and Infrastructure at the beginning of the risk assessment, Critical Facilities are addressed under the category of Essential Facilities.

The HAZUS-MH scenarios returned a probability of expected damages to essential facilities. In the absence of damage and loss information for the HAZUS-MH categories as noted above, plan developers decided to total the value of the overall State asset inventory for each region to show the vulnerability.

With the limitations noted below, the table provides a clear picture of the losses that could be sustained from a 100-year event. Apparent in the data is the very high vulnerability of state-owned or operated facilities in the three coastal counties and diminishing vulnerability of such as the storms moved northward.

Data Limitation:

For the category of government buildings HAZUS-MH does not distinguish between federal, state or local ownership or building operation. Nor does it distinguish between federal, state, local or private ownership in the three other categories of facilities addressed the assessment. Therefore, all facilities regardless of ownership are included in the assessment.

The state of Mississippi does not have a comprehensive list of state-owned or operated buildings, critical facilities and infrastructure sorted by county that could be input into HAZUS-MH to conduct a Level 2 analysis. During the 2018 update state facilities data was available in tabular form from MEMA, but did not include XY coordinates, and thus could not be incorporated into HAZUS-MH.

100-Year Event

Before the hurricane, the region had 17,989 hospital beds available for use. On the day of the hurricane, the model estimates that 15,513 hospital beds (only 86%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 90% of the beds will be in service. By 30-days, 96% will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

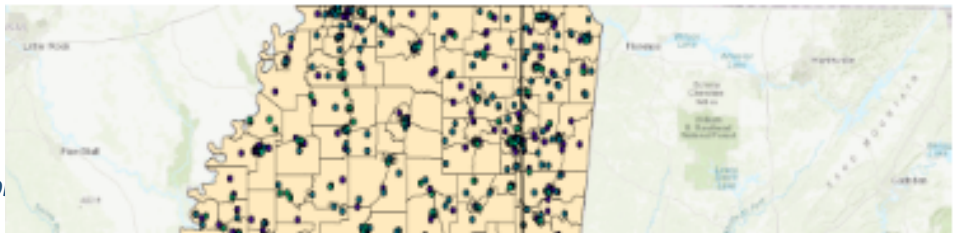


Table 3.5.19
Expected Damages to Essential Facilities

Classification	Total	Number of Facilities		
		Probability of at Least Moderate Damage >50%	Probability of Complete Damage >50%	Expected Loss of Use < 1 Day
EOC's	37	0	0	37
Fire Stations	399	15	0	390
Hospitals	111	12	4	100
Police Stations	368	8	0	362
Schools	1,288	73	0	1,184

Table 3.5.20
Summary of Potential Losses to Essential Facilities

Region	Number of Buildings with available Replacement Values	Total Replacement Value (as available)
MEMA Region 1	171	$57,356,843
MEMA Region 2	331	$156,546,716
MEMA Region 3	552	$256,299,605
MEMA Region 4	134	$27,175,900
MEMA Region 5	1,335	$2,648,653,307
MEMA Region 6	918	$813,681,823
MEMA Region 7	247	$79,618,031
MEMA Region 8	455	$286,676,990
MEMA Region 9	268	$215,287,139

Hurricane Nate. Wikipedia. Retrieved May 22, 2018, from https://en.wikipedia.org/wiki/Hurricane_Nate

3.6: Flood Risk Assessment

Hazard Description

Flooding causes ninety percent of all-natural disaster damages. The effects of a flood can be devastating. Between the inundation and the force of the current, both lives and property can be lost. People and animals can be drowned or injured by the floodwaters and current-borne debris. This same debris causes structural damage to buildings, roads, bridges, and railroads. Sanitary and storm sewers, water and utility installations can be damaged from flooding debris and their systems interrupted for extended periods of time. Crops can be carried away by the current or destroyed by prolonged submergence. Farmlands may be deeply eroded by new channels, resulting in the loss of valuable topsoil.

A flood is any general or temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters or the unusual and rapid accumulation or run-off of surface waters from any source.

Flooding is a natural and inevitable occurrence. Floods occur seasonally with general or torrential rains associated with tropical storms that later drain into river basins and fill them with an abundance of water. Rivers, lakes, and other water bodies have always overflowed their normal beds to inundate nearby land. The land adjacent to these bodies of water is called the floodplain. There are generally four leading causes/ types of flooding. Mississippi is vulnerable to each as will be explained in the following section.

River (Riverine or Stream) Flooding:

Riverine floods occur along rivers, streams, or channels primarily when there is heavy or prolonged rainfall. Other contributing factors include: (1) the elimination of ground cover on drainage slopes as a result of tree cutting or wildfires, land development, or overgrazing; (2) the simultaneous arrival of flood crests from major tributaries; and (3) blocked drainage by items such as debris; dams or inadequately sized drainage structures. Floods from these sources can be “flash” or rapid but are usually more gradual and have longer duration than flash floods. Riverine floods occur in all nine river basins in Mississippi.

Flash Flooding (Rapid):

Flash floods are a result of heavy, localized rainfall, possibly from slow-moving intense thunderstorms that cause small creeks, streams, branches and rivers to overflow. They are most common when rain falls on areas with steep slopes or built-up areas where impervious surfaces, gutters, and storm sewers speed up the flow of run-off. The torrential nature of flash floods makes this hazard particularly lethal, especially in or near river and streambeds, city streets, coastal areas and narrow valleys which contribute to the development of rapid water movement. Rapid or flash flooding occurs in all nine river basins in Mississippi.

Coastal (Tidal) Flooding:

All lands bordering the Mississippi Sound, such as various bays, estuaries or lakes are prone to tidal effects/flooding. Coastal lands, such as sand bars, barrier islands, and deltas provide a buffer zone to help protect human life and real property relative to the sea, much as floodplains provide a buffer zone along rivers or other bodies of water. Coastal floods usually occur as a result of abnormally high tides or tidal waves, storm surge and heavy rains in combination with high winds, tropical storms, or hurricanes. Storm surge is caused by high water from wind and the low air pressure differences that accompany a storm.

Storm surge is not a tidal wave or sudden rush of water; rather it is more of a gradual increase in water surface elevation. A surge can be as high as 20 feet above normal water levels, flooding normally dry areas far inland. A storm surge is associated with a tropical storm or hurricane. Most of the fatalities and damage caused by a tropical storm or hurricane are the result of surge and its associated flooding, not high winds. The effects of coastal flooding can be worsened due to erosion. Coastal dunes and beaches provide natural protection by causing waves to break close to the shore, but these features can be worn down, exposing areas farther inland to storm damage. Tidal flooding occurs within three basins in Mississippi: Pearl River, Coast River, and Pascagoula River Basins.

Drainage

Drainage flooding occurs primarily in urban or developed areas when the volume of run-off exceeds the capacity of drainage systems. Flooding of this nature can be the result of increased development, inadequate drainage, riverine flooding, flash flooding, or a combination of these. Drainage flooding occurs in all nine river basins.

Hazard Profile

Mississippi is situated in a region where water is a bountiful natural resource, coming in third behind Louisiana as the "wettest" state in the union considering the average amount of precipitation over the State's area. The statewide average of above 59 inches over nearly 31 million acres produces a volume in excess of 144 million acre-feet of water delivered to the state by the atmosphere annually, providing both surface and groundwater in abundance. Though Mississippi has no natural large inland lakes, flood control dams in the Yazoo-Tallahatchie basin and water supply reservoirs at Jackson and Meridian have formed large lakes in the north, and these have added to the fishing and recreational resources of the State. All the larger streams flow year-round.

Flood season in Mississippi is considered to primarily occur between the months of November through June (the period of greatest rainfall), while the months of March and April are considered to be the months of greatest flood frequency. The first six months of the year is the season of high flows in the Mississippi River. In other rivers and streams, flooding sometimes occurs during the summer from persistent thunderstorms, or in the late summer and early fall from the heavy rains associated with tropical storms originating in the Gulf of Mexico.

Local overflows occur on many streams three or four times a year in association with extended rainy spells and saturated soil conditions. Severe general flooding occurs about once in two years from upstream runoff. The only important contribution to the Mississippi River within the state is from the Yazoo Basin. A system of levees prevents major damage from Mississippi River floods.

Flash flooding and heavy rain events have posed significant threats to many communities throughout the state. The aging drainage infrastructure and urban sprawl have increased the amount of runoff into area drainage systems and creeks. Creeks that were once narrow enough to jump over are now wider creating exit points for water to drain out of its banks and into developed areas. As road/bridge improvements are made and larger culverts and catch basins are engineered, a more thorough look downstream to assure that the improvements made will not create a "bottleneck" in undeveloped areas behind neighborhoods that could create an increase in flooding events through the washed-out creek systems.

Education and Outreach

Flood Awareness Week occurs in the month of March. For more information on flood awareness call the MEMA Public Information number (866-519-6362) between 8 a.m. and 5 p.m. weekdays.

Mississippi's Coastal Hazard Outreach Strategy Team (C-HOST) is a regional outreach team that was established March 5, 2008. The Team strives to deliver the general floodplain management messaging so that residents are educated about flood hazards, flood insurance, flood protection measures, and the NFIP. Education and outreach information is provided at http://chost.stormsmart.org.

Hurricane Isaac Flooding, 2012

Mississippi River Flooding, Vicksburg 2011

Severe Storms and Flooding, Clarksdale 2016

Location - River Basins

The state of Mississippi is located within the Gulf of Mexico drainage area. The nine primary river basins within the state are categorized (from north to south) as the:

- North Independent Basin
- Tennessee River Basin
- Yazoo River Basin
- Tombigbee River Basin
- Big Black River Basin
- Pearl River Basin
- South Independent Basin
- Pascagoula River Basin
- Coastal River Basin

The state is primarily concerned with the risk associated with the floodplains found within the nine basins listed above. The local governments focus their risk assessments on the tributaries and secondary streams associated with the primary rivers located within their environs.

The state recognizes the importance of watershed planning and regional planning when implementing flood mitigation solutions. The identified basins and their member counties are listed on the subsequent pages. The assignment of a county to a basin was based solely upon the placement of the majority of the county's landmass within the appropriate basin boundary.

North Independent River Basin

The North Independent Basin encompasses portions of Alcorn and Tippah counties. Flood losses associated with this basin are due primarily to the Hatchie, Tuscumbia and Little Hatchie Rivers, Muddy Creek, South Tippah Creek, and their tributaries.

County	Total Area in Sq. Miles
Alcorn	401.3
Tippah	459.9
Totals	**861.2**

Tennessee River Basin

The Tennessee River Basin encompasses portions of Tishomingo County. Flood losses associated with this basin are due primarily to the Tennessee and Tombigbee Rivers, Bear Creek, Yellow Creek, and their tributaries.

County	Total Area in Sq. Miles
Tishomingo	444.6

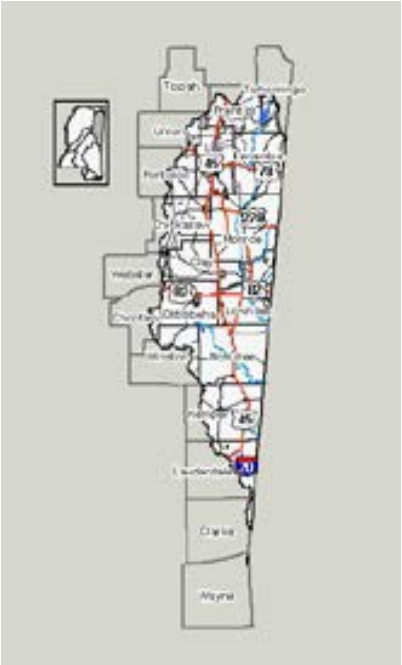
Yazoo River Basin

The Yazoo River Basin encompasses portions of the twenty-five counties listed below. Flood losses associated with this basin are due primarily to the Yazoo, Sunflower, Coldwater, and Tallahatchie Rivers and their associated tributaries.

County	Total Area in Sq. Miles	County	Total Area in Sq. Miles
Benton	408.5	Marshall	709.6
Bolivar	905.7	Panola	704.9
Calhoun	587.8	Pontotoc	500.9
Carroll	634.3	Quitman	406.4
Coahoma	583.0	Sharkey	434.8
Desoto	496.6	Sunflower	707.1
Grenada	449.2	Tallahatchi	651.9
Holmes	764.0	Tate	410.8
Humphrey	431.1	Tunica	480.7
Issaquena	441.4	Union	416.8
Lafayette	679.1	Washingto	761.2
Leflore	606.2	Yalobusha	494.8
		Yazoo	933.9
		Totals	12,773

Tombigbee River Basin

The Tombigbee River Basin encompasses portions of the ten counties listed below. Flood losses associated with this basin are due primarily to the Tombigbee, Luxpalila, ant the Buttahatchee Rivers, the Bull Mountain, Mattubby and Yellow Creeks and their associated tributaries.



County	Total Area in Sq. Miles
Benton	408.5
Bolivar	905.7
Calhoun	587.8
Carroll	634.3
Coahoma	583.0
Desoto	496.6

County	Total Area in Sq.
Marshall	709.6
Panola	704.9
Pontotoc	500.9
Quitman	406.4
Sharkey	434.8
Sunflower	707.1
Totals	12,77

Big Black River Basin

The Big Black River Basin encompasses portions of the seven counties listed below. Flood losses associated with this basin are due primarily to the Big Black and the Bogue Chitto Rivers, the Deer, Black Poplar and Mulberry Creeks and their associated tributaries.

County	Total Area in Sq. Miles
Attala	736.9
Choctaw	419.7
Hinds	877.1
Madison	741.7
Montgomery	407.1
Warren	618.7
Webster	423.2
Totals	**4224.4**

Pearl River Basin

Flood losses associated with this basin are due primarily to the Pearl, Strong and Yockanookany Rivers and the Hobolochitta, Little, Richland, Pelahatchie, Culley, Bogue Chitto, Nanih Waiya and Big Slough Creeks and their associated tributaries.

County	Total Area in Sq. Miles	County	Total Area in Sq. Miles
Jefferson Davis	409.0	Rankin	805.9
Lawrence	435.6	Scott	610.2
Leake	585.2	Simpson	590.3
Lincoln	588.0	Walthall	404.3
Marion	548.4	Winston	610.0
Neshoba	571.5		
		Totals	6,158.

South Independent River Basin

The South Independent Basin encompasses portions of the eight counties listed below. Flood losses associated with this basin are due primarily to the Mississippi, Buffalo, Homochitto Rivers, Bayou Pierre and the Second and St. Catherine Creeks and their associated tributaries.

County	Total Area in Sq. Miles	County	Total Area in Sq.
Adams	486.4	Franklin	566.7
Amite	731.6	Jefferson	527.2
Claiborne	501.4	Pike	410.7
Copiah	779.2	Wilkinson	687.8
		Totals	4691

Pascagoula River Basin

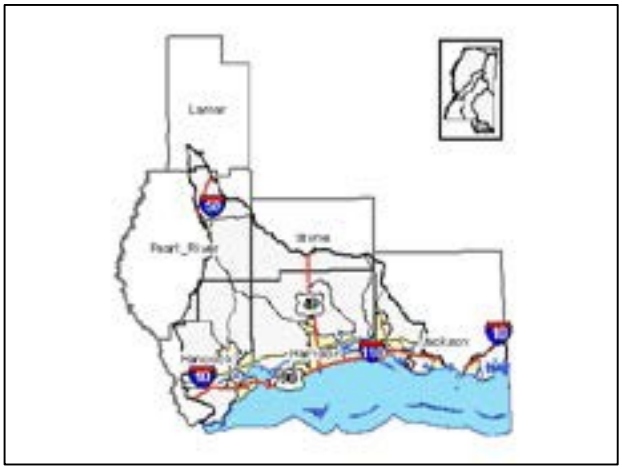
The Pascagoula River Basin encompasses portions of the 15 counties listed below. Flood losses associated with this basin are due primarily to the Pascagoula, Escatawpa, Chickasawhay, and Leaf Rivers, the Bogue Homa, Thomp- son, Tallahala, Tallahoma, Okatoma, Long, Okatibbee, and Sowashee Creeks and their associated tributaries.

County	Total Area Sq Miles
Clarke	693.4
Covington	414.8
Forrest	470.0
George	483.6
Greene	718.7
Jackson	1,043.3
Jasper	677.3
Jones	699.6

County	Total Area Sq
Lamar	500.3
Lauderdale	715.2
Newton	579.4
Perry	650.1
Smith	637.1
Stone	448
Wayne	813.4
Totals	9544.2

Coastal River Basin

The Coastal River Basin encompasses portions of Hancock, Harrison, and Pearl River Counties. Flood losses associated with this basin are due primarily to the Wolf, Jourdan, Biloxi, Little Biloxi, and Tchautacabouffa Rivers, Rotten Bayou, Bayou La Croix, Bernard Bayou, Brickyard Bayou, Turkey and Tuxachanie Creeks, and their associated tributaries.



County	Total Area in Square Miles
Hancock	552.4
Harrison	975.9
Pearl River	818.7
Totals	**2,347**

Mississippi River Basin

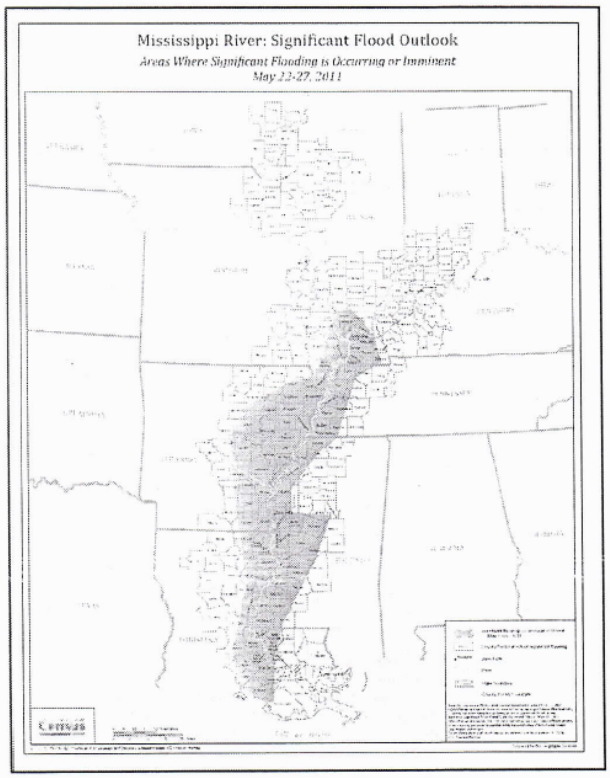
The Mississippi River Basin encompasses small portions of the eleven counties listed in the table below. The flood losses associated with this slice of terrain adjacent to the Mississippi River are primarily structures known as "fish camps." These structures are secondary homes or weekend homes. A large percent- age of the state's repetitive loss structures are thought to consist of such structures, which are constructed on the "wet side" of the levee system. The analyses of the counties will be included in the appropriate basin that contains the largest landmass as indicated.

County	River Basin
Adams	South Independent River
Bolivar	Yazoo River
Claiborne	South Independent River
Coahoma	Yazoo River
Desoto	Yazoo River
Issaquena	Yazoo River
Jefferson	South Independent River
Tunica	Yazoo River
Warren	Big Black River
Washington	Yazoo River
Wilkinson	South Independent River

Historic Flood Events

Mississippi River Flood 2011

The Mississippi River floods in April and May 2011 were among the largest and most damaging recorded along the U.S. waterway in the past century, comparable in extent to the major floods of 1927 and 1993. In April 2011, two major storm systems deposited record levels of rainfall on the Mississippi River watershed. When that additional water combined with the springtime snowmelt, the river and many of its tributaries began to swell to record levels by the beginning of May. Areas along the Mississippi itself experiencing flooding include Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. U.S. President Barack Obama declared the western counties of Kentucky, Tennessee, and Mississippi federal disaster areas. For the first time in 37 years, the Morganza Spillway was opened on May 14, deliberately flooding 4,600 square miles (12,000 km2) of rural Louisiana to save most of Baton Rouge and New Orleans.



Fourteen people were killed in Arkansas, with 392 killed across seven states in the preceding storms. Thousands of homes were ordered evacuated, including over 1,300 in Memphis, Tennessee, and more than 24,500 in Louisiana and Mississippi, though some people disregarded mandatory evacuation orders. The flood crested in Memphis on May 10 and artificially crested in southern Louisiana on May 15, a week earlier than it would have if spillways had not been opened. The United States Army Corps of Engineers stated that an area in Louisiana between Simmesport and Baton Rouge was expected to be inundated with 20-30 feet (6.1- 9.1 m) of water. Baton Rouge, New Orleans, and many other river towns are threatened, but officials stressed that they should be able to avoid catastrophic flooding.

From April 14-16, the storm system responsible for one of the largest tornado outbreaks in U.S. history also produced large amounts of rainfall across the southern and midwestern United States. Two more storm systems, each with heavy rain and tornadoes, hit in the third week of April. In the fourth week of April, from April 25- 28, another, even more extensive and deadly storm system passed through the Mississippi Valley dumping more rainfall resulting in deadly flash floods. The unprecedented extensive rainfall from these four storms, combined with springtime snow melt from the Upper Midwest, created the perfect situation for a 500-year flood along the Mississippi.

Mississippi Summary:

In Tunica County, nine casinos located on stationary river barges were closed most of May. The hotel portions of the casinos are located on adjacent, low-lying land, and began to flood with the rising waters, some up to 6 feet. Near Vicksburg, Highway 465 in Warren and Issaquena counties was closed on May 3 due to high flood waters. North-south access to and from Vicksburg was cut off for more than two weeks. U.S. Highway 61 between Vicksburg and Port Gibson was closed by backwater flooding along the Big Black River on May 12; it reopened June 1. Another portion of U.S. Highway 61 near Redwood was closed by backwater flooding along the Yazoo River on May 13 and was closed until June 3

In anticipation of major flooding, the U.S. federal government declared 14 counties along the Mississippi River: Adams, Bolivar, Claiborne, Coahoma, Desoto, Humphreys, Issaquena, Jefferson, Sharkey, Tunica, Warren, Washington, Wilkinson and Yazoo. Mississippi Governor Haley Barbour urged holdouts to head for higher ground, saying "The biggest danger is that they choose not to evacuate assuming there'll be someone to rescue them," noting that emergency teams could be endangered as well. "More than anything else save your life and don't put at risk other people who might have to come in and save your lives."

The Flood of 2011 set new record stages at Vicksburg and Natchez. The peak streamflow at Vicksburg, 2,310,000 cubic feet per second (65,000 m3/s), exceeded the both the estimated peak streamflow of the Great Mississippi Flood of 1927, 2,278,000 cu ft/s (64,500 m3/s), and the measured peak streamflow of the 1937 flood, 2,080,000 cu ft/s (59,000 m3/s). The Project Design Flood predicts that a flowrate at Vicksburg of 2,710,000 cubic feet per second (77,000 m3/s) would still be within the limits of the downstream capacities, meaning that the May 17 - May 18 peak flow was about 85% of the acceptable flowrate for Vicksburg.

Hurricane Katrina 2005

On August 29, 2005, Hurricane Katrina made landfall resulting in widespread flash flooding across the state. The 26 counties impacted by this event include: Newton, Scott, Neshoba, Leake, Kemper, Winston, Attala, Noxubee, Oktibbeha, Choctaw, Lowndes, Clay, Forrest, George, Greene, Lamar, Perry, Stone, Wayne, Marion, Prentiss, Covington, Jefferson Davis, Jones, Jasper and Smith. This storm dropped five to eight inches of rain over a six to ten-hour period. This rainfall event caused many county roads and other secondary roads to remain flooded for a period of time with a number of roads being closed. Additionally, several roads had small sections washed out or nearly washed out due to their locations in low lying areas near creeks and creek-bottoms.

125-year Event Central Mississippi 2003

On April 6, 2003, many counties in Mississippi experienced a 125-year rainfall event. To put the entire event into perspective, areas north of Interstate 20 and extending west and east across the entire state were impacted. The 16 counties impacted include: Hinds, Scott, Rankin, Yazoo, Grenada, Leflore, Lee, Warren, Choctaw, Madison, Leake, Winston, Newton, Neshoba, Lauderdale and Kemper. Rainfall totals averaged 7 to 12 inches in a period of 18 hours. River flooding quickly became a major problem due to the large amounts of rainfall. Pelahatchie Creek experienced a 100-year flood event. The Chunky River at Chunky set a new record. This river actually flooded a portion of Interstate 20 which had to be closed for a

few hours. The Chickasawhay River at Enterprise also set a record. In addition to the flash flooding, river flooding caused major damage to homes and numerous roads.

Easter Flood on the Pearl River 1979

The flood of record on the Pearl River in 1979 affected about 500 people, contributed to the deaths of four people and resulted in an estimated $400 million in property damages. A worst-case scenario today would equal or double those numbers.

Mississippi River 1927

The flood of record within the state occurred on the Mississippi River in 1927. At that time, the flood resulted in 246 deaths, 650,000 homeless, and caused $284.1 million in property damages.

Other Flood Events

- 2014 – Severe Storms, Tornadoes, and Flooding
- 2012 – Hurricane Isaac
- 1973 – Mississippi River
- 1969 – Hurricane Camille
- 1961 – Pearl River
- 1948 – Tombigbee River
- 1892 – Tombigbee River

Under provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (PL 93 – 288 as amended) and its predecessor, the Disaster Relief Act of 1970 (PL 91-606), 29 floods have resulted in federally declared "Major Disasters" since 1984. (See Table 3.6.1).

Table 3.6.1
Federal Disaster Declarations Flooding 1987 - 2017

Date Declared	Description	Disaster Declaration	Funds Extended	
			Public Assistance (Dollars Obligated)	Individual Assistance Dollars Approved)
Nov 2017	Hurricane Nate	DR-4350	$171,409	Not Available
May 2017	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4314	$14,859,529	Not Available
Jan 2017	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4295	$8,910,037	$3,336,215
Mar 2016	Severe Storms and Flooding	DR-4268	$8,833,631	$8,144,330
Jan 2016	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4248	$5,548,643	$2,903,900
Apr 2014	Severe Storms, Tornadoes, Flooding	DR-4175	$90,521,861	$5,899,175
Feb 2013	Severe Storms, Tornadoes, Flooding	DR-4101	$606,727	$2,974,219
Aug 2012	Hurricane Isaac	DR-4081	$29,319,162	$17,315,143

Date Declared	Description	Disaster Declaration	Funds Extended	
			Public Assistance (Dollars Obligated)	Individual Assistance Dollars Approved)
May 2011	Mississippi Flooding	DR-1983	$7,933,540	$13,724,525
May 2010	Severe Storms, Tornadoes and Flooding	DR-1916	$11,262,731	$1,320,029
April 2010	Severe Storms, Tornadoes and Flooding	DR-1906	$5,913,852	$4,302,971
May 2009	Severe Storms, Floods	DR-1837	$2,721,893	$0
Sept 2008	Hurricane Gustav	DR-1794	$33,693,136	$7,176,481
April 2008	Severe Storms	DR-1764	$4,713,231	$549,481
March	Severe Storms	DR-1753	$0	$1,598,082
Aug 2005	Hurricane Katrina	DR-1604	$3,243,443,38	$1,296,454,55
July 2005	Hurricane Dennis	DR-1594	$1,735,639	$0
Sept 2004	Hurricane Ivan	DR-1550	$14,403,029	$8,514,433
April 2003	Severe Storms	DR-1459	$6,031,462	$18,270,709
Oct 2002	Tropical Storm Isidore and Hurricane Lili	DR-1436	$6,784,617	$0
Nov 2001	Severe Storms	DR-1398	$5,519,322	Not available
June 2001	Tropical Storm Allison	DR-1382	$1,804,361	Not available
April 2001	Severe Storms	DR-1365	$2,855,253	Not available
Sept 1998	Hurricane Georges	DR-1251	$32,124,060	Not available
June1997	Mississippi River Floods	DR-1178	$264,979	Not available
May 1995	Response 1995	DR-1051	$996,257	Not available
May 1991	April – May Floods	DR-906	$7,390,442	Not available
Feb 1990	January – March Floods	DR-859	$7,901,304	Not available
March	Severe Storms, Floods	DR-7687	Not available	Not available

Source: Federal Emergency Management Agency
Total dollars for PA and IA through December 2017

There are 82 counties within the state; all of which suffered at least one event since 1950. The number of instances for each of the counties by MEMA Region is indicated in Table 3.6.2.

Table 3.6.2
Mississippi Flood History January 1950 – October 2017
by County/MEMA Region

MEMA Region	County	Number of Events	Deaths	Injuries	Property Damage
MEMA Region 1	Coahoma	22	0	0	$1,938,000
	Desoto	58	2	0	$10,271,000
	Grenada	46	0	0	$3,789,000
	Panola	24	1	1	$1,244,000
	Quitman	5	0	2	$2,062,000
	Tallahatchie	13	0	0	$1,871,000
	Tate	23	2	7	$478,000
	Tunica	11	2	0	$1,002,000,000
	Yalobusha	7	0	0	$33,000
Total Region 1 Totals		209	7	10	$1,023,686,000
MEMA Region 2	Alcorn	33	1	0	$5,651,000
	Benton	6	0	0	$762,000
	Itawamba	12	0	0	$39,000
	Lafayette	21	0	0	$1,140,000
	Lee	44	0	0	$733,000
	Marshall	18	1	0	$1,092,000
	Pontotoc	18	0	0	$145,000
	Prentiss	20	0	0	$419,000
	Tippah	18	0	0	$1,577,000
	Tishomingo	15	3	0	$1,054,000
	Union	23	0	0	$1,327,000
Total Region 2 Totals		228	5	0	$13,939,000
MEMA Region 3	Attala	22	0	0	$2,695,000
	Bolivar	38	0	0	$4,103,000
	Carroll	17	0	0	$5,000
	Holmes	17	0	0	$13,003,000
	Humphreys	17	0	0	$2,122,000
	Leflore	28	0	0	$1,742,000
	Montgomery	18	0	1	$1,001,000
	Sunflower	27	0	0	$2,547,000
	Washington	42	0	0	$18,212,000

MEMA Region	County	Number of Events	Deaths	Injuries	Property Damage
Total Region 3 Totals		226	0	1	$45,430,000
MEMA Region 4	Calhoun	16	0	0	$259,000
	Chickasaw	6	0	0	$28,000
	Choctaw	13	0	0	$985,000
	Clay	8	0	0	$1,075,000
	Lowndes	35	0	0	$6,581,000
	Monroe	17	0	0	$1,351,000
	Noxubee	13	0	0	$560,000
	Oktibbeha	20	0	0	$1,896,000
	Webster	15	0	1	$1,885,000
	Winston	16	0	0	$1,257,000
Total Region 4 Totals		159	0	1	$15,877,000
MEMA Region 5	Claiborne	16	0	0	$1,279,000
	Copiah	27	0	0	$2,433,000
	Hinds	96	0	1	$27,969,000
	Issaquena	9	0	0	$2,163,000
	Madison	50	0	0	$52,993,000
	Rankin	73	0	1	$43,585,000
	Sharkey	14	0	0	$1,748,000
	Simpson	18	0	0	$466,000
	Warren	39	0	0	$21,870,000
	Yazoo	31	1	0	$19,177,000
Total Region 5 Totals		373	1	2	$173,683,000
MEMA Region 6	Clarke	26	0	0	$4,520,000
	Jasper	25	0	0	$3,501,000
	Kemper	12	0	0	$1,585,000
	Lauderdale	53	0	0	$55,153,000
	Leake	17	0	0	$10,925,000
	Neshoba	23	0	0	$2,069,000
	Newton	31	0	0	$32,275,000
	Scott	26	1	0	$53,276,000
	Smith	19	0	0	$520,000
Total Region 6 Totals		232	1	0	$163,824,000
	Adams	32	0	0	$4,105,000

MEMA Region	County	Number of Events	Deaths	Injuries	Property Damage
MEMA Region 7	Amite	6	0	0	$690,000
	Franklin	22	0	0	$3,616,000
	Jefferson	15	0	0	$3,860,000
	Lawrence	24	0	0	$2,213,000
	Lincoln	32	0	0	$6,781,000
	Pike	14	0	0	$985,000
	Walthall	6	0	0	$1,260,000
	Wilkinson	8	0	0	$6,765,000
Total Region 7 Totals		159	0	0	$30,275,000
MEMA Region 8	Covington	24	0	0	3,093,000
	Forrest	78	1	0	$6,575,000
	Greene	19	0	0	$159,000
	Jefferson	15	0	0	$3,860,000
	Jones	66	0	0	$8,563,000
	Lamar	56	0	0	$10,873,000
	Marion	50	0	0	$24,797,000
	Perry	20	0	0	$183,000
	Wayne	17	0	0	$241,000
Total Region 8 Totals		300	1	0	$58,344,000
MEMA Region 9	George	22	0	0	$42,000
	Hancock	41	0	0	$3,386,000,000
	Harrison	55	1	0	$5,637,000,000
	Jackson	37	0	0	$2,257,000,000
	Pearl River	18	0	0	$3,185,000
	Stone	26	0	0	$223,000
Total Region 9 Totals		199	1	0	$11,283,450,000
Total		2,085	16	14	$12,808,508,000

Source: NCEI Database with the following parameters: coastal flood, flash flood, flood, heavy rain, lakeshore flood, storm surge/tide

Probability of Future Flood Events

Based on available historical data, floods occur within the state of Mississippi multiple times every year resulting in a calculated probability of reoccurrence of 3.21 annually. One in six acres in Mississippi is found within the designated floodplain.

The Flood Insurance Studies (FIS) and their accompanying Flood Insurance Rate Maps (FIRMs) provide a means to identify the probability of future flood events. Through use of the flood profiles for each river and stream, summary of discharge tables, and floodway data tables, each community's future event probability can be adequately identified. The flood levels that can be predicted consist of the 10-year, 50-year, 100-year and 500-year Base Flood Elevation (BFE) depths.

Another means of prediction of future events is the examination of past events, as this also establishes a probability of reoccurring floods or repetitive flooding. There have been 29 federally declared disasters in Mississippi since 1987 (Table 3.6.1) and 19 Small Business Administration (Table 3.6.3) flood declarations. Each event contained some measure of the four types of flooding identified in the flood hazard description of this plan. These statistics place the state of Mississippi within the top tier of disaster prone states.

Table 3.6.3
Number of Counties Designated in SBA Declared Flood Events Since 1998

Disaster Designation	Initial Date of Declaration	Number of Counties Declared
SBA TN-00106*	May 2017	6
SBA MS-00102*	May 2017	8
SBA MS-13543	April 2013	5
SBA MS-13492	February 2013	10
SBA MS-13439	January 2013	7
SBA MS-13273	September 2013	22
SBA MS-12938	November 2011	7
SBA MS-00029	May 2009	7
SBA MS-00033	April 2009	18
SBA MS-00034	March 2009	82
SBA MS-00028	March 2009	4
SBA MS-00026	August 2008	63
SBA MS-00020	May 2008	9
SBA MS-00021	March 2008	12
SBA MS-00009	November 2006	13
SBA (Flooding)	April 2005	18
SBA (Flooding)	August 2004	2
SBA (Flooding)	August 2003	7
SBA (Flooding)	August 2001	1

Source: U.S. Small Business Administration.
*Included counties in neighboring states

FEMA RiskMAP Program in Mississippi

Beginning with FEMA FY2010 funding the state of Mississippi and FEMA flood mapping has shifted from the original FEMA Map Mod Program where DFIRM work was based on county-wide projects to the new RiskMAP Program. What is different about RiskMAP vs. Map Mod is that DFIRM work is now based on HUC-8 basins (for example: Big Sunflower Basin) which will include all or parts of multiple counties under RiskMAP. In addition to the regulatory products (Flood Insurance Study (FIS), DFIRM, and DFIRM GIS Database), communities in a studied basin will receive new non-regulatory products which will include the following; Watershed Flood Risk Report, Watershed Risk Map, and Flood Risk GIS Database with Changes Since Last FIRM data, Multi-Frequency Flood Depth Grids, Percent Annual Chance of Flooding data, Percent Chance of Flooding over 30-Years and new HAZUS Annualized Risk data. All this data can be

used in day-to-day floodplain management, mitigation work and can be incorporated into hazard planning. All new DFIRM work will use Lidar elevation data where available.

New preliminary FIRMs and Flood Insurance Study (FIS) reports were completed for several counties since the last plan update:

- Rankin 2018
- Scott 2018
- Smith 2018
- Claiborne 2017
- Hinds 2017
- Madison 2017
- Itawamba 2016
- Monroe 2016
- Hancock 2016
- Harrison 2016
- Jackson 2016
- Lamar 2016
- Marion 2016
- Pearl River 2016
- Walthall 2016

At the time of the 2018 update, the FEMA interactive ArcGIS tool, which shows Risk Map progress, was not functioning properly. The layer which details the projects that have been studied was unavailable.

National Flood Insurance Program (NFIP)

Mississippi has 363 communities that have federally identified Special Flood Hazard Areas (SFHA) or floodplains. These areas indicate the water surface elevation resulting from a flood that has a one percent or greater chance of being equaled or exceeded in any given year.

There are 330 Mississippi communities that are members of the National Flood Insurance Program (NFIP), including 4 communities (Carrollton, Coahoma, Courtland and Renova) that are in the emergency plan. Additionally, 32 communities also participate in the Community Rating System (CRS). Details on the communities that participate in the program are found in Appendix 7.3.6-A.

To show the forward progress being made by communities, Table 3.6.4 provides a summary of the community participation in the NFIP and CRS communities since the 2007 State of Mississippi Standard Hazard Mitigation Plan.

Table 3.6.4
Number of Counties Designated in SBA Declared Flood Events Since 1998

State Plan Year	NFIP Communities	Emergency Plan	CRS Communities
2018	330	4	32
2013	329	4	31
2010	305	15	23
2007	276	4	19

Mississippi continues to rank high in the nation for NFIP claims payments. Table 3.6.5 details the ten Mississippi counties with the greatest total NFIP claims payments through February 2018. Details on flood insurance policies by county can be referenced in Appendix 7.3.6-B.

Table 3.6.5
NFIP Loss Statistics Top 10 Counties January 1978 to February 2018

County	Total Losses	Closed Losses	Open Losses	Closed w/o Payment Losses	Total Payments
Harrison	15,165	12,777	12	2,376	$1,281,229,535
Hancock	9,646	8,572	14	1,060	$737,684,695
Jackson	10,650	9,121	26	1,503	$703,296,088
Hinds	4,195	3,399	32	764	$59,269,645.97
Washington	1,849	1,515	25	309	$33,696,394
Warren	2,765	2,418	1	346	$30,876,258
Bolivar	1,300	1,135	4	161	$22,411,146
Wilkinson	1,871	1,592	1	278	$20,595,214
Pearl River	730	568	1	161	$13,509,714
Forrest	1,746	1,379	1	366	$9,754,712.47

Source: bsa.nfipstats.html (NFIP Policy and Loss by Community February 2018)

The State's Floodplain Manager and local jurisdictions maintain detailed data on properties classified as repetitive flood claim or severe repetitive flood loss that includes specific addresses and homeowner information. This information is protected under the Privacy Act of 1974 and is not included as an appendix item with this plan update (contact the State Floodplain Manager for details).

Repetitive Loss Property Analysis

A high priority in Mississippi and nationwide is the reduction of losses due to repetitive loss structures. These structures strain the National Flood Insurance (NFIP) Fund. They increase the NFIP's annual losses and the need for borrowing and, more importantly, they drain resources needed to prepare for catastrophic events. The NFIP defines a repetitive loss property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978. At least two of the claims must be more than ten-days apart.

A repetitive loss property is also defined by the following when considering the Pre-Disaster Mitigation Program (PDM): A property covered under a contract for flood insurance made available under the NFIP; and:

- Has incurred flood related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and

- At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

Table 3.6.6 illustrates the number of properties and payments received for Mississippi's top 10 repetitive loss counties. The table ranks counties by repetitive loss dollars paid between 1978 and February 2016 and are sorted by the highest total payments received. The top three counties with repetitive losses continue to be the coastal counties of Harrison, Hancock, and Jackson. Figure 3.6.5 illustrates the number of properties by county. Additional details by county are also provided by MEMA Region later in this section.

Table 3.6.6
Repetitive Loss (RL) Flood Claims by County (1978-2016)

County	No. of RL Properties	No. of Insured Properties	No. of Mitigated Properties	Flood Claims	Total Property Value	Total Payments
Harrison	1,290	427	674	222	$11,203,151,307*	$197,852,894
Jackson	1,260	509	379	3,144	$233,383,062*	$175,661,475
Hancock	1,036	442	428	2,683	$166,055,374*	$121,615,790
Hinds	443	190	18	1,117	$64,181,531*	$24,239,035
Warren	393	18	247	1,418	$79,757,122*	$21,019,934
Washington	191	29	26	631	$21,485,272*	$15,307,508
Wilkinson	190	15	94	774	$34,089,945*	$12,893,255
Pearl River	82	23	18	260	$13,881,972*	$5,921,890
Rankin	94	32	26	237	$21,464,455*	$5,324,565
Forrest	205	26	130	551	$18,920,148*	$4,322,726

Source: State Floodplain Manager NFIP List as of February 2016
*Property values listed for condominiums were removed due to inaccuracy.

Below is a series of figures, which show the repetitive loss and severe repetitive loss structures located within the special flood hazard area (SHFA) per MEMA Region.

Figure 3.6-1 MEMA Region 1 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

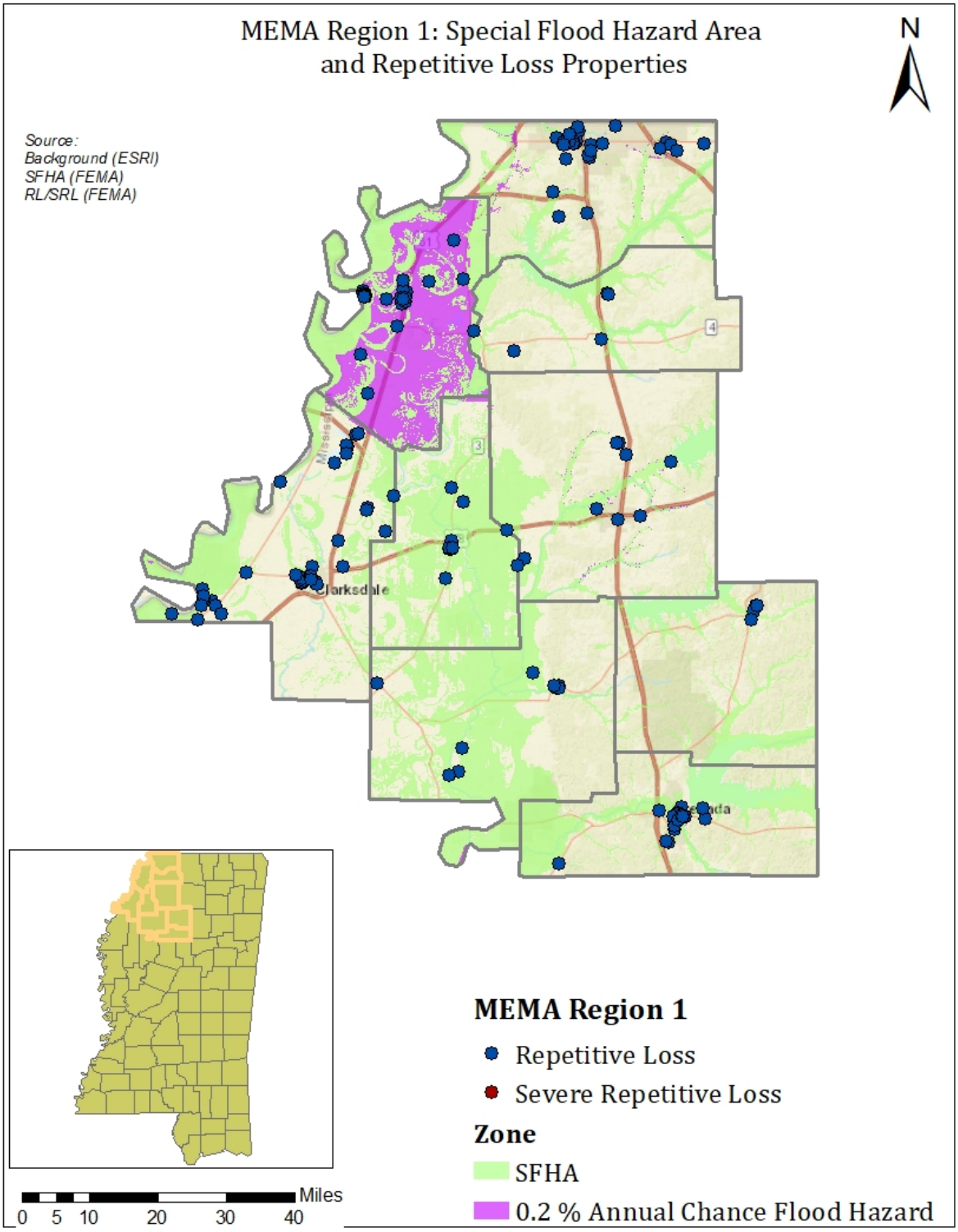


Figure 3.6-2 MEMA Region 2 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

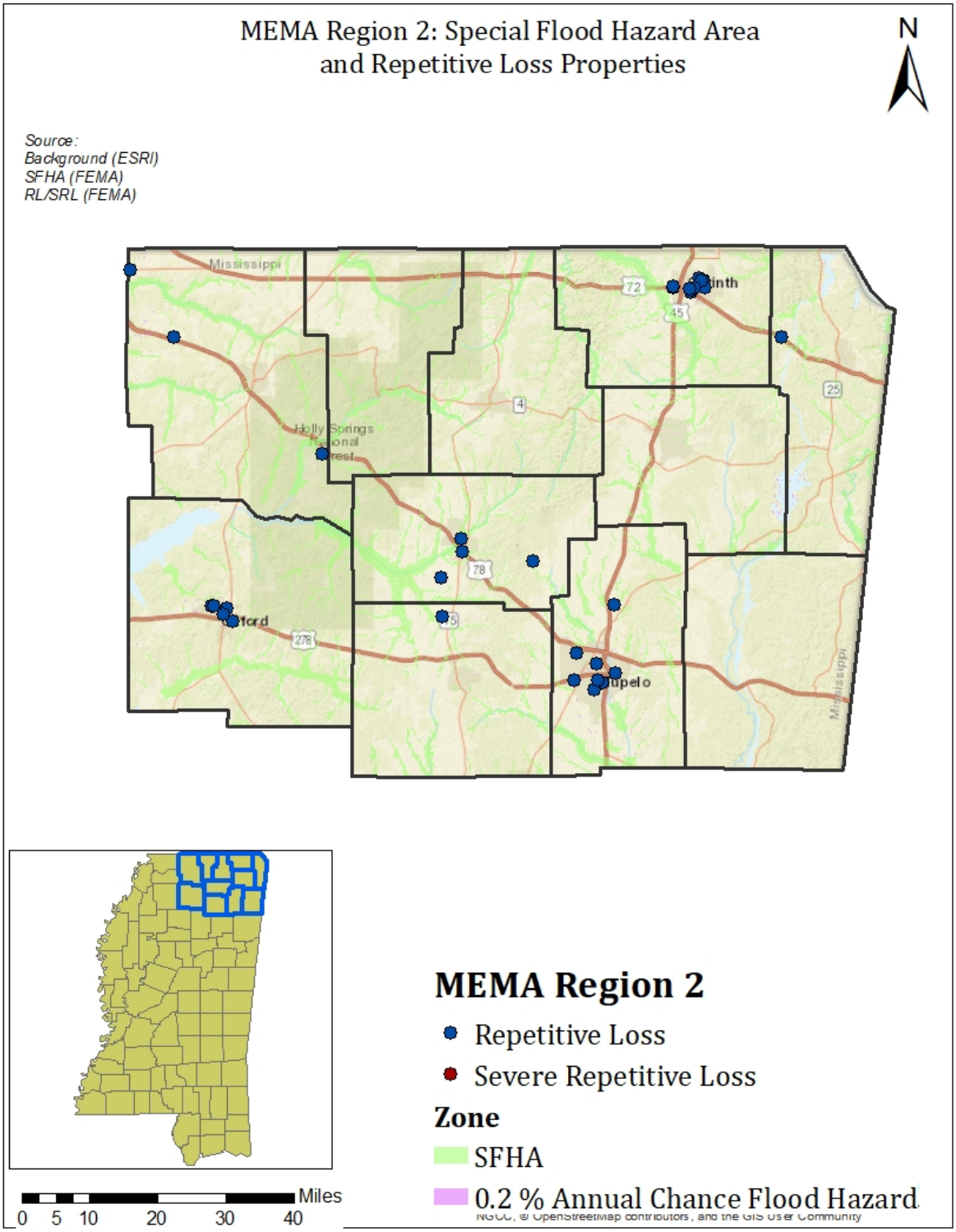


Figure 3.6-3 MEMA Region 3 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

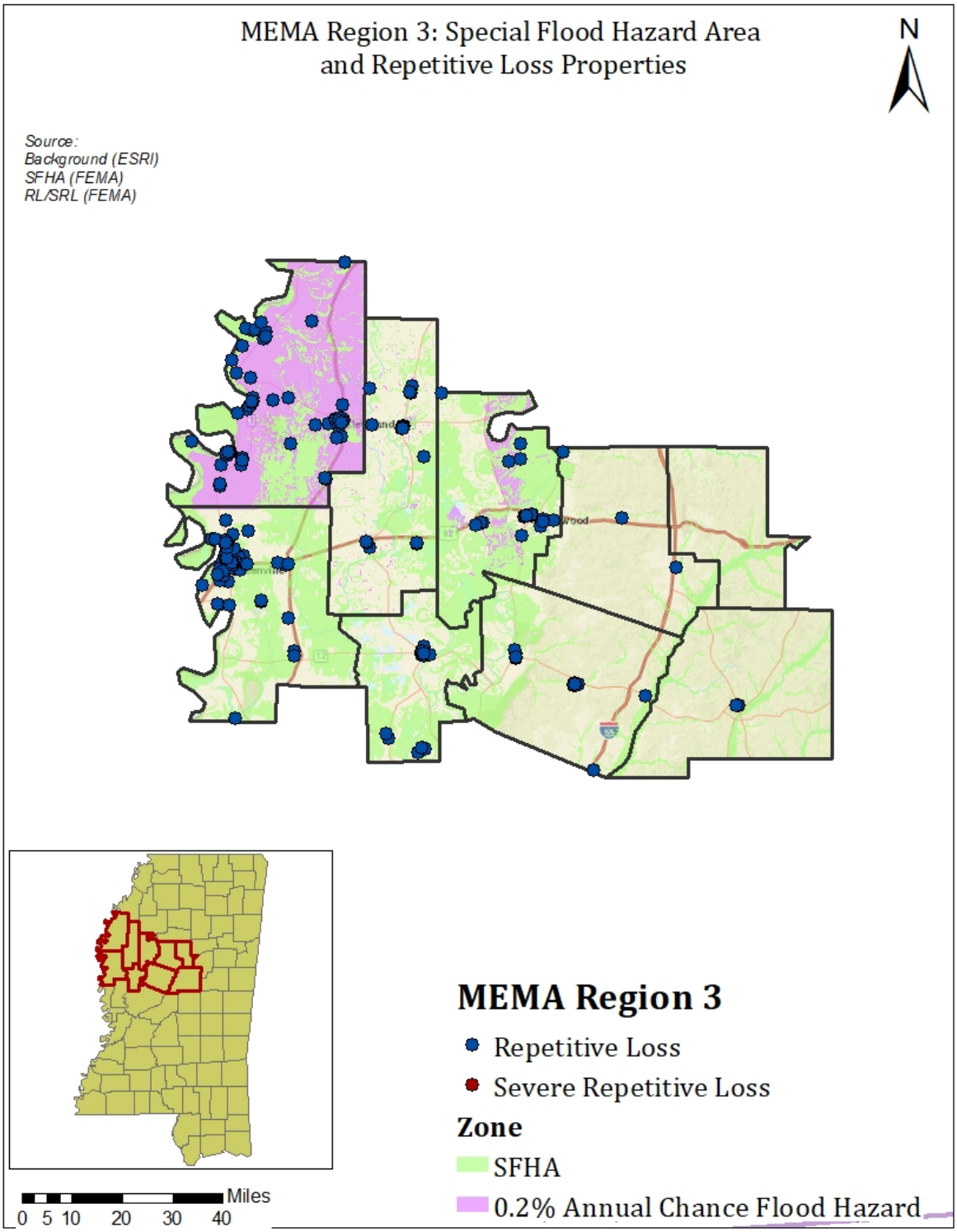


Figure 3.6-4 MEMA Region 4 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

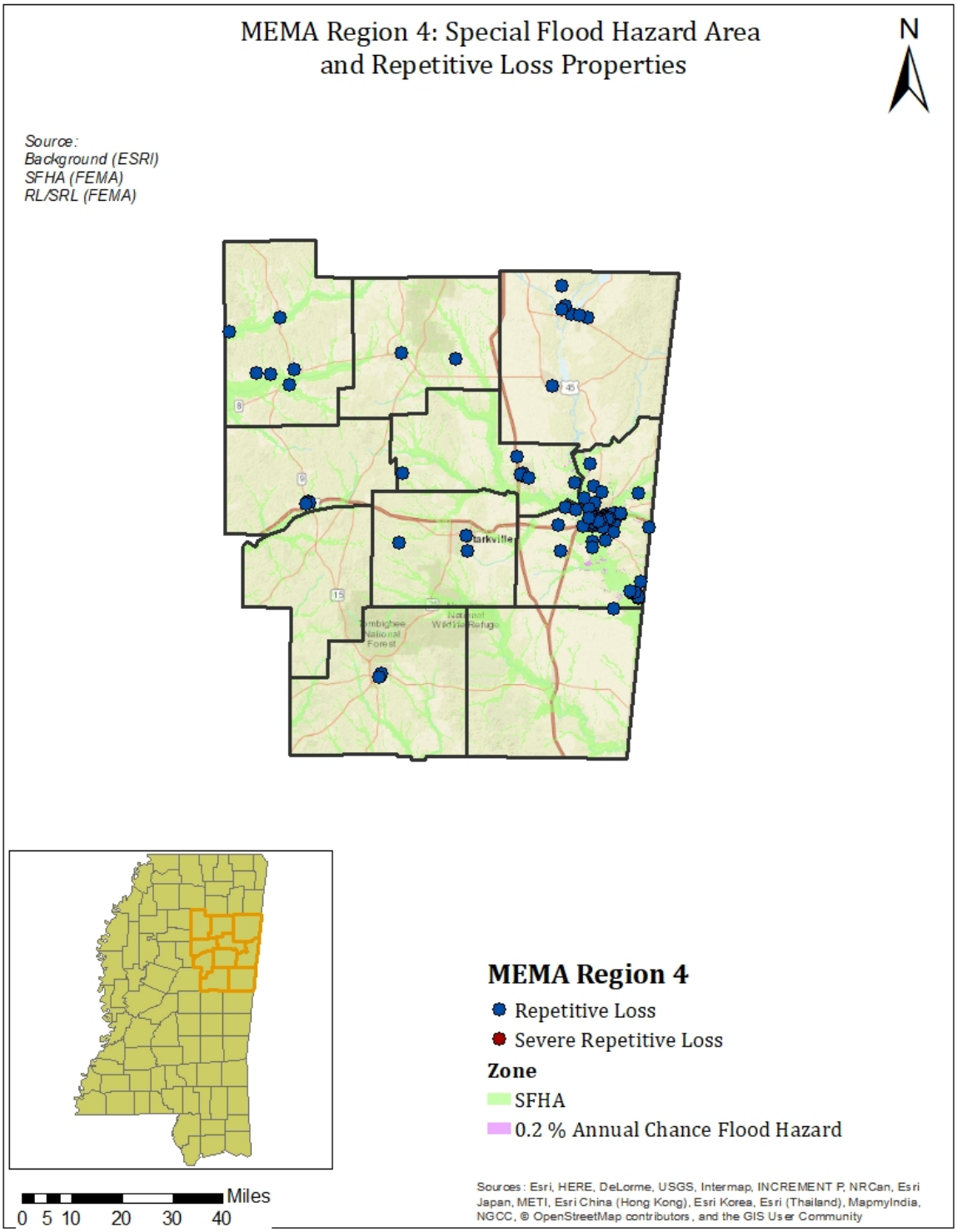


Figure 3.6-5 MEMA Region 5 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

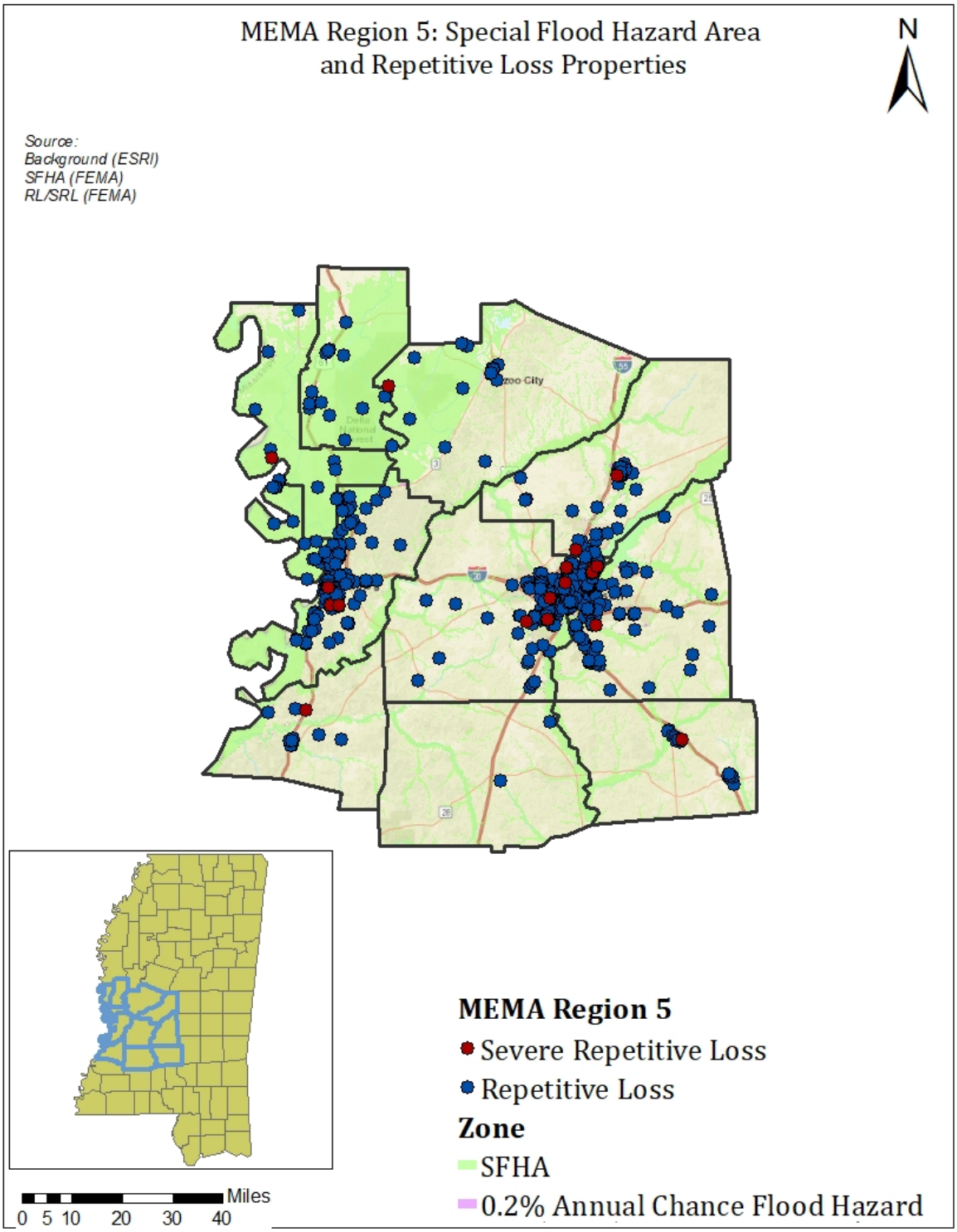


Figure 3.6-6 MEMA Region 6 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

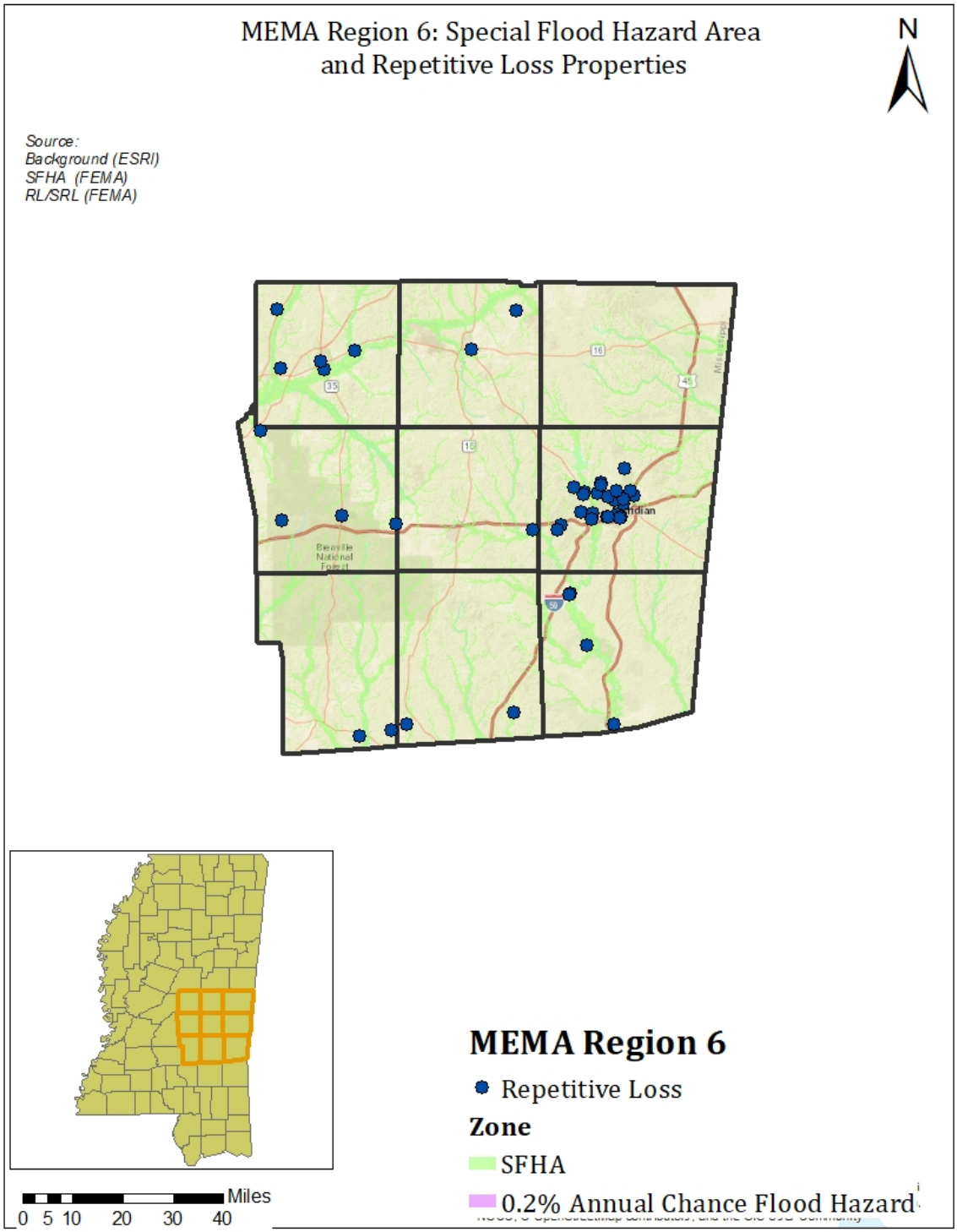


Figure 3.6-7 MEMA Region 7 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

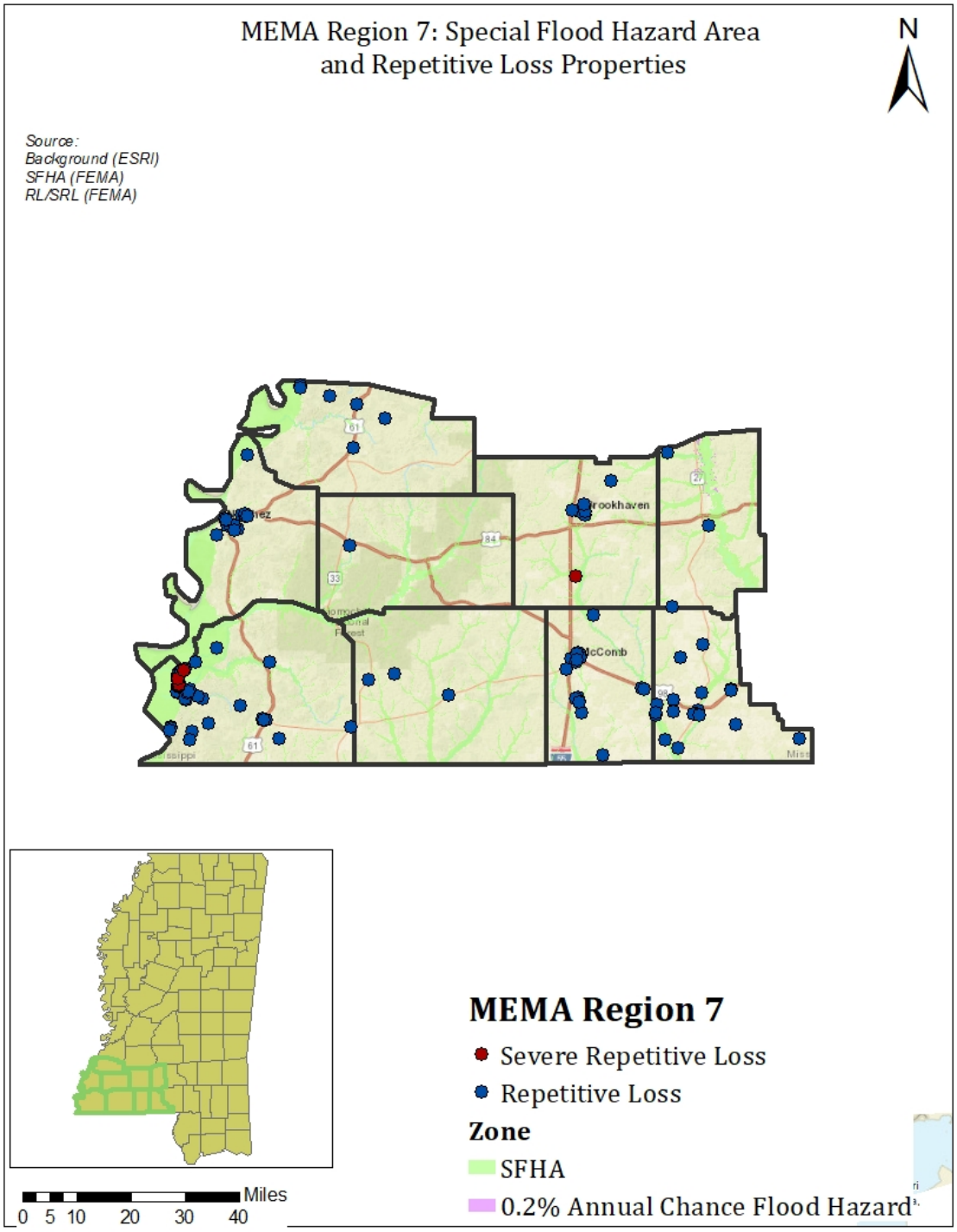


Figure 3.6-8 MEMA Region 8 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures

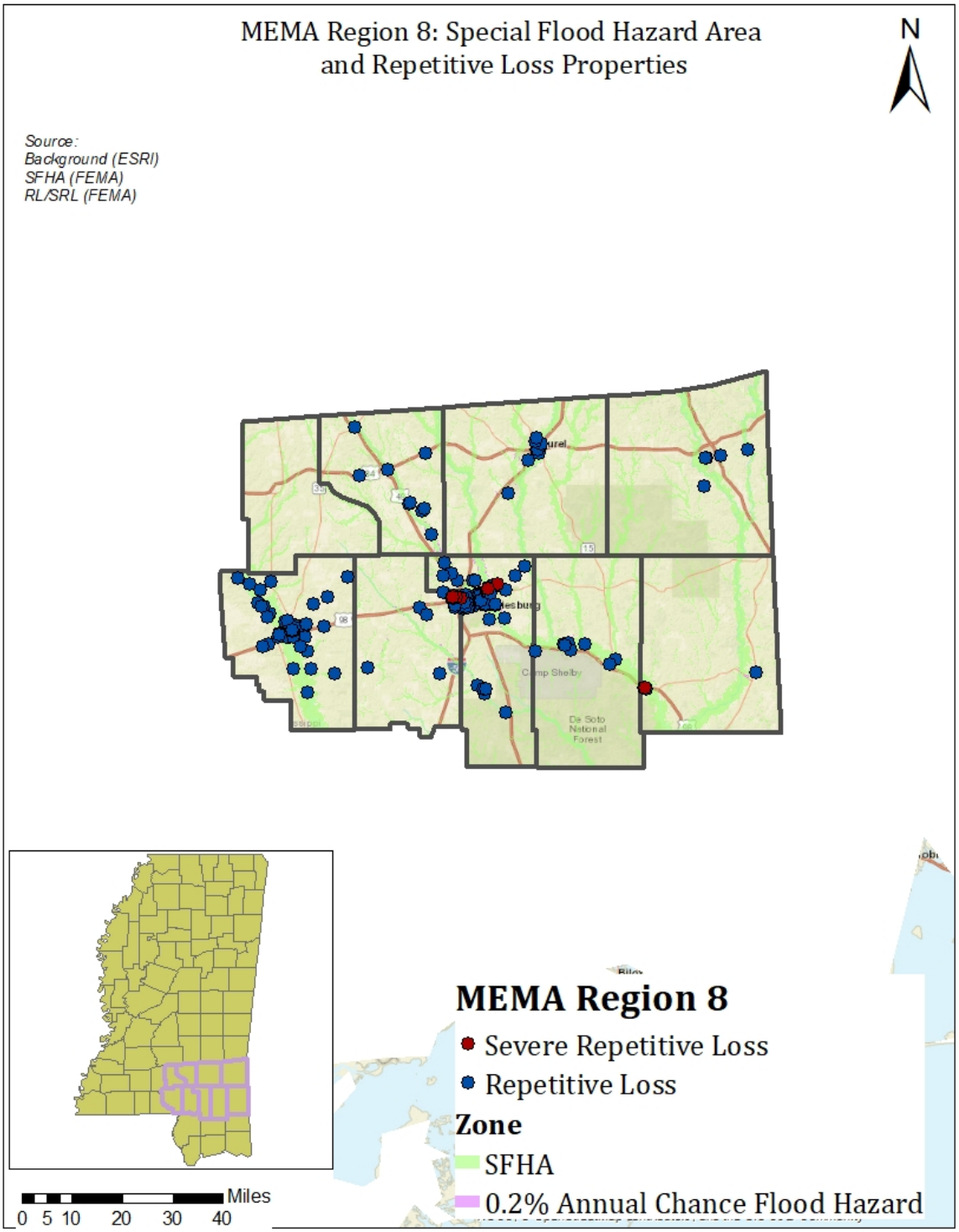
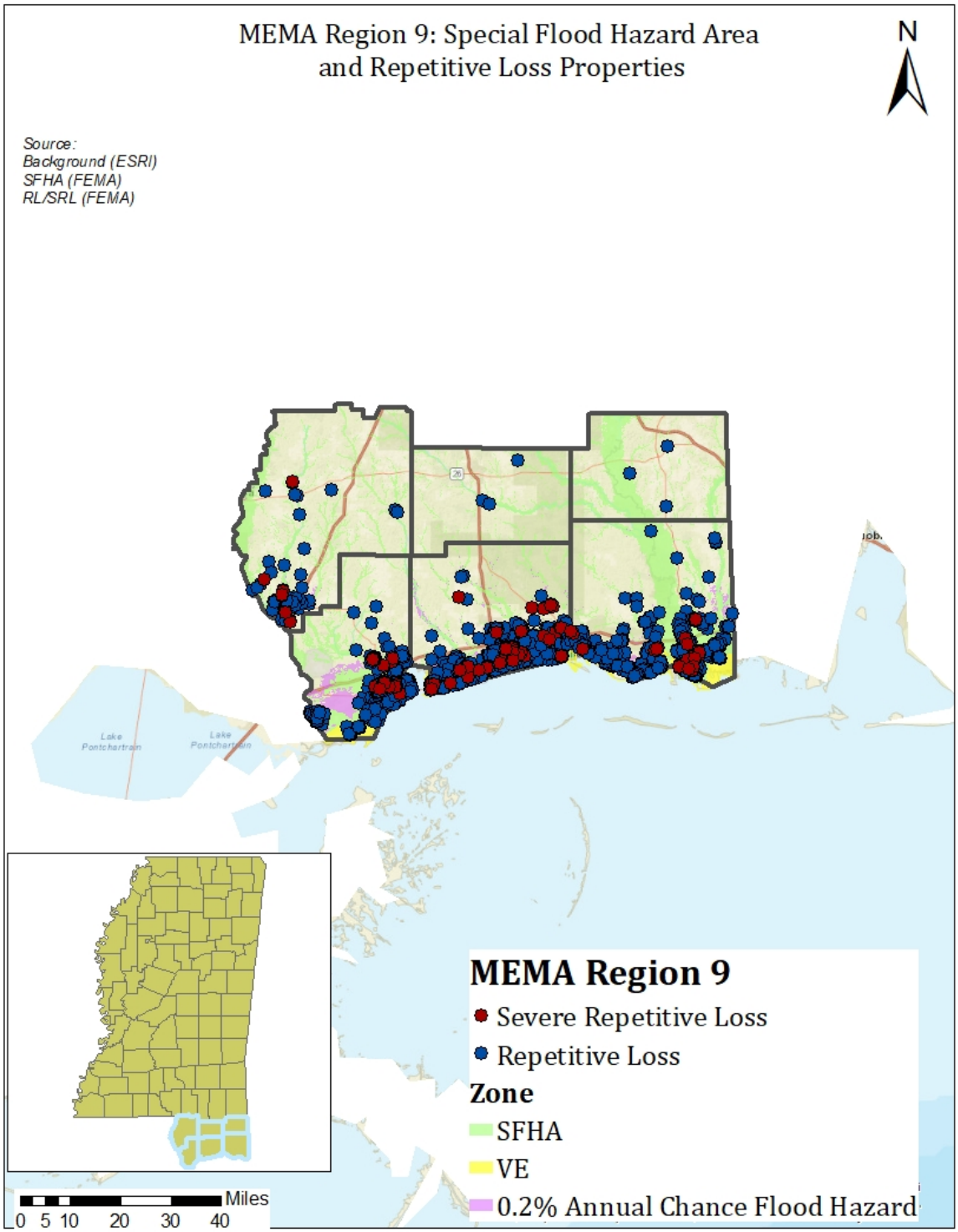


Figure 3.6-9 MEMA Region 9 Special Flood Hazard Area (SHFA) and Repetitive Loss Structures



Severe Repetitive Loss Property Analysis

The Flood Insurance Reform Act of 2004 identified another category of repetitive loss. Severe repetitive loss (SRL) is defined as

A property covered under a contract for flood insurance made available under the NFIP; and

Has incurred flood related damage:

- For which four or more separate claims payments (including building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or

- For which at least two separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Table 3.6.7 illustrates the number of properties and the payments received for Mississippi's top 10 severe repetitive loss counties. The table ranks counties by severe repetitive loss dollars paid between 1978 and February 2016 and are sorted by the highest total payments received. The top three counties with repetitive losses continue to be the coastal counties of Harrison, Hancock, and Jackson. and Figure 3.6.6 illustrates the number of properties by county. Additional details by county are also provided by MEMA Region later in this section.

Table 3.6.7
Mississippi's Severe Rep Loss Summary by County
(Ranked by Total Payment)

County	No. of SRL Properties	No. of Insured Properties	Flood Claims	Total Property Value	Total Payments (Bldg and Contents)
Harrison	51	1*	222	$9,844,971	$11,635,104
Jackson	31	4*	194	$6,057,105	$5,393,976
Hancock	27	0*	93	$4,237,655	$5,368,404
Hinds	15	0*	53	$1,446,339	$1,418,565
Washington	5	2*	22	$806,287	$1,232,560
Lamar	8	0*	48	$1,177,548	$969,758
Wilkinson	6	1*	32	$669,905	$814,558
Warren	2	1*	9	$341,911	$217,869
Bolivar	2	0*	7	$40,876	$84,548
Claiborne	1	0*	10	$25,603	$80,549

Source: State Floodplain Manager NFIP List as of February 2016
*All other structures listed as SDF

MEMA Region Repetitive Loss/Severe Repetitive Loss Summary

MEMA Region 1

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
Coahoma	15	42	51	133	0	5	0	18
Desoto	14	0	40	107	0	0	1	8
Grenada	14	49	63	153	0	13	0	32
Panola	7	7	8	19	0	0	0	0
Quitman	21	20	22	62	0	1	0	4
Tallahatchi	9	9	11	24	0	0	0	0
Tate	1	2	6	12	0	0	0	0
Tunica	77	65	79	206	1	10	0	43
Yalobusha	8	8	9	17	0	0	0	0
Totals	166	202	289	733	1	29	1	105

County	No. of NFIP Communities	No. of Mitigated Properties
Coahoma	7	13
Desoto	6	0
Grenada	2	9
Panola	7	3
Quitman	6	1

County	No. of NFIP Communities	No. of Mitigated Properties
Tallahatchie	6	0
Tate	3	0
Tunica	2	14
Yalobusha	4	0
Totals	43	40

MEMA Region 2

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claim	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Floo
Alcorn	0	7	0	14	0	0	0	0
Benton	0	0	0	0	0	0	0	0
Itawamba	0	0	0	0	0	0	0	0
Lafayette	0	3	6	11	0	0	0	0
Lee	4	7	10	28	0	1	1	5
Marshall	1	1	1	3	0	0	0	0
Pontotoc	1	1	1	2	0	0	0	0
Prentiss	0	0	0	0	3	0	0	0
Tippah	0	0	0	0	0	0	0	0
Tishomingo	1	1	1	2	0	0	0	0
Union	3	2	5	8	0	1	0	2
Totals	**10**	**22**	**24**	**68**	**3**	**2**	**1**	**7**

County	No. of NFIP Communities	No. of Mitigated Properties
Alcorn	5	0
Benton	3	0
Itawamba	3	0
Lafayette	4	0
Lee	10	3
Marshall	4	0

County	No. of NFIP Communities	No. of Mitigated Properties
Pontotoc	7	0
Prentiss	2	0
Tippah	6	0
Tishomingo	7	0
Union	4	0
Totals	**55**	**3**

MEMA Region 3

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
Attala	0	0	1	2	0	0	0	0
Bolivar	155	108	210	631	2	48	2	228
Carroll	4	4	4	8	0	0	0	0
Holmes	11	12	12	27	0	0	0	0
Humphreys	40	31	46	161	2	10	1	61
LeFlore	29	27	27	71	0	2	0	8
Montgomer	0	0	0	0	0	0	0	0
Sunflower	19	16	20	72	1	4	0	21
Washington	152	115	191	631	14	48	8	250
Totals	410	313	511	1,603	19	112	11	568

County	No. of NFIP Communitie s	No. of Mitigated Properties
Attala	5	0
Bolivar	16	20
Carroll	4	0
Holmes	8	0
Humphreys	5	1

County	No. of NFIP Communities	No. of Mitigated Properties
Leflore	6	1
Montgomery	4	0
Sunflower	8	4
Washington	6	26
Totals	62	52

MEMA Region 4

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Floo
Calhoun	5	4	5	15	0	1	0	7
Chickasa	1	1	1	2	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0
Clay	8	8	9	26	0	0	0	0
Lowndes	125	109	123	389	2	14	2	79
Monroe	12	9	11	33	1	3	1	11
Noxubee	0	0	0	0	0	0	0	0
Oktibbeh	2	2	2	7	0	0	0	0
Webster	5	4	5	16	0	1	0	6
Winston	2	2	2	4	0	0	0	0
Totals	160	139	158	474	3	19	3	103

County	No. of NFIP Communities	No. of Mitigated Properties
Calhoun	7	0
Chickasaw	5	0
Choctaw	5	0
Clay	2	0
Lowndes	4	18

County	No. of NFIP Communities	No. of Mitigated Properties
Monroe	6	0
Noxubee	4	0
Oktibbeha	3	0
Webster	2	0
Winston	2	0
Totals	40	18

MEMA Region 5

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
Claiborne	79	48	82	294	7	32	1	162
Copiah	2	2	3	6	0	0	0	0
Hinds	388	365	438	1,102	15	46	15	157
Issaquena	128	93	134	402	3	39	1	137
Madison	40	64	72	351	0	6	3	46
Rankin	47	68	93	237	0	0	0	0
Sharkey	20	16	25	68	2	9	2	25
Simpson	27	26	30	108	0	4	1	38
Warren	191	321	393	1,418	6	60	3	299
Yazoo	9	15	25	64	0	0	0	0
Totals	931	1,018	1,295	4,050	33	196	26	864

County	No. of NFIP Communities	No. of Mitigated Properties
Claiborne	2	14
Copiah	5	1
Hinds	11	18
Issaquena	2	16
Madison	7	34

County	No. of NFIP Communities	No. of Mitigated Properties
Rankin	10	25
Sharkey	4	0
Simpson	5	3
Warren	2	247
Yazoo	5	6
Totals	53	364

MEMA Region 6

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
Clarke	3	4	17	49	0	0	0	0
Jasper	1	0	3	7	0	1	0	3
Kemper	0	0	0	0	0	0	0	0
Lauderdale	24	26	26	73	0	1	0	4
Leake	4	4	4	8	0	0	0	0
Neshoba	0	0	0	0	0	0	0	0
Newton	1	1	1	2	0	0	0	0
Scott	3	3	2	4	0	0	0	0
Smith	0	0	0	0	0	0	0	0
Totals	36	38	53	143	0	2	0	7

County	No. of NFIP Communities	No. of Mitigated Properties
Clarke	6	2
Jasper	5	0
Kemper	3	0
Lauderdale	3	11
Leake	5	0

County	No. of NFIP Communities	No. of Mitigated Properties
Neshoba	4	0
Newton	6	0
Scott	6	0
Smith	3	0
Totals	41	13

MEMA Region 7

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
Adams	11	16	29	72	0	0	0	0
Amite	0	0	3	8	0	0	0	0
Franklin	0	0	2	3	0	0	0	0
Jefferson	9	6	12	40	0	3	0	17
Lawrence	2	1	14	53	1	1	0	11
Lincoln	3	3	2	6	0	0	0	0
Pike	10	12	2	4	0	3	1	16
Walthall	19	16	2	5	0	3	0	8
Wilkinson	204	116	189	774	3	86	6	440
Totals	258	170	255	965	4	96	7	492

County	No. of NFIP Communities	No. of Mitigated Properties
Adams	2	5
Amite	3	0
Franklin	4	0
Jefferson	2	6
Lawrence	4	6

County	No. of NFIP Communities	No. of Mitigated Properties
Lincoln	2	2
Pike	4	2
Walthall	2	2
Wilkinson	4	93
Totals	27	116

MEMA Region 8

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
Covingto	11	11	11	27	0	0	0	0
Forrest	71	191	204	551	2	6	4	43
Greene	0	2	1	2	0	0	0	0
Jefferson Davis	0	0	0	0	0	0	0	0
Jones	12	12	13	36	0	0	0	0
Lamar	36	19	39	198	6	19	8	128
Marion	83	77	91	288	2	14	0	73
Perry	11	9	12	29	0	2	0	6
Wayne	3	3	5	19	0	0	0	0
Totals	227	324	376	1,150	10	41	12	250

County	No. of NFIP Communities	No. of Mitigated Properties
Covington	4	0
Forrest	3	129
Greene	4	0
Jefferson Davis	3	0
Jones	5	0

County	No. of NFIP Communities	No. of Mitigated Properties
Lamar	5	2
Marion	2	10
Perry	4	1
Wayne	3	0
Totals	33	142

MEMA Region 9

County	Repetitive Loss				Severe Repetitive Loss			
	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims	No. of Properties 2009	No. of Properties 2011	No. of Properties 2016	No. of Flood Claims
George	1	1	3	7	0	0	0	0
Hancock	727	818	1,036	2,683	39	70	28	231
Harrison	724	1,085	1,290	3,985	72	125	51	557
Jackson	947	965	1,260	3,144	26	95	33	394
Pearl River	61	61	82	260	6	10	7	44
Stone	1	1	2	4	0	0	0	0
Totals	2,461	2,931	3,674	10,083	143	300	119	1,226

County	No. of NFIP Communities	No. of Mitigated Properties
George	2	0
Hancock	4	428
Harrison	6	674

County	No. of NFIP Communities	No. of Mitigated Properties
Jackson	5	379
Pearl River	4	17
Stone	2	0
Totals	23	1,498

Assessing Vulnerability by Jurisdiction/ Estimating Potential Losses

Methodology

This plan updated the HAZUS runs for flood from the 2013 plan, using the most recent version of the program available. All HAZUS runs were generated by MEMA Region for the applicable hazards.

The HAZUS-MH flood analysis was a significant undertaking for the state. Producing a HAZUS-MH flood run is very computer-resource intensive. Processing a MEMA Region takes a significant amount of time from start to finish, depending on the size of the counties, density of the stream network, and density of census blocks. In some cases, the Regions had to be divided into separate runs and then analyzed on a regional level once complete.

HAZUS-MH produces a flood polygon and flood depth grid that represents the base flood. While not as accurate as official flood maps, such as digital flood insurance rate maps, these floodplain boundaries are available for use in GIS and could be valuable to communities that have not been mapped by the National Flood Insurance Program.

Flood damage is directly related to the depth of flooding. For example, a two-foot deep flood generally results in about 20 percent damage to the structure (which translates to 20 percent of the structure's replacement value). HAZUS-MH takes into account flood depth when modeling damage (based on FEMA's depth-damage functions). The HAZUS-MH reports capture damage by occupancy class (in terms of square footage impacted) by damage percent classes. Occupancy classes in HAZUS-MH include agriculture, commercial, education, government, industrial, religion, and residential. Damage percent classes are grouped by ten percent increments: 1-10 percent, 11-20 percent, etc., up to 50 percent. Buildings that sustain more than 50 percent damage are considered to be "substantially" damaged.

The HAZUS-MH methodology provides the number of buildings impacted, estimates of the building repair costs, and the associated loss of building contents and business inventory. Building damage can also cause additional losses to a community as a whole by restricting the building's ability to function properly. Income loss data accounts for losses such as business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses. These losses are calculated by HAZUS-MH using a methodology based on the building damage estimates.

Data Limitations

Default HAZUS-MH data was used to develop the loss estimates. Thus, the potential losses derived from HAZUS-MH, the best available data, may contain some inaccuracies. The state facility list contained an insufficient number of attributes to be fully integrated into HAZUS-MH.

The damaged building counts generated by HAZUS-MH are susceptible to rounding errors and are likely the weakest output of the model due to the use of census blocks for analysis. The HAZUS-MH "Building Damage Count by General Building Type" report includes this disclaimer:

> "Unlike the earthquake and hurricane models, the flood model performs its analysis at the census block level. This means that the analysis starts with a small number of buildings within each census

block and applies a series of distributions necessary for analyzing the potential damage. The application of these distributions and the small number of buildings make the flood model more sensitive to rounding errors that introduces uncertainty into the building count results. Please use these results with suitable caution."

The counts of buildings at risk collected from flood insurance policy data and biennial reports could potentially provide a more realistic estimate of the actual numbers of buildings in the base-flood hazard areas (see the Flood Insurance Claims Analysis that follows), but the information in the biennial reports could contain errors as well.

HAZUS-MH can analyze additional impacts, including what type of infrastructure could be affected and how severely. Project files for each county are available for use by local governments and the state if more details on the impacts discussed here, or information about other impacts, such as vehicle losses, agricultural losses, utility system losses, essential facility impacts, and transportation impacts, are desired.

Vulnerable Jurisdictions

The intent of this analysis was to enable the state to estimate where flood losses could occur and the degree of severity, regionally, using a consistent methodology. The computer modeling helps quantify risk along known flood hazard corridors such as along the Mississippi and Pearl rivers. In addition, flood losses are estimated for certain lesser streams and rivers where the flood hazard may not have been previously studied.

HAZUS-MH impact analyses were run for direct economic losses for buildings and societal impacts (displaced people and shelter needs) to see which regions ranked the highest on these risk indicators (these losses and impacts are illustrated in the maps and tables that follow). Using GIS, HAZUS-MH flood results were mapped to show flood loss potential and how it varies across the state. The primary indicators used to assess flood losses were:

- direct building losses combined with income losses,
- loss ratio of the direct building losses compared to overall building inventory, and
- population displaced by the flood and shelter needs.

Figure 3.6-10 Mississippi Assets Located in the MEMA Region 1 Special Flood Hazard Area (SHFA)

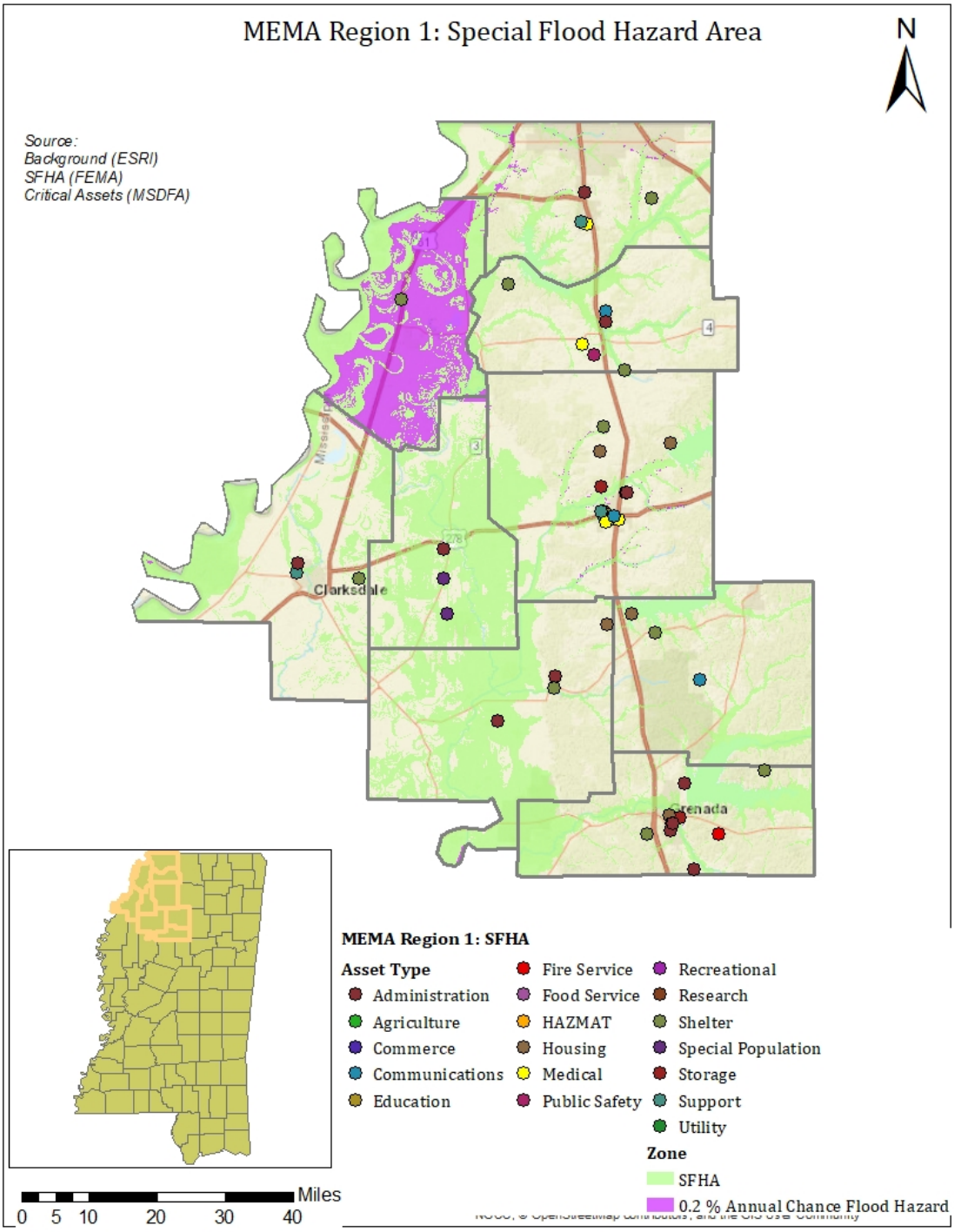


Figure 3.6-11 Mississippi Assets Located in the MEMA Region 2 Special Flood Hazard Area (SHFA)

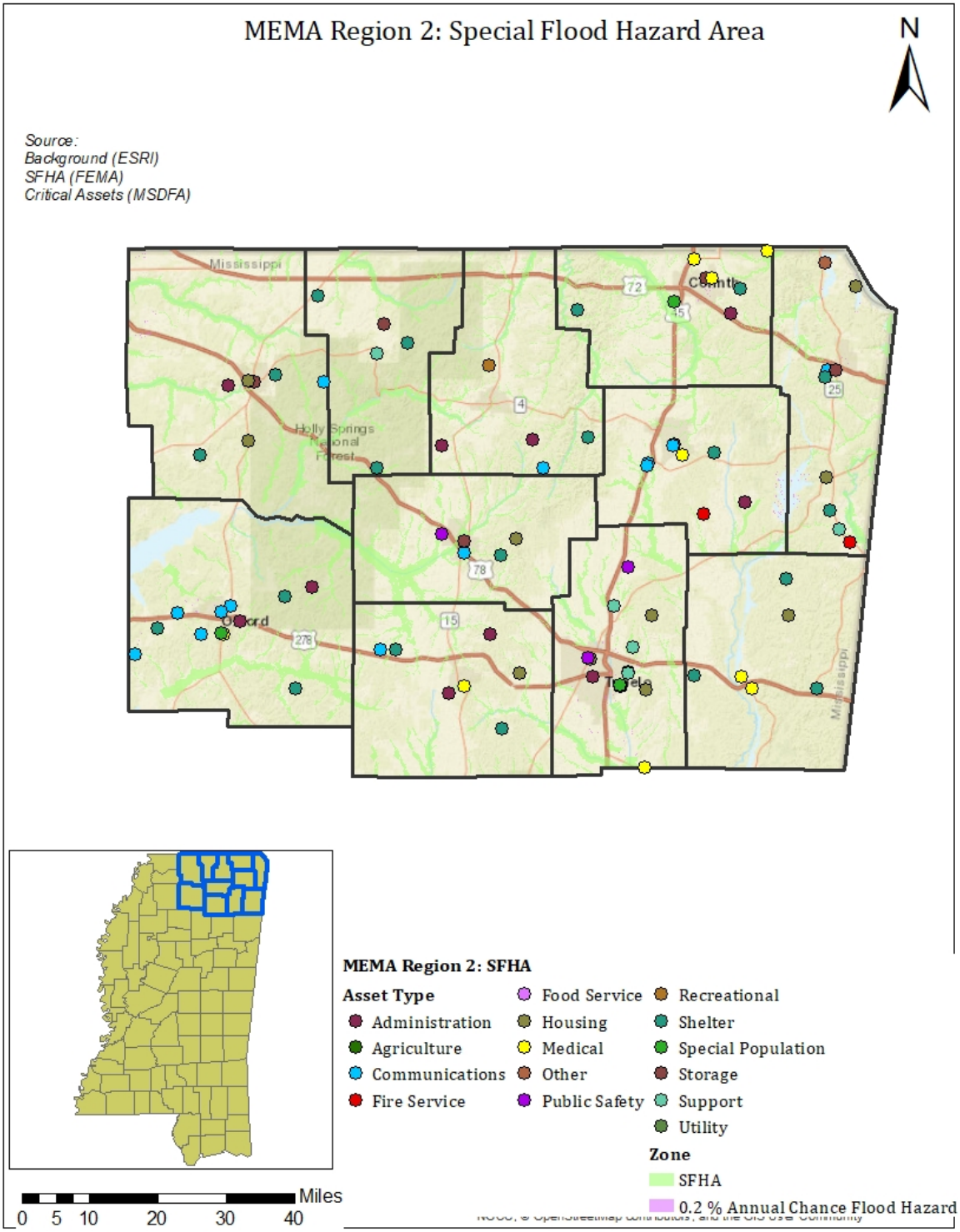


Figure 3.6-12 Mississippi Assets Located in the MEMA Region 3 Special Flood Hazard Area (SHFA)

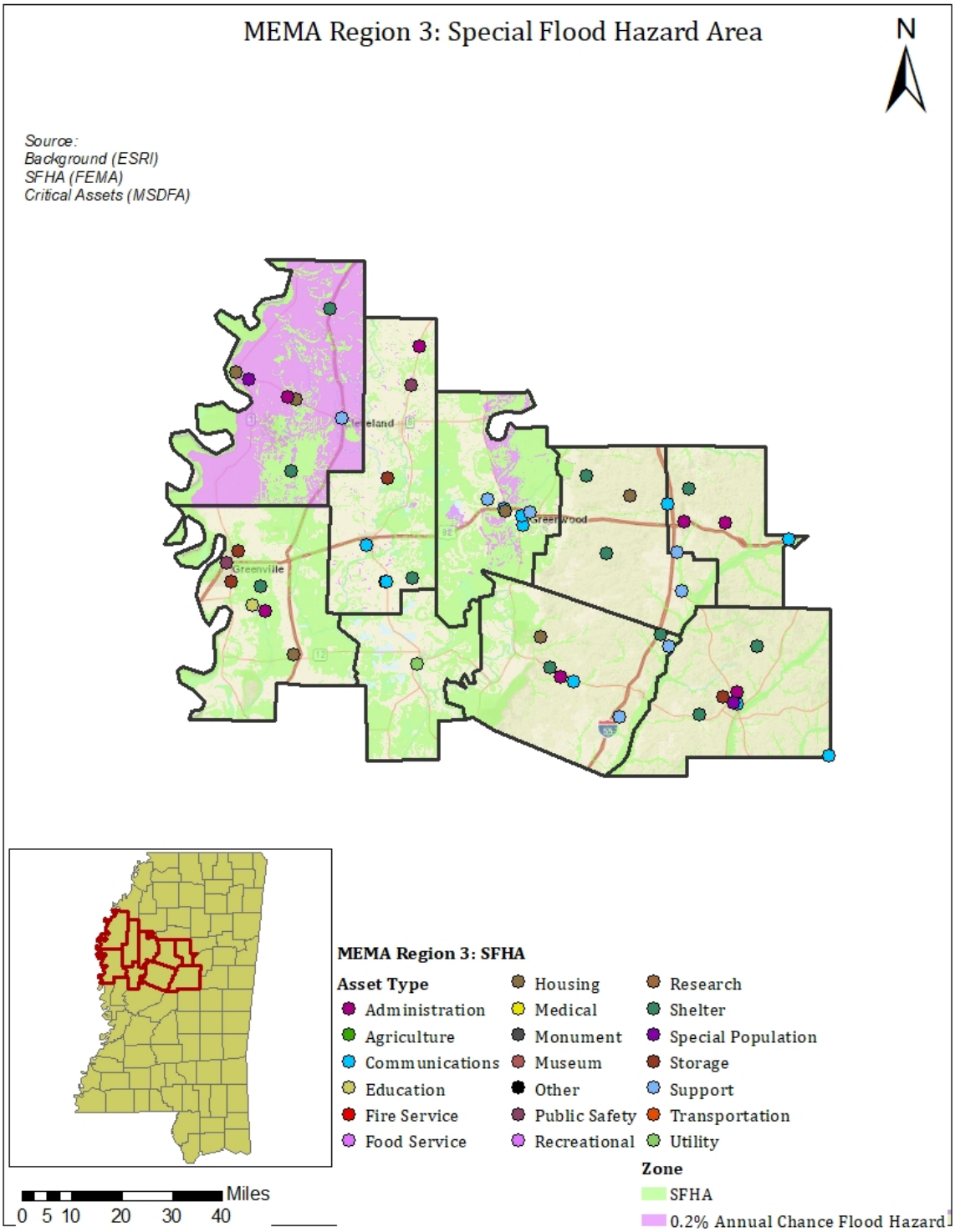


Figure 3.6-13 Mississippi Assets Located in the MEMA Region 4 Special Flood Hazard Area (SHFA)

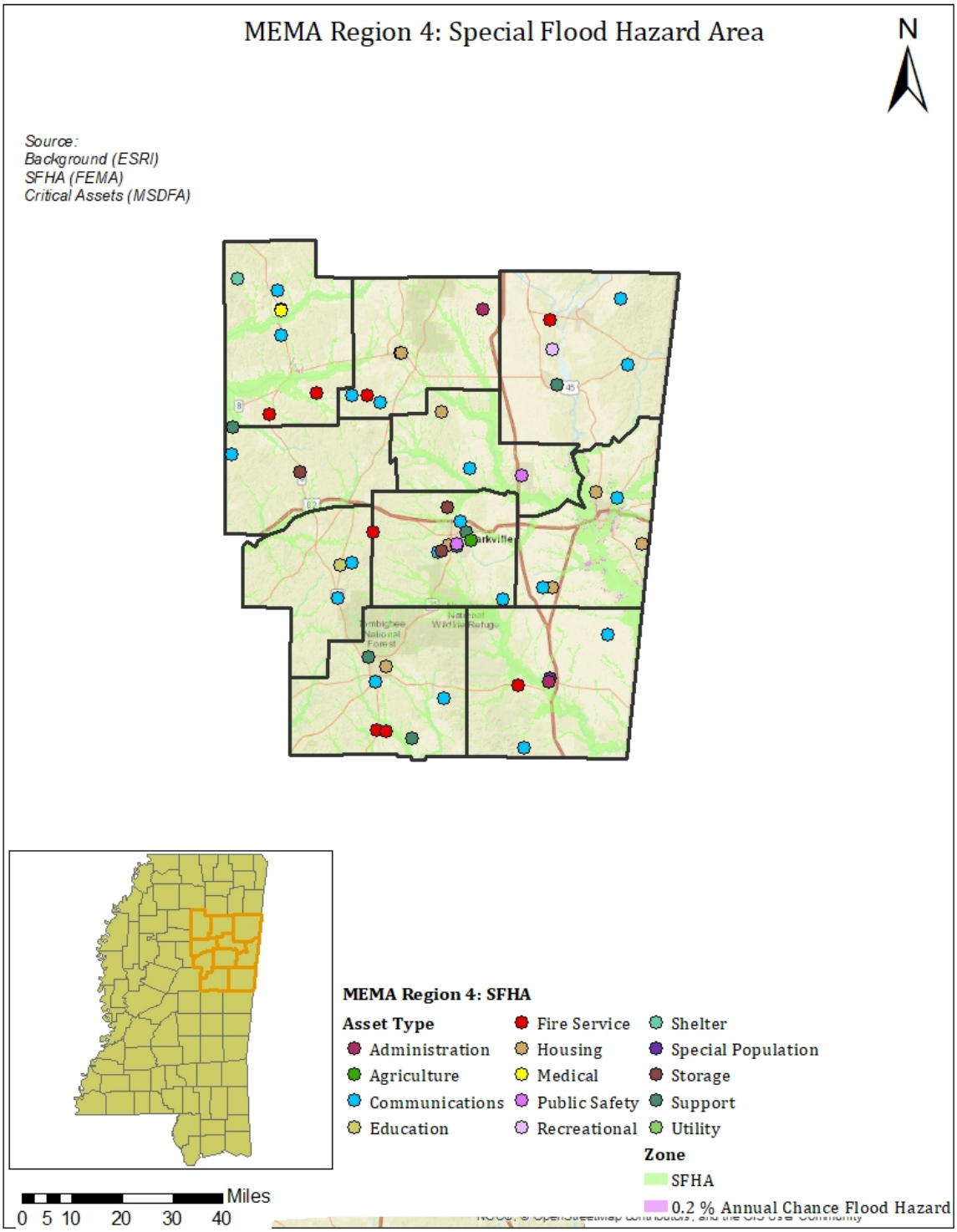


Figure 3.6-14 Mississippi Assets Located in the MEMA Region 5 Special Flood Hazard Area (SHFA)

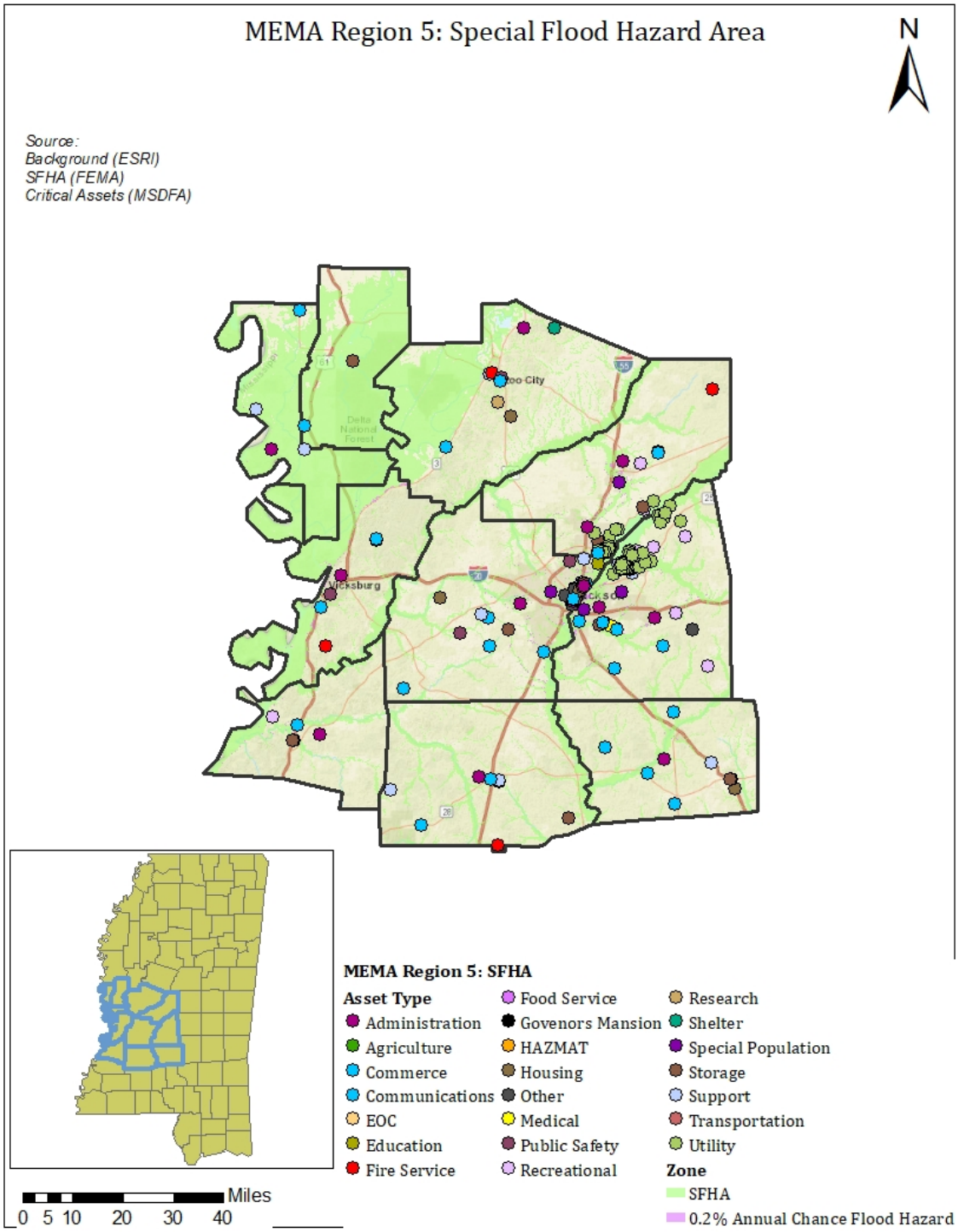


Figure 3.6-15 Mississippi Assets Located in the MEMA Region 6 Special Flood Hazard Area (SHFA)

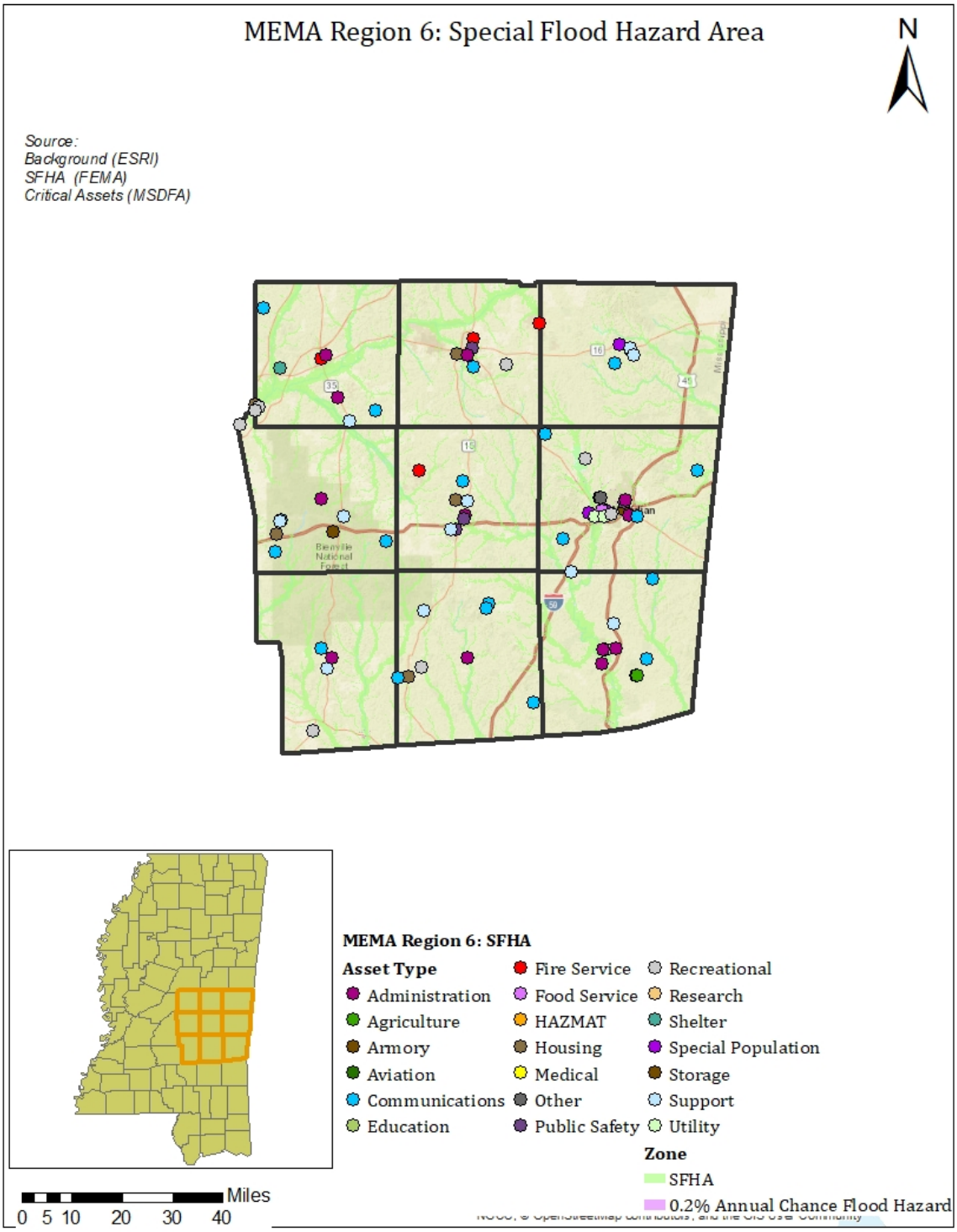


Figure 3.6-16 Mississippi Assets Located in the MEMA Region 7 Special Flood Hazard Area (SHFA)

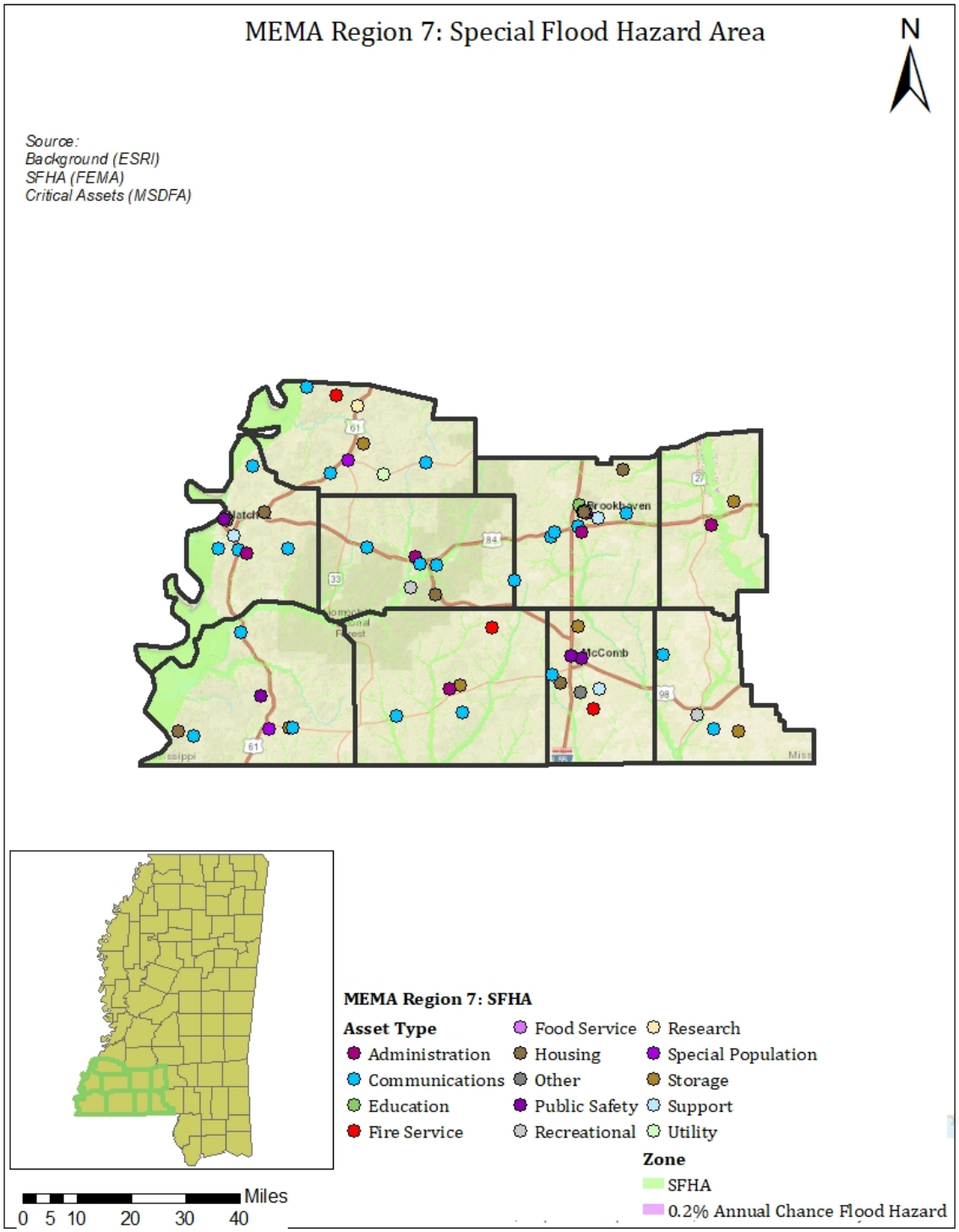


Figure 3.6-17 Mississippi Assets Located in the MEMA Region 8 Special Flood Hazard Area (SHFA)

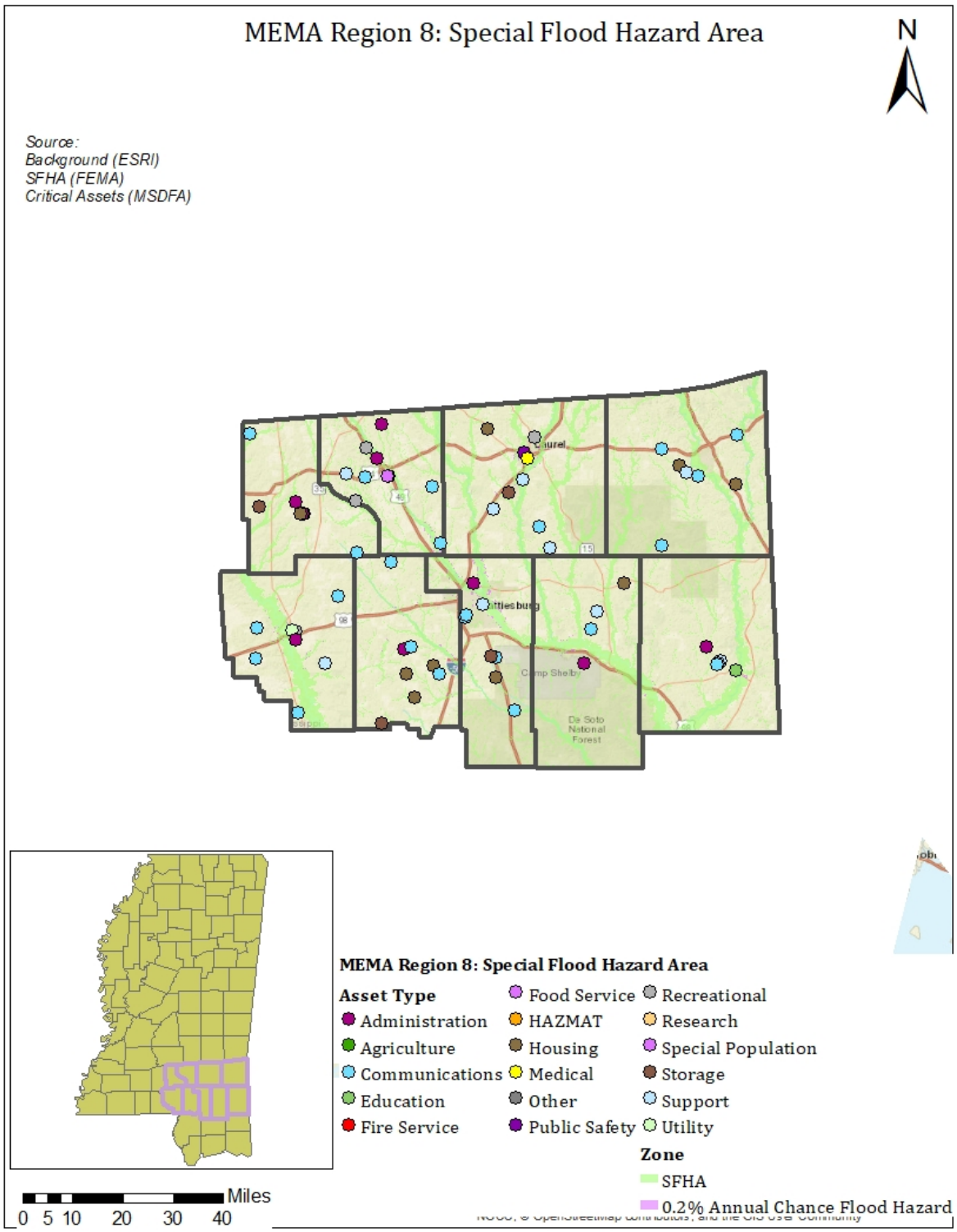


Figure 3.6-18 Mississippi Assets Located in the MEMA Region 9 Special Flood Hazard Area (SHFA)

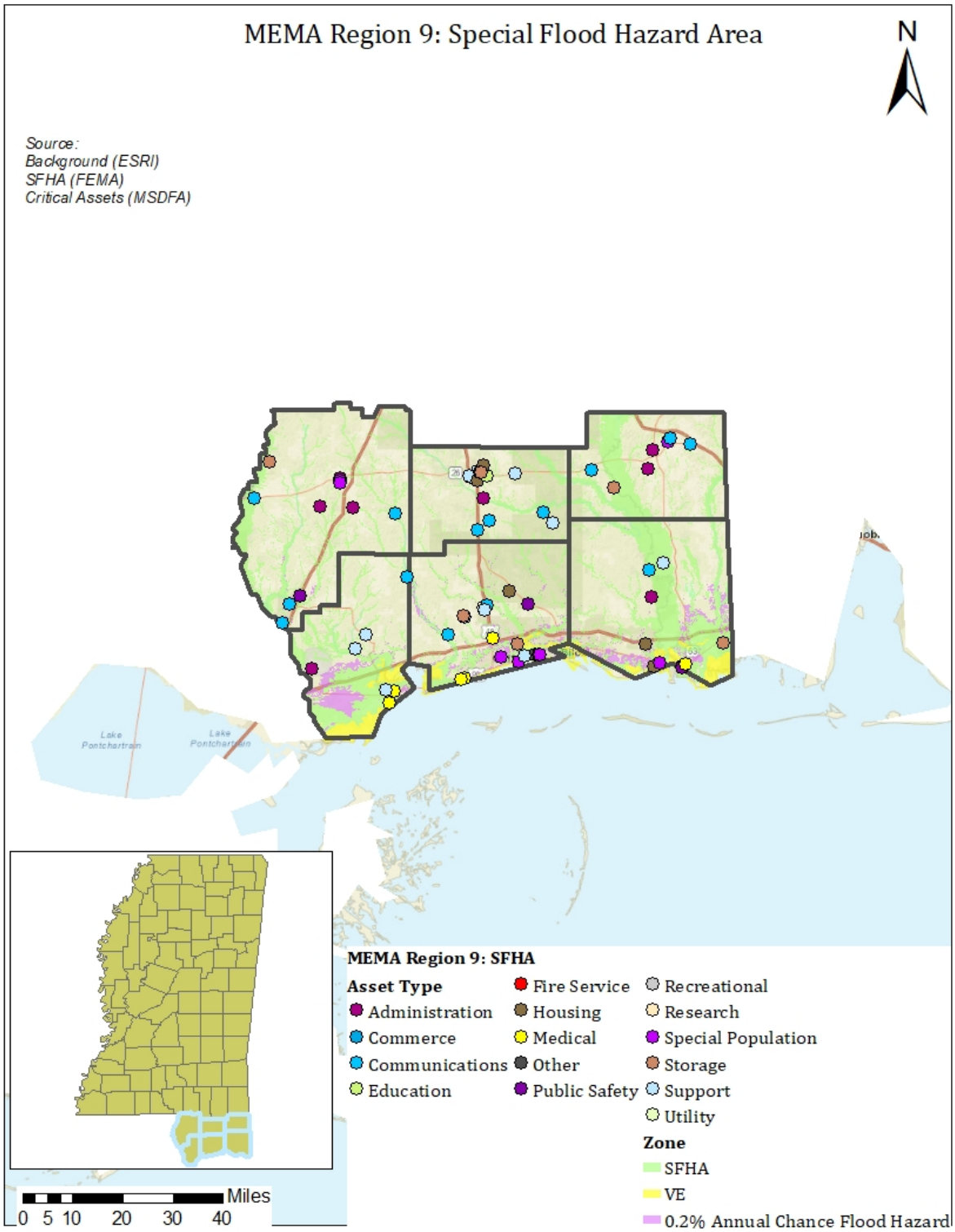


Table 3.6.8
HAZUS-MH 100-Year Flood Loss Estimation
Results: Building and Income Loss by Region

Region	Total Building Loss	Total Business Interruption	Total Building Related Economic Loss
Region 1	$2.239B	$2.408B	$4.647B
Region 2	$4.463B	$4.375B	$8.838B
Region 3	$454.83M	$461.70M	$916.53M
Region 4	$1.32B	$878.36M	$2.200B
Region 5	$2.681B	$3.334B	$6.016B
Region 6	$846.46M	$722.62M	$1.569B
Region 7	$769.26M	$457M	$1.226B
Region 8	$981.64M	$770.5M	$1.752B
Region 9	$1.368B	$953.88M	$2.322B

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes even when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there was no physical access to the property because of flooded roadways. Displaced people using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Age plays a secondary role in shelter use in that there are some individuals who will go to a public shelter even if they have the financial means to go elsewhere. These will usually be younger, less established families and elderly families (HAZUS-MH User's Manual). HAZUS-MH does not model flood casualties given that flood-related deaths and injuries typically do not have the same significant impact on the medical infrastructure as those associated with earthquakes. Table 3.6.9 compares the potential impacts of floods on Mississippi citizens for the MEMA Regions. Detailed results for all regions can be referenced in Appendix 7.3.6-C.

Table 3.6.9
Flooding Impacts on Populations
(Ranked by Displaced People)

County	Number of Households	Number of People Needing Shelter
Region 1	3,193	379
Region 2	3,615	305
Region 3	2,383	390
Region 4	3,289	555
Region 5	5,345	1,219
Region 6	2,255	123
Region 7	1,413	84
Region 8	2,506	178
Region 9	4,281	465

Local Critical Facility Floodplain Analysis

Critical facilities have been inventoried and geolocated where possible by region and are presented in Appendix 7.3.2-D. Information regarding the facility type and location were available, but valuations were not. The statewide HAZUS-MH-derived base-flood layer was overlaid, using GIS, on the geolocated critical facilities. The number and types of facilities located in a possible flood hazard area were summarized by Region in Table 3.6.10. Critical facilities included are emergency operations centers, fire stations, hospitals, police stations, and schools. These results are for general planning purposes only as there could be errors in the location of critical facilities as well as errors in HAZUS-MH modeled flood hazard boundaries noted previously.

Table 3.6.10
Critical Facilities Potentially Within a Base-Flood Hazard Area

Region	Number of Facilities at Risk
Region 1	217
Region 2	272
Region 3	233
Region 4	218
Region 5	404
Region 6	201
Region 7	153
Region 8	210
Region 9	295

Flood Insurance Claims Analysis

As previously stated in the flood profile section, Mississippi is rich in water resources that contribute to flooding issues for residential, commercial and essential facilities. With more than 5.2 million acres of floodplain (of a total landmass of 30,989,376 acres), Mississippi has the 5th largest floodplain in the United States.

A summary of the residential and other facilities building replacement values at risk by region is provided in Table 3.6.11.

Table 3.6.11
Summary of At Risk Properties by Region

Region	Residential Building Replacement Value at Risk	Other Building Replacement Value at Risk	Regional Building Exposure
MEMA Region 1	$2,665,644	$721,734	$3,387,378
MEMA Region 2	$4,136,077	$1,455,228	$5,591,305
MEMA Region 3	$2,054,352	$696,868	$2,751,220
MEMA Region 4	$2,877,659	$858,361	$3,736,020
MEMA Region 5	$6,362,345	$3,016,825	$9,379,170
MEMA Region 6	$2,970,405	$905,737	$3,876,142
MEMA Region 7	$2,017,177	$503,921	$2,521,098
MEMA Region 8	$9,127,035	$3,202,774	$12,329,809
MEMA Region 9	$18,096,969	$3,742,043	$21,839,012
Totals	$50,307,663	$15,103,491	$65,411,154

Local Plan Risk Assessment Summary

Below is a summary of the risk classification identified in the individual local mitigation plans by MEMA Region.

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1	--	--	1	6	--	--	1
2	1	1	--	7	--	--	1
3	1	1	--	8	--	--	4
4	--	1	1	9	--	--	1
5	--	5	12				

* The Town of Pelahatchie, in Region 5, only stated that flood was a hazard but did not provide a ranking. This plan was not included in the table above.

Assessing Vulnerability of State Facilities/ Estimating Potential Losses

Methodology

The state of Mississippi Department of Finance and Administration's Bureau of Buildings, Grounds and Real Property provided the number and value of state-owned buildings located in floodplains. Plan developers know of no building located in a floodplain that is operated, but not owned, by the state.

Specific data on building elevation, location and vulnerability to flooding of varying depths was not available. Without such data it was not possible to accurately determine any degree of building damage and potential loss. Theoretically each building has a potential for total loss. The same data from the 2010 plan was used since the statewide inventory project is not completed. A percentage of loss, instead of total exposure, was applied to estimate potential losses. Damage is directly related to the depth of the flooding. Based on FEMA's depth-damage curves used in their benefit-cost models it can be inferred that a two-foot flood equates to roughly 20 percent loss of the structure value. For purposes of this plan, the value of 20 percent of building value is the estimate of potential loss.

Data Limitations

HAZUS-MH does not distinguish between federal, state or local ownership or operation in its inventory data on bridges. Therefore, all bridges regardless of ownership are included in the assessment. At this time the state of Mississippi does not have a comprehensive list of state-owned or operated infrastructure, including bridges, sorted by region and keyed to location in floodplains. Without such data, plan developers determined that the HAZUS-MH default inventory data was the "best available data" even though all facilities are represented in the data not just state-owned or operated infrastructure.

Because of their potential vulnerability, bridges were chosen to represent infrastructure in the loss estimates. Due to time constraints only bridges, not all state-owned infrastructure, were addressed using HAZUS-MH inventory data. Additionally, the estimate of potential losses to bridges was limited to the top ten of the fifty most vulnerable communities. Vulnerable highways were noted but not included in the loss estimates.

The state has developed an ongoing strategy to address these data limitations for future plan updates. That strategy is included in the mitigation strategy section of the plan.

Table 3.6.12 serves as a summary of the potential losses to state-owned structures within the state of Mississippi. Details by region are provided in Appendix 7.3.2-E. This analysis was completed based on information provided by MEMA and outside of the HAZUS-MH model.

Table 3.6.12
Summary of Potential Losses to State-Owned Facilities

Region	Number of Buildings with available Replacement Values	Total Replacement Value (as available)	Number in Special Flood Hazard Area (SFHA)	Value in Special Flood Hazard Area (SHFA)	Estimated Flood loss (value x 20%)
MEMA Region 1	171	$57,356,843	2	$1,850,051	$35,636,281
MEMA Region 2	331	$156,546,716	0	$0	$0
MEMA Region 3	552	$256,299,605	55	$6,518,567	$1,303,713
MEMA Region 4	134	$27,175,900	0	$0	$0
MEMA Region 5	1,335	$2,648,653,307	52	$182,070,707	$36,414,141
MEMA Region 6	918	$813,681,823	12	$3,351,986	$670,397
MEMA Region 7	247	$79,618,031	0	$0	$0
MEMA Region 8	455	$286,676,990	17	$2,412,581	$482,516
MEMA Region 9	268	$215,287,139	16	$13,410,827	$2,682,165

Table 3.6.13 serves as a summary of the potential losses to state-owned bridges. The bridges are located along state highways that serve as important transportation and evacuation routes. These bridges transverse portions of the state's delineated floodplains and are susceptible to flood damage. Additionally, portions of the roadways themselves are subject to inundation and 'overtopping' by events greater than a 100-year flood.

Included with HAZUS-MH is a database of bridges called the National Bridge Inventory, which was developed by the Federal Highway Administration. One of the database items includes a "scour index" that is used to quantify the vulnerability of bridges to scour during a flood. Bridges with a scour index between 1 and 3 are considered "scour critical," or a bridge with a foundation element determined to be unstable for the observed or evaluated scour condition. A query of the database was performed that identified the scour critical bridges. Out of 4,037 state-owned bridges in Mississippi, 225 met these criteria. The potential loss could include the replacement value of the structure if flooding resulted in bridge collapse. These are bridges that could benefit from mitigation projects or be thoroughly inspected following a flood event. There were no changes to this table for the 2013 or 2018 plan update.

Table 3.6.13
Exposure and Flood Vulnerability of State Bridges by County (Values in thousands of dollars)

County	Bridge Count	Value	Scour Critical
Adams	16	$59,354.35	0
Alcorn	72	$99,883.86	0
Amite	41	$33,621.93	1
Attala	46	$39,324.78	11
Benton	54	$60,391.36	4
Bolivar	28	$22,534.88	2
Calhoun	63	$45,618.08	4
Carroll	43	$43,183.27	7
Chickasaw	51	$36,397.28	9
Choctaw	20	$14,146.20	2
Claiborne	19	$55,342.46	1
Clarke	70	$65,280.27	12
Clay	25	$54,115.41	3
Coahoma	28	$29,869.61	0
Copiah	49	$43,717.27	0
Covington	40	$39,545.24	7
Desoto	72	$119,180.45	1
Forrest	56	$80,733.65	2
Franklin	35	$52,053.90	0
George	27	$55,277.87	2
Greene	28	$101,453.50	1
Grenada	48	$51,207.33	4
Hancock	26	$145,699.13	0
Harrison	82	$460,275.88	1
Hinds	185	$399,360.16	6
Holmes	79	$84,795.11	9
Humphreys	8	$23,971.50	0
Pearl River	70	$90,247.62	3
Perry	36	$64,396.78	3
Pike	54	$58,800.65	3

County	Bridge Count	Value	Scour Critical
Issaquena	8	$12,409.80	0
Itawamba	74	$152,459.10	9
Jackson	56	$649,903.65	2
Jasper	42	$28,508.17	1
Jefferson	11	$6,913.09	0
Jeff. Davis	21	$20,112.19	2
Jones	91	$135,897.51	8
Kemper	48	$61,903.86	0
Lafayette	72	$64,338.53	1
Lamar	34	$38,973.09	2
Lauderdale	141	$208,051.89	1
Lawrence	17	$22,141.20	2
Leake	54	$79,850.72	3
Lee	131	$204,006.54	23
Leflore	32	$45,578.98	0
Lincoln	60	$61,895.46	1
Lowndes	90	$191,660.50	6
Madison	82	$101,987.37	4
Marion	51	$67,208.34	2
Marshall	85	$117,323.02	4
Monroe	76	$188,235.90	1
Montgomery	57	$53,470.84	1
Neshoba	41	$34,011.07	1
Newton	70	$64,145.34	3
Noxubee	24	$39,135.99	3
Oktibbeha	35	$34,457.36	2
Panola	75	$78,814.52	1
Tate	39	$53,338.10	2
Tippah	26	$25,323.31	2
Tishomingo	33	$78,274.19	3

County	Bridge Count	Value	Scour Critical
Pontotoc	54	$42,949.87	6
Prentiss	45	$49,366.41	3
Quitman	29	$21,578.69	0
Rankin	112	$212,858.86	3
Scott	42	$35,451.42	2
Sharkey	16	$14,459.88	0
Simpson	38	$29,888.20	3
Smith	25	$26,402.18	4
Stone	22	$31,987.16	2
Sunflower	23	$29,934.05	0
Tallahatchie	29	$27,133.10	0
Totals			

County	Bridge Count	Value	Scour Critical
Tunica	17	$11,849.09	0
Union	65	$73,748.68	3
Walthall	27	$26,061.52	1
Warren	61	$122,148.99	1
Washington	35	$35,864.93	1
Wayne	30	$42,152.86	2
Webster	29	$31,583.84	1
Wilkinson	19	$65,158.54	0
Winston	40	$33,227.70	0
Yalobusha	67	$54,624.90	5
Yazoo	65	$111,103.38	0
	4037	$6,579,643.64	225

Twenty state-owned or -operated (maintained) highways important to movement of people and freight and are potentially at risk to flooding because all of them have segments that traverse floodplains. These highways are:

Interstate10	U.S. Highway 84
Interstate 20	State Highway 18
Interstate 59	State Highway 80
U.S. Highway 90	State Highway 1
U.S. Highway 45	State Highway 302
U.S. Highway 82	State Highway 25
U.S. Highway 61	State Highway 49
U.S. Highway 72	State Highway 63
U.S. Highway 78	State Highway 11

3.7: Wildfire Risk Assessment

Hazard Description

A wildfire is any fire that burns uncontrollably in a natural setting (such as, grasslands, forest, and brush land). Prescribed burnings are the only exception to a wildfire. Wildfires can be either man-made or natural. In Mississippi, most fires are man-made, with arson being the most prevalent cause, followed by burning of debris. Nationwide, nearly 9 out of 10 wildfires are human-caused and could have been prevented with proper care. In an effort to reduce the number of human-caused wildfires in Mississippi, burn bans are issued by each County Board of Supervisors and approved by the MFC. However, typically, the cause of natural wildfires is lightning.

Prescribed burning, also known as controlled burning, is the deliberate use of fire under specified and controlled conditions. Prescribed burns are used by forest management professionals and individual landowners to accomplish one or more of the following tasks:

- **Fuel reduction:** The reduction of accumulated grass, weeds, pine needles, and hardwood leaves that threaten wildfires in young stands and hinder regeneration of older stands.
- **Hardwood control:** Prevents hardwood trees from competing with pines for nutrients and moisture, impeding visibility and access through the stands and interfering with natural regeneration in land areas is better suited for growing pines.
- **Site preparation:** Reduces the number of small diameter hardwood and exposes mineral soil before harvest cutting.
- **Wildlife habitat improvement:** Prescribed burns in young stands encourage fresh, low vegetation for wildlife, remove heavy brush, and encourage growth of annual plants.
- **Disease control:** Burns done to reduce fuel before thinning trees may help control disease.
- **Harvest cutting area improvement:** Reducing brush growing low to the ground prior to harvesting trees increases visibility and expedites the marking and cutting of the selected trees. This form of prescribed burning can lower costs for the landowner and the logging professional.

Wildfires are very common in many places around the world. Fires are particularly prevalent in summer, autumn and during droughts when fallen branches, leaves, grasses and scrub can dry out and become highly flammable. Some experts believe global warming is increasing the intensity and frequency of droughts in many areas, thus creating more intense and frequent wildfires.

Wildfires tend to be most common and severe during years of drought and occur on days of strong winds. With extensive urbanization of wildlands, these fires often involve destruction of suburban homes located in the wildland urban interface, a zone of transition between developed areas and undeveloped wildland.

On occasion, wildfires cause large scale damage to private or public property, destroying many homes and causing deaths, particularly when they reach urban fringe communities. Wildfires are extremely dangerous, and often deliberately lit.

It is important to note what constitutes an urban fire and how that impacts mitigation planning for local jurisdictions. Urban fires may be created by electrically-related structural and vehicle fires, incendiary arson, unattended cooking fires, smoking materials, heating devices, fuel systems, sparks, hazardous material spills, and spontaneous combustion.

The adjective class rating presented in Table 3.7.1 is a method of normalizing rating classes across different fuel models, indexes, and station locations. It is based on the primary fuel model cataloged for the station, the fire danger index selected to reflect staffing levels, and climatological class breakpoints. This information is provided by local station managers. About 90% use the Burning Index (BI); others use Energy Release Component (ERC). Staffing class breakpoints are set by local managers from historical fire weather climatology.

Table 3.7.1
Adjective Class Rating

Fire Danger Rating and Color Code		Description
Low (L)	Dark Green	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting
Moderate (M)	Light Green or Blue	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy
High (H)	Yellow	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spot- ting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH)	Orange	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics, such as long-distance spotting and fire whirlwinds when they burn into heavier fuels
Extreme	Red	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and

(E)		occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens

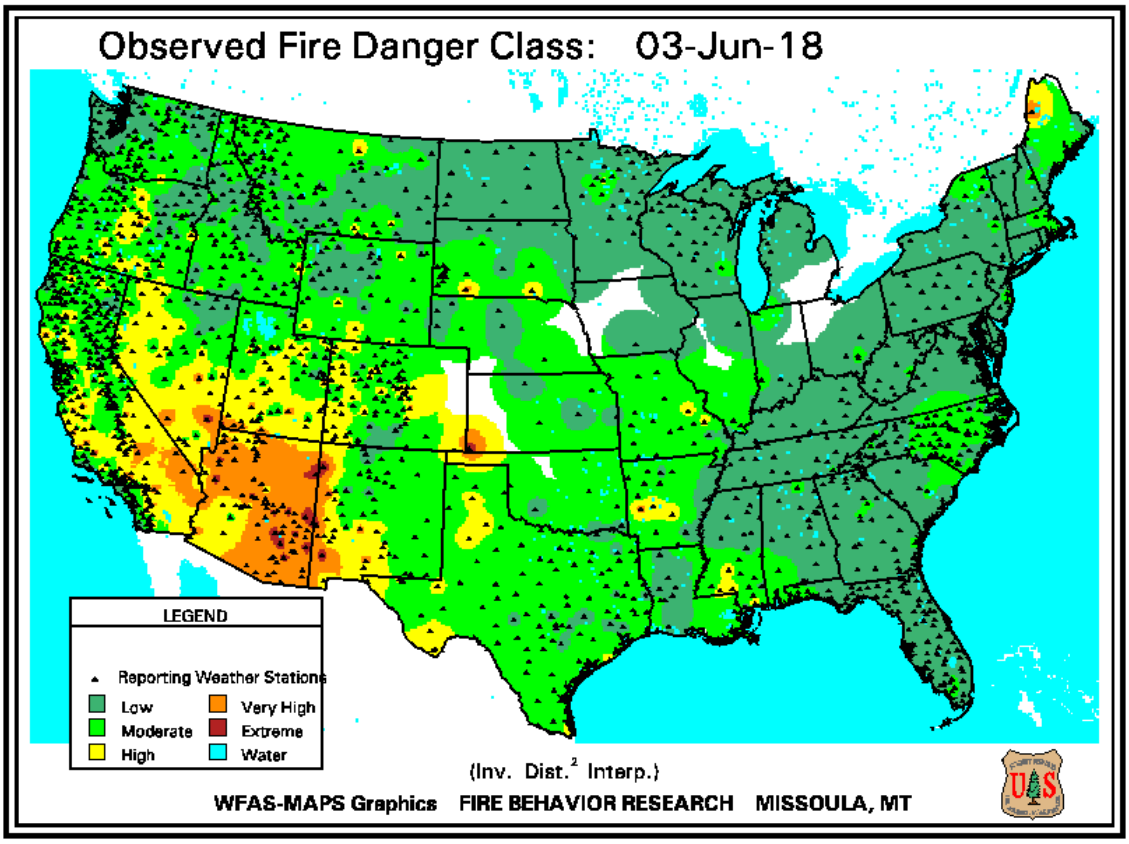
Source USFS WFAS

Fire managers in the south also use the Keetch-Byram Drought Index (KBDI) a mathematical system for relating current and recent weather conditions to potential/expected fire behavior. This system, originally developed for the southeastern United States, is based primarily on recent rainfall patterns and was specifically developed to equate the effects of drought with potential fire activities.

A full discussion on the KBDI is provided in Section 3.8 – Drought.

Figure 3.7.1 provides data on observed fire dangers as reported through various weather stations. For the time period reflected, a majority of Mississippi is in a low danger class while the southern counties experience a moderate danger class.

Figure 3.7.1
Adjective Class Rating



Hazard Profile

Wildland/Urban Interface

According to the MFC 2017 Annual Report, the MFC responded to and suppressed 2,318 wildfires that burned 33,574 acres in FY17. MFC Wildland Firefighters saved 4,441 structures threatened by wildfire activity. Unfortunately, 33 structures were damaged or destroyed. The average wildfire size was 14 acres.

As the population in rural areas increases, so do the issues facing Wildland/Urban Interface (WUI). Wildland/Urban Interface is the development of residential and commercial areas adjacent to or commingled with vegetative areas. More than half of the homes in Mississippi are considered to be part of a WUI. As further development in forested areas occurs this number increases. Wildfires in urban areas threaten human life, structures and wildland resources. As shown in Figure 3.7.2, WUI is broken into categories-intermix and interface. Intermix defines housing and commercial development mixed in with wildland vegetation. Interface describes housing and commercial development in proximity to wildland vegetation. The figure further describes the non-WIU vegetated areas, which are broken out into two categories-no housing and very low housing density. It also demonstrates the non-Vegetated or Agricultural areas. It is also broken into three groups- low and very low housing density, medium and high housing density and water. Figure 3.7.3 represents housing density, Figure 3.7.4 represents Wildland Vegetation Cover and Figure 3.7.5 shows land cover in Mississippi.

Figure 3.7.2
Wildland Urban Interface

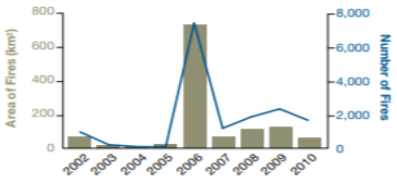
Population and Geography Overview

Census Data	Number	%
Population	2,967,297	
Housing units	1,274,719	
Seasonal use	28,867	2

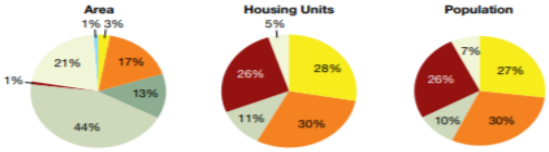
Land Ownership	Area (km²)	%
Public-Federal	4,293	3
Public-State	3,058	2
Public-Local	0	0
Private	116,172	94

Land Cover	Area (km²)	%
Forest	47,776	39
Shrubland/herbaceous	16,246	13
Planted/cultivated	31,532	26
Developed	7,563	6
Water/wetland	20,195	16
Others	211	0
Total area	123,523	

Wildfire History



WUI in Numbers (see legend)



Wildland-Urban Interface (WUI)

- Interface
- Intermix

Non-WUI Vegetated

- No housing
- Very low housing density

Non-vegetated or Agriculture

- Low and very low housing density
- Medium and high housing density
- Water

- County border
- Highway

0 50 100 km

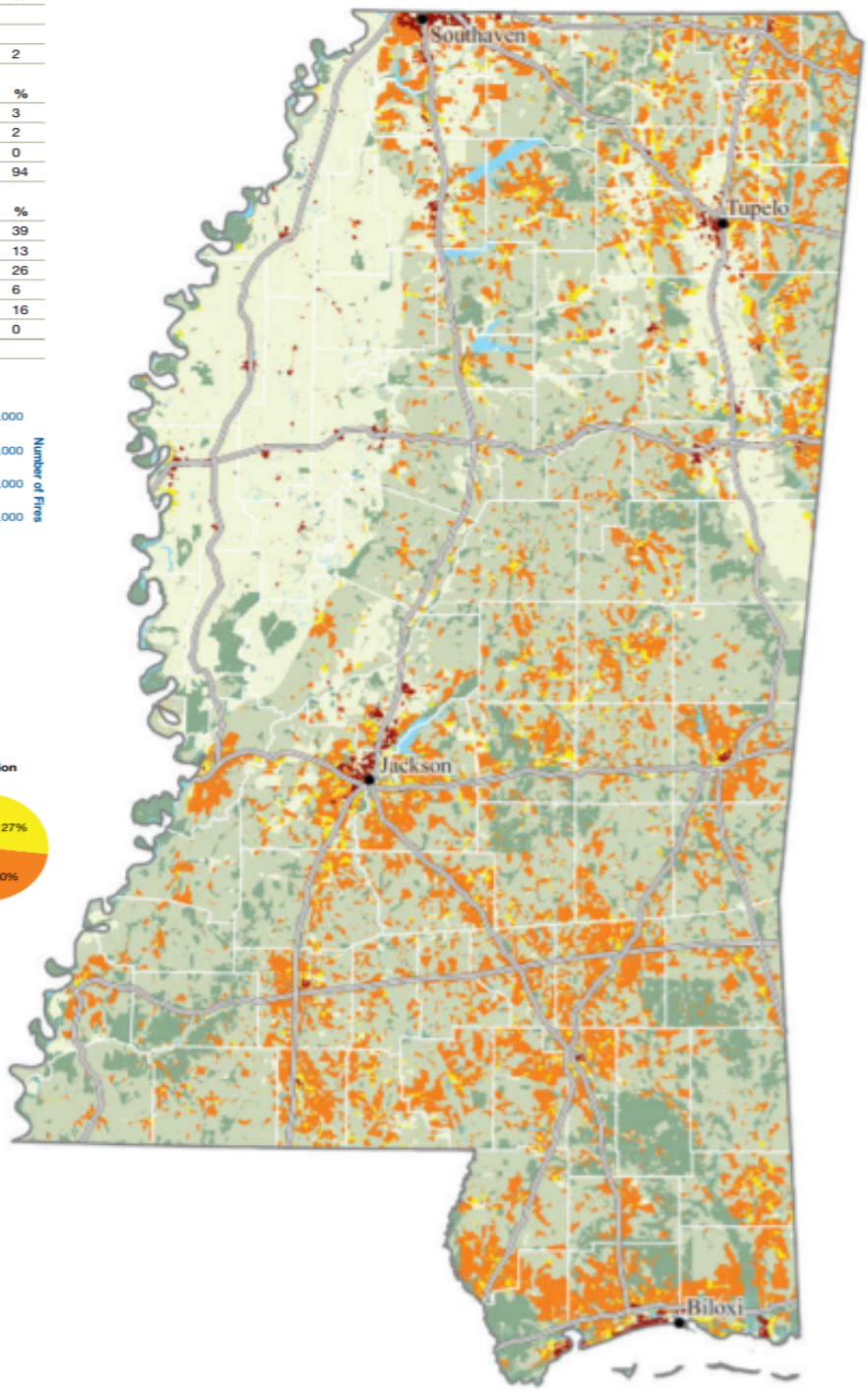


Figure 3.7.3
Wildland Urban Interface

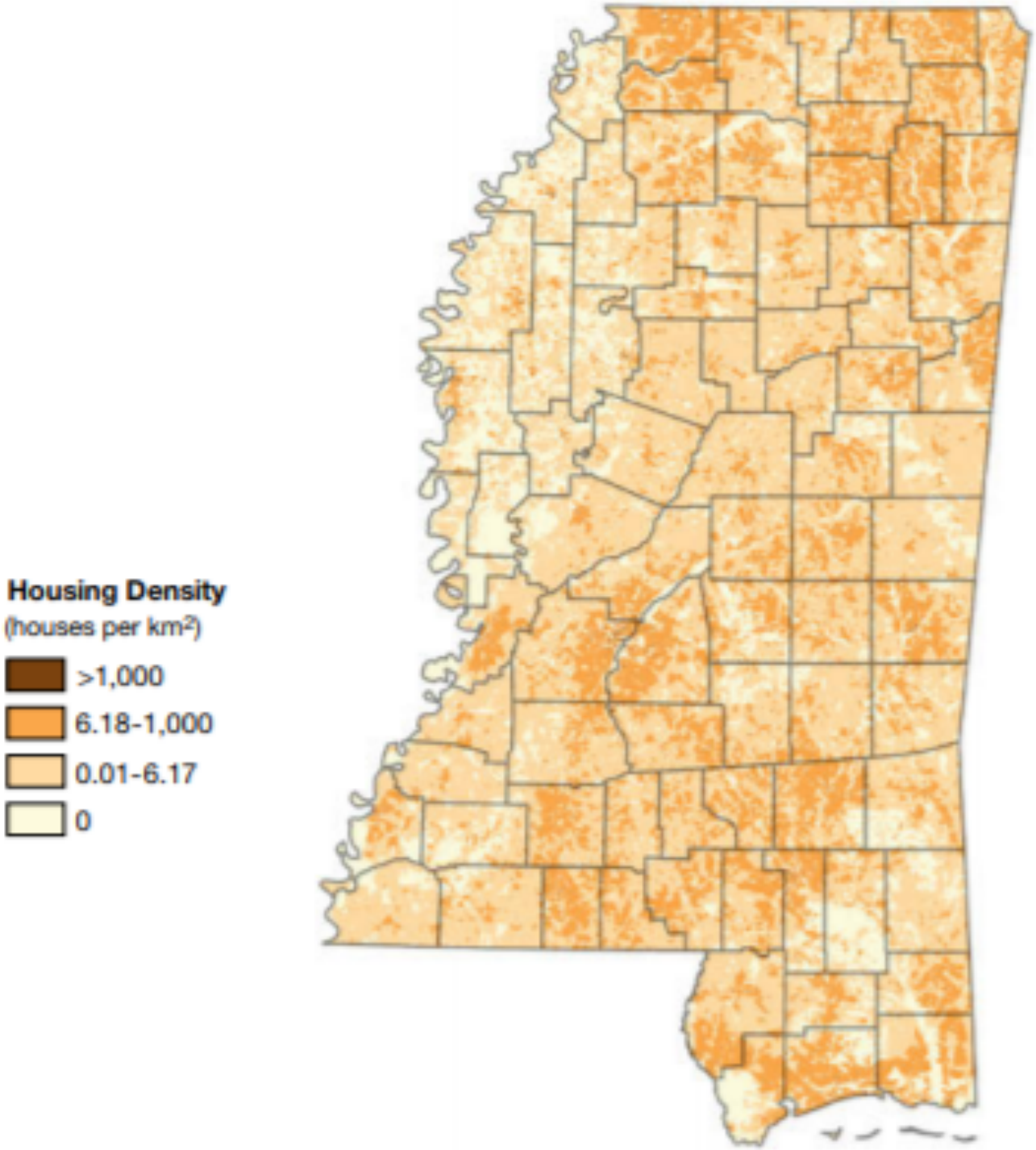


Figure 3.7.4
Wildland Urban Interface

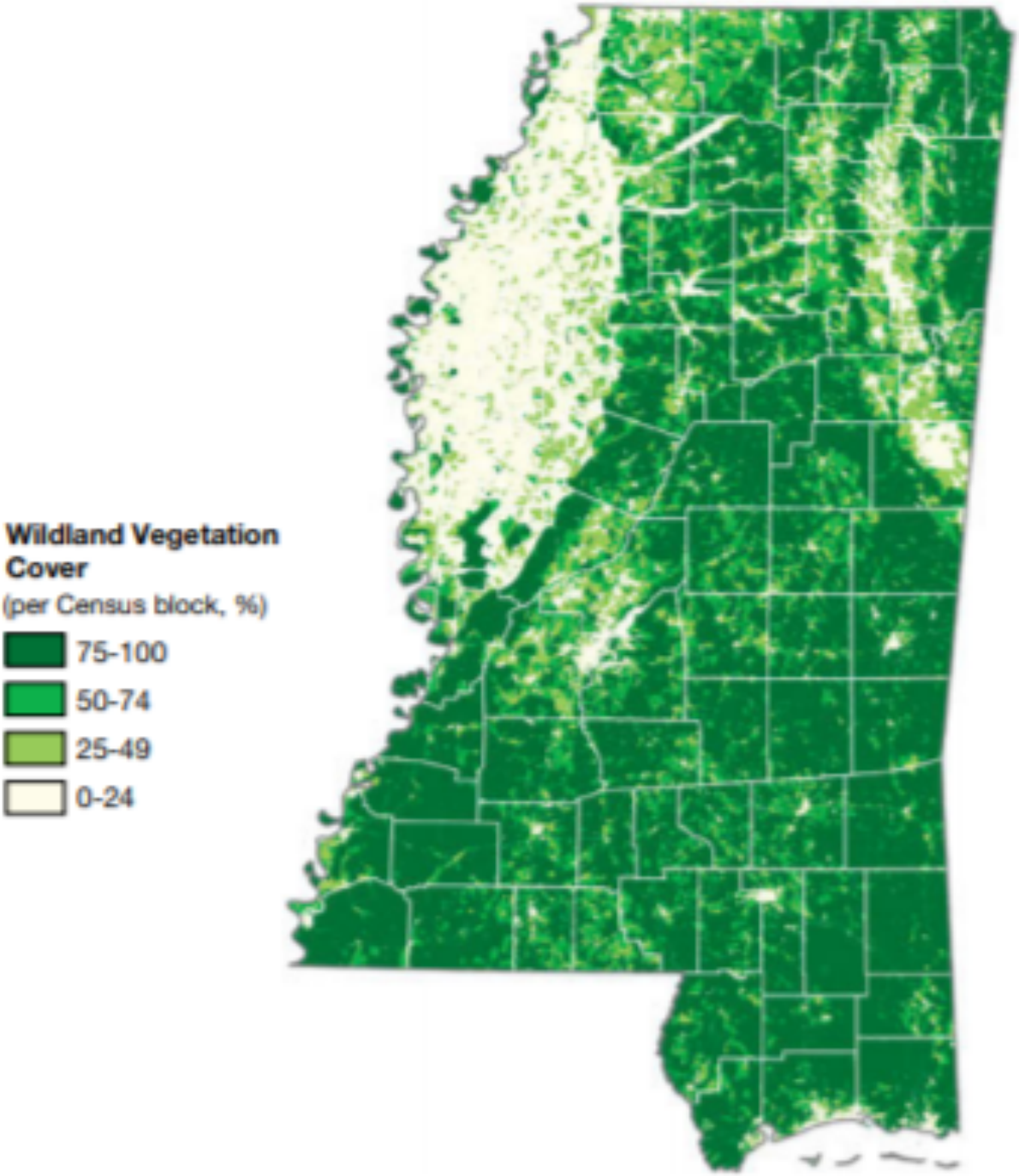
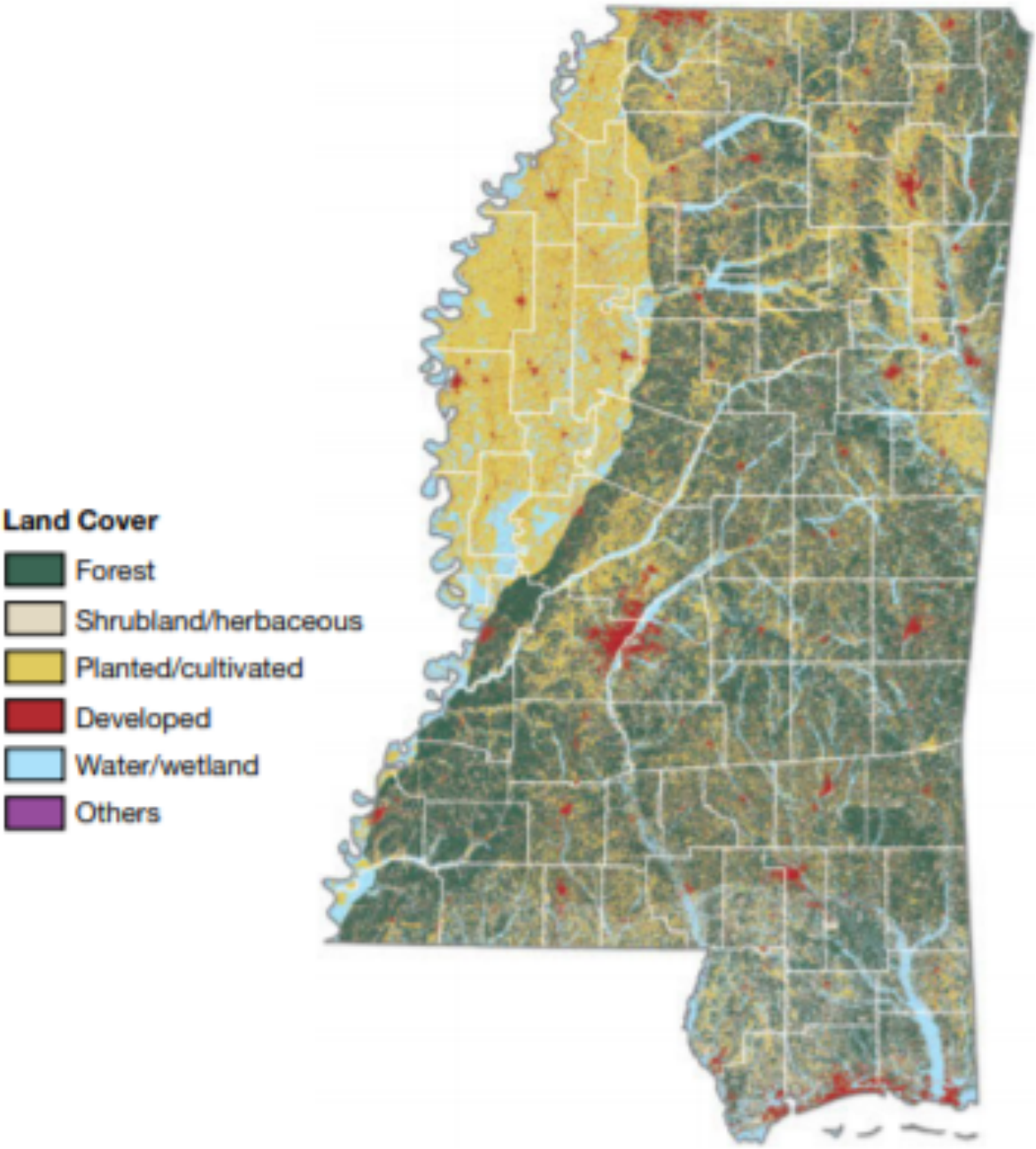


Figure 3.7.5
Wildland Urban Interface



Education and Outreach

Forest Information

The Mississippi Forestry Commission Forest Information Department provides support to all MFC programs through the development of displays, exhibits, brochures and other informational material. The department is the point of contact for media relations and is responsible for maintaining the MFC Web site (www.mfc.ms.gov), producing the agency's newsletter, annual report, and MFC News. The Forest Information Department utilizes social media to help carry the MFC message. Accounts were developed on Facebook and YouTube at no cost to the agency. Other social media outlets are being considered and will be activated if MFC determines they can further assist the Commission in reaching the people of Mississippi.

The Web site, www.mfc.ms.gov, is accessible to the public and employees. During periods of high fire danger, the Web site is used to provide public service information, including daily fire reports and news releases.

The Commission provides the following weather and fire information on the Web site:

- Fire Danger Rating (USDA Forest Service Wildland Fire Assessment System)
- Current Weather Forecast
- Fire Danger Rating and Color Code
- Keetch-Byram Drought Index
- MFC Daily Fire Situation Report
- Southern Area Coordination Center (SACC)
- National Weather Service Enhanced Radar
- Image Loop for the United States
- NWS Enhanced Radar Image Loop for Lower Mississippi Valley Sector
- NWS Fire Weather Report

Public Outreach

The Public Outreach/Conservation Education Department maintains an active outreach program designed to educate youths and adults about forestry and related issues, in addition to the agency's mission and services. Local outreach activities such as civic club presentations, forestry field days and visits to school groups are conducted across the state to reach individuals at the community level. In FY17, $105,283 was distributed to state and local governments, non-profit groups, and educational institutions through the Urban and Community Forestry Challenge Grant Program.

Public Outreach Officers provide customized presentations and displays for schools, community organizations, and events based on the following topics:

- Wildfire Prevention
- Smokey Bear Appearances
- Firewise
- Forest Health
- Forest Stewardship
- General MFC Information
- Best Management Practices
- Underserved Landowner Outreach Program
- Urban and Community Forestry

MFC has consulted with over 234 adult and youth programs boasting at least 193,8008 participants. Please note that this number does not include the participants from the MS State Fair, MS Wildlife. Consult www.mfc.ms.gov/public-outreach for information on other MFC outreach efforts.

Firewise

Firewise is an educational program for homeowners and community leaders. This program is for anyone living in, or connected to, the wildland/urban interface. Information is available to design, construct, landscape and maintain a home or community to withstand a wildfire without the aid of firefighting resources on the scene. Firewise literature can be found on the MFC website at www.mfc.ms.gov/firewise.

Firewise Workshops are also conducted throughout the state. These one-day workshops are free of charge and bring together citizens, business, and community leaders, getting them involved in planning, financing, building, sustaining, and protecting communities in the wildland/urban interface. Participants learn about the reason homes burn, various wildland fuel reduction techniques, and assessing the fire danger of their own home. The dates for Firewise Workshops can be found on the MFC website as well.

During the last plan update, there are six communities in Mississippi officially designated as Firewise Communities/USA Communities. Currently there are 17 communities designated as Firewise Communities.

Table 3.7.2
Firewise Communities

Community	County	Year
Batesville	Panola	2013
Booneville	Prentis	2015
Yazoo City	Yazoo	2015
Ethel	Atalla	2012
Gloster	Amite	2009
Iuka	Tishomingo	2013
Jacinto Volunteer Fire Department, Jacinto Community	Alcorn	2015
Lake Hillsdale, Lumberton	Pearl River	2009
Noxapater	Winston	2011
Pelahatchie	Rankin	2015
Sardis	Panola	2014
Scooba	Kemper	2013
Snow Lake Shores	Benton	2007
Decatur	Newton	2014
Kossuth	Alcorn	2014
Leaksville,	Greene	2015
Wiggins	Stone	2015

Underserved Landowner Program

The Underserved Landowner Outreach Program is a joint project between the MFC, Alcorn State University and the USDA Forest Service. The program offers assistance to underserved landowners in Mississippi and has three primary goals:

- To provide outreach support and technical assistance to underserved landowners
- To encourage young people to seek careers in forestry
- To work with Alcorn State University to develop and/or enhance projects of mutual forestry interest

Urban and Community Forestry Program

The Urban and Community Forestry Division provides assistance and training to urban areas in the development of community forestry programs. Support is offered for counties and municipalities regarding the development of tree ordinances, hazardous tree inventories, and urban forest management plans. The Urban Forestry Program also provides technical advice to builders regarding tree preservation during

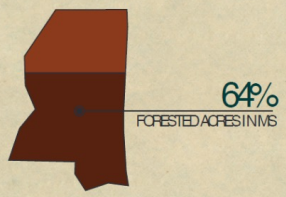
construction and assists homeowners with advice regarding insects, diseases, and other urban forestry issues.

The Urban and Community Forestry Challenge Grant Program is funded by a grant from the USDA Forest Service for administration, demonstration projects, and educational programs. The purpose of the Urban and Community Forestry Challenge Grant Program is to aid in the development of long-term, self-sustaining urban and community forestry programs. The goal of the Urban and Community Forestry Challenge Grant Program is to inspire or enhance local or statewide urban and community forestry programs.

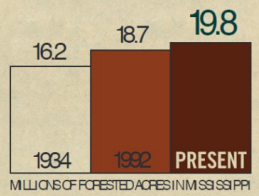
Mississippi Forest Facts

Mississippi Forestry Association, Mississippi Institute for Forest Inventory, and Mississippi State University compiled the following information to help Mississippians gain an understanding of the hazards wildfires pose to lives, homes, other structures, the forestry industry, and the state's economy.

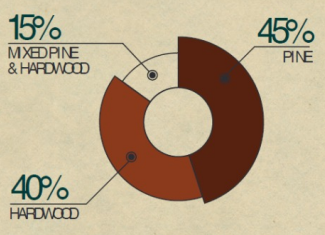
Acreage and Ownership



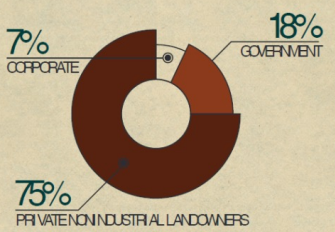
AREA OF COVERAGE



TIMELINE OF GROWTH



FOREST BY COVER TYPE



WHO OWNS MISSISSIPPI'S FORESTS

Employment and Wage Summary

FORESTRY AND FORESTRY-RELATED EMPLOYMENT:

5% ACCOUNTS FOR NEARLY OF ALL JOBS IN MISSISSIPPI

$12.3 BILLION FORESTRY AND FOREST PRODUCT INDUSTRY

ALMOST **70,000** TOTAL JOBS IN MISSISSIPPI

$3.4 BILLION WAGES PAID OUT

Forestry and the Economy

Timber is a very important part of Mississippi's economy.

- The value of timber harvesting in Mississippi has averaged in excess of $1 billion per year over the past 20 years.
- Mississippi forests provide recreational opportunities, encourage tourism, and create environmental benefits such as excellent water quality, cleaner air, improved wildlife habitat, and the storage of atmospheric carbon.
- Promoting sustainable forest management, reforestation after harvest, and keeping forests productive have strategic long-term benefits for Mississippi.

Mssissippi is "First in Forestry"

Thanks to MFA...

- State funded green buildings must equally recognize all forest certification programs.
- Mississippi was the first state in the nation to establish a reforestation tax credit, helping landowners with expenses associated with the stewardship of forest land and encouraging them to replant after harvest. Mississippi Forestry Association and its partners worked with the state legislature to increase the tax credit's lifetime limit from $10,000 to $75,000.
- Mississippi ranks number one in the nation in the number of Certified Tree Farms under the American Tree Farm System.

Mississippi Forest Facts is published by Mississippi Forestry Association, msforestry.net. Statistics were compiled by the Mississippi Forestry Commission and Mississippi State University.

Location

At the time of the previous plan update, the state was divided into seven Mississippi Forestry Commission Districts. Due to budget cuts and departmental restructuring, it is now divided into four Mississippi Forestry Commission districts, shown in Figure 3.7.6. The commission tracks wildfires by district and causes (Table 3.7.3). Averaging over 700 fires annually during the last three years, the Southeast District maintains the highest history of wildfires in the state. The areas with minimal amounts of previous wildfire events are along the Mississippi River. With the exception of one district in the northeast section of the state, Mississippi's three southernmost districts continue to experience the highest average of wildfires. This trend is most apparent flowing major Gulf Coast storms, when forest floor litter is greatest.

Figure 3.7.6

Mississippi Forestry Commission
FY18 Service Areas & Regions

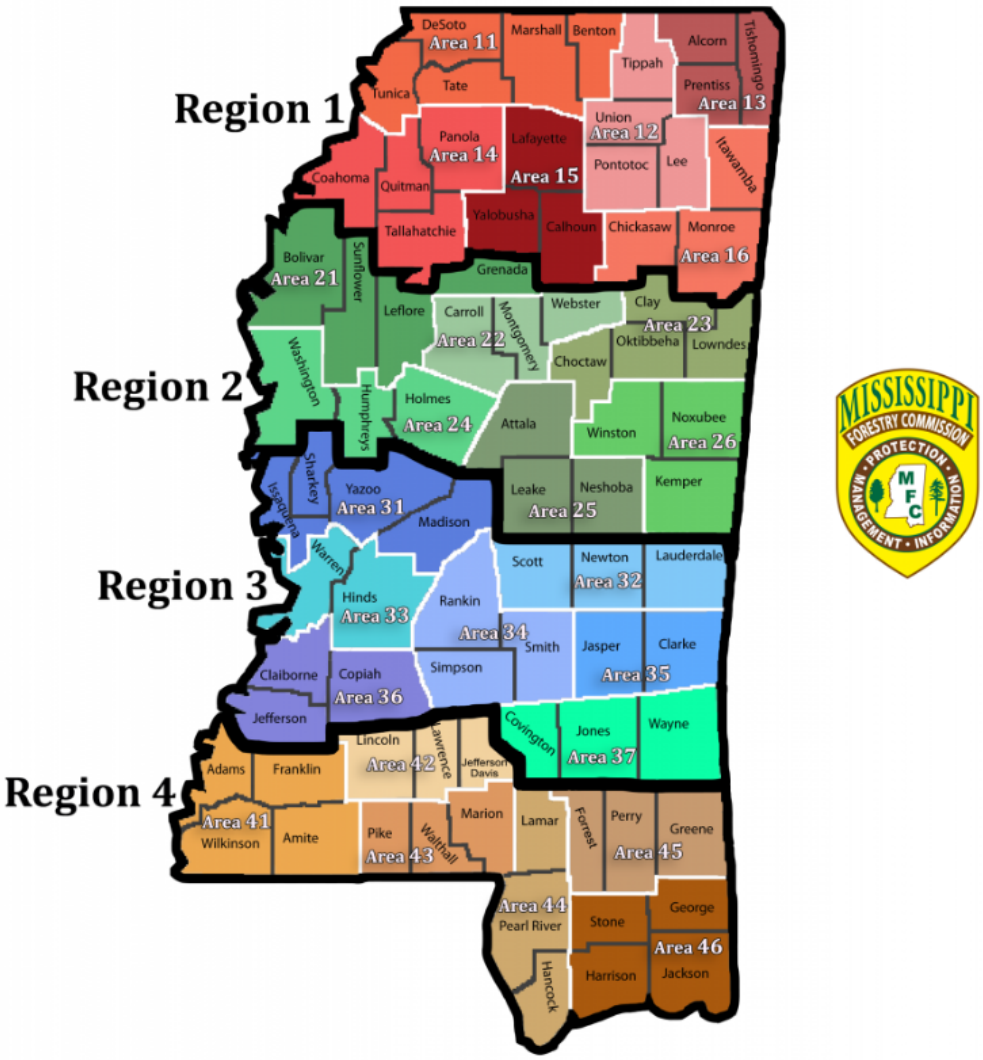


Figure 3.7.7

Mississippi Forestry Commission Central Dispatch Regions

To report a wildfire or obtain a burning permit, call the Central Dispatch number for your area:

Northwest Dispatch
1-877-226-5414

Bolivar
Carroll
Coahoma
DeSoto
Grenada
Holmes
Humphreys
Leflore
Montgomery
Panola
Quitman
Sunflower
Tallahatchie
Tate
Tunica
Washington
Yalobusha

Northeast District
1-800-681-8760

Alcorn
Attala
Benton
Calhoun
Chickasaw
Choctaw
Clay
Itawamba
Kemper
Lafayette
Leake
Lee
Lowndes
Marshall
Monroe
Neshoba
Noxubee
Okitbbeha
Pontotoc
Prentiss
Tippah
Tishomingo
Union
Webster
Winston

Southwest Dispatch
1-888-823-3473

Adams
Amite
Claiborne
Copiah
Franklin
Hinds
Issaquena
Jefferson
Jefferson Davis
Lawrence
Lincoln
Madison
Marion
Pike
Rankin
Sharkey
Simpson
Walthall
Warren
Wilkinson
Yazoo

South Central Dispatch
1-800-736-9115

Clarke
Covington
Jasper
Jones
Lauderdale
Newton
Scott
Smith
Wayne

Southeast Dispatch
1-800-240-5161

Forrest
George
Greene
Hancock
Harrison
Jackson
Lamar
Pearl River
Perry
Stone

Figure 3.7.6

Mississippi Forestry Commission Administrative Districts

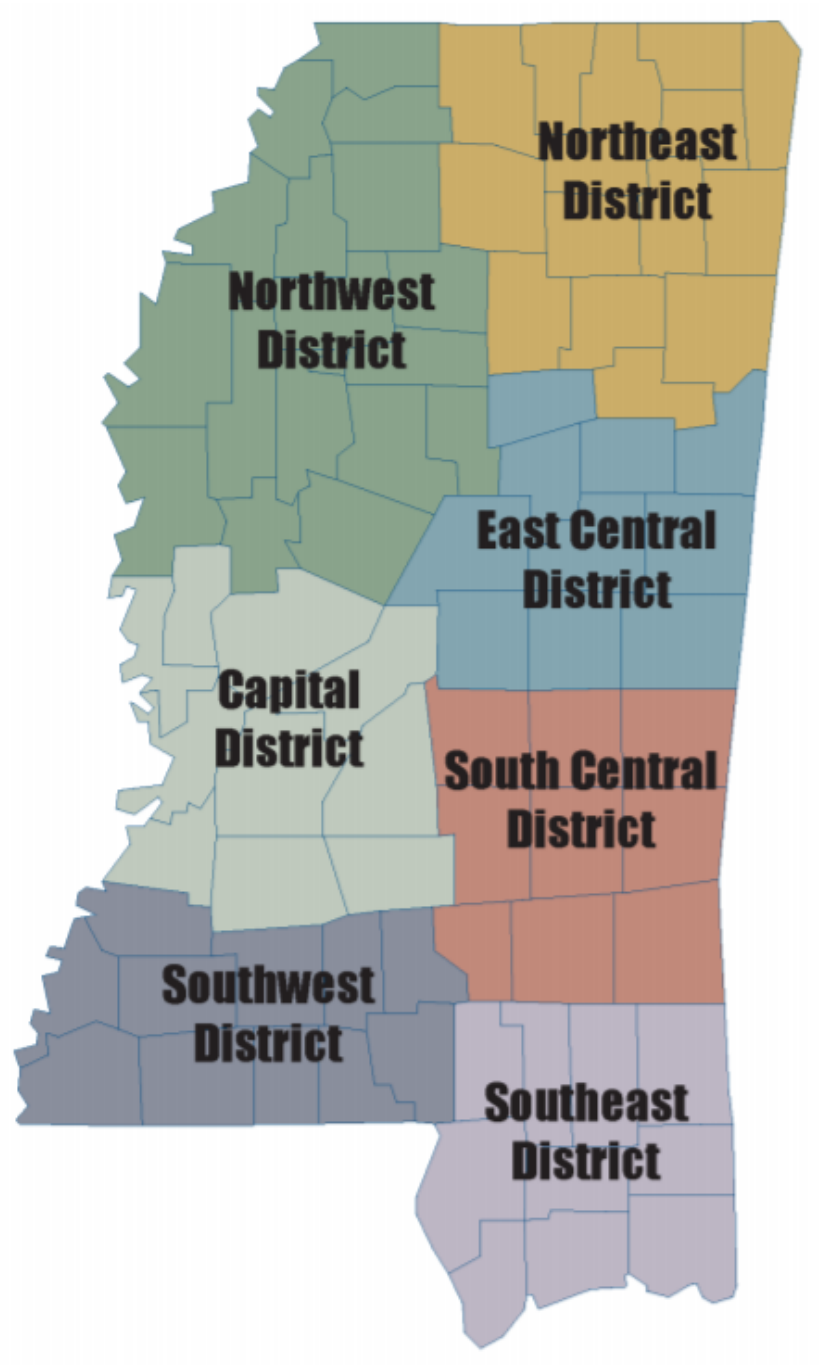


Table 3.7.2
Top 10 States for Wildfires Ranked by Number of Fires

Rank	State	Number of Fires
1	Texas	9,827
2	California	9,560
3	North Carolina	5,125
4	Georgia	3,929
5	Missouri	3,398
6	Florida	3,280
7	Mississippi	2,775
8	Montana	2,422
9	Arizona	2,321
10	Oregon	2,049

Source: National Interagency Fire Center

With 100 state parks, national parks and forests, and wildlife management areas and refuges in 63 counties, Mississippi is number seven on the top 10 of states for Wildfires in 2017 (Table 3.7.2).

Past Occurrences

During the last plan update, the majority of Mississippi's wildfires were started by man-made causes, such as arson. However, causing an average of 871 fires each year in Mississippi (2010 - 2017), debris burning is the state's biggest fire threat. The second cause of wildfires in Mississippi is arson, averaging about 805 fires a year.

Other man-made causes of wildfires in Mississippi include railroads, children, smoking, and other miscellaneous causes. Individually these elements do not pose a serious threat to Mississippi's natural resources, but combined they account for approximately 347 fires annually, about 14% of all fires.

As shown in Table 3.7.3, lightning strikes typically make up a small percentage of wildfires in Mississippi. Contributing to an average of 25 wildfires ignited annually, lightning-ignited wildfires are not considered a serious hazard to the state.

Table 3.7.3
Mississippi Wildfire by Cause
2010 – 2017

Cause of Fire	2017 No. of Fires	2017 No. Acres Burned	2016 No. of Fires	2016 No. Acres Burned	2015 No. of Fires	2015 No. Acres Burned	2014 No. of Fires	2014 No. Acres Burned
Incendiary/Arson	655	12,963	325	11,772	740	10,923	850	14,457
Debris Burning	816	10,180	743	6,747	780	8,276	828	7,788
Lightning	10	92	16	320	8	50	14	1,015
Campfire	10	119	8	17	4	90	3	7
Smoking	19	107	20	170	6	18	17	190
Equipment	72	844	69	1,641	40	544	36	397
Railroads	3	12	5	66	4	13	2	30
Children	7	16	13	45	10	66	22	162
Miscellaneous	658	8,246	717	10,592	119	2,704	156	1,824
Re-ignition	0	0	0	0	45	712	0	0
Undetermined	68	995	0	0	0	0	0	0
TOTALS	**2,318**	**33,574**	**1,916**	**31,370**	**1,756**	**23,396**	**1,928**	**25,870**

Cause of Fire	2013 No. of Fires	2013 No. Acres Burned	2012 No. of Fires	2012 No. Acres Burned	2011 No. of Fires	2011 No. Acres Burned	2010 No. of Fires	2010 No. Acres Burned
Incendiary/Arson	680	9,125	758	11,452	1,706	29,240	728	11,005
Debris Burning	584	5,678	773	5,735	1,713	15,230	731	6,612
Lightning	25	478	21	275	47	641	10	147
Campfire	7	16	3	31	9	155	1	3
Smoking	7	39	22	110	37	279	14	34
Equipment	27	222	51	297	115	949	311	254
Railroads	4	102	9	141	8	66	2	3
Children	7	79	12	6	20	241	9	125
Miscellaneous	133	1,828	154	1,366	249	2,710	108	503
Re-ignition	0	0	62	585	238	5,279	38	427
TOTALS	**1,474**	**17,567**	**1,865**	**20,056**	**4,142**	**54,790**	**1,672**	**19,113**

Potential Damages from Wildfires

Agriculture is Mississippi's number one industry, employing roughly 260,000 people, approximately 17% of the state's workforce, either directly or indirectly. Additionally, agriculture contributes $7.4 billion in income. Add an estimated $2.7 billion annual economic impact from hunting, fishing, and other natural resource related enterprises.

There are roughly over 37,100 farms covering over 10.9 million acres of farmed. Mississippi also includes 19.7 million acres of forest land; 14,000 miles of streams; and 640,000 acres of ponds and lakes. On average, Mississippi farms are composed of 264 acres, and are spread across every region of the state with the highest concentration of cropland located in the Delta.

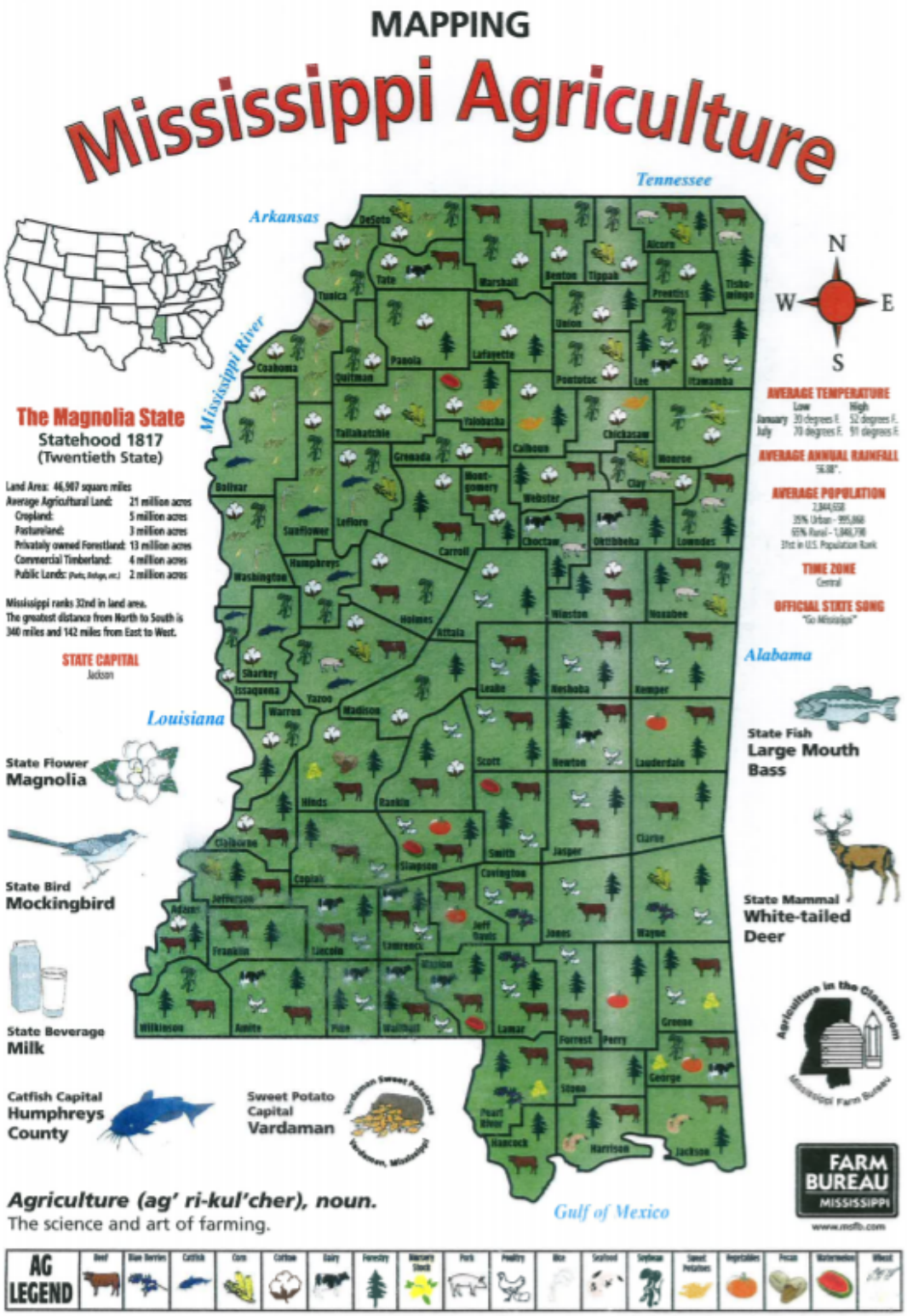
Table 3.7.4 list Mississippi's top to agricultural crops. As shown by the map in Figure 3.7.5, agriculture makes a significant impact in all of Mississippi's 82 counties.

Table 3.7.4
Mississippi's Top Ten Agricultural Crops

Rank	Agricultural Crop	2017 Revenue	Rank	Agricultural Crop	2017 Revenue
1	Poultry/Eggs	$2.8 billion	6	Cattle & Calves	$285 million
2	Forestry	$1.4 billion	7	Catfish	$181 million
3	Soybeans	$1.1 billion	8	Sweet Potatoes	$123 million
4	Cotton	$562 million	9	Hogs	$117 million
5	Corn	$337 million	10	Hay	$116 million

Source: Mississippi Department of Agriculture and Commerce

Figure 3.7.5
2017 Mississippi Agricultural Map



The best available data to calculate job and wages for direct impact were those based on 2014 data. The 2013 plan indicated that in 2010, the Forest Industry Sector provided over 36,000 jobs and paid $1.6 billion in wages to Mississippi. In 2014, there were increases in all areas with the exception of Miscellaneous Forest Products. The Forestry Industry Sector provided over 40,000 jobs and paid more than $1.9 billion in wages as indicated in Table 3.7.5.

Table 3.7.5
Mississippi Forest Industry's
Direct Impact on Job and Wages – 2014 and 2010

Forest Industry Sector	2014 Wages Paid (in Millions)	2014 Jobs	2010 Wages Paid (in Millions)	2010 Jobs
Miscellaneous Forest Products	$31.29	505	$32.91	449
Logging	$500.39	10,634	$244.35	5,734
Solid Wood Products	$447.63	9,071	$391.06	8,443
Wood Furniture	$622.55	16,178	$654.90	17,882
Pulp and Paper	$313.21	3,770	$309.24	3,623
TOTALS	**$1,915.07**	**40,158**	**$1,632.46**	**36,131**

Probability of Future Events

Fire is a natural part of a healthy ecosystem. However, as more development (commercial and residential) occurs, the future of wildfires is inevitable. (See Figure 3.7.2) Mississippi may be able to decrease future wildfire events through continued education and outreach. Making well-informed decisions when recreating outdoors can reduce wildfire occurrences in the state. Increasing manpower to fight and deter arson can also lower Mississippi's threat of future wildfires.

Assessing Vulnerability

The state of Mississippi has not added any new County Wildfire Protection Plans since the last plan update. As a result, the analysis of the state's vulnerability that led to the information in this section will remain the same.

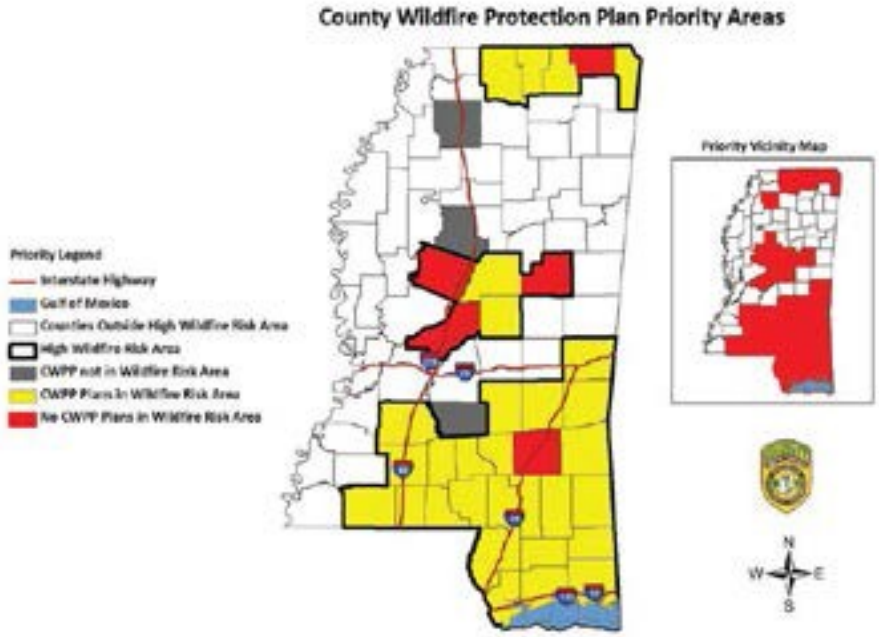
An assessment of Mississippi's vulnerability to wildfires is dependent on the proximity of development to natural wildland areas. The most common means of assessing wildfire threat is to quantify the amount of development (residential and non-residential structures) in proximity to or built within wildland areas. The best available information for assessing wildfire threat to Mississippi is contained in the Southern Wildfire Risk Assessment (SWRA). Using that data, the state of Mississippi used funding received after Hurricane Katrina to prepare County Wildfire Protection Plans (CWPPs) for the 15 lower counties in Mississippi. Following that initial effort, the state prepared CWPPs for 19 high-occurrence counties, making a total of 34 counties with prevention plans (Table 3.7.6). The Mississippi Forestry Commission has a copy of these completed plans. The CWPPs will also be incorporated into the update of local hazard mitigation plans as

they are developed. These CWPPs contain valuable initiatives for improved safety and economic security. Counties are encouraged to move toward their implementation. (See Figure 3.7.6).

Table 3.7.6
County Wildfire Protection Plans

County	Plan Date	County	Plan Date
Amite	September 2008	Lawrence	September 2009
Attala	September 2008	Leake	July 2008
Benton	September 2009	Lincoln	September 2008
Carroll	September 2008	Marshall	September 2008
Clarke	September 2009	Panola	September 2008
Copiah	September 2009	Pearl River	December 2007
Covington	October 2008	Perry	October 2008
Forrest	October 2008	Pike	September 2009
George	December 2007	Simpson	September 2009
Greene	October 2008	Smith	September 2009
Hancock	October 2008	Stone	December 2007
Harrison	December 2007	Tippah	September 2008
Jackson	December 2007	Tishomingo	September 2008
Jasper	July 2008	Walthall	September 2008
Jefferson Davis and Marion	October 2008	Wayne	October 2008
Lamar	October 2008	Winston	September 2008
Lauderdale	August 2008		
Source: Mississippi Forestry Commission			

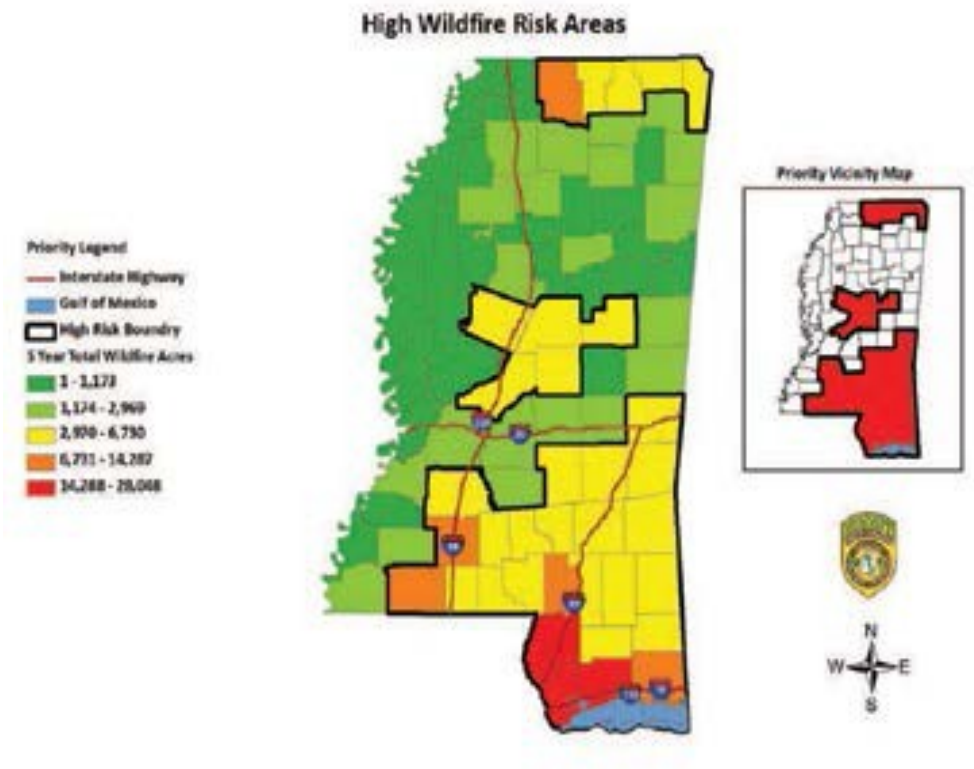
Figure 3.7.6
Forestry Commission 2017



The development of *Mississippi's Statewide Forest Resource Assessment and Forest Resource Strategy Plan* was completed and approved by the U.S. Forest Service in 2010. It was fully implemented in FY2011. To date, this information has not changed. No updates have occurred to this plan since its implementation. This plan is a comprehensive analysis of forest-related conditions, trends, threats, and opportunities; as well as strategies to address them. Wildfire fuel reduction strategies in the plan include:

- Identify at-risk communities and high fire-occurrence areas
- Increase the Number of Certified Prescribed Burn Managers (CPBMs)
- Increase the number of prescribed-burn acres annually in high-risk areas identified in the 34 WPP's (Figure 3.7.7)
- Use current land owner burn assistance programs to reduce fuel loading from invasive species plants
- Continue to provide funding to insure plans are completed in remaining counties
- Provide equipment to volunteer fire departments for use in controlling non-forest fires inside and outside the WUI.
- Identify locations of MFC tractor/plow units and volunteer fire departments.

Figure 3.7.7



Local Plan Risk Assessment Summary

Below is a summary of the risk classification identified in the individual local mitigation plans by MEMA Region.

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1		9		6		9	
2		12		7		9	
3	9	1		8		5	1
4		10	1	9		6	
5		45	1				

Exposure Analysis of Critical Facilities

The state of Mississippi developed a definition for "critical facilities and infrastructure" as discussed in Section 3.0. Location data for these facilities was collected from various state agencies for the purpose of determining which facilities are at risk to various hazards. The critical facility categories deemed most pertinent to wildfire risk are: Emergency Operations Centers, Fire Stations, Police Stations, Medical and Power Facilities and Red Cross shelters and facilities. The following maps have been created to demonstrate this per region.

Figure 3.7.8

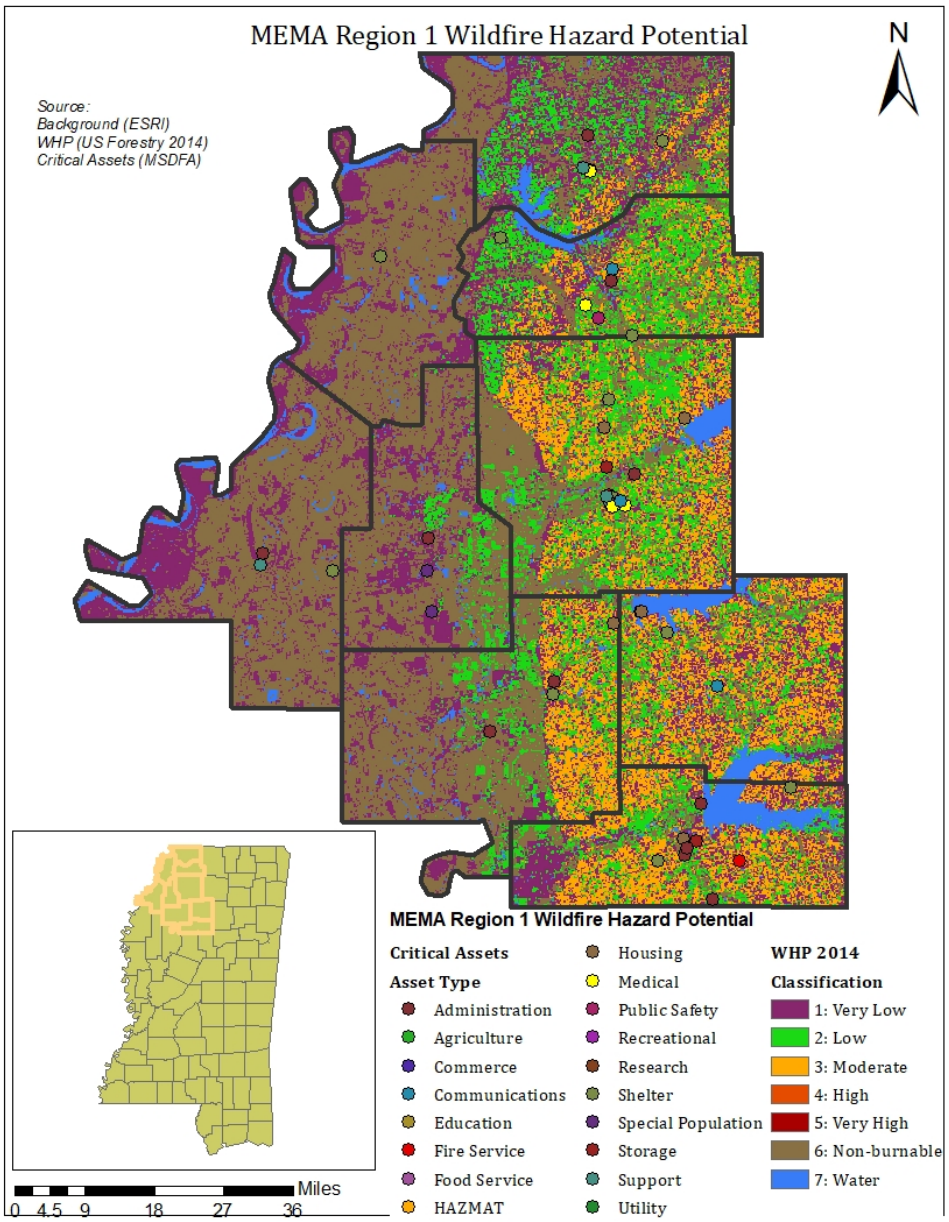


Figure 3.7.9

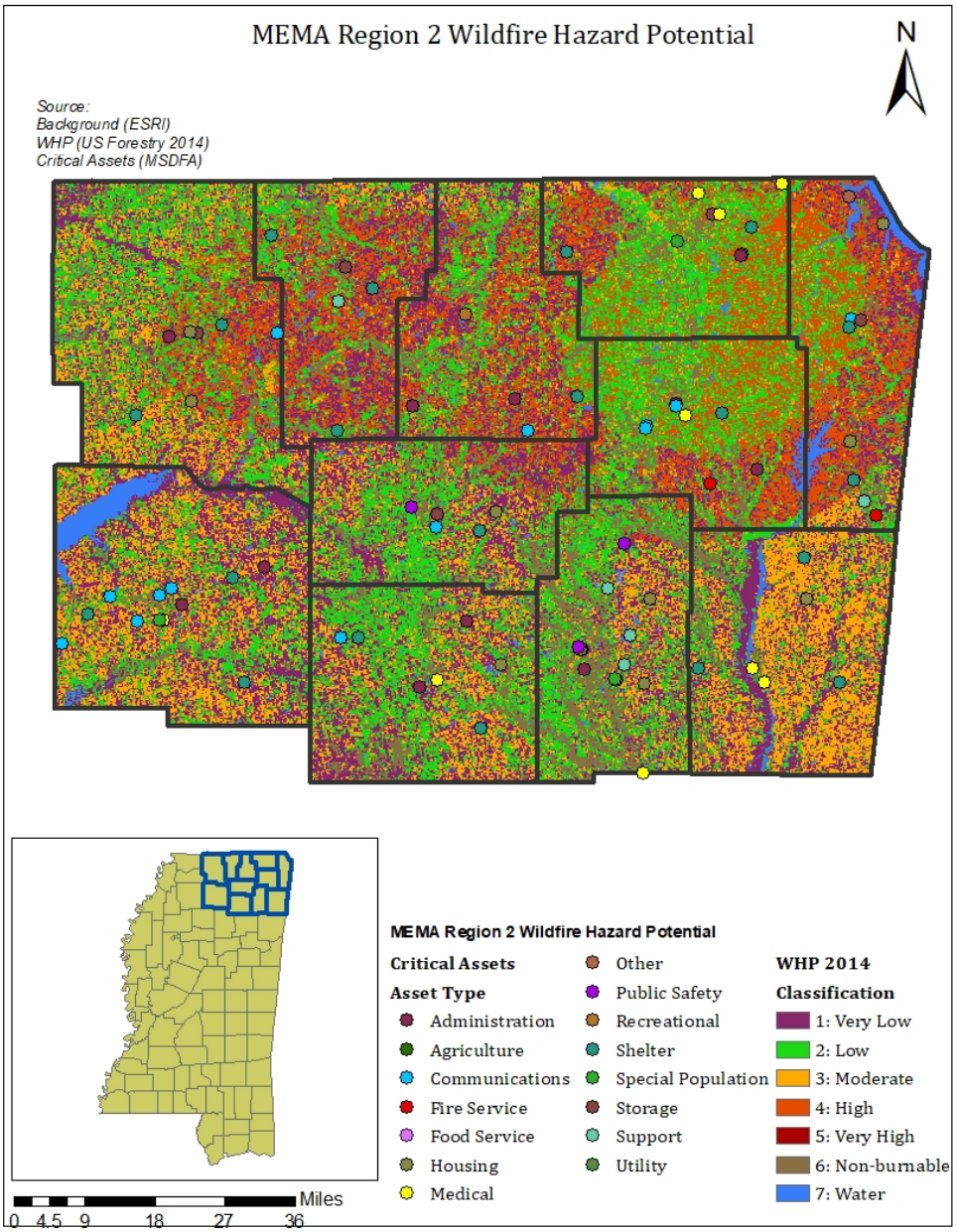

MEMA Region 2 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 2 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Agriculture
Communications
Fire Service
Food Service
Housing
Medical
Other
Public Safety
Recreational
Shelter
Special Population
Storage
Support
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 4.5 9 18 27 36

Figure 3.7.10

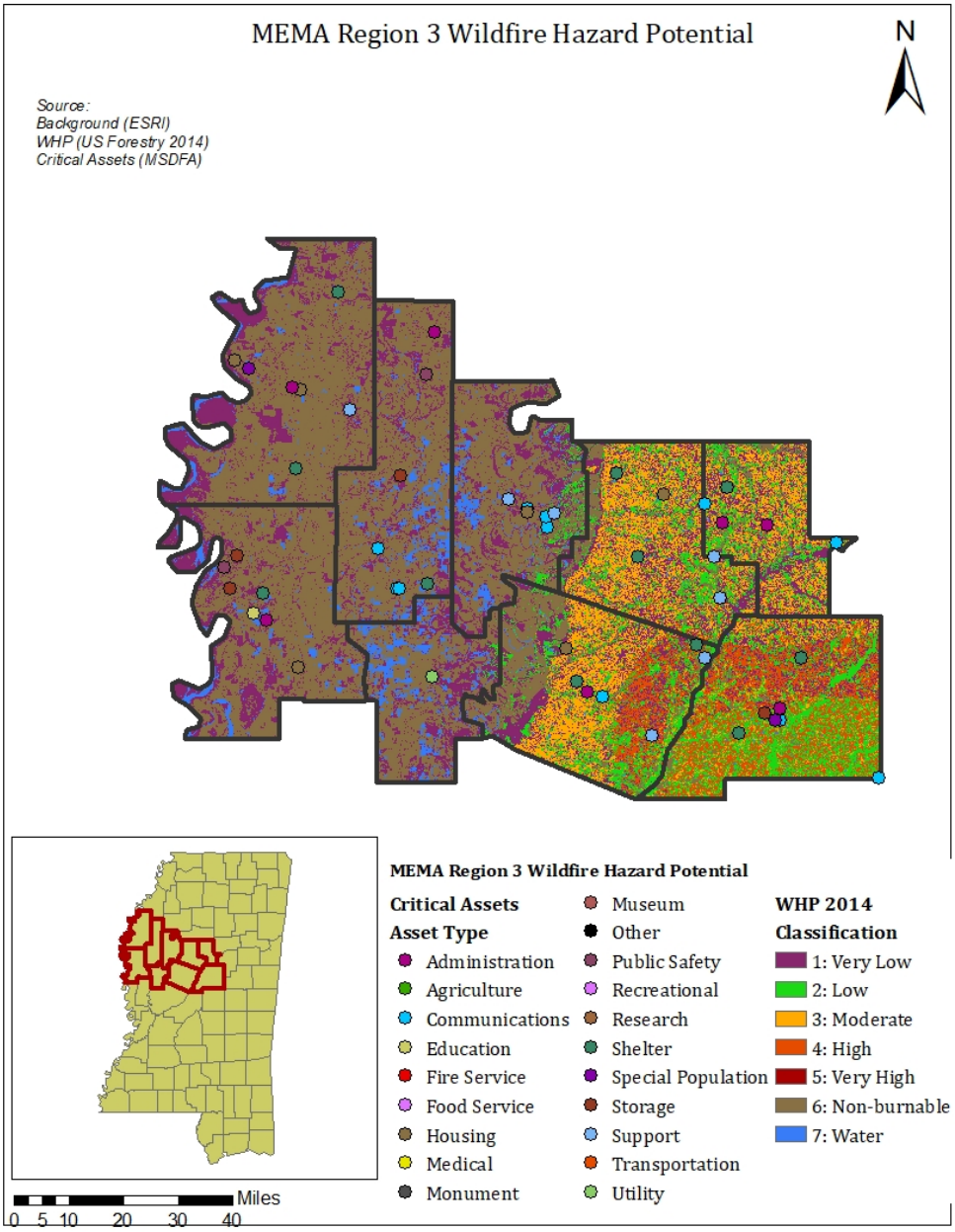

MEMA Region 3 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 3 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Agriculture
Communications
Education
Fire Service
Food Service
Housing
Medical
Monument
Museum
Other
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Transportation
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

Figure 3.7.11

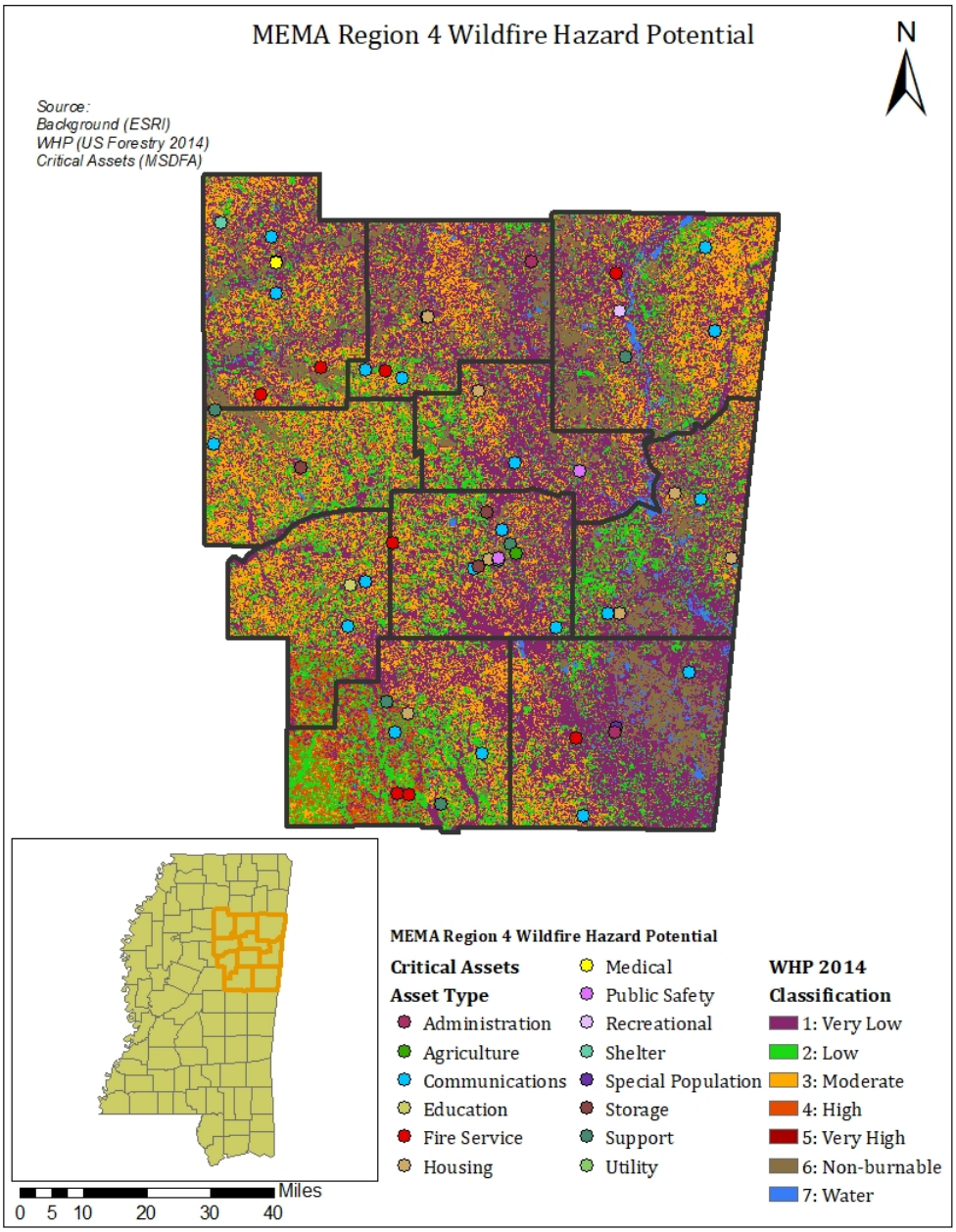

MEMA Region 4 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 4 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Agriculture
Communications
Education
Fire Service
Housing
Medical
Public Safety
Recreational
Shelter
Special Population
Storage
Support
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

Figure 3.7.12

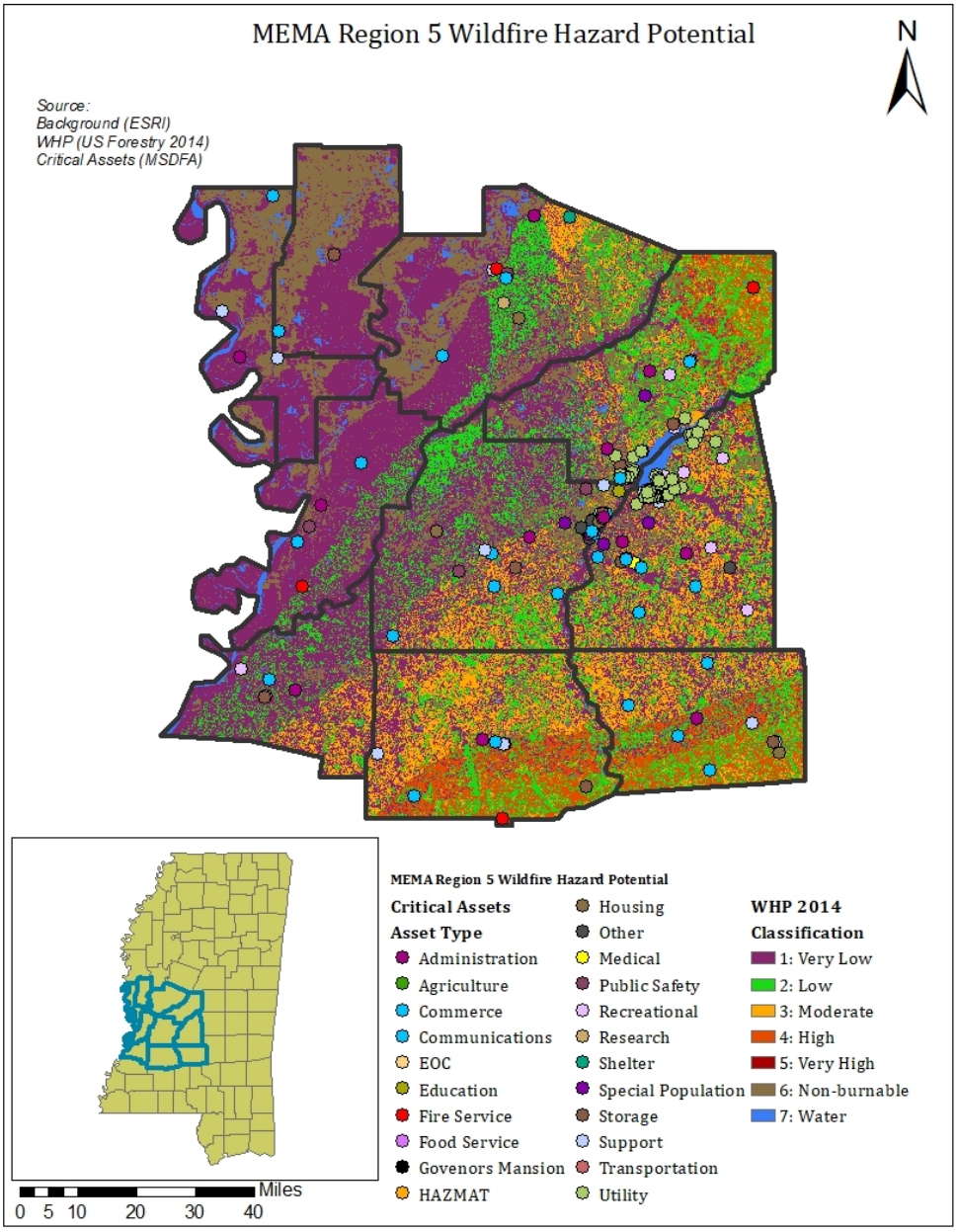

MEMA Region 5 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 5 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Agriculture
Commerce
Communications
EOC
Education
Fire Service
Food Service
Govenors Mansion
HAZMAT
Housing
Other
Medical
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Transportation
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

Figure 3.7.13

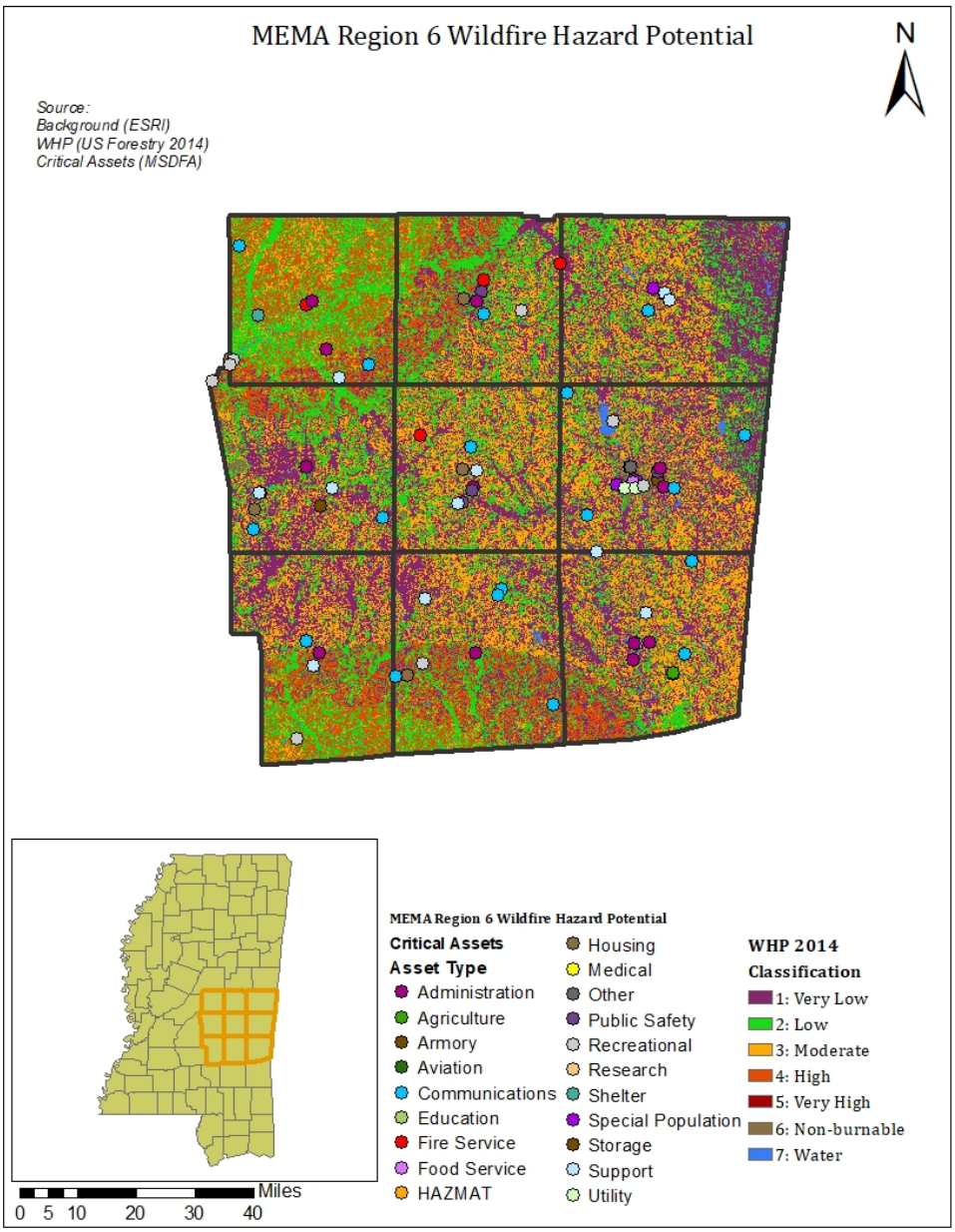

MEMA Region 6 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 6 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Agriculture
Armory
Aviation
Communications
Education
Fire Service
Food Service
HAZMAT
Housing
Medical
Other
Public Safety
Recreational
Research
Shelter
Special Population
Storage
Support
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

Figure 3.7.14

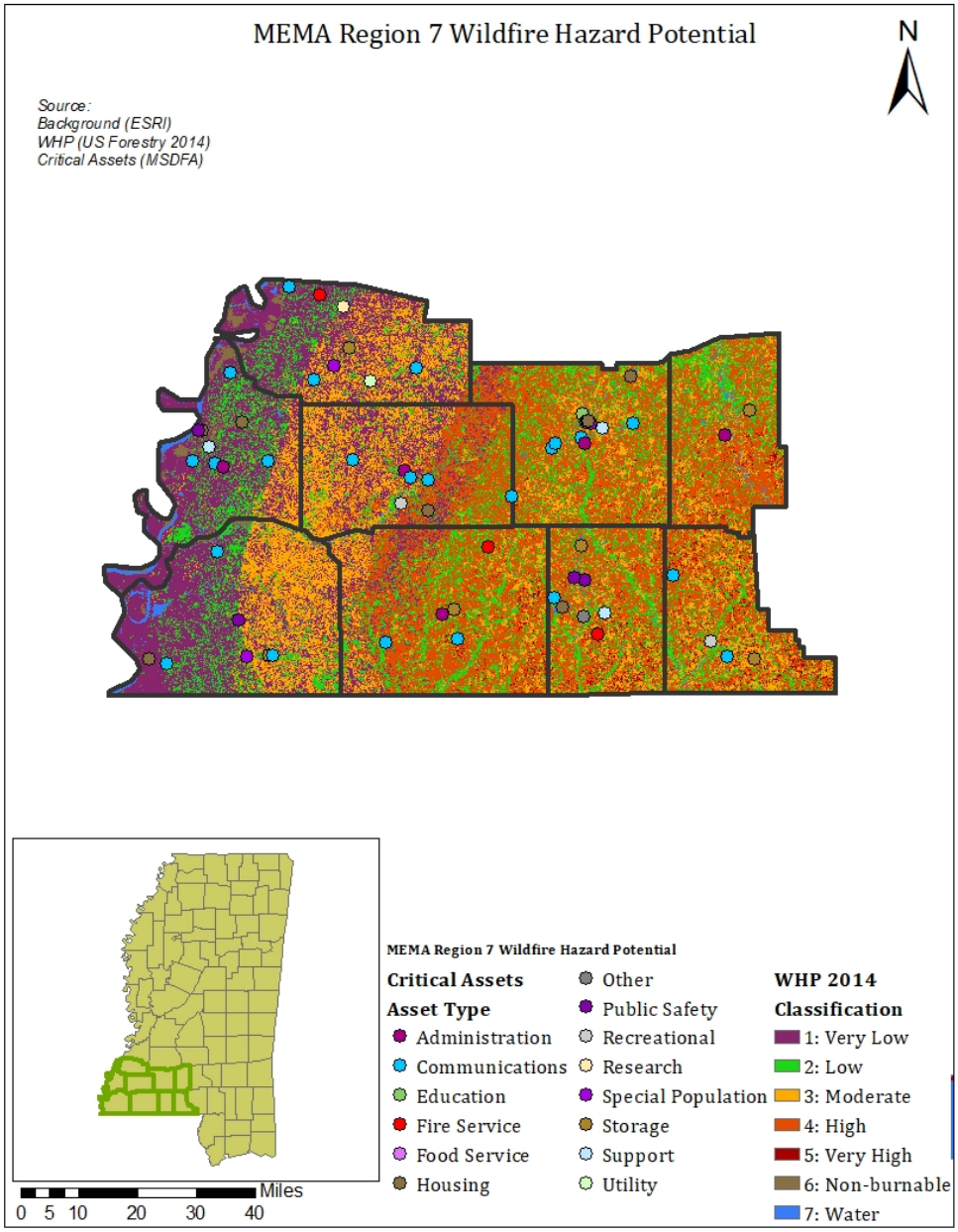

MEMA Region 7 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 7 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Communications
Education
Fire Service
Food Service
Housing
Other
Public Safety
Recreational
Research
Special Population
Storage
Support
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

Figure 3.7.15

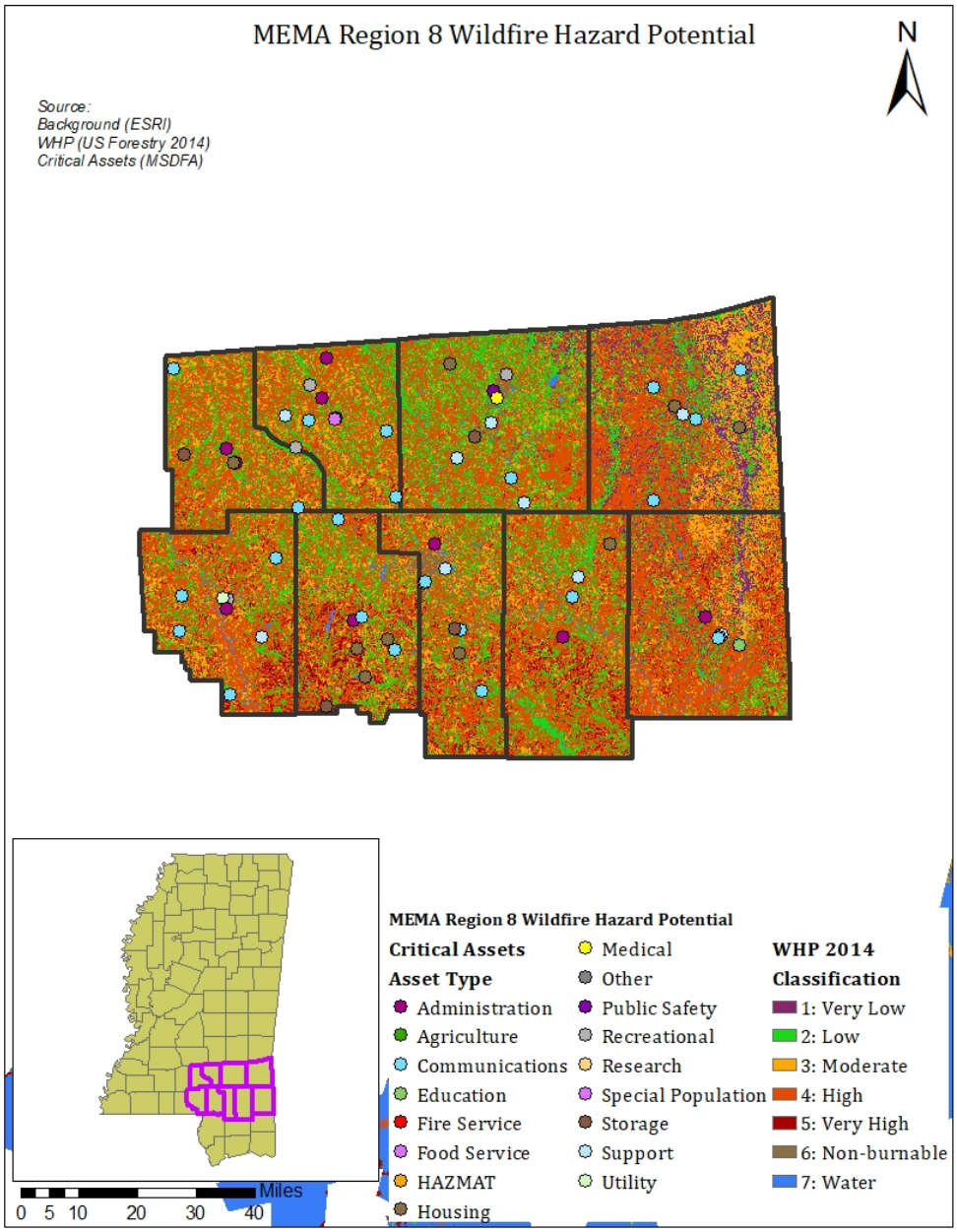
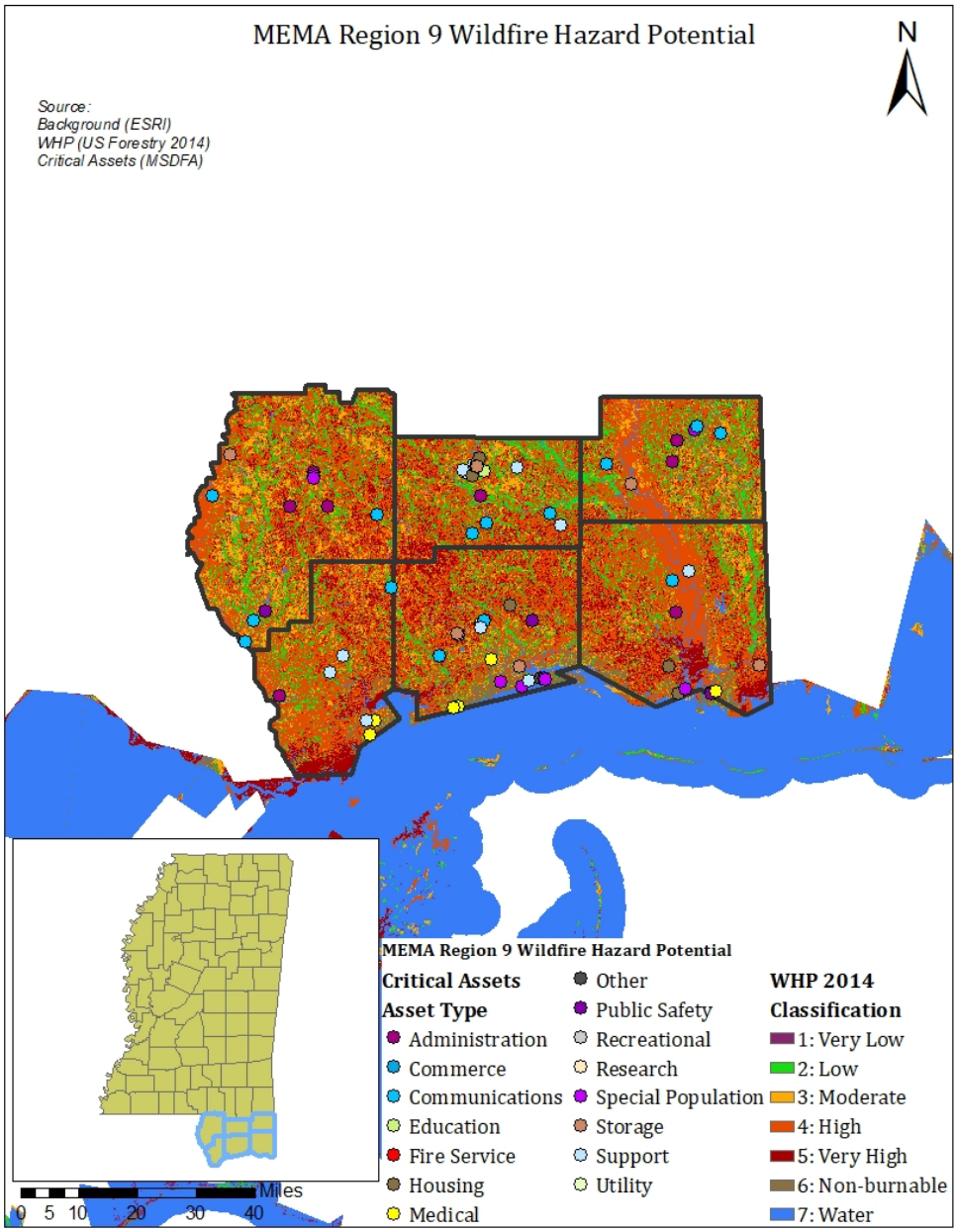

MEMA Region 8 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 8 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Agriculture
Communications
Education
Fire Service
Food Service
HAZMAT
Housing
Medical
Other
Public Safety
Recreational
Research
Special Population
Storage
Support
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

Figure 3.7.16


MEMA Region 9 Wildfire Hazard Potential
N
Source:
Background (ESRI)
WHP (US Forestry 2014)
Critical Assets (MSDFA)
MEMA Region 9 Wildfire Hazard Potential
Critical Assets
Asset Type
Administration
Commerce
Communications
Education
Fire Service
Housing
Medical
Other
Public Safety
Recreational
Research
Special Population
Storage
Support
Utility
WHP 2014
Classification
1: Very Low
2: Low
3: Moderate
4: High
5: Very High
6: Non-burnable
7: Water
Miles
0 5 10 20 30 40

3.8: Drought Risk Assessment

Hazard Description

Based on the local plan roll-up of identified and ranked hazards, limited options for state level mitigation, and lack of historical need for state-level response, it was concluded that drought does not pose a serious statewide threat capable of being addressed by this plan. Droughts can and do, however, occur in Mississippi.

According to the National Oceanic and Atmospheric Administration (NOAA), a drought is defined as a period of unusually dry weather persisting long enough to cause serious problems, such as crop damage and/ or water supply shortages. The severity of the drought depends upon the degree of moisture deficiency and the duration of the drought.

Drought occurs under differing conditions, based on these reference points:

> ***Meteorological*** drought is defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the average moisture supply.
>
> ***Agricultural*** drought occurs when there is inadequate soil moisture to meet the needs of a particular crop during a given time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought and can affect livestock and other dry-land agricultural operations.
>
> ***Hydrological*** drought refers to deficiencies in surface and subsurface water supplies from lack of precipitation. It is measured as stream flow, snow pack, and as lake, reservoir, and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes, and reservoirs. Therefore, hydrological measurements tend to lag behind other drought indicators.
>
> ***Socio-economic*** drought occurs when physical water shortages start to affect the health, well-being, and quality of life of people, or when drought starts to affect the supply and demand of an economic product.

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent, as well as regional water demands by humans, livestock, crops, and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

In 1965, Wayne Palmer developed an index to "measure the departure of the moisture supply." This index was based on the supply-and-demand concept of the water balance equation, taking into account more than merely the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI) was to provide a measurement of "standardized" moisture conditions so comparisons using

the index could be made between locations and between time periods. While Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff), another commonly used drought index, the Standardized Precipitation Index (SPI), is a probability index considering only precipitation. Therefore, for the purposes of this plan, drought will be analyzed using the PDSI.

The PDSI varies between -4.0 and +4.0. Weekly Palmer Index values are calculated for the Climate Divisions during every growing season and are available from the Climate Prediction Center. Mississippi could expect to experience the entire range of drought severity and classification. Table 3.8.1 lists the Palmer Drought Severity Index.

Table 3.8.1
Palmer Drought Severity Index

Index Value	Classification	Index Value	Classification
4.00 or more	Extremely wet	-0.50 to -0.99	Incipient dry spell
3.00 to 3.99	Very wet	-1.00 to -1.99	Mild drought
2.00 to 2.99	Moderately wet	-2.00 to -2.99	Moderate drought
1.00 to 1.99	Slightly wet	-3.00 to -3.99	Severe drought
0.50 to 0.99	Incipient wet spell	-4.00 to less	Extreme drought
0.49 to -0.49	Near normal		

Source: http://drought.unl.edu/whatis/indices.htm

Another means of analyzing drought is the Keetch-Byram Drought Index (KBDI), a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. This system, originally developed for the southeastern United States, is based primarily on recent rainfall patterns.

The KBDI drought index system is the most widely used by fire managers in the south. It is also one of the only drought index systems specifically developed to equate the effects of drought with potential fire activities.

The result of this system is a drought index number ranging from 0 to 800 accurately describing the amount of moisture missing. A rating of zero defines the point of no moisture deficiency and 800 is the maximum drought possible.

These numbers correlate with potential fire behavior as follows:

- 0 - 200: Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. Typical of spring dormant season following winter precipitation.

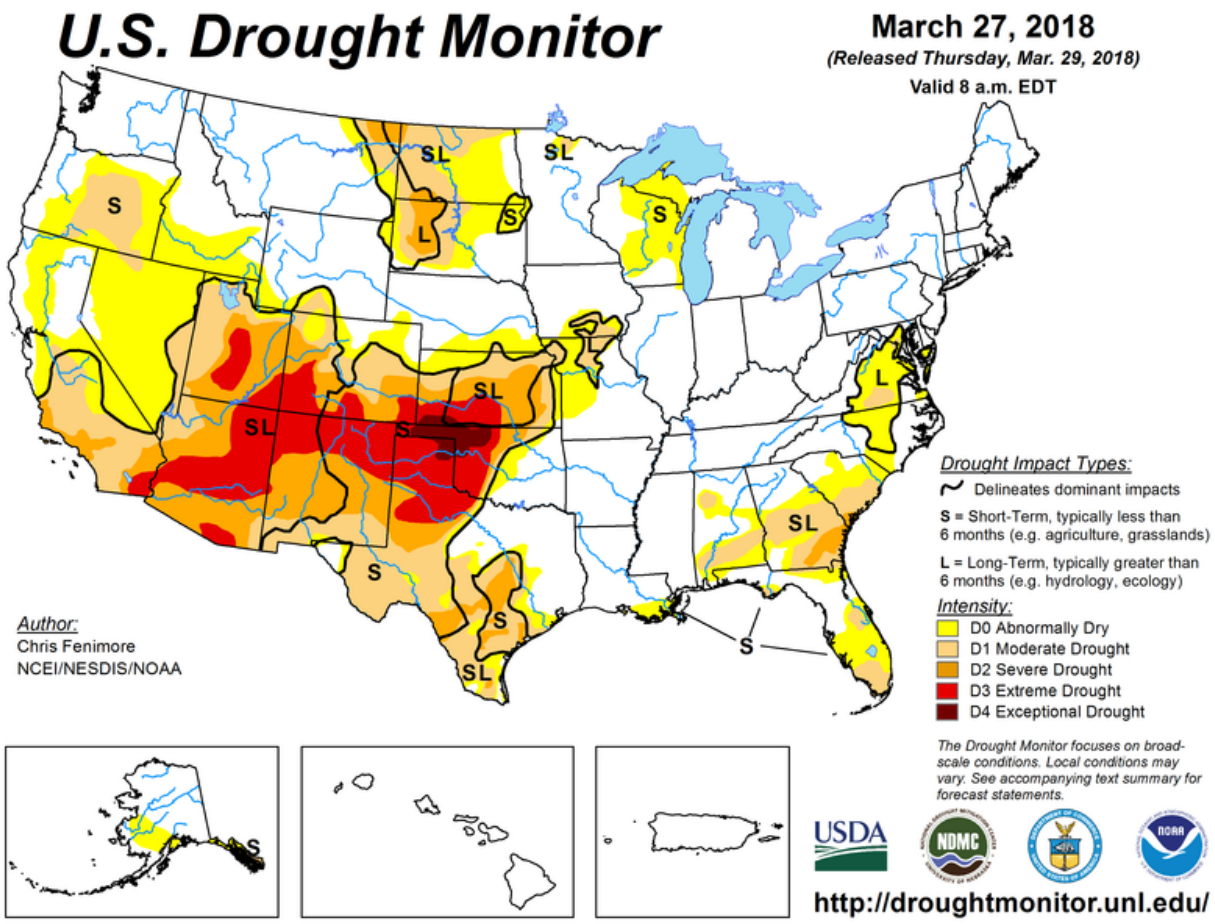
- 200 - 400: Typical of late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.

- 400 - 600: Typical of late summer, early fall. Lower litter and duff layers actively contribute to fire intensity and will burn actively.

- 600 - 800: Often associated with more severe drought with increased wildfire occurrence. Intense, deep burning fires with significant downwind spotting can be expected. Live fuels can also be expected to burn actively at these levels.

Figures 3.8.1 provides another illustration of drought potential by using the Keetch-Bryam index for a similar time period as the U.S. Drought Monitor. These figures indicate fire intensity significantly increased due to lower litter and duff layers drying out.

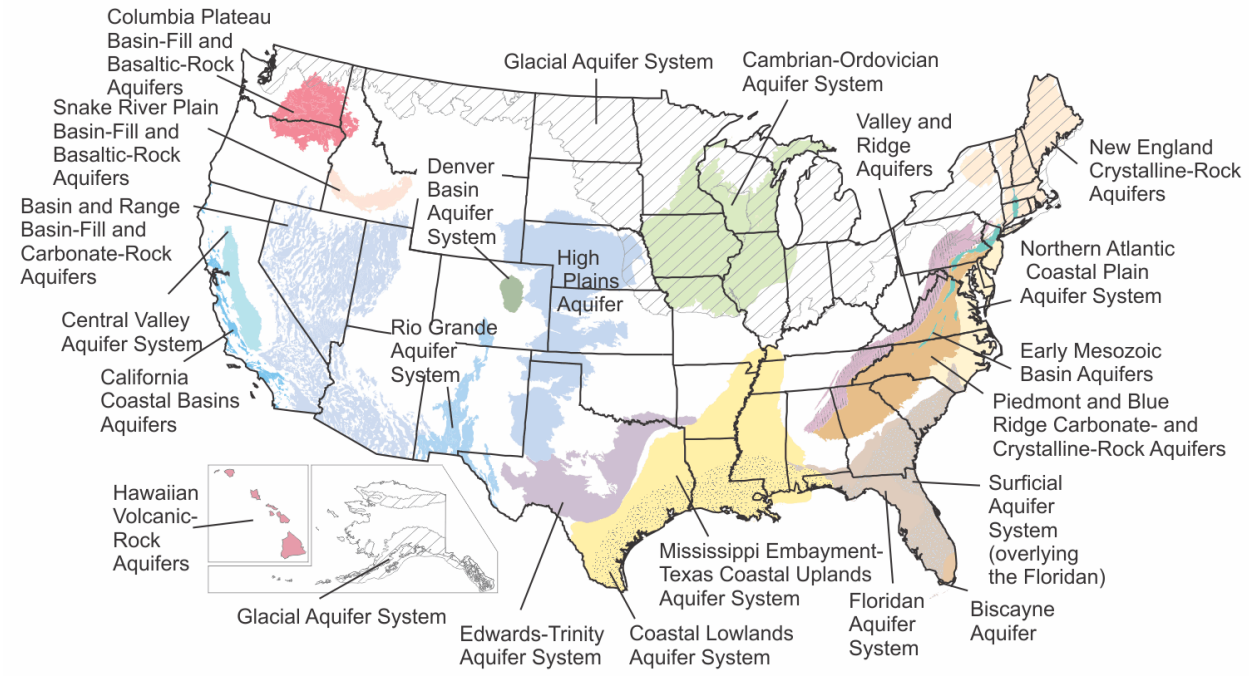
Figure 3.8.1
Keetch-Byram Drought Index Data
for the United States March 27, 2018
(Source: USDA)



Location and Extent

Drought is not a location-specific hazard. All areas of Mississippi are vulnerable to drought. Figure 3.8.2 shows the location of the Mississippi Embayment of the Texas Coastal Uplands Aquifer System and the Coastal Lowlands Aquifer System, which provide water to the majority of the state of Mississippi.

Figure 3.8.2
United States Aquifer System
(Source: USGS)



A severe, prolonged drought could have negative and lasting impacts on residents, agriculture, industry and infrastructure of Mississippi. When available water tables decline, and potable water becomes harder to obtain. The residents, commuting population, and visitors are exposed to greater health risks. Any water-dependent functions in the state are exposed to potential loss of or failure to function.

Previous Occurrences

As during the time of the last plan update, current conditions across Mississippi at the time of this document publication showed the state outside any drought condition zone, with the PDSI indicating moisture conditions throughout the state ranging from near normal to extremely moist (Source: U.S. Drought Portal, U.S. Drought Monitor). Historically, Mississippi is the third wettest state in the nation (behind Hawaii and Louisiana), with an average rainfall of 59.23' per year (source NCDC). Since the forecast period is a snapshot of current or foreseeable conditions over a reasonably long planning period, seasonal weather

trends and use of the U.S. Drought Monitor can provide indicators of oncoming drought conditions. Table 3.8.2 provides an account by county, of estimated property and crop damages caused by drought.

Table 3.8.2
Past Occurrences Drought

Date	Counties Affected	Property Damage	Property Damage
04/01/2017	Monroe, Lee, Itawamba, Chickasaw	$0	$0
03/01/2017	Chickasaw, Lee, Monroe, Itawamba	$0	$0
02/21/2017	Chickasaw, Lee, Monroe, Itawamba	$0	$0
01/01/2017	Chickasaw, Monroe, Itawamba	$0	$0
12/01/2017	Neshoba, Forrest, Jefferson, Covington, Jones, Lowndes, Clay, Oktibbeha, Noxubee, Webster, Grenada, Leflore, Washington, Sunflower, Humphreys, Issaquena, Sharkey, Carroll, Holmes, Montgomery, Attala, Yazoo, Choctaw, Warren, Rankin, Madison, Winston, Claiborne, Leake, Copiah, Scott, Newton, Kemper, Simpson, Clarke, Hinds, Lauderdale, Jasper, Smith	$0	$2,000,000
11/15/2016	Tate, DeSoto, Tunica, Leflore, Sunflower, Covington, Forrest, Bolivar, Washington, Sharkey, Jefferson, Issaquena, Franklin, Adams, Lincoln, Jefferson Davis, Marion, Lamar, Lawrence	$0	$800,000
11/08/2016	Alcorn	$0	$0
11/01/2016	Tishomingo, Coahoma, Monroe, Itawamba, Quitman, Tallahatchie, Panola, Yalobusha, Lafayette, Union, Prentiss, Calhoun, Chickasaw, Pontotoc, Lee, Tippah, Benton, Marshall, Jones, Hinds, Humphreys, Copiah, Neshoba, Leake, Madison, Holmes, Claiborne, Simpson, Rankin, Hinds, Lowndes, Clay, Webster, Montgomery, Lauderdale, Noxubee, Okitbbeha, Choctaw, Winston, Atalla, Newton, Kemper, Scott, Grenada, Clarke, Jasper, Smith, Warren, Wayne, Stone, George, Greene, Perry	$1,500,000	$0
10/25/2016	Copiah, Claiborne, Clarke, Smith, Jones, Jasper, Simpson	$0	$210,000
10/18/2016	Tishomingo, Prentiss, Warren, Yazoo, Humphreys, Rankin, Hinds	$0	$200,000
10/11/2016	Webster, Montgomery, Newton, Lauderdale, Leake, Neshoba, Kemper, Madison, Carroll, Grenada, Winston, Noxubee, Oktibbeha, Choctaw, Attala, Holmes, Scott, Calhoun, Union	$0	$680,000

10/01/2016	Coahoma, Yalobusha, Lafayette, Panola, Tallahatchie, Monroe, Chickasaw, Pontotoc, Itawamba, Lee, Quitman, Wayne, Perry, Greene, Lowndes, Clay	$0	$50,000
09/27/2016	Pontotoc, Quitman, Coahoma	$0	$0
09/01/2016	Lowndes, Clay, Panola, Monroe, Chickasaw, Lafayette, Lee, Yalobusha, Tallahatchie, Itawamba,	$0	$90,000
08/09/2016	Lafayette	$0	$0
08/01/2016	Clay, Madison, Montgomery, Grenada, Oktibbeha, Holmes, Lowndes, Leflore, Webster, Carroll, Tishoingo, Prentiss, Pontotoc, Calhoun, Chickasaw, Panola, Monroe, Itawamba, Yalobusha, Tallahatchie, Lee	$0	$360,000
07/26/2016	Leflore, Carroll, Webster, Madison, Holmes, Clay, Montgomery, Panola, Pontotoc	$210,000	$0
07/12/2016	Lee, Prentis	$0	$0
07/05/2016	Tallahatchie, Yalobusha, Chickasaw, Tishomingo, Monroe, Itawamba, Calhoun, Grenada	$30,000	$0
11/01/2015	Coahoma	$0	$0
10/15/2015	Calhoun, Tunica	$0	$0
10/13/2015	Newton, Jasper, Jones, Noxubee, Lamar, Oktibbeha, Covington	$0	$7,000
10/08/2015	Yalobusha	$0	$0
10/06/2015	Grenada, Choctaw, Winston, Neshoba, Jefferson, Lincoln, Lawrence, Adams, Marion, Jefferson, Franklin	$0	$11,000
10/01/2015	Coahoma, Tallahatchie, Washington, Bolivar, Simpson, Leake, Rankin, Hinds, Smith, Attala, Madison, Yazoo, Holmes, Humphreys, Leflore, Sunflower, Montgomery, Carroll, Claiborne, Warren, Issaquena, Sharkey, Copiah	$0	$26,600
09/15/2015	Bolivar, Washington, Montgomery, Issaquena, Claiborne, Warren, Sharkey, Carroll,	$0	$3,200,000
09/01/2015	Leake, Sunflower, Leflore, Humphreys, Holmes, Yazoo, Copiah, Attala, Scott, Smith, Hinds, Rankin, Simpson, Madison,	$0	$5,600,000
09/17/2013	Tallahatchie, Quitman, Tunica, Yalobusha, Panola,	$0	$0
09/03/2013	Coahoma	$0	$0
11/01/2012	DeSoto	$0	$0
10/01/2012	Tunica, Coahoma, Quitman, Tate, Lafayette, Marshall, DeSoto, Panola	$0	$0
09/01/2012	Tunica, Tate, Coahoma, Quitman, Tallahatchie, DeSoto, Marshall, Benton, Lafayette, Panola	$0	$0

08/01/2012	Tunica, Tate, Coahoma, Quitman, Tallahatchie, DeSoto, Marshall, Benton, Panola	$0	$0
07/10/2012	Benton, Marshall	$0	$0
07/01/2012	Tate, DeSoto, Coahoma, Tunica, Tallahatchie, Panola, Quitman	$0	$0
06/19/2012	Tate, DeSoto, Coahoma, Tunica, Tallahatchie, Panola, Quitman	$0	$0
04/01/2011	Coahoma, Tallahatchie, Quitman, Yalobusha	$0	$0
03/22/2011	Tallahatchie, Quitman, Yalobusha	$0	$0
03/01/2011	Coahoma	$0	$0
02/01/2011	Coahoma, Desoto, Tunica	$0	$0
01/01/2011	Coahoma, Desoto, Tunica	$0	$0
12/28/2010	Coahoma, Desoto, Tallahatchie, Tunica	$0	$0
11/01/2010	Calhoun, Chickasaw, Coahoma, Desoto, Monroe, Panola, Quitman, Tallahatchie, Tate, Tunica, Yalobusha	$0	$0
10/12/2010	Calhoun, Chickasaw, Desoto, Monroe, Panola, Tallahatchie, Tate, Yalobusha	$0	$0
10/01/2010	Adams, Attala, Bolivar, Carroll, Choctaw, Claiborne, Clarke, Clay, Coahoma, Copiah, Forrest, Franklin, Grenada, Hinds, Holmes, Humphreys, Issaquena, Jefferson, Jones, Kemper, Lauderdale, Lawrence, Leake, Leflore, Lincoln, Lowndes, Madison, Montgomery, Neshoba, Newton, Noxubee, Oktibbeha, Quitman, Rankin, Scott, Sharkey, Simpson, Smith, Sunflower, Tunica, Warren, Washington, Webster, Winston, Yazoo	$500,000	$20,500,000
09/01/2010	Bolivar, Coahoma, Issaquena, Quitman, Sharkey, Sunflower, Tunica, Washington	$0	$2,500,000
08/03/2010	Tunica, Quitman	$0	$0
08/01/2010	Bolivar, Coahoma, Issaquena, Sharkey, Sunflower, Washington	$0	$2,500,000
07/27/2010	Coahoma	$0	$0
07/15/2010	Bolivar, Issaquena, Sharkey, Sunflower, Washington	$0	$1,700,000
10/01/2007	Alcorn, Benton, Calhoun, Chickasaw, Coahoma, Desoto, Itawamba, Lafayette, Lee, Marshall, Monroe, Panola, Pontotoc, Prentiss, Quit- man, Tallahatchie, Tate, Tippah, Tishomingo, Tunica, Yalobusha	$0	$0

09/01/2007	Alcorn, Benton, Chickasaw, Desoto, Itawamba, Lafayette, Lee, Marshall, Monroe, Panola, Pontotoc, Prentiss, Tate, Tippah, Tishomingo, Tunica, Union	$0	$0
08/06/2007	Clarke, Clay, Kemper, Lauderdale, Lowndes, Neshoba, Newton, Noxubee, Oktibbeha, Winton	$0	$1,600,000
08/01/2007	Alcorn, Benton, Chickasaw, Desoto, Itawamba, Lafayette, Lee, Marshall, Monroe, Panola, Pontotoc, Prentiss, Tate, Tippah, Tishomingo, Tunica, Union	$0	$0
07/71/2007	Alcorn, Attala, Benton, Calhoun, Carroll, Chickasaw, Choctaw, Claiborne, Clarke, Clay, Copiah, Covington, Forrest, Franklin, Hinds, Holmes, Humphreys, Issaquena, Itawamba, Jasper, Jefferson, Jefferson Davis, Jones, Kemper, Lafayette, Lamar, Lauderdale, Lawrence, Leake, Lee, Leflore, Lincoln, Lowndes, Madison, Marion, Marshall, Monroe, Montgomery, Neshoba, Newton, Noxubee, Oktibeha, Panola, Pontotoc, Prentiss, Rankin, Scott, Sharkey, Simpson, Smith, Tallahatchie, Tippah, Tishomingo, Union, Warren, Webster, Winston, Yalobusha, Yazoo	$2,650,000	$0
06/01/2007	Alcorn, Attala, Benton, Calhoun, Carroll, Chickasaw, Choctaw, Claiborne, Clarke, Clay, Copiah, Covington, Forrest, Franklin, Grenada, Hinds, Holmes, Humphreys, Issaquena, Itawamba, Jasper, Jefferson, Jefferson Davis, Jones, Kemper, Lafayette, Lamar, Lauderdale, Lawrence, Leake, Lee, Leflore, Lincoln, Lowndes, Madison, Marion, Marshall, Monroe, Montgomery, Neshoba, Newton, Noxubee, Oktibbeha, Panola, Pontotoc, Prentiss, Rankin, Scott, Sharkey, Simpson, Smith, Tallahatchie, Tippah, Tishomingo, Union, Warren, Webster, Winston, Yalobusha, Yazoo	$0	$748,500,000
05/01/2007	Alcorn, Attala, Benton, Calhoun, Carroll, Chickasaw, Choctaw, Claiborne, Clarke, Clay, Copiah, Covington, Forrest, Franklin, Grenada, Hinds, Holmes, Humphreys, Issaquena, Itawamba, Jasper, Jefferson, Jefferson Davis, Jones, Kemper, Lafayette, Lamar, Lauderdale, Lawrence, Leake, Lee, Leflore, Lincoln, Lowndes, Madison, Marion, Marshall, Monroe, Montgomery, Neshoba, Newton, Noxubee, Oktibbeha, Panola, Pontotoc, Prentiss, Rankin, Scott, Sharkey, Simpson, Smith, Tallahatchie, Tippah, Tishomingo, Union, Warren, Webster, Winston, Yalobusha, Yazoo	$0	$28,800,000
04/25/2007	Attala, Carroll, Choctaw, Claiborne, Clarke, Clay, Copiah, Covington, Grenada, Hinds, Holmes, Jasper, Jefferson Davis, Jones, Kemper, Lauderdale, Lawrence, Leake, Lincoln, Lowndes, Madison, Montgomery, Neshoba, Newton, Noxubee, Oktibbeha, Rankin, Scott, Simpson, Smith, Warren, Webster, Winston, Yazoo	$0	$0
04/12/2007	Attala, Choctaw, Clarke, Clay, Hinds, Jasper, Kemper, Lauderdale, Leake, Lowndes, Madison, Montgomery,	$0	$0

	Neshoba, Newton, Noxubee, Oktibbeha, Rankin, Scott, Smith, Webster, Winston		
04/05/2007	Alcorn, Benton, Calhoun, Chickasaw, Itawamba, Lafayette, Lamar, Lee, Monroe, Pontotoc, Prentiss, Tippah, Tishomingo, Union, Yalobusha	$0	$0
Total Damages		**$4,890,000**	**$818,534,600**

Source: NCDC 2018

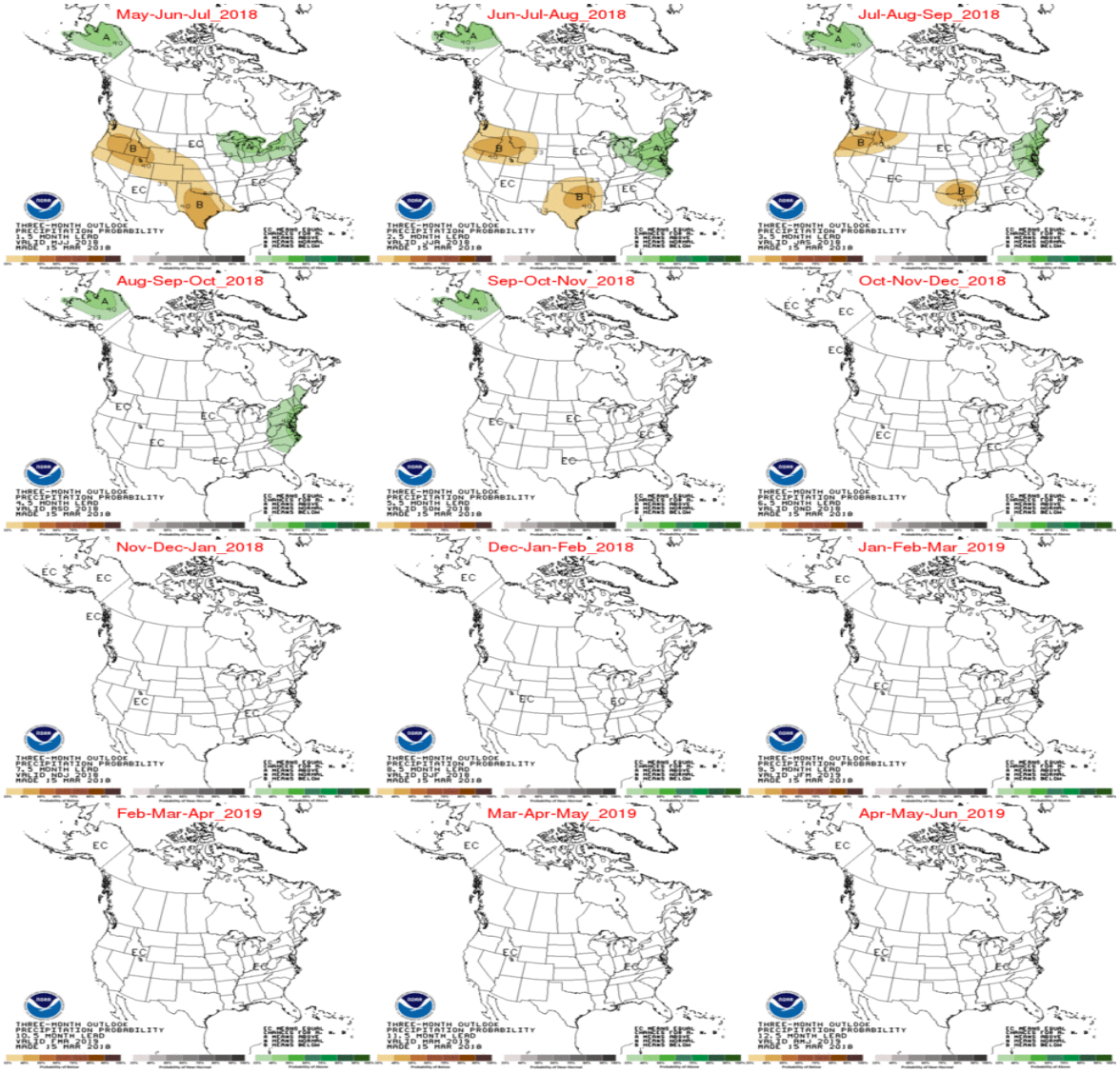
Probability of Future Occurrences

Forecasting limitations makes estimating probability of drought unrealistic within the context of this plan. Given statewide drought indices and as determined by the U.S. seasonal drought outlook, the probability of future drought conditions is considered to be low. However, it is important to note the seasonal drought outlook is forecast through June 2019 (Figure 3.8.3), a much shorter timeframe than the five-year planning horizon of this plan. Continuous monitoring of drought indices and forecasts is recommended.

Figure 3.8.3

U.S. 12 Month Climate Forecast

(Source: Climate Prediction Center)



Vulnerability Assessment

The vulnerability assessment remains the same as last plan update. Again, it is very difficult to quantify the vulnerability of any given area to droughts or to assess inventories of at-risk property for estimating exposure or losses. The intense agricultural land use areas are most vulnerable. Drought would have a negligible impact to state-owned and critical facilities and public safety and deemed not to pose a serious statewide threat that could be addressed by this plan. For that reason, this plan defers to local vulnerability assessments.

Being that Mississippi is primarily an agricultural state, the most obvious primary impact from drought in Mississippi remains crop damage. This can and has resulted in significant secondary impacts such as economic losses. Drought can also create conditions that promote the occurrence of other natural hazards such as wildfires and wind erosion. While dry conditions increase the likelihood of wildfires, low-flow conditions decrease the quantity and pressure of water for use by firefighters. The likelihood of flash flooding is increased if a period of severe drought is followed by a period of extreme precipitation.

Environmental drought impacts include human and animal habitats and hydrologic units. During periods of drought, the amount of available water decreases in lakes, streams, aquifers, soil, wetlands, springs, and other surface and subsurface water sources. This decrease in water availability can affect water quality by altering the salinity, bacteria, turbidity, temperature, and pH levels. Changes in any of these levels can have a significant effect on the aquatic habitat of numerous plants and animals found throughout the state.

Low water flow may result in decreased sewage flows and subsequent increases in contaminants in the water supply. Decreased availability of water decreases the drinking water supply and the food supply. This disruption can work its way up the food chain within a habitat. Loss of biodiversity and increases in mortality can lead to increases in disease and endangered species.

Local Plan Risk Assessment Summary

Below is a summary of the risk classification identified in the individual local mitigation plans, which includes all corresponding municipalities and Disaster Resistant University Plans by MEMA Region:

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1		9		6		9	
2		12		7		9	
3	9	1		8		5	1
4		10	1	9		6	
5		45	1				

3.9: Extreme Winter Weather Risk Assessment

Hazard Description

The National Weather Service defines a winter storm as having three factors: cold air, moisture and lift. These three factors acting together create conditions suitable for a winter storm. Below are definitions for winter weather events that could impact the Mississippi Gulf Coast:

Snow Flurries: Light snow falling for short durations. No accumulation or light dusting is all that is expected.

Snow Showers: Snow falling at varying intensities for brief periods of time. Some accumulation is possible.

Sleet: Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. However, it can accumulate like snow and cause a hazard to motorists.

Freezing Rain: Rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Even small accumulations of ice can cause a significant hazard.

Wind Chill: The combination of wind and temperature that serves as an estimate of how cold it actually feels to exposed human skin. Wind chill values below -19 degrees are considered dangerous.

Winter Storm Warning: Issued when hazardous winter weather in the form of heavy snow, heavy freezing rain, or heavy sleet is imminent or occurring. Winter Storm Warnings are usually issued 12 to 24 hours before the event is expected to begin.

Winter Storm Watch: Alerts the public to the possibility of a blizzard, heavy snow, heavy freezing rain, or heavy sleet. Winter Storm Watches are usually issued 12 to 48 hours before the beginning of a Winter Storm.

Winter Storm Outlook: Issued prior to a Winter Storm Watch. The Outlook is given when forecasters believe winter storm conditions are possible and usually issued 3 to 5 days in advance of a winter storm.

Wind Chill Warning: Issued when wind chill temperatures are expected to be hazardous to life within several minutes of exposure.

Wind Chill Advisory: Issued when wind chill temperatures are expected to be a significant inconvenience to life with prolonged exposure and, if caution is not exercised, could lead to hazardous exposure.

Winter Weather Advisories: Issued for accumulations of snow, freezing rain, freezing drizzle, and sleet which will cause significant inconveniences and, if caution is not exercised, could lead to life-threatening situations.

Winter storms in the south typically consist of light snow (snow flurries with little to no accumulation), freezing rain (rain that falls when ground temperatures are below freezing), or sleet (transparently frozen or partially frozen raindrops).

Hazard Profile

The hazard profile for extreme winter weather in Mississippi was updated from the previously approved plan of 2013 to include current statistics regarding winter activity throughout the state.

Maximum Winter Storm Threat

Severe winter storms can cause immense economic losses to the state of Mississippi. Hampered transportation routes caused by closed or blocked roads can prevent the movement of essential economic goods by airports and waterways. An intense cold weather system during the winter of 1989 – 1990 brought about a widespread emergency in Central Mississippi. Unlike previous winter emergencies, this crisis occurred because manufacturers and product brokers were unable to gain access to essential transportation systems, such as pipelines, trucks and rail tankers that move heating fuel (propane). This lack of fuel had a cascading effect on the domestic and manufacturing economies

Extreme winter weather in 2010 caused a similar disruption of the Central Mississippi economy. According to the National Weather Service (NWS), the winter of 2009/2010 was characterized by below-normal temperatures across the state of Mississippi. In Jackson, it was the fourth-coldest winter since temperature records were first collected in 1896. It was also the ninth-snowiest winter in Jackson, with one snowfall of 5.5 inches recorded by the NWS Forecast Office. In January, prolonged sub-freezing temperatures caused massive failure of water mains throughout Jackson and the Central Mississippi region, creating problems for residents and causing emergency conditions at hospitals, police precincts, businesses, restaurants, communications systems and state facilities. (See a recap of this event under the heading “Prolonged Sub- Freezing Temperatures – January 2010” in this section.)

Timber, a vital asset to the state’s economy, was severely impacted by the February 1994 ice storm (FEMA- 1009-DR-MS). Damage to public facilities – coupled with $1.3 billion from timber losses – resulted in one of the costliest disasters of this type the state ever experienced. Not only did the downed timber create a problem from potential wildfires, but. collapsed roofs and downed power lines, resulted in loss of heating, lighting, water and sewer systems.

Other secondary problems included flooding from melting ice and snow, and rainfall on heavily glazed and saturated surfaces. Icy, snow-covered areas can create increased accidents to drivers and walkers. Downed power lines can create a risk of electrocution to residents and to electric power workers. Finally, frozen and broken water lines in homes are not only costly to repair but create additional hazards from electrocution.

Education and Outreach

Severe Weather Awareness Week occurs in the month of February and is set each year in coordination with the National Weather Service. For more information on severe weather awareness call the MEMA Public Information number (866-519-6362) between 8 a.m. and 5 p.m. weekdays.

Location/Past Occurrences

The NCDC improved their data for winter-weather events by enhancing classifications and reassessing the events from 1996 to current. The data for the years 1993 and 1994 were brought forward from the 2010 plan, but the data was not available through NCDC to verify any changes. Table 3.9.1 was updated from the previous plan to reflect the new categories and number of events reported.

Table 3.9.1
Summary of Mississippi Winter Storm Events
1996-2017

	Incident Type (Events Recorded)					
Year	Heavy Snow	Ice Storm/Sleet	Winter Storm	Winter Weather	Total Property Damage ($)	Total Crop Damage ($)
2017	0	22	0	14	$2,125,000	$0
2016	0	0	3	10	$0	$0
2015	0	0	0	2	$0	$0
2014	18	8	2	8	$0	$0
2013	28	24	0	18	$540,000	$0
2012	0	0	0	0	$0	$0
2011	41	71	44	29	$25,845,000	$240,000
2010	40	4	35	46	$12,695,000	$0
2009	24	0	6	23	$0	$0
2008	52	10	14	42	$3,390,000	$0
2007	0	0	0	19	$0	$0
2006	0	10	22	0	$1,372,000	$0
2005	0	0	0	0	$0	$0
2004	7	2	11	0	$408,700	$0
2003	3	4	0	0	$148,000	$0
2002	6	0	0	16	$30,000	$0
2001	0	0	0	0	$0	$0
2000	37	16	3	0	$1,415,000	$0
1999	0	0	0	0	$0	$0
1998	0	53	21	0	$16,699,000	$0
1997	16	0	0	0	$50,000	$0
1996	3	30	32	0	$3,500,000	$0
1995	0	0	0	0	$0	$0
1994	0	1	0	0	$500,000	$5,000,000,000
1993	0	1	0	0	$0	$0

Table 3.9.2 summarizes the number of incidents recorded by NCDC for winter weather events in Mississippi by MEMA Regions.

Table 3.9.2
Summary of Events by MEMA Region/County
1996-2017

County	No. of Events	Total Property Damage	Total Crop Damage	County	No. of Events	Total Property Damage	Total Crop Damage
MEMA Region 1				**MEMA Region 2**			
Coahoma	20	$37,000	$0	Alcorn	27	$27,100	$0
DeSoto	33	$33,000	$0	Benton	32	$25,100	$0
Grenada	14	$3,176,000	$0	Itawamba	19	$23,000	$0
Panola	18	$27,000	$0	Lafayette	22	$22,000	$0
Quitman	17	$31,000	$0	Lee	19	$43,000	$0
Tallahatchie	15	$30,000	$0	Marshall	32	$24,100	$0
Tate	26	$24,100	$0	Pontotoc	22	$27,000	$0
Tunica	30	$34,000	$0	Prentiss	21	$32,000	$0
Yalobusha	19	$30,000	$0	Tippah	30	$24,100	$0
				Tishomingo	21	$32,100	$0
				Union	23	$27,100	$0

County	No. of Events	Total Property Damage	Total Crop Damage	County	No. of Events	Total Property Damage	Total Crop Damage
MEMA Region 3				**MEMA Region 4**			
Atalla	15	$1,343,000	$0	Calhoun	16	$26,000	$0
Bolivar	25	$2,087,000	$0	Chickasaw	17	$26,000	$0
Carroll	13	$1,595,000	$0	Choctaw	14	$1,461,000	$0
Holmes	13	$1,195,000	$0	Clay	13	$990,000	$0
Humphreys	14	$1,110,000	$0	Lowndes	14	$1,168,000	$0
Leflore	15	$4,010,000	$0	Monroe	17	$26,000	$0
Montgomery	12	$1,318,000	$0	Noxubee	15	$943,000	$0
Sunflower	20	$2,415,000	$0	Oktibbeha	17	$2,310,000	$0
Washington	21	$2,317,000	$0	Webster	15	$1,523,000	$0
				Winston	15	$1,741,000	$0

County	No. of Events	Total Property Damage	Total Crop Damage	County	No. of Events	Total Property Damage	Total Crop Damage
MEMA Region 5				**MEMA Region 6**			
Claiborne	10	$1,065,000	$0	Clarke	7	$635,000	$0
Copiah	12	$1,380,000	$0	Jasper	9	$1,155,000	$0
Hinds	14	$3,335,000	$0	Kemper	12	$920,000	$0
Madison	13	$2,389,000	$0	Lauderdale	14	$2,260,000	$0
Rankin	13	$2,726,000	$0	Leake	12	$1,495,000	$0
Simpson	10	$1,370,000	$0	Neshoba	10	$1,450,000	$0
Warren	13	$2,495,000	$0	Newton	13	$1,515,000	$0
Yazoo	14	$1,975,000	$0	Scott	12	$1,220,000	$0
				Smith	10	$1,325,000	

County	No. of Events	Total Property Damage	Total Crop Damage	County	No. of Events	Total Property Damage	Total Crop Damage
MEMA Region 7				**MEMA Region 8**			
Adams	10	$1,265,000	$0	Covington	9	$1,690,000	$40,000
Amite	13	$0	$0	Forrest	6	$305,000	$0
Franklin	8	$0	$800,000	Greene	7	$0	$0
Jefferson	9	$815,000	$20,000	Jefferson Davis	9	$1,141,000	$0
Lawrence	8	$1,180,000	$0	Jones	10	$1,355,000	$40,000
Lincoln	9	$1,785,000	$20,000	Lamar	4	$205,000	$0
Pike	8	$	$0	Marion	6	$305,000	$0
Walthall	7	$	$0	Perry	5	$0	$0
Wilkinson	9	$	$0	Wayne	10	$10,000	$0

County	No. of Events	Total Property Damage	Total Crop Damage	County	No. of Events	Total Property Damage	Total Crop Damage
MEMA Region 9							
George	4	$0	$0	Jackson	4	$0	$0
Hancock	4	$0	$0	Pearl River	4	$0	$0
Harrison	4	$0	$0	Stone	3	$0	$0

The following maps (Figures 3.9.1 and 3.9.2), "Winter Storm Events by County 1996 – 2017" indicates which counties were impacted by winter storms documented in Table 3.9.2. As illustrated on the map, event occurrence follows a geographic pattern. Winter storms occur most frequently in the northern counties with frequency of occurrence diminishing in a southward pattern.

Snowfall in Mississippi occurs in the northern and central areas, but rarely in the southern areas. Snow in the northern counties is most frequent from December to March, with accumulations lasting only one or two days.

Figure 3.9.1

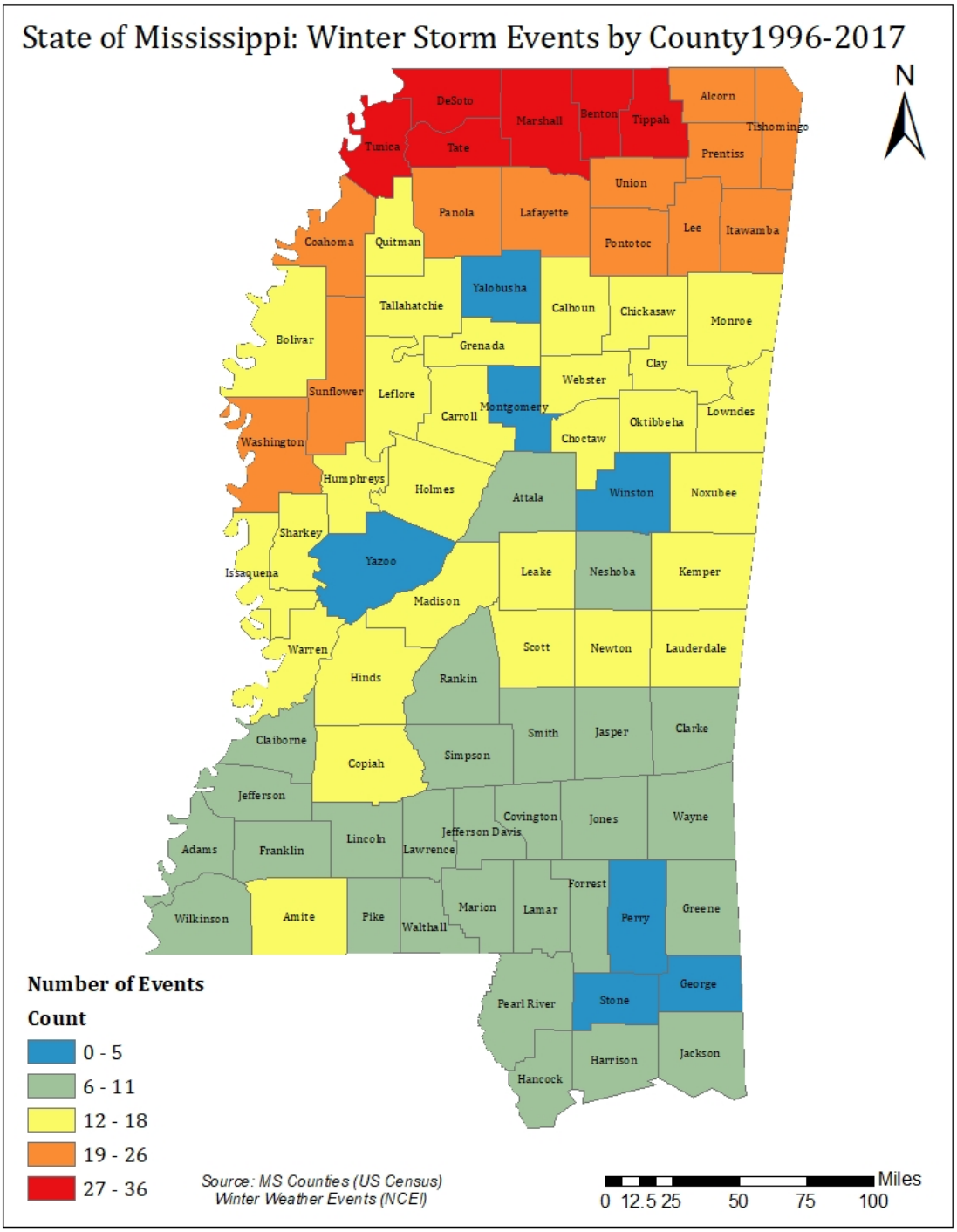
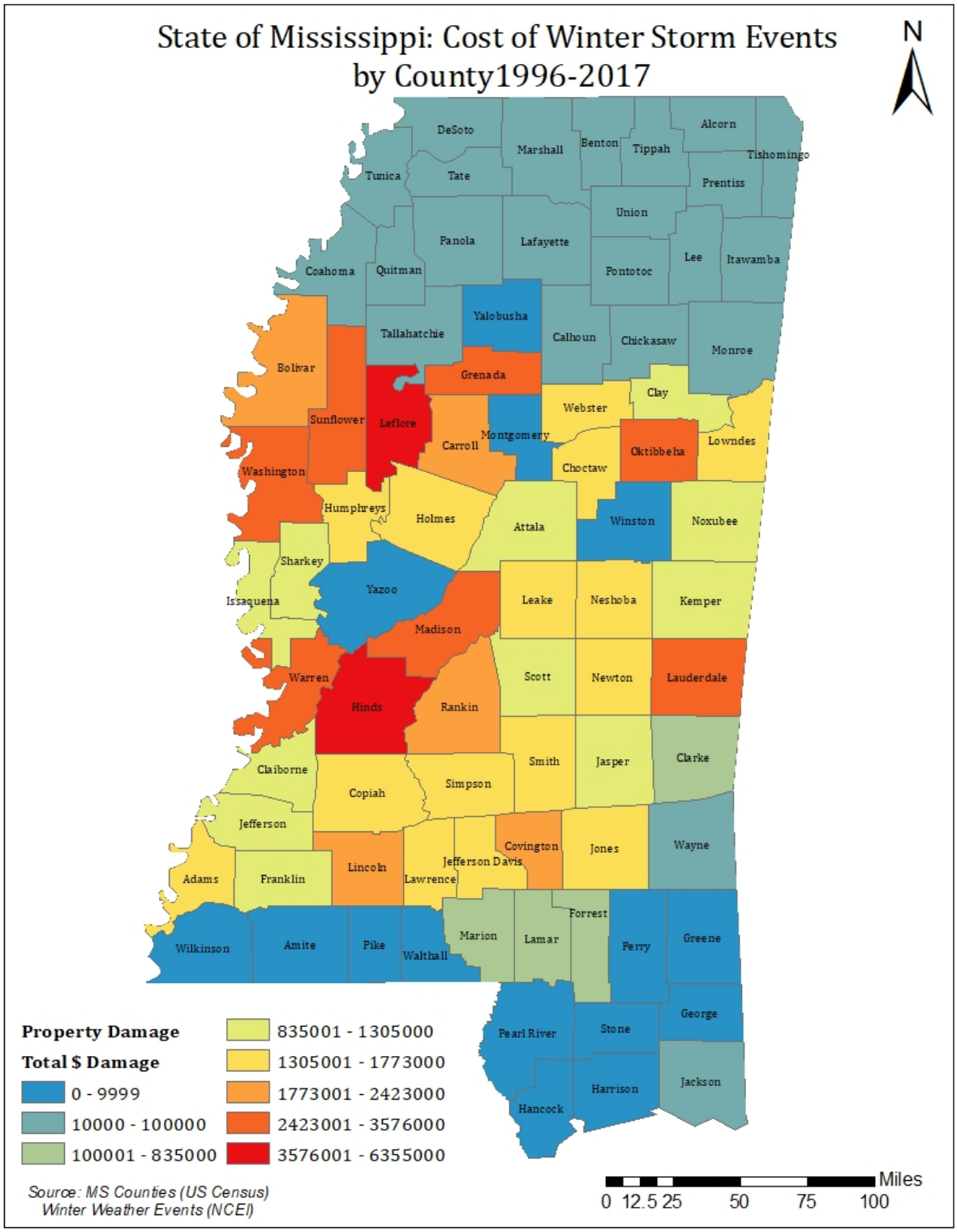


Figure 3.9.2


State of Mississippi: Cost of Winter Storm Events
by County1996-2017
N
DeSoto
Marshall
Benton
Tippah
Alcorn
Tishomingo
Tunica
Tate
Prentiss
Union
Panola
Lafayette
Lee
Itawamba
Coahoma
Quitman
Pontotoc
Yalobusha
Tallahatchie
Calhoun
Chickasaw
Monroe
Bolivar
Grenada
Clay
Webster
Sunflower
Leflore
Montgomery
Carroll
Lowndes
Oktibbeha
Washington
Choctaw
Humphreys
Holmes
Attala
Winston
Noxubee
Sharkey
Yazoo
Issaquena
Leake
Neshoba
Kemper
Madison
Warren
Scott
Newton
Lauderdale
Hinds
Rankin
Smith
Jasper
Clarke
Claiborne
Copiah
Simpson
Jefferson
Covington
Jones
Wayne
Lincoln
Jefferson Davis
Adams
Franklin
Lawrence
Forrest
Wilkinson
Amite
Pike
Walthall
Marion
Lamar
Perry
Greene
George
Pearl River
Stone
Harrison
Jackson
Hancock
Property Damage
Total $ Damage
0 - 9999
10000 - 100000
100001 - 835000
835001 - 1305000
1305001 - 1773000
1773001 - 2423000
2423001 - 3576000
3576001 - 6355000
Source: MS Counties (US Census)
Winter Weather Events (NCEI)
Miles
0 12.5 25 50 75 100

Cold weather, including extreme cold and wind chill, impact Mississippi causing property damage and deaths. These events also impact aging infrastructure, as in 2010, which is described in the historical events section. Table 3.9.3 and Figure 3.9.3 provide details of these events and the counties impacted.

Table 3.9.3
Cold-Related Events

Event Type	Date	No. of Events	Counties Affected	Deaths	Property Damage
Winter Weather	December 31, 2017	11	Chickasaw, Choctaw, Clay, Jasper, Lowndes, Monroe, Montgomery, Newton, Oktibbeha, Rankin, Webster	0	$0
Heavy Snow/Winter Storm	December 7, 2017	48	Adams, Amite, Attala, Choctaw, Claiborne, Clarke, Clay, Copiah, Covington, Forrest, Franklin, Greene, George, Hancock, Harrison, Hinds, Jackson, Jasper, Jefferson, Jefferson Davis, Jones, Kemper, Lamar, Lauderdale, Lawrence, Leake, Lincoln, Lowndes, Madison, Marion, Neshoba, Newton, Noxubee, Oktibbeha, Pearl River, Perry, Pike, Rankin, Scott, Simpson, Smith, Stone, Walthall, Warren, Wayne, Wilkinson, Winston, Yazoo	1	$820,000
Winter Storm/Sleet/ Winter Weather/Ice Storm	January 6, 2017	36	Adams, Alcorn, Amite, Benton, Claiborne, Clarke, Copiah, Covington, DeSoto, Franklin, Hinds, Jasper, Jefferson, Jefferson Davis, Jones, Kemper, Lauderdale, Lawrence, Leake, Lincoln, Madison, Marshall, Neshoba, Newton, Noxubee, Rankin, Scott, Simpson, Smith, Tate, Tippah, Tunica, Warren, Wayne, Winston	0	$2,125,000
Winter Storm/Winter Weather	January 22, 2016	13	Benton, Coahoma, DeSoto, Lafayette, Marshall, Panola, Pontotoc, Quitman, Tallahatchie, Tate, Tippah, Tunica, Union	0	$0
Winter Storm/Sleet	March 4-5, 2015	46	Attala, Alcorn, Benton, Bolivar, Calhoun, Carroll, Chickasaw, Claiborne, Clay, Choctaw, Coahoma,	0	$0

			DeSoto, Grenada, Hinds, Holmes, Humphreys, Issaquena, Itawamba, Lafayette, Lee, Leflore, Lowndes, Madison, Marshall, Montgomery, Monroe, Oktibbeha, Panola, Pontotoc, Prentiss, Quitman, Sharkey, Sunflower, Tallahatchie, Tate, Tippah, Tishomingo, Tunica, Union, Warren, Washington, Wayne, Webster, Winston, Yalobusha, Yazoo		
Winter Storm/Heavy Snow	February 25, 2015	42	Alcorn, Attala, Benton, Bolivar, Calhoun, Carroll, Chickasaw, Choctaw, Clay, Coahoma, DeSoto, Grenada, Holmes, Humphreys, Issaquena, Itawamba, Lafayette, Lee, Leflore, Lowndes, Marshall, Montgomery, Monroe, Noxubee, Oktibbeha, Panola, Pontotoc, Prentiss, Quitman, Sharkey, Sunflower, Tallahatchie, Tate, Tippah, Tishomingo, Tunica, Winston, Washington, Webster, Union, Yalobusha, Yazoo	0	$0
Winter Weather	February 23, 2015	5	Bolivar, Hinds, Madison, Warren, Washington	0	$39,000
Winter Weather	February 20, 2015	25	Alcorn, Benton, Bolivar, Calhoun, Chickasaw, Coahoma, DeSoto, Hinds, Itawamba, Lafayette, Lee, Marshall, Monroe, Panola, Prentiss, Pontotoc, Quitman, Rankin, Tallahatchie, Tate, Tippah, Tishomingo, Tunica, Union, Yalobusha	0	$19,000
Winter Storm	February 16, 2015	8	Alcorn, Benton, DeSoto, Marshall, Tate, Tippah, Tishomingo, Tunica	0	$0
Winter Weather	January 9, 2015	1	Pike	0	$0
Winter Weather	November 13, 2014	1	Marshall	0	$0
Winter Storm/Winter Weather	March 3-4, 2014	4	Amite, DeSoto, Tunica, Wilkinson	0	$0

Winter Weather/Ice Storm	February 11, 2014	22	Adams, Alcorn, Calhoun, Chickasaw, Claiborne, Humphreys, Issaquena, Itawamba, Jefferson, Lafayette, Lee, Monroe, Prentiss, Pontotoc, Sharkey, Tippah, Tishomingo, Union, Warren, Washington, Yalobusha, Yazoo	0	$50,000
Winter Weather	February 2-4, 2014	1	Tunica	0	$0
Winter Storm/Sleet/Heavy Snow/Winter Weather	January 28, 2014	27	Adams, Amite, Claiborne, Clarke, Copiah, Covington, Franklin, Greene, Hancock, Harrison, Hinds, Jackson, Jasper, Jefferson, Jefferson Davis, Jones, Lauderdale, Lawrence, Newton, Pearl River, Pike, Rankin, Scott, Simpson, Smith, Walthall, Wayne	0	$0
Winter Weather	Jan 23-24, 2014	8	Amite, Hancock, Harrison, Jackson, Pearl River, Walthall, Wilkinson	0	$0
Winter Weather	December 6-7, 2013	8	DeSoto, Coahoma, Marshall, Panola, Quitman, Tate, Tippah, Tunica	0	$0
Ice Storm	January 13-17, 2013	50	Alcorn, Attala, Bolivar, Benton, Carroll, Chickasaw, Choctaw, Claiborne, Clay, Copiah, Grenada, Hinds, Holmes, Humphreys, Issaquena, Itawamba, Jefferson Davis, Kemper, Lafayette, Lauderdale, Leake, Leflore, Lowndes, Madison, Marshall, Monroe, Montgomery, Neshoba, Newton, Noxubee, Oktibbeha, Prentiss, Pontotoc, Quitman, Rankin, Scott, Sharkey, Simpson, Smith, Sunflower, Tallahatchie, Tippah, Tishomingo, Union, Warren, Washington, Webster, Winston, Yalobusha, Yazoo	0	$540,000
Cold/Wind Chill	Jan 1-14, 2010	47	Adams, Attala, Bolivar, Carroll, Choctaw, Claiborne, Clarke, Clay, Covington, Copiah, Forrest, Franklin, Grenada, Hinds, Holmes, Humphreys, Issaquena, Jasper, Jefferson, Jefferson Davis, Jones, Kemper, Lamar, Lauderdale, Lawrence, Leake, Leflore,	3	$15,180,000

			Lincoln, Lowndes, Madison, Marion, Montgomery, Neshoba, Newton, Noxubee, Oktibbeha, Rankin, Scott, Sharkey, Simpson, Smith, Sunflower, Warren, Washington, Webster, Winston and Yazoo		
Cold/Wind Chill	Dec 25, 2004		Itawamba	1	$0
Cold/Wind Chill	Jan 24, 2003	1	Monroe	1	$0
Extreme Cold/ Wind Chill	Dec 31, 2000	1	Lafayette	1	$0
Cold/Wind Chill	Dec 18, 1996	8	Amite, Hancock, Harrison, Jackson, Pearl River, Pike, Walthall and Wilkinson	0	$0
Cold/Wind Chill	Feb 1-2, 1996	10	Amite, Desoto, Hancock, Harrison, Jackson, Pearl River, Pike, Walthall, Wilkinson and Yalobusha,	3	$100,000
Total				**10**	**$18,873,000**

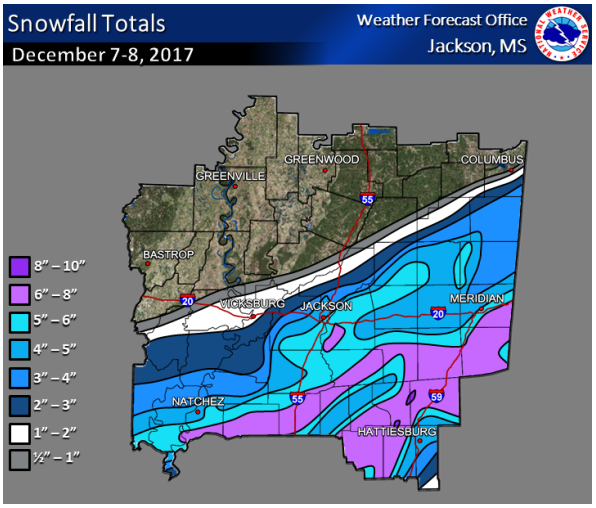
As previously stated, Mississippi is susceptible to winter-weather related events causing deaths and significant property and crop damages. Table 3.9.4 identifies two presidentially declared events in 1994 and 1998, followed by brief descriptions of each. The 2010 and 2017 cold weather events, described in the historical events section, caused damage to water lines serving residents, city and state agencies and crippled the city of Jackson. There have been no declarations since December 1998.

Table 3.9.4
Presidential Disaster Declarations – Winter Weather

Declaration Number	Incident Period	No. of Counties Affected	Date of Major Declaration
DR-1265	December 23 – 26, 1998	33	January 25, 1999
DR-1009	February 9 – 14, 1994	26	February 18, 1994

Historical Events

December 8, 2017 Snow



Just three days prior to the winter storm, temperatures were in the upper 60s and lower 70s across much of the area ahead of a series of arctic cold fronts. The first arctic front moved through the area during the day on December 5th and ushered in a cooler and drier airmass in its wake as temperatures dropped into the 40s with dewpoints in the upper 20s. A second reinforcing arctic cold front moved through the ArkLaMiss during the day on December 7th and brought another shot of drier and colder air. A modified continental polar airmass became locked in across the region with a parent 1035 mb high centered over the Southern Plains. As the stronger upper level flow and support pulled away from the southeastern United States, the two arctic cold fronts slowed down and eventually stalled over the northern Gulf of Mexico, helping to establish a strong quasi-stationary front. Further aloft, the synoptic pattern leading up to the winter storm was characterized by an upper level longwave trough centered over the Northern Plains and Great Lakes with multiple shortwave troughs rotating through the Inter-Mountain West and Four Corners region. On the morning of December 7th, a stout shortwave trough was located over the Four Corners and was forecast to eject into the Southern Plains, thus setting the stage for a significant winter storm across the Deep South.

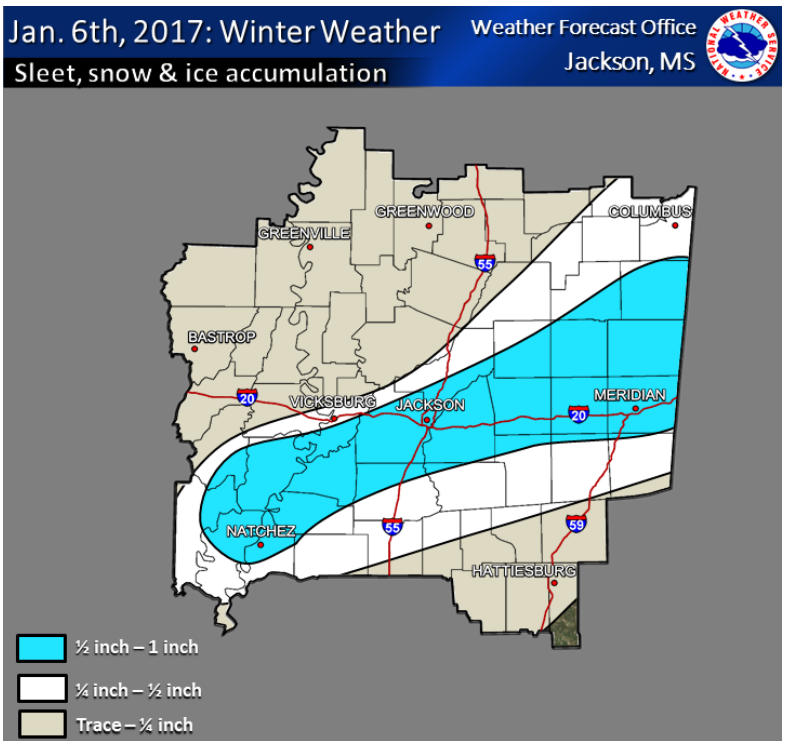
Source: JWS Photo: Zander Williamson

Strong upper-level divergence and ascent ahead of the advancing shortwave trough overspread the northern Gulf of Mexico in the vicinity of the stalled baroclinic zone and helped to induce surface cyclogenesis. The nose of a strengthening jet streak moved into southern Texas as the shortwave progressed into central Texas on the evening of December 7th. The resulting force for ascent allowed heavy snowfall to begin accumulating in many locations across the Deep South of Texas throughout the evening. This snowfall spread across south and east Texas and into Louisiana and Mississippi through the early morning hours on December 8th. Strong isentropic ascent on top of the sloped boundary, working in concert with exceptional upper-level divergence in the right entrance region of an impressive 180 kt jet, allowed heavy snowfall to spread across a large portion of central and southern Mississippi. While surface temperatures

were above freezing, evaporational and dynamical cooling due to a dry sub-cloud layer allowed surface temperatures to drop into the low 30s, and heavy snow began accumulating quickly as higher snowfall rates overspread the area through the morning hours. While the heaviest snow accumulations were limited to grassy and elevated surfaces, decent slushy accumulations were able to build on roadways, especially during the highest snowfall rates. Snowfall gradually tapered off from west to east through the day with snow ending in the Jackson metro by mid-morning and eventually ending in the south and east portion of the forecast area by mid-afternoon. The highest storm total snowfall amounts were focused along and southeast of a line from Brookhaven to Meridian where higher snowfall rates were realized in an area of banded snowfall that occurred in the presence of conditional symmetric instability.

The highest snowfall total was 8", which was reported in two different locations (see totals below) and was part of a heavy swath of widespread 6-7.5" from Brookhaven to Meridian where the aforementioned snow banding occurred. Elsewhere, totals dropped off gradually to the north with 4-6" in the Jackson metro. The official snowfall measurement at the **NWS Jackson** office was 5.1", which was high enough to rank as the **7th snowiest day all-time** and the largest snowfall since 1982. In **Meridian**, the total was 5" and was the **3rd highest daily snowfall on record** and the largest daily snowfall since 1993. For Hattiesburg, the event total snowfall was 4.1"

January 6, 2017 Winter Weather



A complex weather pattern eventually evolved into a widespread winter weather event across the area on January 6th, 2017. Strong surface high, near 1030mb, was building into the central and southern Plains. Tuesday, January 2nd, 2017 was much warmer being in the 70s with severe weather and tornadoes, while in the wake over the two days after on Wednesday and Thursday, strong surface high pressure with much cooler air gradually filtered in. The strongest push of strong high pressure and colder air began to move in Friday morning.

A sharp contrast in temperatures existed across the area from the lower Mississippi Valley into the Gulf of Mexico as a stalled frontal boundary stayed situated along the coast. This helped the cold air stay locked in place over the area, with temperatures near freezing Friday morning. In addition, a strong upper level disturbance was helping to promote lift and an area of snowfall moving through Oklahoma/Arkansas region by early Friday morning. This area mostly stayed just to the north of the region. Along and over top of the shallow arctic airmass, as the upper disturbance approached, moisture began to overrun the cold air below by early Friday morning. This moisture gradually overran the entire region by mid-morning. The atmosphere contained a deep melting layer, that as a snowfall fell, it

completely melted. However, there was enough of a layer below that near the ground that helped to refreeze most of the precipitation to fall in the form of sleet and freezing rain. By early Friday morning, sleet began to fall over northeast Louisiana and spreading to the north and east into most of the ArkLaMiss by mid-morning to late afternoon. There were some cases of some shallow instability present for some thunder to occur with the sleet.

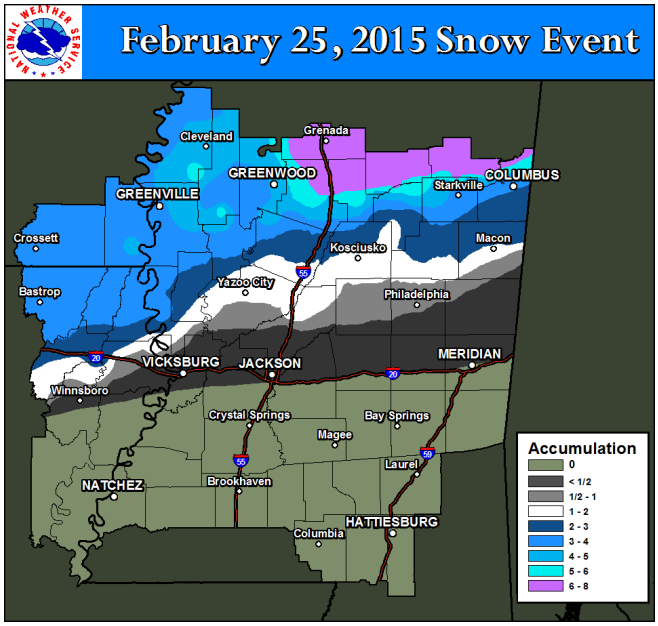
The main disturbance and lift occurred in the mid-to-late afternoon and the heaviest sleet production occurred during that time, right around rush hour. To make matters worse, temperatures were hovering in the low 30s to upper 20s while precipitation was falling. Overall, with such cold temperatures throughout the afternoon, there was significant sleet accumulation, especially from Franklin Parish in Louisiana, southeast towards Adams County in Louisiana, over to Warren County in Mississippi, throughout the Jackson Metro area and east along I-20 towards Lauderdale County and as far north as Noxubee County. Heavy sleet occurred throughout this region, with some areas approaching a 1/2 to 1 inch of sleet. Some areas in east-northeast Mississippi had enough precipitation with temperatures cooling in the atmosphere to briefly change over to snow as well near Meridian and east-northeast Mississippi. Most areas in southeast Mississippi were slower to change over to mixed precipitation until later in the event. With cold ground and road temperatures, significant icing and accumulation began across the roadways throughout portions of northeast Louisiana, central, east and northeast Mississippi, especially along the Interstate 20 corridor. This led to significant icing on roadways and bridges, leading to icy roadways and major traffic issues. Many accidents occurred across the region, leading to some major thoroughfares being shut down, at least temporarily, especially for portions of Interstate 55, Interstate 20 and other roadways. This led to many area residents encountering slow-downs in traffic and some being stuck for many hours on the roadways. In addition, the Jackson International Airport had to be shut down due to icy runways. The disturbance gradually moved east, helping the precipitation to taper off and move out by late evening, around 9-10PM.

The strong surface high built and strengthened near 1040mb, leading to much colder air filtering in overnight and through the weekend. This led to hard freeze conditions with highs struggling to reach the freezing mark, especially across central and northern areas. A snowpack existed over central Arkansas, northern Mississippi and southern Tennessee. With northerly winds over that snowpack, this helped to lock in even colder air and biting wind chills, with wind chills falling into the single digits over most of the area. Some areas in the Delta stayed below freezing for over 60 hours. This in addition to temperatures falling into the low-mid teens over the next several nights, kept a lot of winter weather accumulation lingering around through the weekend, with icy roadways for the next couple of days into Saturday, January 7th and Sunday, January 8th. This led to significant traffic issues lingering into the early weekend, with roadways gradually improving as some of that melted under full sun by Saturday and mostly gone by Sunday into the start of the following work week. This significant winter weather event will be one that will be remembered for years to come.

February 25, 2015 Snow Event

Multiple rounds of wintry weather had occurred prior to this snowfall event. A cold front had moved through the region four days earlier on February 21st with a cold airmass in its wake. Several waves of upper level disturbances moved through Mid-South, over the course of the next three days. The first, on the night of the 22nd, brought mostly rain to the region but some light icing occurred in the far northern Delta early on the 23rd. A second, more potent disturbance, moved through Central Mississippi during the

afternoon and evening hours on the 23rd. This brought a better icing event to locations generally along and north of I-20, causing some power outages and accidents.



With the cold remaining in place, the final round of wintry weather moved in on the morning of February 25th. A strong upper level disturbance moved across the region, which induced a low-pressure system to move east across the northern Gulf of Mexico. With the cold air already entrenched over the region, this brought the needed moisture and atmospheric lift needed to generate precipitation. At first, the precipitation started as rain and freezing rain, with some light icing reported across the ArkLaMiss. As the atmosphere cooled through the late morning, the rain began to change to snow in the early afternoon across southeast Arkansas, northeast Louisiana and the Mississippi Delta. The changeover line from rain to snow slowly progressed from northwest to southeast across northern portions of the ArkLaMiss region. By the time the changeover occurred near the I-20 corridor, the precipitation was moving off to the east into Alabama.

Those who got snow north of I-20 saw several heavier bursts, which led to some high snowfall totals. The highest totals were generally along and north of the Highway 82 corridor. Locations from Grenada to northern Lowndes county saw the highest amounts in our county warning area, with totals ranging from six to eight inches. Those who saw the higher totals also dealt with trees being weighed down by the heavy snow. This led to snapping trees and numerous power outages.

January 28, 2014 Winter Storm

Temperatures on January 27th were in the upper 40s in the northwest Delta to the mid-50s to low 60s in southeastern Mississippi. However, a large upper trough was diving southeast, bringing an arctic front and 1032mb surface high pressure into the ArkLaMiss. Temperatures dropped rapidly in the evening as very dry air filtered into the region, with dewpoints falling into the single digits. The large spread between the surface and dewpoint temperature would be an important player in the winter weather event on January 28th. As the upper trough deepened and strong upper level winds began to move over the region, an upper level low center over northern Mexico to the southwestern United States began to merge with the strong upper level system and moistened the mid-levels of the atmosphere across the region. Temperatures were only in the low to mid 20s throughout the ArkLaMiss as the precipitation began to fall. Areas along and north of a line from around Natchez to just south of Meridian began to observe precipitation that initially fell as sleet but gradually transitioned to snow in just a few hours as temperatures cooled in the mid-levels of the atmosphere and the lower atmosphere saturated from falling precipitation and evaporative cooling. Due to a warm layer in the mid-levels of the atmosphere, mixed precipitation occurred from south of a line near Natchez to south of Meridian. The deep melting layer caused precipitation to remain as sleet throughout most of the afternoon south of that line. These areas

had a prolonged period of sleet before finally transitioning over to snow in the mid to late afternoon hours. All precipitation moved out of the region by around 6-8pm on the evening of January 28th.

In total, areas north of the mixed precipitation line had more significant snowfall. This was a heavy confined band of precipitation that dropped off quickly closer to the Jackson metro with areas in southeastern Rankin County having the highest snowfall totals. This area had 2-4 inches of snowfall, with maximum of 4 inches in the Puckett area. Snow tapered off quickly near the Interstate 20 corridor with only near ½ inch to 1-inch snowfall, with some locally higher amounts. Snow accumulation extended into north central Mississippi up to the Highway 82 corridor near Indianola eastward towards Macon but only a light dusting occurred in these regions. South of the mixed precipitation line, significant icing and sleet occurred in the region with upwards of 1-3 inches of sleet and snow. The significant icing occurred into far southern Marion, Lamar and Forrest counties.

Significant icing occurred on the roadways and led to multiple accidents and issues with travel. There was an extended hard freeze, with temperatures dropping into the low teens and single digits regionwide on the morning of January 29th. This kept lingering snow and sleet accumulations frozen and made travel hazardous, especially along and south of the Interstate 20 corridor. Temperatures only climbed into the low to mid 30s on January 29th before falling back into the teens overnight of January 30th. The region finally warmed above freezing on the mid to late morning hours of January 30th.

January 14-17, 2013 Snow and Ice

A near record-long duration of wet weather brought widespread flooding and two winter storms to the ArkLaMiss during the period from January 6th through January 17th. There were three key ingredients that allowed this very active weather pattern to take shape.

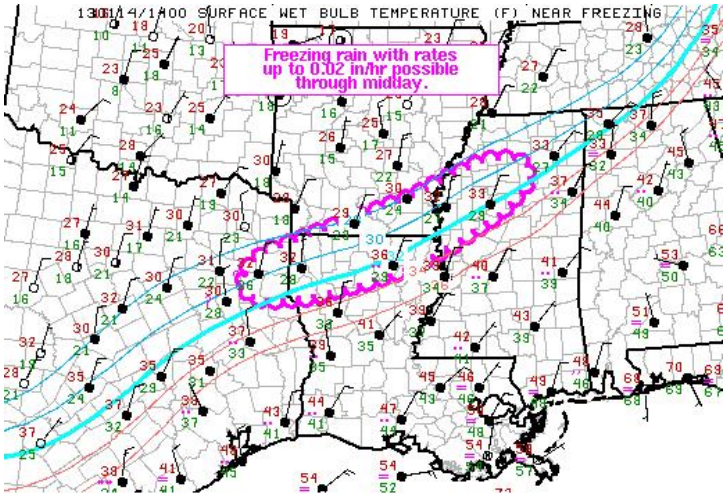
- An unseasonably strong and very warm high-pressure center set up over the South Atlantic states. The clock-wise flow around this high-pressure center was able to tap tropical moisture and transport it northward through the Lower Mississippi Valley.

- An upper level trough took up residence over the western states and this created upper level southwest flow. Such upper level patterns are favorable for heavy rain in our region because they focus very moist air along stalled fronts.

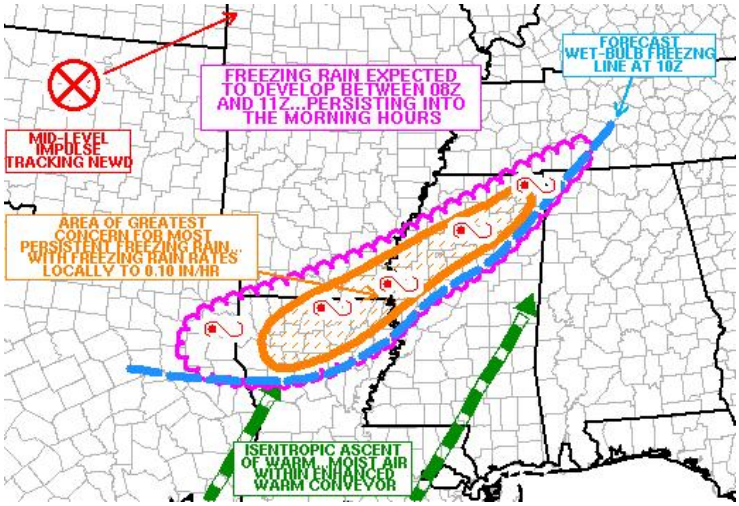
- The northern stream sent a series of cold fronts southward to the Gulf Coast. Not only did the cold air behind the front support ice and snow, but the frontal lift was necessary for multiple rounds of heavy rainfall that led to flooding.

Ice Storm – January 14-16, 2013

A strong cold front brought a shallow and very chilly air mass southward into the ArkLaMiss the night of January 13th. The cold air undercut relatively mild air aloft, thus setting the stage for freezing rain over northwest portions of the ArkLaMiss. A couple of episodes of moderate freezing rain accompanied by thunder occurred in this time frame with temperatures hovering near or just below 32 deg F.



These weather maps from the Storm Prediction Center, analyzed during the ice storm, depict the general set-up and potential area for heavier ice accumulation.



Just as the ice storm was ending in the “Delta” region, an upper level low was moving steadily east toward the region and this ultimately brought the heavy snow that fell over much of the ArkLaMiss.

Heavy Snow – January 17, 2013

The very cold air aloft associated with the upper low made the atmosphere more favorable for snow as we went into the early morning hours of Thursday, January 17th. A strong lift caused widespread light to moderate rain to develop during the evening of January 16th as surface temperatures held just above

freezing. Late that night rain transitioned briefly to sleet before switching to all snow from west to east. In far eastern portions of Mississippi, rain did not switch to snow until after daybreak.

There were two main bouts of freezing rain causing icing over portions of northeast Louisiana, southeast Arkansas, and northwestern portions of central Mississippi - one during the daytime hours of January 14th and another during the daytime and evening hours of January 15th. In many areas, temperatures remained below freezing during this entire time period, and thus, there was no melting between the two icing events. The above ice accumulation map represents the greatest reported storm total ice accumulation at any given location, which for some locations includes cumulative amounts over the 2-to-3-day period. The greatest accumulation amounts of around or just above 1/2" of ice were in a corridor from near Bastrop, LA to Cleveland, MS. Most icing occurred on elevated surfaces, such as trees and other vegetation, cars, utility lines, and bridges. However, there was also some icing on roadways, causing several traffic accidents.

Snowfall totals were generally around 2-3" from the I-55 corridor between Grenada and Jackson eastward to the Alabama state line. Because of the nature of this system, there were multiple heavier north-to-south oriented snow bands, creating great variations in snow accumulations over short distances. For instance, there were snow accumulation amounts as great as 3.5" along the Pearl River in the Jackson area, while accumulations of as little as 1" were reported just to the west in Raymond and as little as 1.5" just to the east in Goshen Springs. The greatest reported snowfall accumulation in the NWS Jackson forecast area occurred under a heavier snow band over portions of Webster, Choctaw, western Clay, and western Oktibbeha counties;6 inches of snow was reported just to the east of Ackerman. Conditions along Highway 82 were very treacherous in this area.

Prolonged Sub-Freezing Temperatures – January 1-14, 2010

The Central Mississippi water supply failure of January 2010 is an example of how large metropolitan and less populated areas can be affected by extreme cold weather events. Prior to January 11, 2010, Central Mississippi experienced 11 straight days of sub-freezing overnight temperatures and six days of overnight temperatures of 20 degrees or less. From the evening of January 7 to the morning of January 10, temperatures remained below 32 degrees. By January 10, the Jackson, Mississippi water supply system began losing pressure, and when the daily high temperature reached 48 degrees on January 11, it became apparent Jackson and several other Central Mississippi towns and cities would experience major water-pressure problems due to water main breaks.

On January 11, Governor Haley Barbour issued an emergency declaration that was eventually expanded to include all affected areas. The state's Emergency Operations Center was partially activated January 13 to help cities and counties with the ongoing crisis. Staff specializing in public works, engineering, logistics management and public health went on 12-hour shifts. Mississippi Emergency Management Agency delivered bottled water to the affected areas.

The City of Jackson water system sustained 80 major breaks and spewed 22 million gallons of water throughout the city. That number eventually reached 150 broken water mains with an unknown quantity of wasted water. According to news reports, the City of Jackson reported up to 200,000 residents were without water. Adding to the problems, an electrical fire took a city water treatment plant off line and further diminished the city's capacity to pump water. Many Jackson residents were entirely without water

for more than 24 hours. The cities of Madison, Ridgeland, Hattiesburg and Greenville offered water crews to help patch the leaks, and the city of Pearl furnished water for two of Jackson's largest hospitals.

On January 7, portions of Jackson and the City of Byram, south of Jackson, were placed on a boil water notice that remained in effect until January 24. On January 11, the entire Jackson water system, including most of the metropolitan area, was placed under a boil water notice that lasted seven days. These requirements, combined with a lack of water pressure, caused a multitude of problems including business, restaurant and school closures, relocation of two police precincts and adjournment of the Mississippi Legislature, which was in session at the Capitol in Jackson. For locations that remained in operation, flushing toilets and other hygienic measures became a problem. The Jackson Convention Complex was forced to provide extraordinary water and restroom facilities for a 400-person Affordable Housing Conference. Fire departments delivered water to jails and other critical facilities. Portable toilets were in such demand that vendors had to go out of state to supply the crisis.

AT&T, which operates switching centers for its cell and land lines and other providers that utilize the company's infrastructure, including emergency communications systems, was forced to park water-filled tanker trucks outside its facilities to cool equipment and provide fire protection. A National Guard tanker provided 5,000 gallons of water to cool computers for several state agencies providing essential services.

Mississippi State Department of Health (MSDH) went into emergency mode. Tasked with providing engineers for Emergency Support Function (ESF) #3 of the State's Comprehensive Emergency Management Plan (CEMP), MSDH also began emergency procedures to protect the health and safety of the public. That task included providing extra staff to sample and test potable water supplies from affected communities and inspect food service providers such as restaurants, shelters, clinics and schools to ensure safe operation. The department temporarily closed some restaurants until they could adjust to emergency operation requirements.

State Agencies Impacted

On Sunday, January 17 the boil-water alert was cancelled for most of the city, ending a week of crises unequaled in recent Jackson history. This event left behind a legacy of business losses, school days to be made up, huge potholes to be repaired where water crews accessed system breaks, and a large budgetary problem for the City of Jackson. Mitigation of future problems for Jackson's aging water main system was projected to cost over $75 million. With tax revenues in decline, the City's water supply problem was not a small one.

Affected Cities and Counties

The following numbers of residents of Central Mississippi cities and counties were affected by the January 2010 water supply:

> Emergency: Jackson (200,000); Lauderdale County (14,000); Port Gibson (10,500); Marks (2,300); Walnut (500); Vicksburg (250); Wayne County (150); Tunica County (number not available); Carroll County (number not available).

DR-1265 – December 23-26, 1998

A crippling ice storm struck Arkansas, Louisiana, and Mississippi on the evening of December 22, 1998, bringing freezing rain and sleet to the three-state region. Much of the fall and early winter season of late 1998 was very mild, but a strong surge of shallow arctic air drove southward and spelled an end to the unseasonable warmth. A moist southwest flow above the cold air brought several upper level disturbances. The combination of cold air and moisture caused periods of freezing rain and sleet until Christmas morning.

Almost two inches of ice accumulated on power lines, causing outages for up to seven days. Tree and power line damage was moderate to severe from northeast Louisiana to northcentral Mississippi. Due to more foliage than usual on trees, the extra weight of ice accumulation caused large oaks and maples to split in half. Travel was severely hampered for several days with motorists stranded at airports, bus stations, and truck stops.

Counties in Mississippi affected by the storm included Leake, Lee, Leflore, Lowndes, Monroe, Montgomery, Neshoba, Noxubee, Oktibbeha, Pontotoc, Prentiss, Sharkey, Sunflower, Tallahatchie, Tishomingo, Union, Warren, Washington, Webster, Winston, Yalobusha, and Yazoo.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 33** • **Deaths: 0** • **Injuries: 0** • **Estimated Property Damage: $16,699,000**	$6,970,269	$2,590,192	$4,349,918

DR-1009 – February 9-14, 1994

In 1994, a damaging ice storm with freezing rain accumulations of three to six inches occurred across north Mississippi, southeast Arkansas, west Tennessee, northwest Alabama, north Louisiana, and extreme northeast Texas between February 9th and 11th. In Mississippi, the ice storm was the worst since 1951, with total damage estimates exceeding $300 million and a federal disaster declaration for 26 counties.

According to Mississippi Power and Light Company estimates, 500,000 persons in roughly 200,000 homes had no electricity at the height of the storm and 175,000 homes had no water. Twenty percent of Mississippians lost power for at least one day. Approximately 300 water systems were also severely affected for a week or more with over 300,000 customers advised to boil water before use.

The United States Department of Agriculture studied forest damage in the storm-affected area. There were 2.1 million acres of forest land in northeast Mississippi within the 3.7-million-acre study area. Less than 1 percent of the forest land was untouched by some degree of damage. Net loss to live-tree volume, due to probable mortality, amounted to 16.5 percent of hardwoods and 15.3 percent of softwoods. The majority of volume loss occurred in areas that received about 25 percent mortality to the forest resource.

Mississippi counties included in the federal disaster declaration included: Alcorn, Benton, Bolivar, Calhoun, Chickasaw, Coahoma, Desoto, Grenada, Itawamba, Lafayette, Lee, Leflore, Marshall, Panola, Pontotoc, Prentiss, Quitman, Sunflower, Tallahatchie, Tate, Tippah, Tishomingo, Tunica, Union, Washington and Yalobusha.

Impact Summary	Public Assistance Dollars Obligated Declared Counties		
	Total PA Grants	**Emergency Work (Categories A-B)**	**Permanent Work (Categories C-G)**
• **No of Counties Affected: 26** • **Deaths: 0** • **Injuries:0** • **Estimated Property Damage: $500,000** • **Estimated Crop Damage: $5,000,000,000**	Unknown		

Source: NCDC Source: FEMA

It is important to note that there have been no declarable events since 1994.

Winter Storm Events Prior to 1993

The National Weather Service, via NCDC, has created a consistent database of winter events since 1993; however, there were many severe storms prior to this time period. The chart below plus two specific events present some of the significant historical winter storms in Mississippi.

Significant Historical Snow Storms
1940 – 2017

Year	Area	Inches
January 2017	Central and North Mississippi	2.5
January 2016	Central and North Mississippi	8
January 2015	Central and North Mississippi	1
January 2014	North and Central Mississippi	2
January 2013	North Mississippi	8
January 2012	Central Mississippi	4
January 2011	Adams County	3
January 2010	North Mississippi	6
January 2009	North Mississippi	7
January 2008	North Mississippi	10
January 2007	Central and South Mississippi	8
January 2006	North Mississippi	3
January 2005	Central and South Mississippi	9
January 2004	Chico and Bolivar County	6
January 2003	Covington, Jefferson Davis, and western Jones Counties,	5
January 2002	South Mississippi	4.5
March 1993	Mississippi	6
1974	Gulf Coast	5
1967 – 1968	Tate County	25.2
1966	Bolivar County	23
1960	Hinds County	9.1
1940	Hinds County	10.6

January 28 – February 5, 1951: Approximately $50 million in damages was incurred in Mississippi. Twenty-two people died in the storm throughout Mississippi, Louisiana and Arkansas.

January 11 – 15, 1982: An ice storm centered in the northern and eastern parts of the state, caused heavy damages in 44 counties and affected 25% of the states' nurseries. One death was reported.

Probability of Future Winter Storm Events

The area most likely to receive an ice storm, heavy snow, or winter storm activity is the area north of Interstate 20, the northern half of Mississippi. Historically based on data from the NCDC, winter events occur as early as mid-December and as late as mid-March. In the past 20 years, Mississippi recorded some magnitude of winter weather except for the years of 1995, 1999, 2001, 2005 and 2012. Therefore, a 25 percent probability of a winter weather event striking the state should be expected.

Assessing Vulnerability

An assessment of Mississippi's vulnerability to winter storms reveals advance warnings are often not regarded or taken seriously enough. Preparedness for a winter storm is just as important as preparing for other hazards. As is the case with other natural hazards, the very young, the elderly, persons with special needs and handicapped people are vulnerable to winter storms. Officials also suggest institutions housing these individuals develop a plan to include preparedness for lack of electricity, water, and fuel for heating

Public buildings are not as vulnerable to winter storms as infrastructure such as electric transmission lines and utility poles that can all be weighed down by ice and freezing rain. During the 1994 ice storm 8,000 utility poles were downed by the weight of ice, 4,700 miles of power lines were downed, and 491 water systems were affected, with 741,000 customers without water

Vulnerability of People to Winter Storms

The public warning systems alerting the general public of an impending storm are the existing media outlets, the National Weather Service and NOAA weather radios. Now, there is Twitter, Facebook, Instagram and other social media outlets.

The oxygen and insulin-dependent, the elderly, those whose medical conditions require regular visits by home health care workers, and children living in these households make up the special needs group whose lives are most in danger when a power failure occurs. These citizens must rely on neighbors and relatives for contact, supplies and assistance throughout the disruption. Previous incidents have left remote areas of the state without power for up to a month.

Roads are often blocked by trees felled by heavy ice, and road and bridge conditions may prevent home healthcare workers from reaching their patients until emergency personnel can clear roads and offer transport by ambulance. Any unnecessary automobile or pedestrian travel during icy conditions by citizens not involved in emergency assistance increases the burden on emergency personnel during these crises.

Loss of Life from Extreme Cold in Mississippi

Although the National Weather Service does not record cold-related deaths along with winter storm event statistics, the following information collected by the Mississippi State Department of Health, Bureau of Health Statistics, provides an understanding of recorded deaths in Mississippi due to extreme natural cold. Table 3.9.5 below summarizes cold-related deaths over a 28-year period from 1984 to 2011, the last year for which data was available. During that time, a total of 175 deaths from this cause occurred, an average of 6.25 deaths per year. Information on the location of the deaths was not available.

Table 3.9.5
Loss of Life Due to Excessive Cold

Year	Exposure to Excessive Natural Cold
2017	1
2016	0
2015	0
2014	0
2013	0

Vulnerability of Natural Resources to Winter Storms

Trees, crops, and decorative vegetation are subject to damage from winter storms. Ice storm damage documented by the National Weather Service in 1994 caused damage to over 3.7 million acres of commercial forestland. The value of damaged timber was estimated at $27 million. The state's pecan crop was reduced by 25% over the following five-to-ten years at an estimated cost of $5.5 million per year.

Fallen timber and tree limbs during winter storms provide a possibility of wildfires later in the year. Forestry Commission officials and private landowners minimize the severity of wildfires by cutting and sawing fallen timber and debris to prevent the spread of fire.

Vulnerability of Private Improvements to Winter Storms

In Mississippi, occasionally roofs of businesses and homes are stressed or collapse due to the weight of snow and ice accumulations. Cars and passengers are vulnerable when driving on icy or wet roads and surfaces. Decorative trees and shrubs can be expensive to replace should the weight of ice and snow force down or break limbs.

Businesses within the affected area are vulnerable to power outages and may be unable to open their doors for business, thus losing income due to closure. Communications facilities, such as telephone lines, microwave, and cellular telephone repeater towers were disrupted if not downed in the past. The failure of nine fiber optic lines, 26 local telephone exchanges and several cellular telephone repeater towers was caused by vulnerability to ice and snow accumulations as documented in the FEMA-1009-DR-MS (February 18, 1994) Hazard Mitigation Team Report.

Homes and businesses served by local firefighters are vulnerable in an ice storm where downed power lines have reduced the amount of water available to fight fires. Other municipal services such as sewer and water purification services are not available to municipal and other residents.

Assessing Vulnerability by Jurisdiction Methodology

The 2013 plan update deferred to the local mitigation plan rating of vulnerability shown by MEMA Region in the chart below. The 2018 plan update will do the same. Not all local mitigation plans (single jurisdictions, county and regional plans) included winter weather in their plans such as the case for Region 6. As a result of this ranking, the state will consider winter weather a medium risk.

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1	-	9	-	6	-	9	-
2	-	11	-	7	9	-	-
3	4	5	-	8	10	-	-
4	-	-	10	9	6	-	-
5	-	40	-				

Past damages are a significant indicator of vulnerability. However, county-by-county damage information was not available for winter storm damages. The National Weather Service provides a single dollar amount for all counties impacted by a particular winter storm event. It is inaccurate to average this amount across the impacted counties. Tables 3.7.1 and 3.7.3 provide the estimated damage losses by event/year.

The data collected by NWS reflects what is known by the state given the northern part of the state is more significantly impacted by winter storms than the southern part of the state.

Exposure Analysis

The following section consists of three exposure analyses, using three different sets of data. Exposure analyses are different from loss estimates because they present facilities and structures that may be exposed to winter storms, but do not attempt to estimate the amount of damages to be incurred during a winter storm event. Loss estimations are discussed in the Potential Losses section following the exposure analyses.

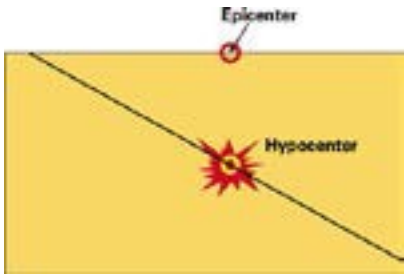
Exposure Analysis of State-Owned Facilities

As previously discussed in this section, state-owned facilities are equally at risk to extreme winter weather events (including power outages associated with this type of event). These events can occur anywhere and with any severity.

3.10: Earthquake Risk Assessment

Hazard Description

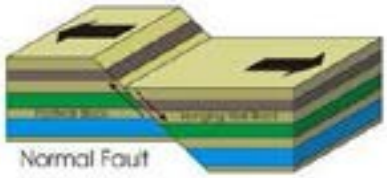
The United States Geographic Survey (USGS) defines an earthquake as a sudden motion or trembling of the each caused by an abrupt release of stored energy beneath the earth's surface. A description of technical terms associated with earthquakes are provided below:



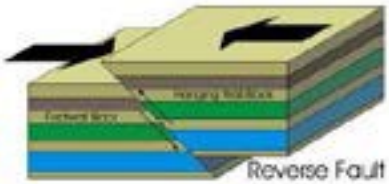
Epicenter - The epicenter is the geographic location directly above the hypocenter on the earth's surface. Ideally, the epicenter and the highest MMI values on the isoseismic map coincide; this relation- ship does not, however, always hold true.

Hypocenter - The hypocenter is the location in the subsurface where the rupture actually took place.

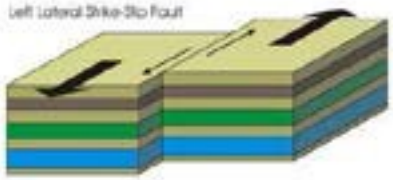
Fault - Faults can be defined as a rupture in subsurface geological materials where there is relative movement on the opposing sides of the rupture. The origin of this movement is stress built up in the earth's crust from plate movement or other geological forces.



Normal Fault -. A normal or gravity fault is one where a fault block has moved downward as gravity moves a fault block down along an inclined fault plane.



Reverse Fault - A reverse fault is the opposite of a normal fault where a fault block has moved up an inclined fault plane, opposite of the movement that would be expected if gravity were the main force acting on the block.



Strike Slip Fault - A strike-slip fault is one where the movement is largely horizontal and oriented in the same direction as the fault trends. Normal faults are the result of an extension of the earth's crust, reverse faults are a result of a shortening or compression of the earth's crust and strike-slip faults result from forces acting in a horizontal fashion.

Fault Plane - The rupture along which the movement of the fault blocks takes place can be a sharp planar feature, referred to as a fault plane. In this case, the direction the fault blocks moved (up, down or sideways) can be fairly straightforward.

Fault Zone - Unfortunately, it is also common for the movement of fault blocks to take place across a zone consisting of a number of faults planes with small individual displacements. This zone of displacement is referred to as a fault zone and it can be only a few inches wide or it can consist of a series of large faults and may be measured in miles.

Isoseismal Map - Typically, site intensities are plotted on a map and like intensities are grouped. The groupings are separated by lines referred to as isoseismal and the map itself is referred to as an isoseismal map. Intensities are always denoted by roman numbers so as to distinguish them from magnitude values which are always in Arabic numerals. The assigned intensity value for any particular earthquake represents the highest MMI value assigned in the felt area.

Liquefaction - Liquefaction is an earthquake-related hazard involving geological conditions that pose a potential hazard to structures. Liquefaction is a complex process resulting in soils losing their bearing strength (i.e. they act more like a liquid than a solid) due to seismic induced vibrations. The major concern is that during an earthquake the liquefaction soils become "liquid" and move laterally away from the foundation of buildings causing foundation failure or causing them to literally topple over.

Peak Ground Acceleration (PGA) - The maximum level of vertical or horizontal ground acceleration caused by an earthquake. The PGA is typically expressed as a percent of the acceleration due to gravity.

Magnitude - There are several magnitude scales. All are different from intensity scales as they measure completely different aspects of the earthquake *i.e.* the strength of the earthquake source (Reiter, 1990). Reiter (1990, p. 34) also defines the difference between intensity and magnitude stating that "... magnitude is determined by quantitatively analyzing instrumental recordings utilizing specific, explicitly defined formulas ..." Magnitude scales were originally devised in 1934 for use in California. This scale came to be known as the Richter or Local Magnitude Scale.

Modified Mercalli Intensity Scale - The size of an earthquake can be expressed in several ways, most commonly used are the various magnitude scales and the Modified Mercalli Intensity Scale (MMI). There are several intensity scales, but the MMI is most commonly used in this country. The intensity scales differ from magnitude scales in that they measure the effects of seismic waves as they are perceived by people in the "felt" area of the earthquake. The first question, for example, is usually "Did you feel the earthquake?" If the answer is "yes" then a set of questions are asked that will help the interviewer determine the level of intensity at that site (referred to as site intensity). Intensity levels vary from a MMI intensity level I, where the earthquake was not felt to a MMI value of XII which is described as total damage.

A comparison of magnitude and intensity is shown in the chart below followed by abbreviated descriptions for each intensity level.

Magnitude	Modified Mercalli Intensity*
1.0 – 3.0	I
3.0 - 3.9	II - III
4.0 - 4.9	IV - V
5.0 - 5.9	VI - VII
6.0 - 6.9	VII - IX
7.0 and higher	VII – or Higher

***Based on a typical maximum Modified Mercalli Intensity Scale as defined below Source: USGS Earthquake Hazards Program**

Intensity Scale	
I.	**Not felt except by a very few under especially favorable conditions.**
II.	**Felt only by a few persons at rest, especially on upper floors of buildings.**
III.	**Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations are similar to the passing of a truck. Duration estimated.**
IV.	**Felt indoors by many, outdoors by a few during the day. At nights, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation is like a heavy truck striking building. Standing motor cars rocked slightly.**
V.	**Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects over-turned. Pendulum clocks may stop.**
VI.	**Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage is slight.**
VII.	**Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.**
VIII.	**Damage slight – especially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage is great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.**
IX.	**Damage considerable in specially-designed structures; well-designed, frame structures thrown out of plumb. Damage is great in substantial buildings, with partial collapse. Buildings shifted off foundations.**
X.	**Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.**
XI.	**Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.**
XII.	**Damage total. Lines of sight and level are distorted. Objects are thrown in the air.**

Hazard Description

Earthquakes originating in Mississippi are not the only threat; those originating in surrounding states have also affected Mississippi in the past. The greatest threat to Mississippi from earthquakes is from a strong

event in the New Madrid Seismic Zone. 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. The vibrations from these earthquakes were so powerful they rang church bells in Boston, Massachusetts more than 1,000 miles away.

Although the New Madrid Seismic Zone (NMSZ) is the primary seismic activity source for the Southeastern United States, there are other potential earthquake sources in Mississippi. The USGS has recorded more than 40 earthquakes originating within the boundaries of Mississippi since 1911. Though none of these Mississippi-centered earthquakes have inflicted severe damage, they should not be disregarded.

One area of notable earthquake activity is in east-central Mississippi in Lauderdale and Clarke counties. This area is not well known, but it has produced more than 14 earthquakes in the past 30 years, according to data gathered from the Mississippi Department of Environmental Quality (MDEQ). Most of these events occurred within the boundaries of Clarke County.

The White River Fault Zone (WRFZ) is another notable seismic zone that was identified in 1944. The Charleston earthquake of 1931 in Tallahatchie County, Mississippi may have been centered along this fault. This is the largest recorded Mississippi-centered earthquake at a magnitude of 5.0. The WRFZ runs from Grenada, Mississippi northward to Newport, Arkansas, approximately 280 miles. Many of Mississippi's epicenters are in the northwest quadrant of the state; some may be associated with the WRFZ. The WRFZ is an area that should be assessed as a significant seismic hazard.

Earthquakes do not occur solely from naturally active faults. Volcanoes and oil and gas production are also potential sources of earthquakes. Mississippi has not had volcanic activity for millions of years; therefore, this impact is minimal. Oil and gas production is common in Mississippi but might produce only relatively small earthquakes that have minimal hazard.

Education and Outreach

The Great Central U.S. ShakeOut is an annual opportunity to practice how to be safer during big earthquakes: "Drop, Cover and Hold On." The ShakeOut has also been organized to encourage individuals, communities, schools and organizations to review and update emergency preparedness plans and supplies, and to secure a space in order to prevent damage and injuries. Registration for this event is located at www.shakeout.org.

The web site also includes numerous educational resources such as 20 Cool Facts about the New Madrid Seismic Zone that summarizes a few of the more significant facts about the series of large earthquakes that struck the New Madrid seismic zone of southeastern Missouri, northeastern Arkansas, and adjacent parts of Tennessee and Kentucky from December 1811 to February 1812.

History of Mississippi Earthquakes

Historically, not many earthquakes are centered within Mississippi. As seen in Table 3.10.1 many earthquakes that originated in Mississippi had a magnitude of 3.5 or less. Damage typically begins to occur when an earthquake reaches a magnitude of 4 or greater. Nevertheless, every earthquake is unique and

potentially dangerous. Since the 2013 plan update, there were four events in 2015. Table 3.10.1 shows earthquakes that have originated and impacted Mississippi.

Table 3.10.2 shows a sampling of earthquakes that have originated in other states but have been powerful enough for residents of Mississippi to feel the effects of the vibrations. Based on best available data, there appears to be no changes or seismic activity since the last plan update. Table 3.10.3 presents seismic activity for Mississippi's neighboring states during those years. It is not known if any effects of this activity were felt in Mississippi. Figure 3.10.1 shows the epicenter distribution of events originating in and near Mississippi.

Table 3.10.1
Mississippi Earthquakes

Date	Latitude	Longitude	Magnitude	City/Town
August 17, 2015	32.54	-90.12	2.6	Madison
June 29, 2015	32.56	-90.07	3.2	Canton
May 3, 2015	32.58	-90.11	3.0	Canton
May 3, 2015	32.58	-90.07	3.2	Canton
August 30, 2013	32.99	-88.46	2.0	Farmington
October 10, 2012	34.33	-90.52	2.3	Jonestown
July 30, 2012	32.54	-88.64	1.6	Meridian Station
July 27, 2012	32.56	-88.64	2.1	Meridian Station
May 10, 2008	34.35	-88.83	3.1	Sherman
October 26, 2002	34.03	-90.68	3.1	Duncan
August 11, 2002	34.34	-90.17	2.8	Batesville
May 10, 2008	34.35	-88.83	3.1	Sherman
October 26, 2002	34.03	-90.68	3.1	Duncan
August 11, 2002	34.34	-90.17	2.8	Batesville
February 25, 1999	34.1	-89.87	2.9	Oakland
August 11, 1996	33.58	-90.87	3.5	Meltonia
September 25, 1984	34.06	-89.82	Not available	Long Branch
February 5, 1983	34.70	-88.37	2.9	Cairo
October 12, 1980	34.26	-89.13	Not available	Turnpike
June 9, 1978	32.09	-88.58	3.3	Quitman
November 4, 1977	33.83	-89.28	3.4	Calhoun City
October 23, 1976	32.20	-88.73	3.0	Meridian
September 9, 1975	30.66	-89.25	2.9	Riceville
May 25, 1973	33.94	-90.63	Not available	Lombardy
January 1, 1973	33.78	-90.62	3.5	Ruleville
June 29, 1967	33.55	-90.81	Not available	Shaw
June 4, 1967	33.55	-90.84	4.4	Shaw
October 22, 1964	31.23	-89.56	Not available	Pine Grove
June 1, 1962	34.98	-90.18	Not available	Walls
September 27, 1956	31.9	-88.50	Not available	Shubuta
February 1, 1955	30.4	-89.10	Not available	Gulfport
June 28, 1941	32.4	-90.9	Not available	Vicksburg
December 17, 1931	33.8	-90.1	4.6	Oxberry
November 13, 1927	32.8	-90.20	Not available	Linwood
October 28, 1923	34.9	-88.10	Not available	Eastport

March 27, 1923	34.6	-89.8	Not available	Barr
March 31, 1911	34	-91.8	4.7	Tutwiler

Source: USGS

Table 3.10.2
Earthquakes Affecting Mississippi 2006 - 1812

Date	Origin	Magnitude	Maximum Intensity	Intensities Reported in MS	Counties Affected
September 10, 2006	253 miles SSW of Apalachicola, FL	6	VI	I, II, III, IV	Alcorn, Bolivar, Covington, Desoto, Forrest, George, Hancock, Harrison, Hinds, Jackson, Jones, Lauder- dale, Lee, Marion, Pearl River, Rankin, Scott, Walthall, Warren and Webster
June 2, 2005	10 miles NNW of Dyersburg, TN	4	III	I	Alcorn, Desoto, Tate, Tishomingo, Tunica and Yalobusha
May 1, 2005	15 miles WSW of Blytheville, AR	4.1	VI	I, II, III	Bolivar, Tate and Tunica
February 10, 2005	22 miles WSW of Blytheville, AR	4.1	V	I, II, III	Alcorn, Benton, Coahoma, Desoto, Itawamba, Jones, Lafayette, Lee, Marshall, Pontotoc, Prentiss, Tate, Tippah, Tishomingo, Tunica, and Union
November 7, 2004	25 miles SW of Tuscaloosa, AL	4	V	I, II, III, IV	Clay, Coahoma, Desoto, Lauderdale, Leake, Oktibbeha, Monroe, Newton, and Scott
April 29, 2003	8 miles ENE of Fort Payne, AL	4.6	V	I, II, III, IV	Alcorn, Chickasaw, Clay, Desoto, Hancock, Harrison, Itawamba, Lafayette, Lauderdale, Lee, Lowndes, Monroe, Oktibbeha, Panola, Prentiss, Tate, Tishomingo, and Yalobusha
March 29, 1972	New Madrid Seismic Zone	Not available	IV	I, II, III, IV	Bolivar, Desoto, and Panola

1811-1812	New Madrid Seismic Zone	7.8 - 8.1	XI	Not available	Affected counties as far as the Gulf Coast

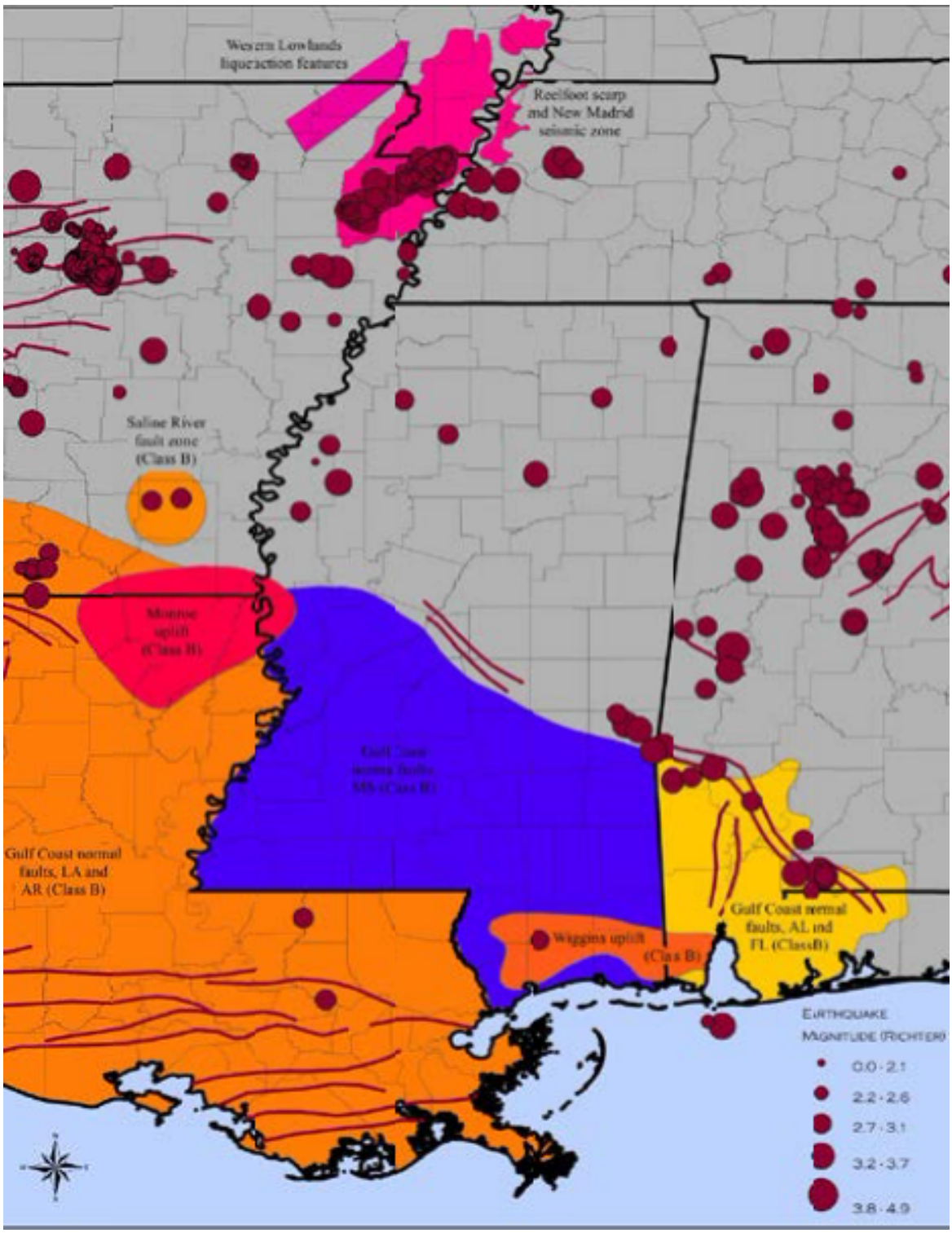
Source: USGS and MDEQ Office of Geology

Table 3.10.3
Seismic Activity Neighboring States
2010 – 2018

Year	State	Occurrences	Range of Magnitudes
2018	Alabama Tennessee	17 4	1.7 – 2.7 1.5 – 2.4
2017	Arkansas	75	.05 – 3.6
2016	Arkansas Tennessee	49	.09 – 2.8
2015	Arkansas Tennessee	64 5	1.3 – 2.5 2.5 – 3.5
2014	Arkansas Tennessee	126 5	1.3 – 2.7 2.5 – 3.1
2013	Arkansas Tennessee	181 1	1.5 – 3.2 2.6
2012	Arkansas Alabama Tennessee Arkansas	9 5 2 175	2.1 – 3.9 1.7 – 2.7 2.0 – 2.5 2.2 – 4.1
2011	Alabama Arkansas	8 70	1.8 – 3.5 1.8 – 4.0
2010	Alabama Louisiana	5 1	2.6 – 3.2 3

Source: USGS

Figure 3.10.1
Regional Earthquakes, Normal and Quaternary Faults and Fault Areas



Summary of Previous Events

Although the number of earthquakes known to have been centered within Mississippi's boundaries is small, the state has been affected by numerous shocks located in neighboring States. In the winter of 1811 and 1812, the New Madrid seismic zone generated a sequence of earthquakes that lasted for several months and included three very large earthquakes estimated to be between magnitude 7 and 8. The three largest 1811-1812 earthquakes destroyed several settlements along the Mississippi River, caused minor structural damage as far away as Cincinnati, Ohio, and St. Louis, Missouri, and were felt as far away as Hartford, Connecticut, Charleston, South Carolina, and New Orleans, Louisiana. In the New Madrid region, the earthquakes dramatically affected the landscape. They caused bank failures along the Mississippi River, landslides along Chickasaw Bluffs in Kentucky and Tennessee, and uplift and subsidence of large tracts of land in the Mississippi River floodplain. One such uplift related to faulting near New Madrid, Missouri, temporarily forced the Mississippi River to flow backwards. In addition, the earthquakes liquefied subsurface sediment over a large area and at great distances resulting in ground fissuring and violent venting of water and sediment. One account of this phenomena stated that the Pemiscot Bayou "blew up for a distance of nearly fifty miles."

The 1811-1812 New Madrid sequence consisted of three large earthquakes:

1. M-7.5 on December 16,1811
2. M-7.3 on January 23,1812
3. M-7.5 on February 7,1812

According to some reports, the earthquakes of 1811-12 made the land roll like waves. There are letters and descriptions which tell how the land "rocked." The story of the first steamer trip down the Ohio and Mississippi Rivers has many times been told-how the Roosevelts on board found themselves rocked and tossed about on the agitated waters.

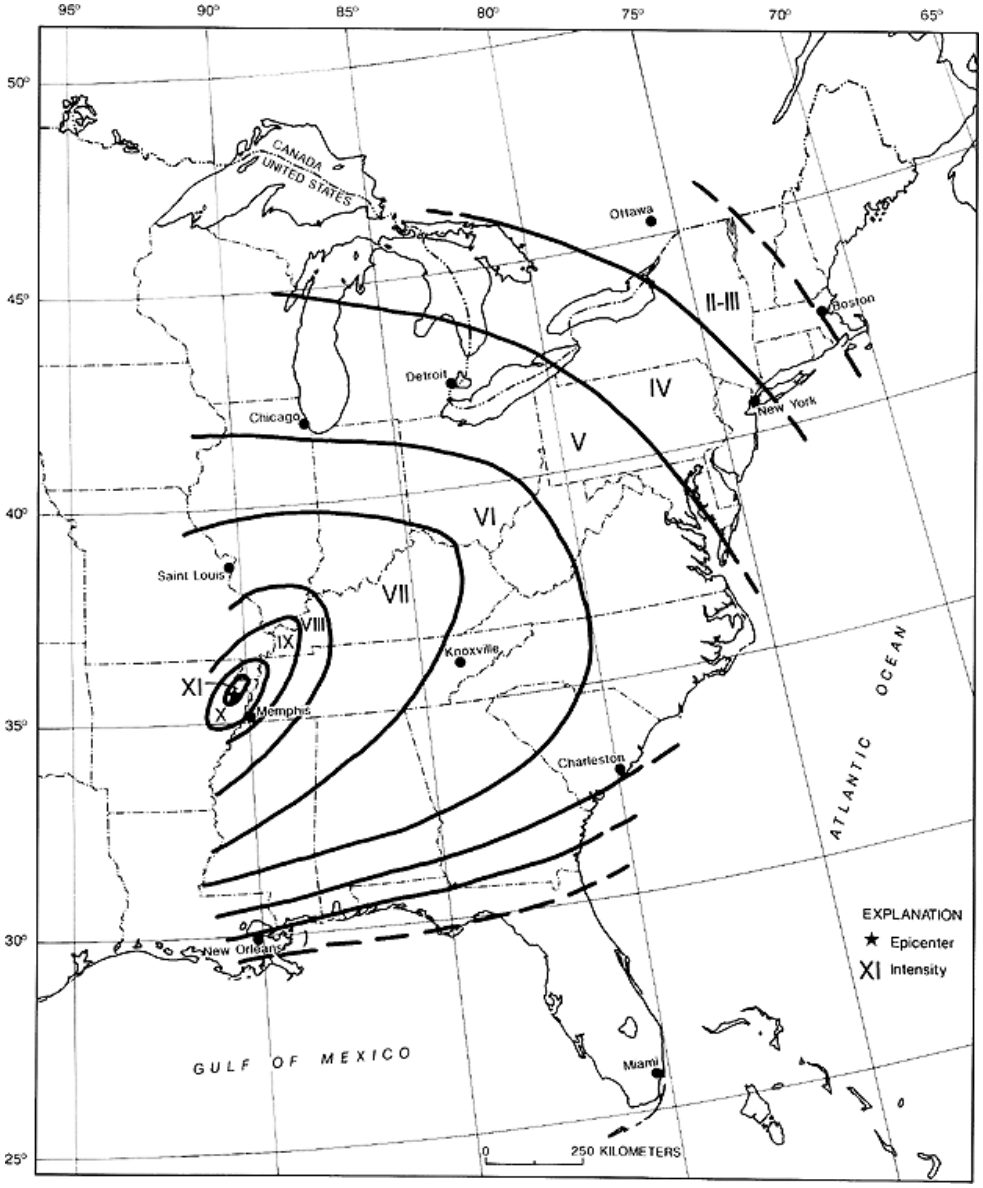
A 19th-century print of New Madrid earthquake chaos. (Granger Collection, NYC)

Source: The Smithsonian

Figure 3.10.2

Isoseismal Map 1811 – 1812

(Isoseismal map for the Arkansas earthquake of December 16,1811, 08:15 UTC
(first of the 1811-1812 New Madrid series). – USGS)



The earliest and strongest earthquake reported within Mississippi occurred on December 16, 1931, at about 9:36 p.m. at Charleston, in the area of maximum intensity, the walls and foundation of the agricultural high school cracked and several chimneys were thrown down (intensity VI - VII). At Belzoni, plaster fell and several chimneys were damaged (intensity VI). In Tillatoba, one chimney toppled and a vase was thrown to the floor (intensity VI). At Water Valley, several chimneys were damaged (intensity VI). The shock was perceptible over a 65,000 square mile area including the northern two-thirds of Mississippi and adjacent portions of Alabama, Arkansas, and Tennessee.

On February 1, 1955, an earthquake was strongly felt by many people along a 30 mile strip of the Mississippi Gulf Coast. In Gulfport, houses shook, windows and dishes rattled, and deep rumbling sounds were heard by many (intensity V). At Biloxi, several persons were alarmed and a rumbling noise was heard. Simi- lar effects were noted at Mississippi City and Pass Christian. The Tremor was reported by many persons at Bay St. Louis, where buildings creaked, and loose objects and windows rattled.

In June 1967, two earthquakes occurred about 18 miles northeast of Greenville, Mississippi. The first, on June 4, measured magnitude 3.8 on the Richter Scale and was felt over approximately 25,000 square miles. The region affected by this tremor included the Northwest quadrant of Mississippi and parts of Arkansas, Louisiana, and Tennessee. A few instances of cracked plaster were reported in the epicentral region. One resident near the epicenter reported a ground crack 1/4 to 1/2 inch wide and 39 feet long in his lawn.

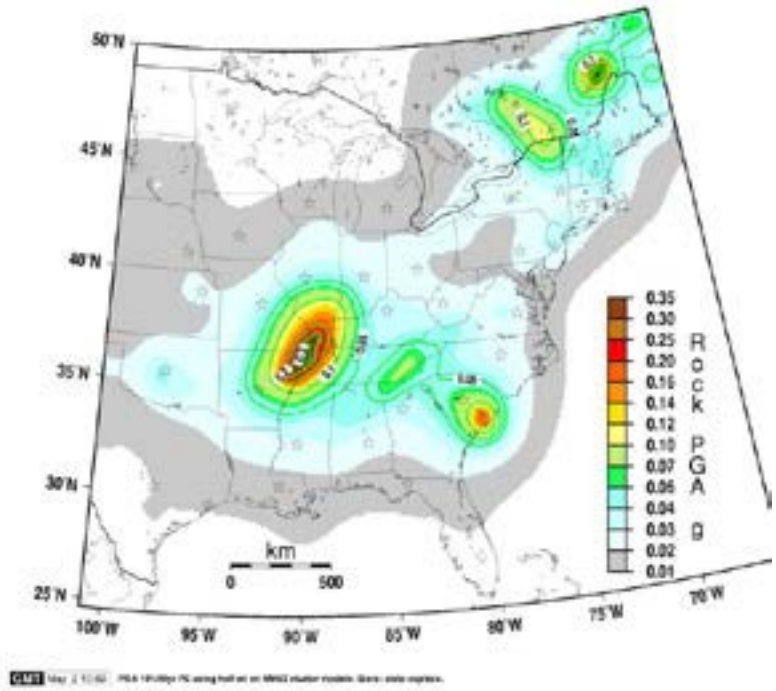
On June 29, a second earthquake occurred in the same region with a magnitude of 3.4. The shocks were limited to parts of Bolivar, Sunflower, and Washington Counties.

Another earthquake felt in Mississippi occurred on March 29, 1972. This shock, which was centered in the New Madrid, Missouri region, reached a peak intensity of IV in Mississippi at Hillhouse, Mineral Wells, and Pleasant Grove. Intensity I to III effects were noted at Horn Lake.

Potential Damages from Earthquakes

The potential for an earthquake to produce damage arises from many factors, such as condition and/or construction of the affected structures, soil characteristics, and earthquake characteristics. Earthquake characteristics include magnitude, peak ground acceleration, and distance from the epicenter. The epicenter of an earthquake is located on the ground surface directly above the focus, or the location, where the earthquake begins. In most cases, the damage incurred by an earthquake is greatest near the epicenter and decreases with distance. Peak Ground Acceleration (PGA) is the maximum acceleration of a particle during an earthquake. More simply, PGA is the measure of the strength of ground movement. An earth- quake's PGA is greatest near its epicenter, which helps explain why earthquake damage is greatest near the epicenter. Figure 3.10.3 provides the PGA potential for a ten percent in 50-year rupture of the New Madrid Fault along with the frequency at which the ground will shake. Figures 3.10.4-a-b on the subsequent page provide spectral acceleration for one and five hertz rupture.

Figure 3.10.3
Peak Ground Acceleration Rupture of the New Madrid Fault
10% in 50 Years Probability
Acceleration measured as a percent of the acceleration due to gravity (g's)



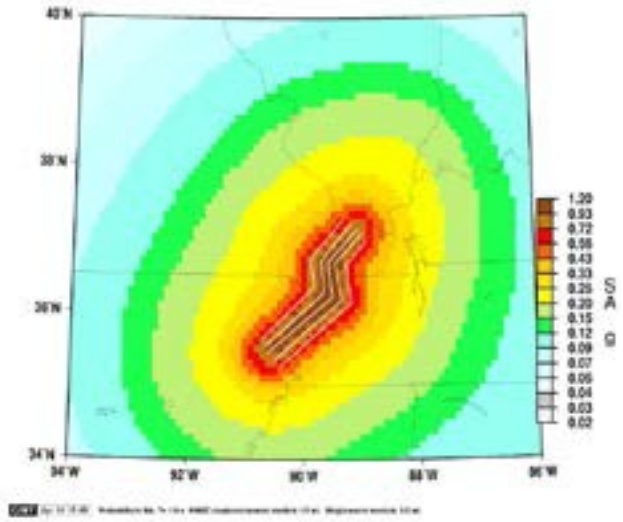


Figure 3.10.4-a
Spectral Acceleration at one Hz
Rupture of the New Madrid Fault
2% in 50 Years Probability

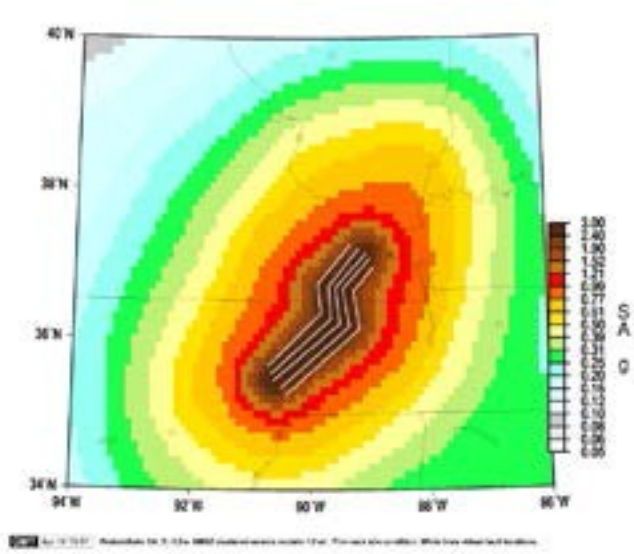


Figure 3.10.4-b
Spectral Acceleration at five Hz
Rupture of the New Madrid Fault 2% in 50 Years Probability

Hz: Hertz, or cycles per second (frequency of ground shaking) SA measured in g's

Seismic waves may also create other earthquake-related hazards such as liquefaction and slope failure. Liquefaction may occur where loose sand and silt that is saturated with water is shaken by earthquake energy. The mixture takes on the qualities of a liquid when shaken and can result in a lack of structural support and eventual failure of a structure built upon the liquid-like soil. In Mississippi, liquefaction is more likely to occur where there is a significant floodplain. The rivers with significant floodplains of concern in Mississippi include the Mississippi River, Yalobusha River, Yocona River, Tallahatchie River and Coldwater River. As shown in Table 3.10.4, counties were evaluated based on their location within the aforementioned floodplains and seismic zone. This data has not been updated since the last plan. The liquefaction potential listed in the table references the HAZUS scenario for liquefaction potential in each county. Since the liquefaction data has not changed, the HAZUS scenario will remain the same.

Slope failure during a seismic event can result in extensive damage. The areas most likely to experience slope failure during an earthquake are the bluffs that bound the Mississippi River floodplain, river banks, steep slopes in the Bluff Hills, levees, earth-filled embankments and transportation embankments.

Table 3.10.4
High Liquification Hazard by County

County	Seismic Source[1]	Geographic Area of Concern[2]	Liquification Potential
Benton	NMSZ	CRFP, WoRFP	Very High, Very Low
Bolivar	NMSZ	MRFP	Very High
Carroll	NMSZ, WRFZ	MRFP	Very High, Very Low
Coahoma	NMSZ, WRFZ	MRFP	Very High
DeSoto	NMSZ, WRFZ	MRFP, CRFP	Very High, Very Low
Grenada	NMSZ, WRFZ	MRFP, YaRFP	Very High, Very Low
Holmes	NMSZ	MRFP	Very High, Very Low
Humphreys	NMSZ	MRFP	Very High
Issaquena	NMSZ	MRFP	Very High
Lafayette	NMSZ, WRFZ	TRFP	Very High, Very Low
Leflore	NMSZ, WRFZ	MRFP, YaRFP	Very High
Marshall	NMSZ, WRFZ	CRFP	Very High
Panola	NMSZ, WRFZ	MRFP, TRFP, YRFP	Very High, Very Low
Quitman	NMSZ, WRFZ	MRFP, CRFP, TRFP, YRFP	Very High
Sharkey	NMSZ, WRFZ	MRFP	Very High
Sunflower	NMSZ, WRFZ	MRFP	Very High
Tallahatchie	NMSZ, WRFZ	MRFP, CRFP	Very High, Very Low
Tate	NMSZ, WRFZ	MRFP, CRFP	Very High, Very Low
Tunica	NMSZ, WRFZ	MRFP, CRFP	Very High
Union	NMSZ	TRFP	Very High, Very Low
Washington	NMSZ	MRFP	Very High

[1]NMSZ = New Madrid Seismic Zone

WRFZ = White River Fault Zone

[2]CRFP = Coldwater River Floodplain

MRFP = Mississippi River Floodplain

TRFP = Tallahatchie River Floodplain

WoRFP = Wolf River Floodplain (Major River originating in Tennessee)

YaRFP = Yalobusha River Floodplain

YRFP = Yocona River Floodplain

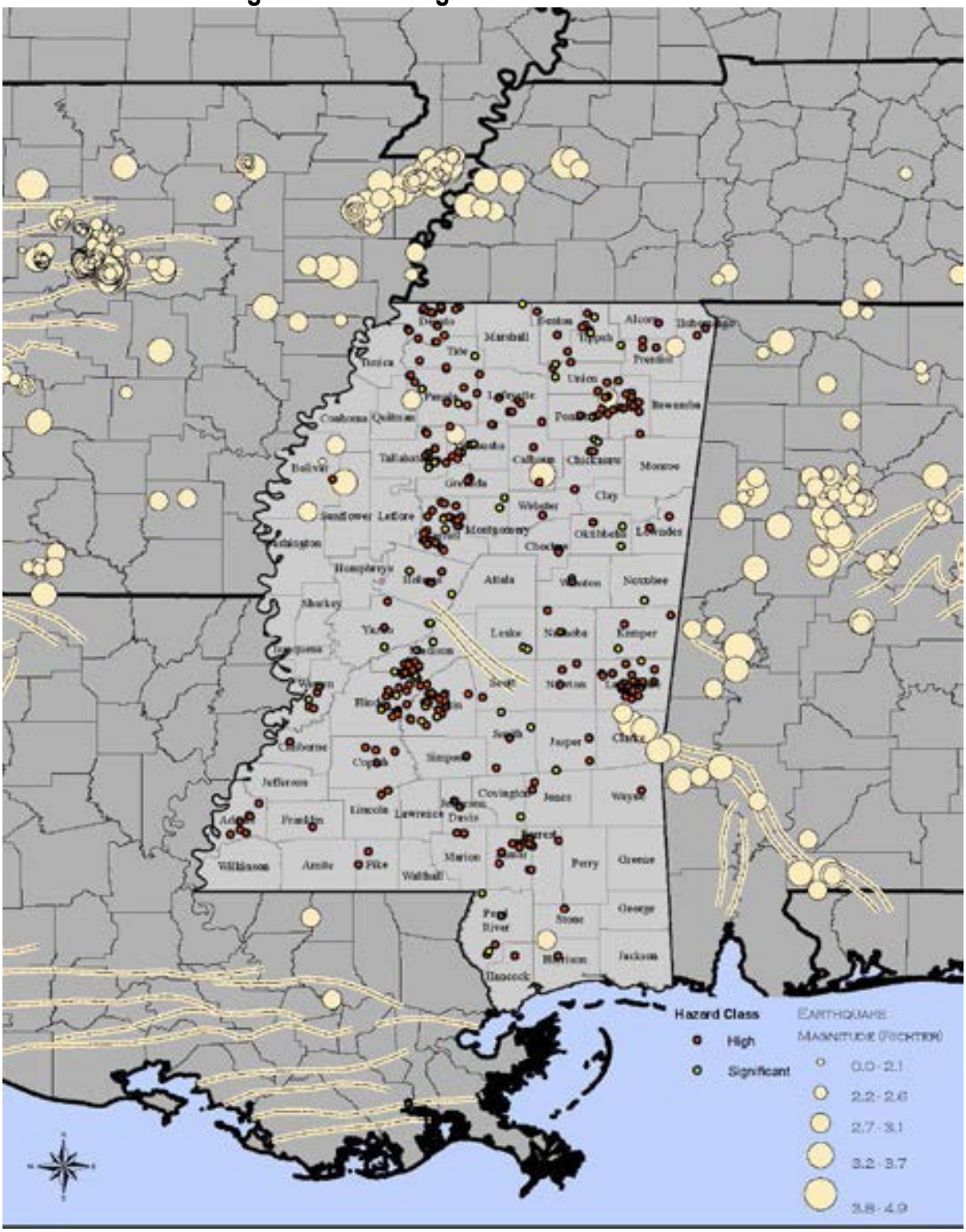
Earthquakes Effects on Dams

In reviewing potential impacts of earthquakes for the 2018 plan update, it was determined that vulnerability of dams should continue to be addressed. To assess this potential threat, the inventory of dams for MEMA Regions 1 and 3 are provided in Table 3.10.5 (the complete inventory of dams for all counties is provided in Section 3.4). These counties are located in areas that have felt impacts from previous tremors or are geographically susceptible to future impacts. Figure 3.10.4 overlays the significant and high hazard dams with the historic seismic recordings.

Table 3.10.5
Dam Inventory in Relation to Earthquake Prone Counties

County	Significant	High	Low	Total	County	Significant	High	Low	Total
MEMA Region 1					**MEMA Region 3**				
Coahoma	-	-	2	2	Attala	1	2	44	47
DeSoto	1	21	112	134	Bolivar	-	-	14	14
Grenada	-	3	32	35	Carroll	4	23	86	113
Panola	1	9	95	105	Holmes	1	5	39	45
Quitman	-	-	1	1	Humphreys	-	-	4	4
Tallahatchie	2	10	32	44	Leflore	-	-	-	-
Tate	1	4	65	70	Montgomery	2	22	24	2
Tunica	-	-	1	1	Sunflower	-	-	12	12
Yalobusha	3	7	50	60	Washington	-	-	3	3

Figure 3.10.5
Significant and High Hazard Dam Locations



Bridge Retrofit Program

The Mississippi Department of Transportation (MDOT) conducts ongoing biennial inspections for all bridge structures. In anticipation of a future earthquake resulting from activity in the New Madrid Fault, it also monitors and inspects bridges that it has "retrofitted," or upgraded, to perform better as a result of newer technology developed to address a seismic event. The bridge retrofit program is concentrated on primary and secondary access routes in Northwest Mississippi. Retrofit activities consist basically of securing bridge caps to piers, thus increasing the probability of the structure will remain standing after an earthquake. Today, all new bridges are constructed using earthquake technology. Table 3.10.6 provides a listing of bridges in Northwest Mississippi that have been upgraded to seismic retrofit.

Table 3.10.6
Bridges Retrofitted in Northwest Mississippi

Bridge ID	Feature Inspection	County	Facility Carried
10932	Creek	Desoto	US 51
10941	Lake Cormorant	Desoto	US 61
10950	Coldwater River	Desoto	US 78
10951	Coldwater River	Desoto	US 78
10970	Horn Lake Creek	Desoto	SR 302
10983	Coldwater River	Desoto	SR 305
13155	Barrow Creek	Marshall	US 78
13156	Barrow Creek	Marshall	US 78
13167	Spring Creek	Marshall	US 78
13172	Spring Creek	Marshall	US 78 13173
14612	Canal & Shands Bottom Road	Tate	I-55
14615	Hickahala Creek	Tate	I-55
14616	Hickahala Creek	Tate	I-55
14617	Hickahala Relief	Tate	I-55
14618	Hickhala Relief	Tate	I-55
14621	Coldwater River	Tate	I-55
13156	Barrow Creek	Marshall	US 78
13167	Spring Creek	Marshall	US 78
13172	Spring Creek	Marshall	US 78 13173
14612	Canal & Shands Bottom Road	Tate	I-55
14615	Hickahala Creek	Tate	I-55
14616	Hickahala Creek	Tate	I-55
14617	Hickahala Relief	Tate	I-55
14618	Hickhala Relief	Tate	I-55
14621	Coldwater River	Tate	I-55
14622	Coldwater River	Tate	I-55
14631	Coldwater River	Tate	SR 3
14633	Arkabutla Canal	Tate	SR 3
13634	CNIC RR	Tate	SR 3
15413	Johnson Creek	Desoto	US 61

Probability of Future Events

The Central U.S. does not have as many earthquakes as the Western U.S. As a result, statistically valid data are not yet available for determining probabilities of future earthquake events in this region. The USGS has stated that there are marked differences in determining probabilities of future earthquakes in California as opposed to along the New Madrid Seismic Zone. On the west coast, locations of future earthquakes can be anticipated based on measurements of land deformation. Such predictions are much more difficult with earthquakes along the New Madrid. The New Madrid Fault Zone generates very little surface deformation over time; therefore, as seismic events occur along the New Madrid, data are collected and probabilities can be calculated. According to a study by the Center for Earthquake Research and Information (CERI) at the University of Memphis in 2002, the probability of a repeat of the 1811-1812 earthquakes in a 50-year time period is 7-10%. In the same study, the probability of a magnitude 6.0 or greater earthquake within a 50-year time period was estimated to be 25-40%.

Local Plan Risk Assessment Summary

Below is a summary of the risk classification identified in the individual local mitigation plans by MEMA Region.

MEMA Region	Low	Medium	High	MEMA Region	Low	Medium	High
1		9		6		9	
2		12		7		9	
3	9	1		8		5	1
4		10	1	9		6	
5		45	1				

Vulnerability Assessment

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery. The earthquake loss estimates provided in this report was based on a region that includes 82 counties.

The geographical size of the region is 47,651.55 square miles and contains 661 census tracts. There are over 1,115 thousand households in the region which has a total population of 2,967,297 people (2010 Census Bureau data).

There are an estimated 1,241 thousand buildings in the region with a total building replacement value (excluding contents) of 280,518 (millions of dollars). Approximately 92.00 % of the buildings (and 75.00% of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems is estimated to be 95,370 and 27,142 (millions of dollars), respectively.

Results of the Earthquake Impact Assessment

Mississippi New Madrid Seismic Zone Scenario

Overall and statewide HAZUS estimates that about 72,788 buildings will be at least moderately damaged. This is over 6.00 % of the buildings in the region. There are an estimated 14,407 buildings that will be damaged beyond repair.

The NMSZ event on the southwest segment of the fault generates intense shaking in Mississippi's northern counties. As a result, 25 counties are identified as critical and most of the damage incurred by the state of Mississippi is expected to occur in this set of counties. These 25 critical counties are highlighted in Figure 16 and are listed below:

- ✓ Alcorn
- ✓ Benton
- ✓ Bolivar
- ✓ Calhoun
- ✓ Chickasaw
- ✓ Coahoma
- ✓ DeSoto
- ✓ Grenada
- ✓ Itawamba
- ✓ Lafayette
- ✓ Lee
- ✓ Marshall
- ✓ Monroe
- ✓ Panola
- ✓ Pontotoc
- ✓ Prentiss
- ✓ Quitman
- ✓ Sunflower
- ✓ Tallahatchie
- ✓ Tate
- ✓ Tippah
- ✓ Tishomingo
- ✓ Tunica
- ✓ Union
- ✓ Yalobusha

Buildings in Mississippi are expected to incur moderate damage in the northern portion of the state, with limited cases of complete damage which are limited to the critical counties. There are 13,991 buildings that are estimated to incur complete damage, all of which are in the 25 critical counties. Approximately 55,000 of the 58,000 moderate and severe damage cases occur in the critical counties. Table 3.10.7 illustrates the distribution of building damage by occupancy type. Nearly all complete and moderate/severe damage is experienced by residential construction, leaving 45,000 of the one million residential structures in Mississippi damaged.

As with many other NMSZ states, wood frame buildings and mobile homes are the most common structural systems. What is uncommon, however, is the small percentage of building inventory belonging to URMs (unreinforced masonry building).

In Mississippi, approximately 7.5% of the total building inventory is URM construction. Nearly 71% of all complete damage occurs in mobile home buildings. Approximately 37% of all moderate damage is attributed to wood frame buildings, as shown in Table 3.10.8. It is also relevant to note that while steel, concrete and precast (concrete) structures are a much smaller portion of the building stock in Mississippi, approximately 9% of each of these building types experiences at least moderate damage, while 63% of mobile homes incurs extensive damage.

Table 3.10.7
NMSZ Event Building Damage by Occupancy Type for the State of Mississippi

General Occupancy Type Damage			
General Occupancy Type	Total No. of Buildings	Moderate to Severe Damage	Complete Damage
Single Family	834,634	54,383	562
Other Residential	177,552	15,747	10,317
Commercial	51,200	4,585	2,169
Industrial	12,470	1,087	717
Other	15,928	1,436	643
Total	**1,091,784**	**77,238**	**14,408**

Table 3.10.8
NMSZ Event Building Damage by Building Type for the State of Mississippi

Building Damage by Building Type					
Building Type	None	Slight	Moderate	Extensive	Complete
Wood	835,196	53,218	14,221	1,791	317
Steel	21,795	1,568	2,311	2,370	2,320
Concrete	6,143	495	536	420	335
Precast	6,218	425	551	405	306
Reinforced Masonry	2,577	141	180	138	94
Unreinforced Masonry	75,870	8,023	5,821	2,221	844
Mobile Home	144,006	13,367	14,689	12,726	10,193
Total	**1,091,784**	**77,237**	**38,309**	**20,071**	**14,409**

The northernmost counties in Mississippi are greatly affected by damage and functional losses to essential facilities. Statewide, over 58 schools experience at least moderate damage and over 1,151 are not functioning the day after the earthquake, as shown in Table 3.10.9. Nearly all of these damaged schools are located in Desoto, Tunica, Tate, Marshall and Benton Counties. Additionally, Lafayette, Union, Tippah, Alcorn, and Prentiss Counties experience substantial functional loss to schools immediately after the earthquake. There are 27 at least moderately damaged fire stations and nearly 353 not functioning the day after the earthquake. Statewide there are overall with 111 facilities, with the majority of the hospitals most impacted located in northwest Mississippi. Approximately, 103 hospitals will be unable to function after the earthquake. Not only will this region be without medical care services for those injured by the earthquake, but care for current patients will likely require transport to fully functioning facilities outside the critical counties.

Before the earthquake, the region had 17,989 hospital beds available for use. On the day of the earthquake, the model estimates that only 14,695 hospital beds (82.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 91.00% of the beds will be back in service. By 30 days, 97.00% will be operational.

Transportation lifelines experience damage primarily in northwestern Mississippi. Table 3.10.10 illustrates that statewide there are over 13,692 bridges. Of this number, 347 bridges will experience at least moderate damaged and 13,359 bridges will not functioning the day after the earthquake. Most of these non-functioning bridges are in Desoto, Tunica, Tate and Marshall Counties. Five airports in northwest Mississippi incur at least moderate damage, though they are expected to remain fully functional. In some cases, damage to structures may not affect functionality of the facility. Using airports as an example, some portion of the facility may be damaged, though enough of the facility's structure remains undamaged so that the facility can remain operational, despite some damage to one portion of the facility.

Table 3.10.9
NMSZ Event Essential Facilities Damage for the State of Mississippi

Essential Facilities Damage & Functionality				
Essential Facility Type	**Total No. Facilities**	**At Least Moderate Damage (Damage >50%)**	**Complete Damage (Damage >50%)**	**Functionality >50% at Day 1**
Hospitals	111	3	0	103
Schools	1,288	58	0	1,151
EOCs	37	1	0	34
Police Stations	368	13	0	330
Fire Stations	399	27	0	353

Table 3.10.10
NMSZ Event Highway Bridge Damage
for the State of Mississippi

Highway Bridge Damage Assessments				
	Total No. of Bridges	At Least Moderate Damage (Damage >50%)	Complete Damage (Damage >50%)	Functionality >50% at Day 1
Total No. of Bridges for State	**13,692**	**347**	**0**	**13,359**

Table 3.10.11
NMSZ Event Communication Facilities Damage
for the State of Mississippi

Communication Damage Assessments				
	Total No. of Communication Facilities	At Least Moderate Damage (Damage >50%)	Complete Damage (Damage >50%)	Functionality >50% at Day 1
Total State	**299**	**0**	**0**	**299**

Utility lifelines experience substantial losses in the critical counties, especially in the northwestern-most critical counties. Damage to communication facilities is shown in Table 3.10.11, which illustrates that nearly 300 communication facilities, majority in Desoto and Tate Counties, are at least moderately damaged. Damage to these facilities is not severe enough to cause a substantial loss of functionality, however.

There are approximately one million households, or residences, in the state of Mississippi and nearly 42,000 of those are without potable water the day after the earthquake. In addition, 33,000 are without electricity. Only approximately 39,000 households have potable water service restored after a week, though approximately 6,000 have electricity restored in that same period of time. A lack of potable water service for an extended period of time, may force some families to leave their homes, even if the home is not significantly damaged.

Table 3.10.12
NMSZ Event Utility Service Interruptions
for the State of Mississippi

Utility Service Interruptions Number of Households without Service						
	No. Households	Day 1	Day 3	Day 7	Day 30	Day 90
Potable Water	1,046,434	41,790	40,256	39,782	28,749	0

Electric Power		32,601	18,416	6,452	1,276	44

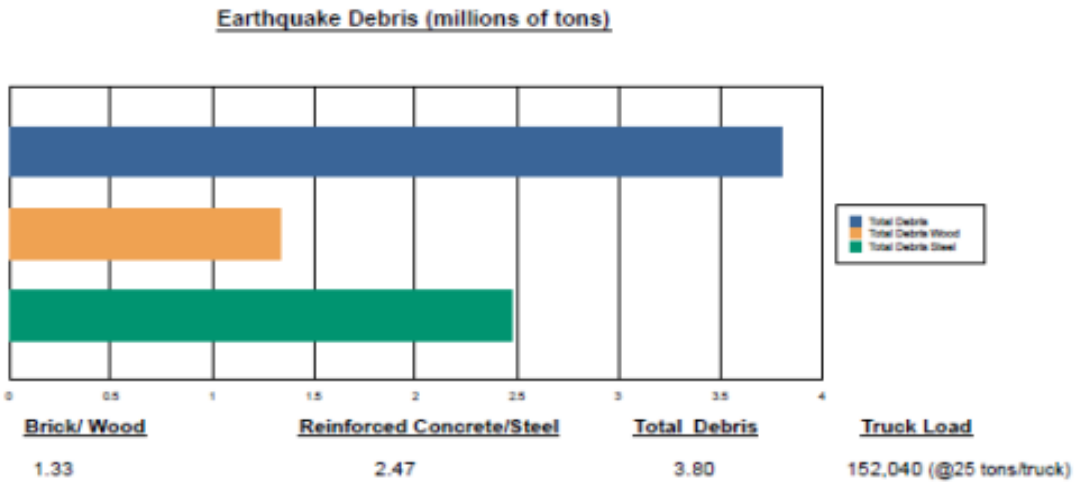
Social Impact and Direct Economic Loss

This section provides social impacts and direct economic losses for Mississippi from the scenario developed in the New Madrid Seismic Zone Catastrophic Event Planning project. Induced damage is also included in this section and is quantified by various types of debris resulting from infrastructure damage. Social impacts include displaced residents, temporary shelter population, various food, medical and housing requirements for sheltered populations and casualties. Lastly, direct economic losses include estimates of building, transportation and utility losses plus building loss ratios.

Mississippi New Madrid Seismic Zone Scenario

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris. The model estimates that a total of 3.80 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 152,040 truckloads (at 25 tons/truck) to remove the debris generated by the earthquake.

Figure 3.10.6
Debris Totals



HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 2,705 households to be displaced due to the earthquake. Of these, 2,085 people (out of a total population of 2,967,297) will seek temporary shelter in public shelters, as shown in Table 3.10.12. To care for this sheltered population, 2.7 million square feet of space are required, with 334,000 square feet reserved just for sleeping.

Table 3.10.12
NMSZ Event Shelter Requirements
for the State of Mississippi

Displaced and Shelter Seeking Population			
	Total Population	Displaced Population	Shelter Seeking Population
Total Nos. of State	**2,967,297**	**2,705**	**2,085**

Structural damage to buildings and lifelines leads to nearly 1,000 casualties throughout the state of Mississippi. Over 75% of all casualties are minor injuries (Level 1) and 25% require immediate or delayed medical attention (Levels 3 & 2, respectively). Table 3.10.13 shows that 574 fatalities are expected throughout the state.

The total economic loss estimated for the earthquake is 9,206.92 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 8,791.45 (millions of dollars); 24 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 33 % of the total loss.

Table 3.10.13
NMSZ Event Casualties
for the State of Mississippi

Worst Case Casualties (2:00 PM)					
Severity Level	Level 1 (Green)	Level 2 (Yellow)	Level 3 (Red)	Level 4 (Black)	Total
Total State	**7,351**	**2,041**	**301**	**574**	**10,267**

Table 3.10.14
NMSZ Event Total Direct Economic Losses
for the State of Mississippi

Total Direct Economic Losses		
System	**Inventory Value**	**Total Direct Economic Loss**
Buildings	$6,675,238,000	$2,116,211,000
Transportation	$95,370,000	$159,500,000
Utility	$27,142,090	$255,980,000
Total	**$129,187,328,000**	**$417,596,211,000**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 3.10.15 and 3.10.16 provide a detailed breakdown in the expected lifeline losses.

Figure 3.10.7
Transportation System Economic and Loss Ratio
(Millions of Dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	77,061.57	$0.00	0.00
	Bridges	10,003.59	$128.54	1.28
	Tunnels	0.00	$0.00	0.00
	Subtotal	**87,065.00**	**$128.50**	
Railways	Segments	4,469.84	$0.00	0.00
	Bridges	6.09	$0.02	0.33
	Tunnels	0.09	$0.00	0.00
	Facilities	71.90	$1.00	1.39
	Subtotal	**4,548**	**$1.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**$0.00**	
Bus	Facilities	25.02	$0.81	3.25
	Subtotal	**25**	**$0.80**	
Ferry	Facilities	5.32	$0.02	0.46
	Subtotal	5	**$0.00**	
Port	Facilities	413.38	$6.56	1.59
	Subtotal	**413**	**$6.60**	
Airport	Facilities	617.76	$22.53	3.65
	Runways	2,695.44	$0.00	0.00
	Subtotal	**3,313**	**$22.50**	
	Total	**95,370.00**	**$159.50**	

Figure 3.10.8
Utility System Economic and Loss Ratio
(Millions of Dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Portable Water	Pipelines	0.00	$0.00	0.00
	Facilities	481.20	$0.97	0.20
	Distribution Lines	2,313.70	$0.00	0.00
	Subtotal	**2,794.85**	**$0.97**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	18,964.40	$216.28	1.14
	Distribution Lines	1,388.20	$0.00	0.00
	Subtotal	**20,352.55**	**$216.28**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	51.00	$0.48	0.93
	Distribution Lines	925.50	$0.00	0.00
	Subtotal	**976.42**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.90	$0.00	0.04
	Subtotal	0.85	**$0.00**	
Electrical Power	Facilities	2,992.00	$38.02	0.46
	Subtotal	**2,992.00**	**$38.02**	
Communication	Facilities	25.40	$0.23	1.59
	Subtotal	25.40	$0.23	0.91
	Total	**27,142.09**	**$255.98**	

3.11: Climate Change/Sea Level Rise Risk Assessment

Hazard Description

Sea level, the average height of the ocean's surface apart from the daily changes of the tides, is rising. Both the main causes of this change are linked to anthropogenic (human-caused) global warming. First, warming of the ocean causes it to expand. This effect, confined mostly to the ocean's top 2,300 ft (701 m), is called thermal expansion or thermosteric expansion. Second, melting of glaciers and other bodies of ice lying on land causes the total mass of water in the ocean to increase.

The heat energy causing both thermal expansion and ice melting comes from warming of the atmosphere, which has in turn been caused in recent decades primarily by anthropogenic climate change. Retention of liquid water on the continents, as for example by damming of rivers, makes a small negative contribution to sea-level rise, withholding some water from the oceans.

Hazard Profile

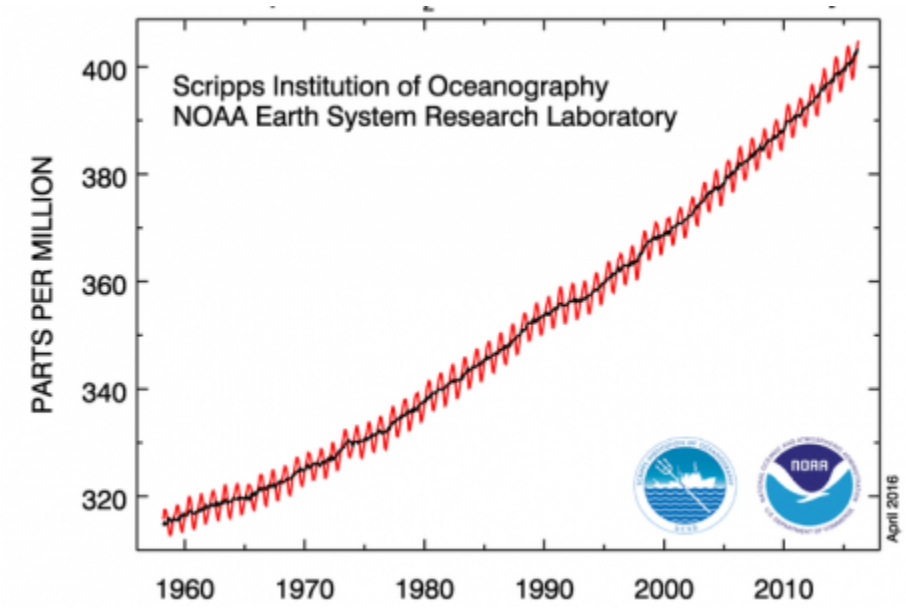
Scientists agree that the changes in climate that we are seeing today are largely caused by human activity, and its climate change that drives sea level rise. Sea level started rising in the late 1800s, soon after we started burning coal, gas and other fossil fuels for energy. When burned, these high-energy fuel sources send carbon dioxide up into the atmosphere. Carbon dioxide absorbs heat from the sun and traps it, warming the atmosphere and the planet.

As the planet gets warmer, sea level rises for two reasons. First, warmer temperatures cause ice on land like glaciers and ice sheets to melt, and the meltwater flows into the ocean to increase sea level. Second, warm water expands and takes up more space than colder water, increasing the volume of water in the sea.

The Intergovernmental Panel on Climate Change (IPCC), a key body that publishes the scientific consensus on global warming, has suggested that average global sea levels have risen by around .12 inches annually since the early 1990s. That number is expected to skyrocket in the coming decades as temperatures continue to increase, leading to a total rise of somewhere between 2.5 feet and 6.2 feet by 2100, according to an analysis of IPPC projections published in the journal *PNAS (*Proceedings of the National Academy of Sciences).

In the late 1800s, after two or three thousand years of stability, sea level began to rise steadily at about 0.07 inches per year. From 1993 to 2007, the rate of sea-level rise increased to about 0.12 inches per year.

Figure 3.11.1
Carbon Dioxide Emissions



Source: Smithsonian Institute

Figure 3.11.1 depicts measurements of carbon dioxide in the atmosphere since 1958. The amount of carbon dioxide (CO2) in the atmosphere has been measured at Mauna Loa Observatory on Hawaii since the 1950's. There has been a steady rise in carbon dioxide since the measurements began, and you can see the rise and fall on a yearly basis due to plants growing and absorbing CO2 every spring and summer. In 2015, the annual **growth rate jumped by 3.05 parts per million**, the largest year-to-year increase in their 56 years of measurements.

Some scientists surmise that over the past 20,000 years or so, sea level has climbed some 400 feet. As the climate warmed as part of a natural cycle, ice melted, and glaciers retreated until ice sheets remained only at the poles and at the peaks of mountains. Early on, the sea rose rapidly, sometimes at rates greater than 10 feet per century, and then continued to grow **in spurts of rapid sea level rise** until about 7,000 years ago. Then, the climate stabilized and sea level rise slowed, holding largely steady for most of the last 2,000 years, based on records from corals and sediment cores. Now, however, sea level is on the rise again, **rising faster now than it has in the past 6,000 years.** The oldest tide gauges and coastal sediment preserved beneath swamps and marshes show that sea level began to rise around 1850, which is right around the time people started burning coal to propel steam engine trains, and it has not stopped since. The climate likely started warming as a part of a natural cycle, but the accelerated warming in the last two hundred years or so is due to **a rise in atmospheric carbon dioxide**. The resulting rise in sea level is **likely twice what we would have seen without the increase in greenhouse gasses** due to human activities.[1]

[1] Sea Level Rise by The Ocean Portal Team; Reviewed by Dr. Joshua K. Willis, NASA-JPL; Dr. Andrew Kemp, Tufts University; and Dr. Benjamin H. Strauss, Climate Central.

Currently, global sea level is 5 to 8 inches higher on average than it was in 1900. Between 1900 and 2000, global sea level **rose between 0.05 inches** and **0.07 inches** per year on average. In the 1990s, that rate jumped to around .12 inches per year. In 2016 the rate was estimated to be .13 inches per year, and it is expected to jump higher by the end of the century. Scientists with the Intergovernmental Project on Climate Change predict that eventually, sea level is expected to **rise around .10 inches for every degree** (°F) that climate change warms the planet, and Earth has warmed by 34°F already. What scientists do not know is how long it will take for sea level to catch up to the temperature increase. Whether it takes another 200 or 2000 years largely depends on how quickly the ice sheets melt. Even if global warming were to stop today, sea levels would continue to rise.

Location and Extent

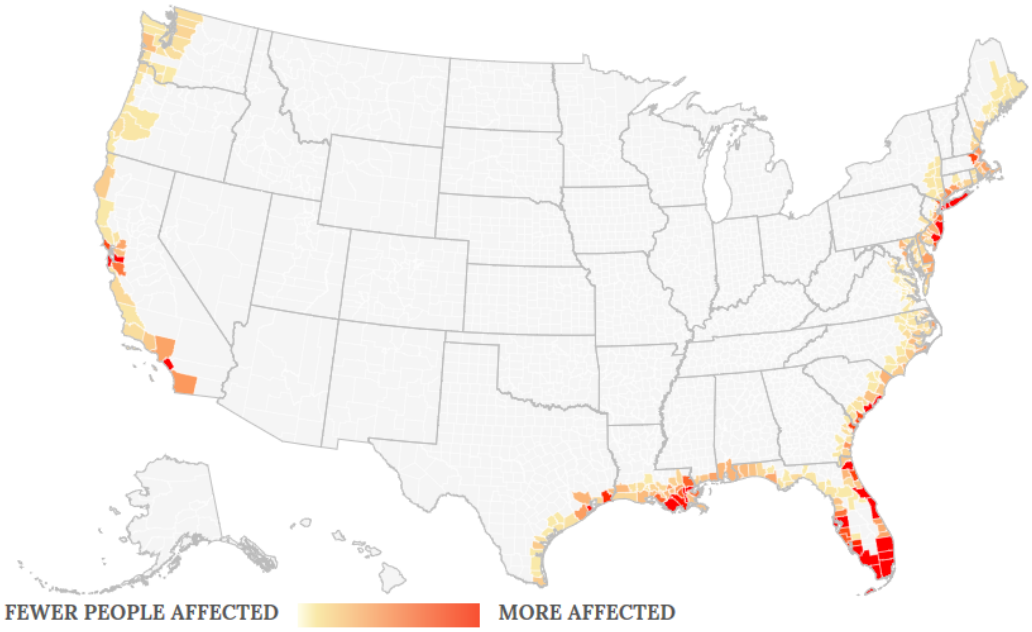
As the waterline creeps up along coasts, storms and flooding will happen more frequently. The closer the sea is to communities, the easier it is for floods to reach homes, roads and towns. Flooding over roads, which is already becoming more common in some places during high tides, can cause traffic jams and block emergency vehicles from reaching flooded areas.

A 2014 Reuters analysis found that before 1971, water reached flood levels no more than five days every year (on average) in several U.S. east coast cities. Since 2001, however, that number has risen to 20 days or more (on average). At this point, each of these floods is a relatively minor event, maybe closing a few roads, some home damage or causing businesses to close for a period of time. However, as they become more frequent, these inconveniences will add up and make people's lives harder, not to mention the monetary costs caused by the damages that occur.

Likewise, flooding during storms (sometimes referred to as storm surges) will reach farther inland as sea level rises. During hurricanes and other large storms, like Nor'easters, strong winds push water beyond the normal high tide mark. They are likely to get worse as sea level rises due to increased flooding danger across the board. Additionally, as the ocean warms from climate change, it will provide more energy to hurricanes, potentially making them stronger. According to NOAA, over the next century, hurricanes are estimated to grow between 2 and 11 percent stronger on average.

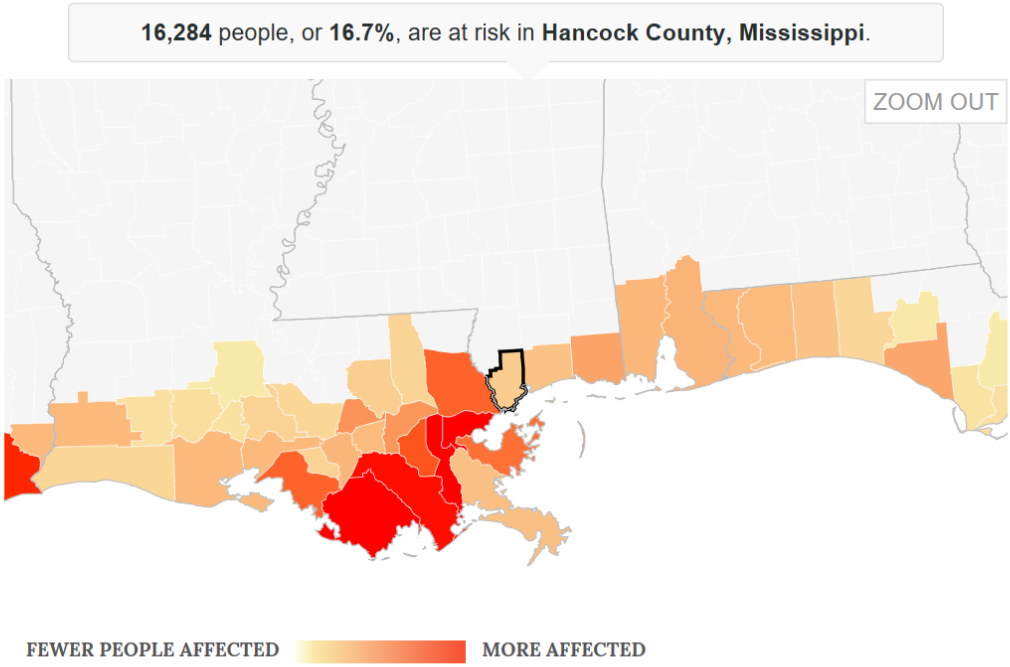
Figure 3.11.2 shows those areas affected by sea level rise across the nation. Figures 3.11.3, 3.11.4, and 3.11.5 describes the lower three counties that are bordered by the Gulf of Mexico.

Figure 3.11.2
Nationwide Sea Level Rise Map



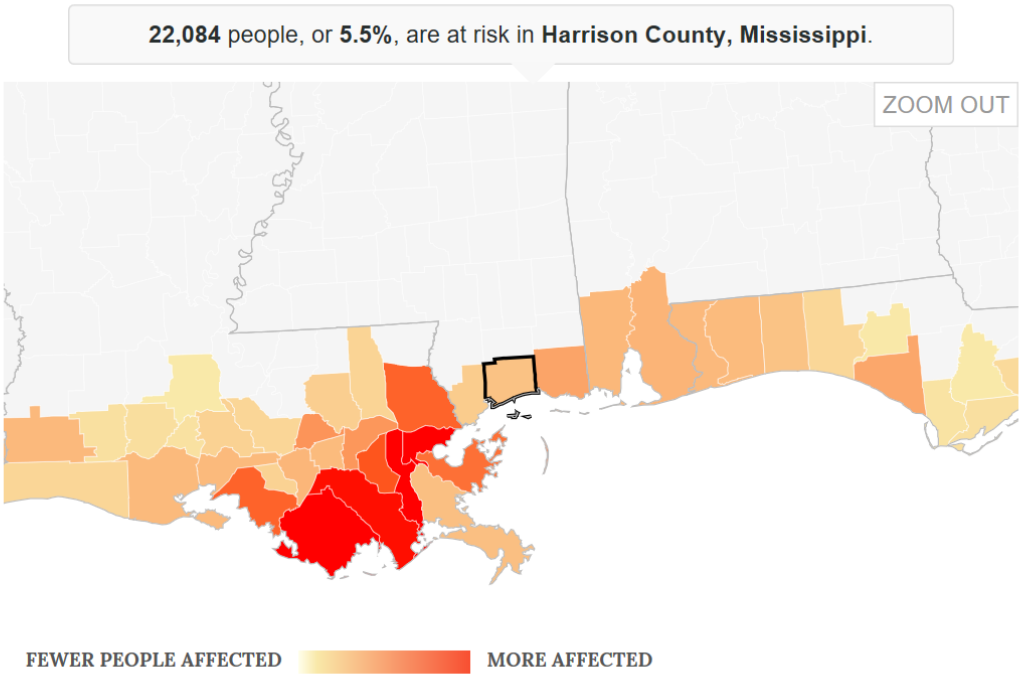
Source: Nature Climate Change

Figure 3.11.3
Hancock Sea Level Rise Map



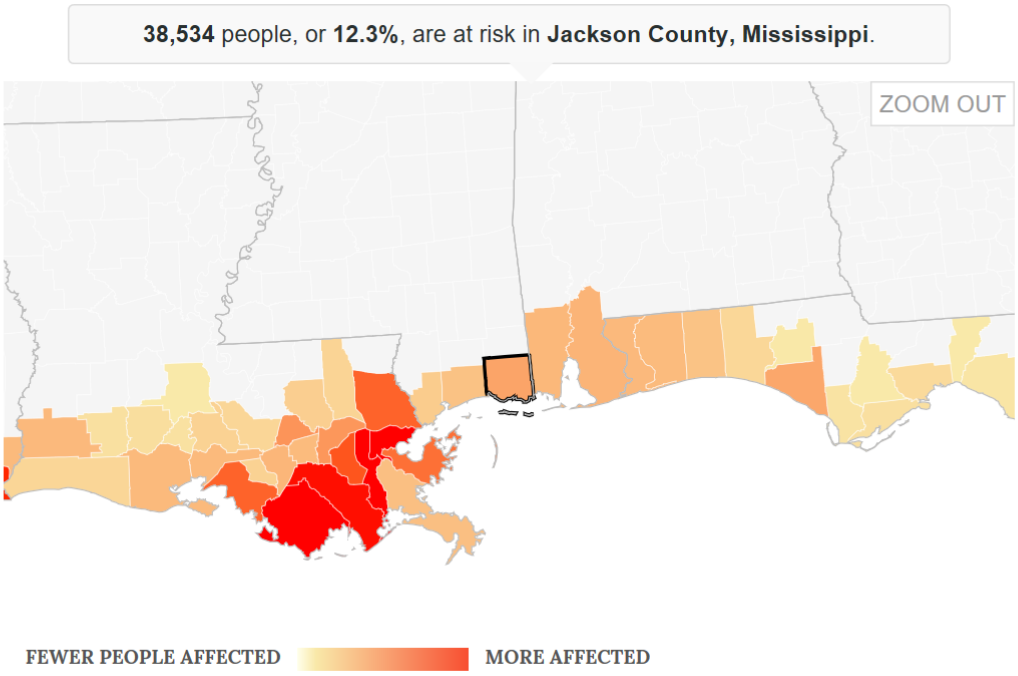
Source: Nature Climate Change

Figure 3.11.4
Hancock Sea Level Rise Map



Source: Nature Climate Change

Figure 3.11.5
Hancock Sea Level Rise Map



Source: Nature Climate Change

Previous Occurrences

Since studies show that sea level rise multiplies extreme coastal flood risk, and global warming contributes to sea level rise, and global warming effectually multiplies flood risk. If this is in fact true, then we may be able to contribute the extremities and intensity of storm events to sea level rise/climate change.

As sea level rises, dangerous storm surges will become more frequent and powerful. As sea level rises, bigger floods will become more frequent. Storm surges already present the biggest danger to communities whenever a hurricane hits. During Hurricane Katrina in 2005, storm surges of 10 to 28 feet destroyed buildings in Louisiana and Mississippi, flooded parts of New Orleans, and killed (directly or indirectly) around 1,200 people.

Probability of Future Occurrences

Predicting future sea level rise/climate change is a difficult task because scientists do not know how quickly the planet will respond to the warming climate.

The Intergovernmental Panel on Climate Change is the International United Nations group tasked with summarizing climate change research every few years. Their 2013 report projected that sea level will rise by 2 to 3 feet by the year 2100 if we do not slow our carbon dioxide emissions by using less energy or use renewable energy. This projected sea level rise is enough to threaten coastal cities and flood island nations. Even if we reduce our emissions, the report predicts that by the year 2100 sea level will rise by 1 to 2 feet, which is enough to cause much coastal flooding and erosion. Some scientists consider these estimates to be conservative and expect greater sea level rise. The U.S. National Climate Assessment, for example, estimates that sea levels will rise between 2 and 6 feet by 2100.

Vulnerability Assessment

Based on sheer geography, coastal Mississippi will be more susceptible to the sea level rise. More than 99% of people, property and infrastructure in harm's way in Mississippi are in Jackson, Hancock, and Harrison counties. Within the State of Mississippi, some $1.5 billion in property value plus more than 14,500 people living in more than 8,000 homes sit on 131 square miles of land less than 6 feet above the local high tide line. The exposure of populations with high social vulnerability is disproportionately high, 50% greater than would be expected by chance alone. Of the exposed high vulnerability population, more than 60% live in just one zip code, in Bay St. Louis. Compared to 6 feet, more than double the total property, population and housing sit on land below 10 feet: $3.7 billion and nearly 44,000 people living in more than 22,000 homes, across 227 square miles.[2]

Based on estimates gathered by Climate Central, nonresidential buildings and infrastructure are widely at risk as well. All told, 386 miles of road lie on land below 6 feet in the state; 2 museums; 2 schools; 9 houses of worship; 2 power plants; and 57 EPA-listed sites, screened to include mostly hazardous waste sites,

[2] Mississippi and the Surging Sea a Vulnerability Assessment with Projections for Sea Level Rise and Coastal Flood Risk, published by Climate Central.

facilities with significant hazardous materials, and wastewater generators. At 10 feet, these numbers amount to 898 miles of road, 4 museums, 6 schools, 60 houses of worship, 2 power plants, and 112 EPA-listed sites.

3.12: Cyberterrorism Risk Assessment

Hazard Description

A cyber-attack is a malicious, intentional attempt to breach the information technology (IT) infrastructure of an individual or organization. The State of Mississippi defines a cyberterrorism incident as any adverse premeditated, politically, financially or maliciously motivated attack against informational systems. A cyberterrorism event can impact one or more of the State and its counties', corresponding departments' and divisions' information assets by the following ways, which includes, but are not limited to, the following:

- Unauthorized use
- Denial of Service
- Malicious code
- Network system failures
- Application system failures
- Unauthorized disclosure or loss of information
- Information security breach
- Structured Query Language (SQL) Injection

Incidents can be the result of any of the following:

- Intentional and unintentional acts
- Actions of employees
- Actions of vendors or constituents
- Actions of third parties
- External or internal acts
- Credit card fraud
- Potential policy violations
- Natural disasters and power failures
- Acts related to violence, warfare or terrorism
- Serious wrongdoing

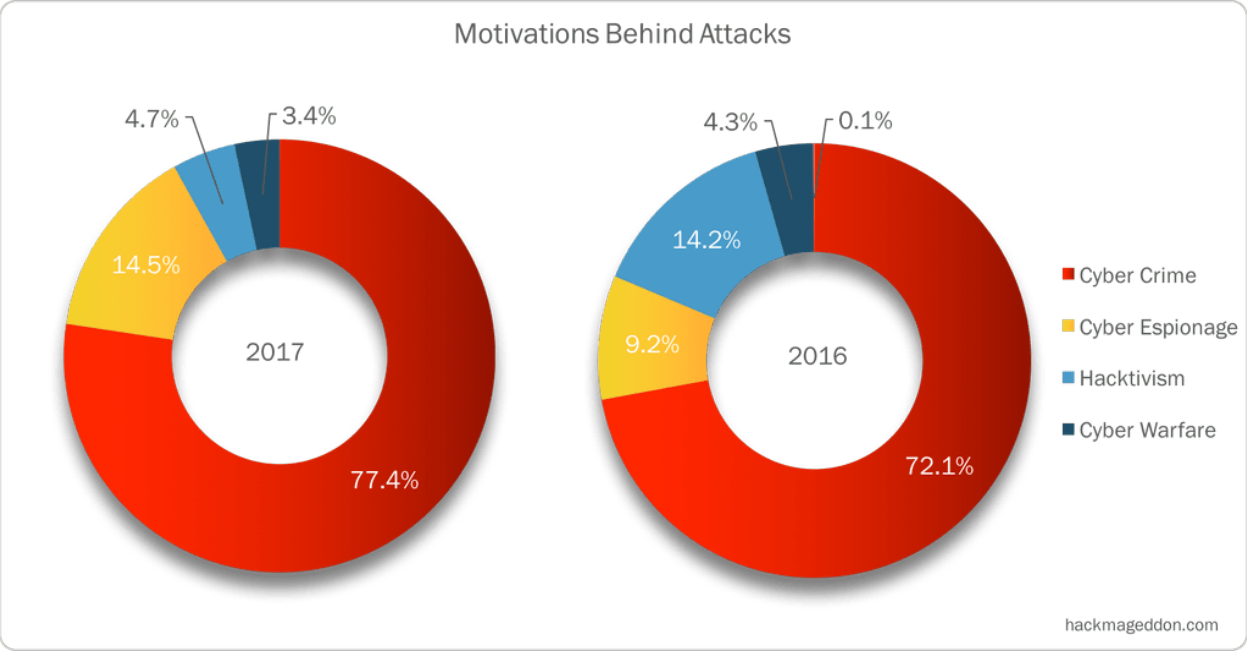
The motives behind cyberterrorism attacks can vary. However, according to Hackmageddon, a comprehensive website that catalogs cyber-attacks through timelines and statistics, the top four motives in 2017 are listed in the table below.

Table 3.12.1
Top 4 Motives

Motives	Definitions
Cyber Crime	Crime that involves or carried out by a computer and a network. The computer may have been used in the commission of a crime, or it may be the target.
Cyber Espionage	The act or practice of obtaining secrets and information without the permission and knowledge of the holder of the information from individuals, competitors, rivals, groups, governments and enemies for personal, economic, political or military advantage using methods on the Internet, networks or individual computers through the use of proxy servers, cracking techniques and malicious software including Trojan horses and spyware.
Hacktivism	Refers to the use of computers and any other IT system and network to debate and sustain a political issue, promote free speech, and support human rights. Hacktivism is mainly interpreted by society as the transposition of the protest and the civil disobedience into cyberspace.
Cyber Warfare	Actions by a nation-state to penetrate another nation's computers or networks for the purposes of causing damage or disruption.

The figure below, Figure 3.12.1 describes the differences between 2017 are listed in the table below. According to research, Cyber Crime confirmed its crown from 2016 into 2017 with a similar percentage 77.4% versus 72.1% in 2016. Hacktivism events fell down to 4.3% in 2017, from 14.2% in 2016. Cyber Espionage had an opposite trend, soaring to 14.5% from 4.3%. Cyber Warfare reported a slight decrease to 3.4% in 2017 from 4.3% in 2016.

Figure 3.12.1
Top 4 Motives

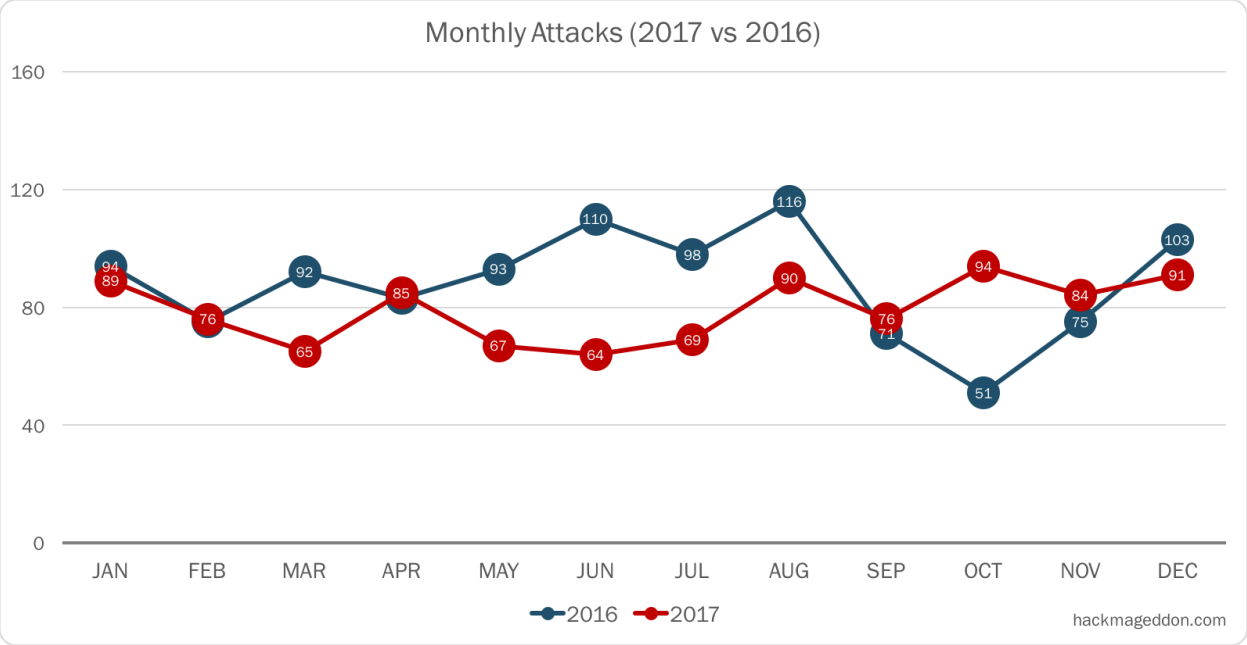


Hazard Profile

According to Hackmageddon, in comparison to 1,061 events collected in 2016, 950 events were collected in 2017, which is approximately a 10% decrease. Despite a minor number of events being recorded, 2017 was characterized by large scale attacks like WannaCry. WannaCry is a ransomware cryptoworm, which targeted computers running the Microsoft Windows operating system by encrypting data and demanding ransom payments in the Bitcoin cryptocurrency. It is considered a network worm because it also includes a "transport" mechanism to automatically spread itself. The ransomeware encrypting files required victims to pay anywhere from $300 - $600 to recover their documents. This attack affected over 200,000 victims and over 300,000 computers were infected.

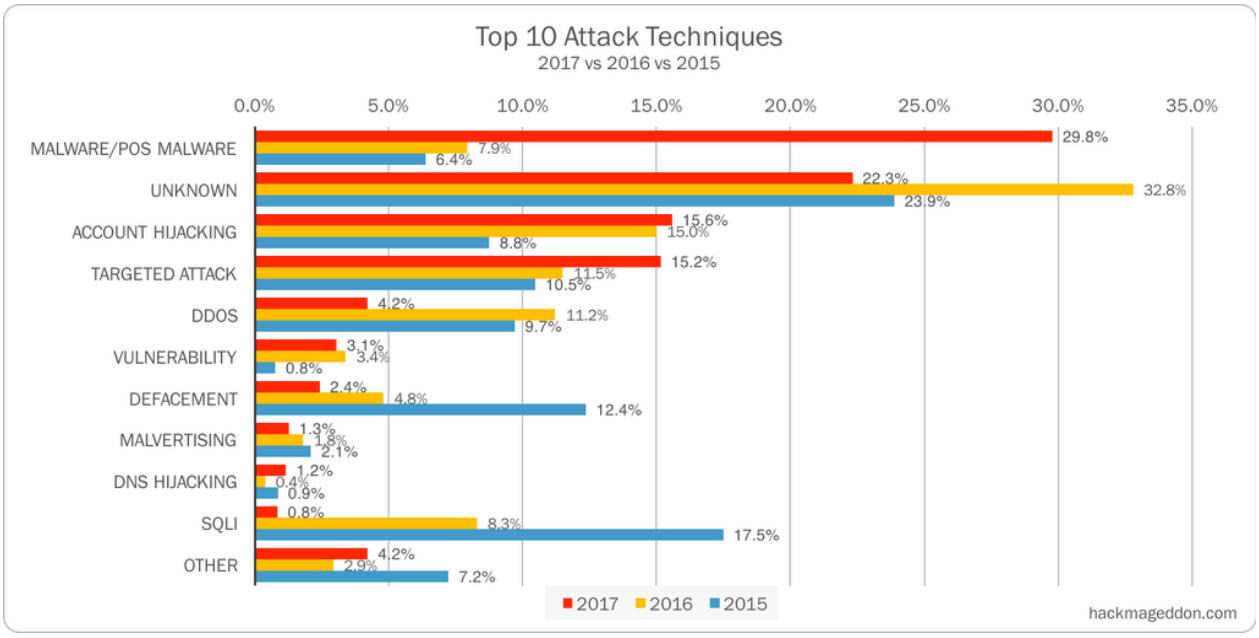
The **Monthly Attacks** chart shows that the level of activity has been generally lower in 2017 in comparison with 2016, with the exception of October.

Figure 3.12.2
Monthly Attacks



The type of cyberterrorism attacks varies. Hackmageddon recognizes at least 10 different kinds. As the figure below demonstrates, 2017 has been the year of Malware. Account hijackings were essentially in line with the findings of 2016 where typically vulnerabilities were exploited. Targeted attacks rose to 15.2% and Hacktivism fell continuously. The potential reason for this may be the increasing emergence of cyber-attacks through ransomware, which implements Distributed Denial of Service (DDOS) and Structured Query Language injection (SQLi). A DDOS attack is an attempt to make a machine or network resource unavailable to its intended users, such as to temporarily or indefinitely interrupt or suspend services of a host connected to the Internet. SQLi is a common attack vector that uses malicious SQL code for backend database manipulation to access information that was not intended to be displayed. This information may include any number of items, including sensitive company data, user lists or private customer details.

Figure 3.12.3
Top 10 Techniques



Source: *Hackmageddon.com*

Location and Extent

The cyberterrorism hazard is not geography-based. Attacks can originate from any computer to affect any other computer in the world. If a system is connected to the Internet or operating on a wireless frequency, it is susceptible to exploitation. Targets of cyberterrorism can be individual computers, networks, organizations, business sectors, or governments. Financial institutions and retailers are often targeted to extract personal and financial data that can be used to steal money from individuals and banks.

When a cyber security incident occurs, the State of Mississippi uses the following factors to evaluate its severity:

- Nature of the attack
- Criticality of systems that are (or could be) made unavailable
- Value of the information compromised (if any)
- Number of people, agencies, or functions impacted
- Business considerations
- Public relations
- Effects on the State's entire IT enterprise

Cyberterrorism may range from the infection of a single machine by a common computer virus to a large-scale, organized incident that cripples an organization or infrastructure.

Previous Occurrences

Even there have been no disruption of services within State government, Mississippi is no stranger to similar types of cyberterrorism attacks. In 2017, a Lebonese national executed a distributed denial of service (DDOS) attack on a Ridgeland business. The hacker utilized a computer in Lebanon to extort payments from the Ridgeland business while conducting computer attacks to interfere with its computer business and operations. This type of act is considered a denial-of-service attack, where an attacker attempts to prevent legitimate users from accessing information or services, preventing one from accessing email, websites, online accounts (banking, etc.), or other services that rely on the affected computer.

Even as this plan is being updated, the City of Atlanta has been held hostage by a ransomware attack for 6 days and counting. So far, the hackers are asking $51,000 in Bitcoin to unlock the city's systems. Luckily, emergency services such as 911 calls and control of wastewater treatment have been exempt from the attack.

To date, most experts believe this one of the most sustained, coordinated and consequential cyberterrorism attacks ever mounted against a major American city. The assault on Atlanta, the core of a metropolitan area of about 6 million people, represented a serious escalation from other recent cyberattacks on American cities, like the one last year in Dallas where hackers gained the ability to set off tornado sirens in the middle of the might.

Actions are taken by the Department of Information Technology Services to mitigate security risks presented by, for example, blocking IP address ranges, identifying vulnerable servers, performing scans as necessary, opening Help Desk tickets to scan/check machines, etc. Losses can include loss of productivity, financial theft, and the exposure of secure information. To date, no specific losses from cyberterrorism that have affected the State are available.

Probability of Future Occurrences

As is the case for any large governmental organization, the State of Mississippi will continue to be impacted and compelled to respond to cyberterrorisms in the future. The nature of these attacks is projected to evolve in sophistication over time. The State has taken a proactive position in its cyber security efforts and is expected to remain vigilant in its efforts to prevent attacks from occurring and/or disrupting business operations. The reality remains that many computers and networks in organizations of all sizes and industries around the United States will continue to suffer intrusion attempts on a daily basis from viruses and malware that are passed through web sites and emails.

Vulnerability Assessment

To understand risk, the State will continue to evaluate what assets are exposed or vulnerable in the identified hazard area. For the cyberterrorism hazard, the entire State of Mississippi is exposed to this hazard. Therefore, all assets in the State (population, structures, critical facilities and lifelines), as described in the State's profile section are exposed and potentially vulnerable to a cyberterrorism attack.

Because it is difficult to predict targets of cyberterrorism, assessing vulnerability to the hazard is also difficult. All populations who directly use a computer or those receiving services from automated systems are vulnerable to cyberterrorism. Although all individuals in the State of Mississippi are vulnerable to an attack, certain types of attacks would impact specific segments of the population. If the cyberterrorism attack were to target the State's power or utility grid, individuals with medical needs would be impacted the greatest. Unfortunately, these populations are most vulnerable because many of the life-saving systems they rely on require power. Also, if an attack occurred during months of extreme heat or winter weather, the State's elderly population (those 65 years of age and older) would be vulnerable to the effects of the lack of climate control. These individuals would require shelter or admission to a hospital.

3.13: Other Significant Hazards

As noted in Section 3.1.6, this State Plan also considers risks identified outside of the process used in selecting hazards for analysis. Section 5, Coordination of Local Mitigation Planning, covers in detail hazards identified and addressed in all local plans.

Continuing with the process established during the last plan update, the Hazard Mitigation Council chose not to select and rank severe storm (thunderstorm, lightning, hail and high wind). They do not typically cause a statewide impact requiring a state response and would be mitigated at the local level. However, during a review of the plan, and based on the fact that 97% of local jurisdictions indicated severe weather (thunderstorms, lightning, hail, high wind) were of significant concern, the state opted to expand the hazard profile and assessment in this section. A general discussion of vulnerability, histories of events and calculations of probabilities are included for thunderstorms, wind, lightning, and hail, which are all captured under Severe Weather. Property damage, loss of life and injuries expected statewide on an annual basis are also addressed generally. It was not possible to specifically address expected losses to critical facilities or state-owned facilities with the limited data available

It was determined hazards initially ranked and identified by over 45 percent or fewer of local jurisdictions as hazards of concern do not pose a significant state-level threat to Mississippi. Those hazards are illustrated in Table 3.13.1 below:

Table 3.13.1
Hazards Identified by Jurisdictions in Local Plans

Hazard Type	No. of Jurisdictions Profiling Hazard	Percent of Plans
Severe Weather (thunderstorms, lightning, hail, high wind)	115	97%
Expansive Soils	84	71%
Extreme Heat	61	51%
Coastal Erosion	0	0%
Erosion	60	50%
Land Subsidence	46	39%
Tsunami	3	2%
Storm Surge	6	5%
Sea Level Rise/Climate Change	6	5%

As noted earlier in the chapter, hazards identified and addressed in local plans, but not included in this plan, will receive the support of the state mitigation program. Examples of state support to local hazard mitigation plans are the severe weather siren and saferoom programs. These mitigation programs satisfy multi-hazards by alerting the public and providing shelter, not only from tornadoes, but also severe storms.

Severe Storms

Hazard Description

Severe storms caused by cold fronts and daytime heating of the atmosphere can occur at any time in Mississippi. These storms can produce tornadoes, high winds, lightning, hail and heavy rain, and this hazard section focuses on thunderstorm, high wind, hail and lightning.

Thunderstorms are defined by the National Weather Service (NWS) as a local storm (accompanied by lightning and thunder) produced by a cumulonimbus cloud, usually with gusty winds, heavy rain, and sometimes hail. Non-severe thunderstorms rarely have lifetimes over two hours. The NWS considers a thunderstorm severe if it produces hail at least three-quarters of an inch in diameter, has winds of 58 miles per hour or higher, or produces a tornado. Severe thunderstorms are distinguished by stronger winds and heavier rain than the normal thunderstorm. These severe storms have the potential to produce damaging hail, spawn tornadoes, and initiate flash flooding. Thunderstorms may occur singly, in clusters, or in lines. Some of the most severe weather occurs when a single thunderstorm affects one location for extended time.

High winds are a general term associated with sustained or gusting winds of significant strength to cause risk or damage to crops, vegetation, buildings, infrastructure, or transportation. High winds are typically associated with weather frontal systems often bringing other severe weather products, such as hail and lightning.

High winds can damage property by carrying projectile debris or breaking building envelopes as wind buffets weak points around doors, windows, and roof structures. Wind speed can increase as it passes between closely situated buildings through a Venturi effect increasing the potential for damage. Metal buildings, tall structures, open fields, and swimming pools are at greater risk of lightning strikes.

The National Weather Service recognizes and defines three levels of wind events:

- Wind Advisory – Sustained winds of 30 mph or more or gusts of 45 mph or greater for a duration of one hour or longer.
- High Winds – Sustained winds of 40 mph or greater for at least one hour, or frequent gusts of wind of 58 mph or greater.
- Extreme Wind Warnings – Sustained winds of 115 mph or greater during a land-falling hurricane.

Winds and related damages can also be defined through the Beaufort Wind Scale as shown in Table 3.13.2. Damaging wind events in the state of Mississippi typically occur in the form of tornadoes, straight-line wind events, and severe thunderstorms. Depending on the type of wind event, the damage sustained can range from extremely localized to widespread and from moderate to devastating. The potential impacts of a severe wind event in the state depend on the specific characteristics of the storm, but can include broken tree branches and uprooted trees; snapped power, cable, and telephone lines; damaged radio, television, and communication towers; damaged and torn-off roofs; blown out walls and garage doors; overturned vehicles; totally destroyed homes and businesses; and serious injury and loss of life. Downed trees and

power lines can fall across roadways and block key access routes, as well as cause extended power outages to portions of the state.

Table 3.13.2
Beaufort Wind Scale

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps, waves 13-19 ft., white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break info spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	91-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, stale blows off roofs
10	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, “considerable structural damage”
11	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white and driving spray, visibility greatly reduced	

Lightning is a visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud. Lightning is created by static electrical energy and can generate enough electricity to set buildings on fire and electrocute people.

Lightning can strike anywhere and anytime thunderstorms are in the area. Almost all lightning occurs within 10 miles of the parent thunderstorm, but in rare cases it can strike as much as 50 miles away. There are two major categories of lightning:

- Cloud Flashes – Cloud flashes sometimes have visible channels extending out into the air around the storm but not striking the ground. This is further defined as cloud-to-air, cloud-to-cloud, or intra-cloud lightning.
- Ground Flashes – Lightning channels that travel from cloud-to-ground or ground-to-cloud. There are two categories of ground flashes: natural and artificially initiated/triggered. Artificially initiated lightning includes strikes to tall structures, airplanes, rockets, and towers on mountains. Artificially initiated lightning travels from ground to cloud while natural lightning travels from cloud to ground.

Hail is defined by the National Weather Service (NWS) as a showery precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter, falling from a cumulonimbus cloud. Studies of thunderstorms provided through the NWS indicate two conditions are required for hail to develop: sufficiently strong and persistent up-draft velocities and an accumulation of liquid water in a super-cooled state in the upper parts of the storm. Hailstones are formed as water vapor in the warm surface layer rises quickly into the cold upper atmosphere. The water vapor is frozen and begins to fall; as the water falls, it accumulates more water vapor. This cycle continues until there is too much weight for the updraft to support and the frozen water falls too quickly to the ground to melt along the way.

The size of hailstones is best determined by measuring their diameter with a ruler. In the absence of a ruler, hailstone size is often visually estimated by comparing its size to known objects. Table 3.13.3 provides a reference of commonly used objects for this purpose.

Table 3.13.3
Hail Size Chart

Hail Diameter Size	Description	Hail Diameter Size	Description
¼”	Pea	2”	Hen Egg/Lime
½”	Plain M & M	2 ½”	Tennis Ball
¾”	Penny	2 3/4 “	Baseball
7/8”	Nickel	3”	Teacup/Large Apple
1” (severe)	Quarter	4”	Softball
1 ¼”	Half Dollar	4 ½”	Grapefruit
1 ½”	Ping Pong Ball/Walnut	4 ¾“-5”	Computer CD-DVD
1 ¾”	Gold Ball		

Source: National Weather Service

Location and Extent

Severe storms events are typically isolated to relatively small areas. Historical records indicate the entire state is vulnerable to severe thunderstorms. Trends in the data do not clearly indicate if portions of the state are more vulnerable than others. Based on available data during this update process, the Hazard Mitigation Council draws the same conclusion - every county is vulnerable.

To demonstrate the extent and location of severe wind and hail, Figures 3.13.1 and 3.13.2 are provided on the subsequent pages and reflect the location of past events (2000 to 2017). A summary of the past occurrences and probability of future impacts is also presented.

Figure 3.13.1
Severe Winds

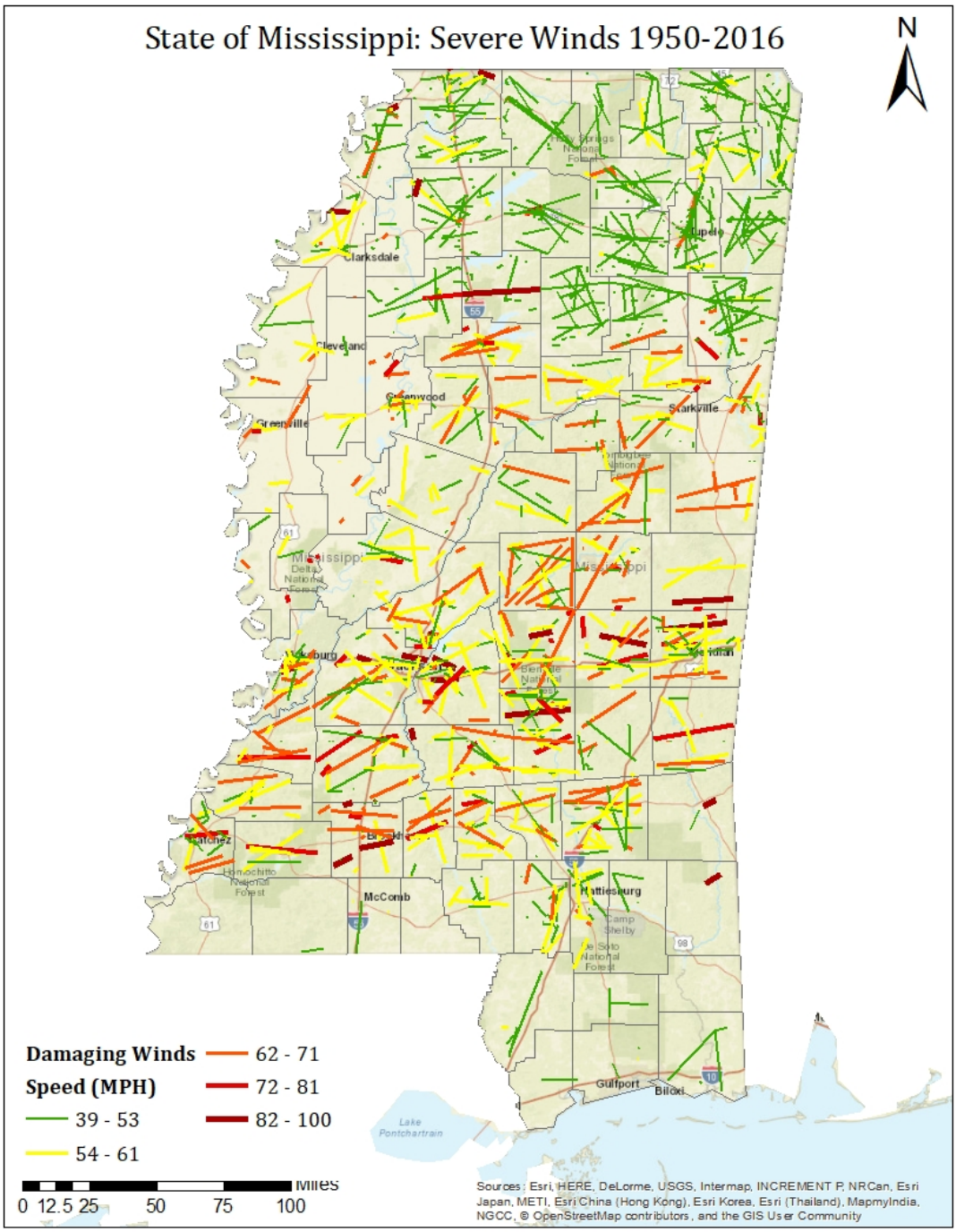
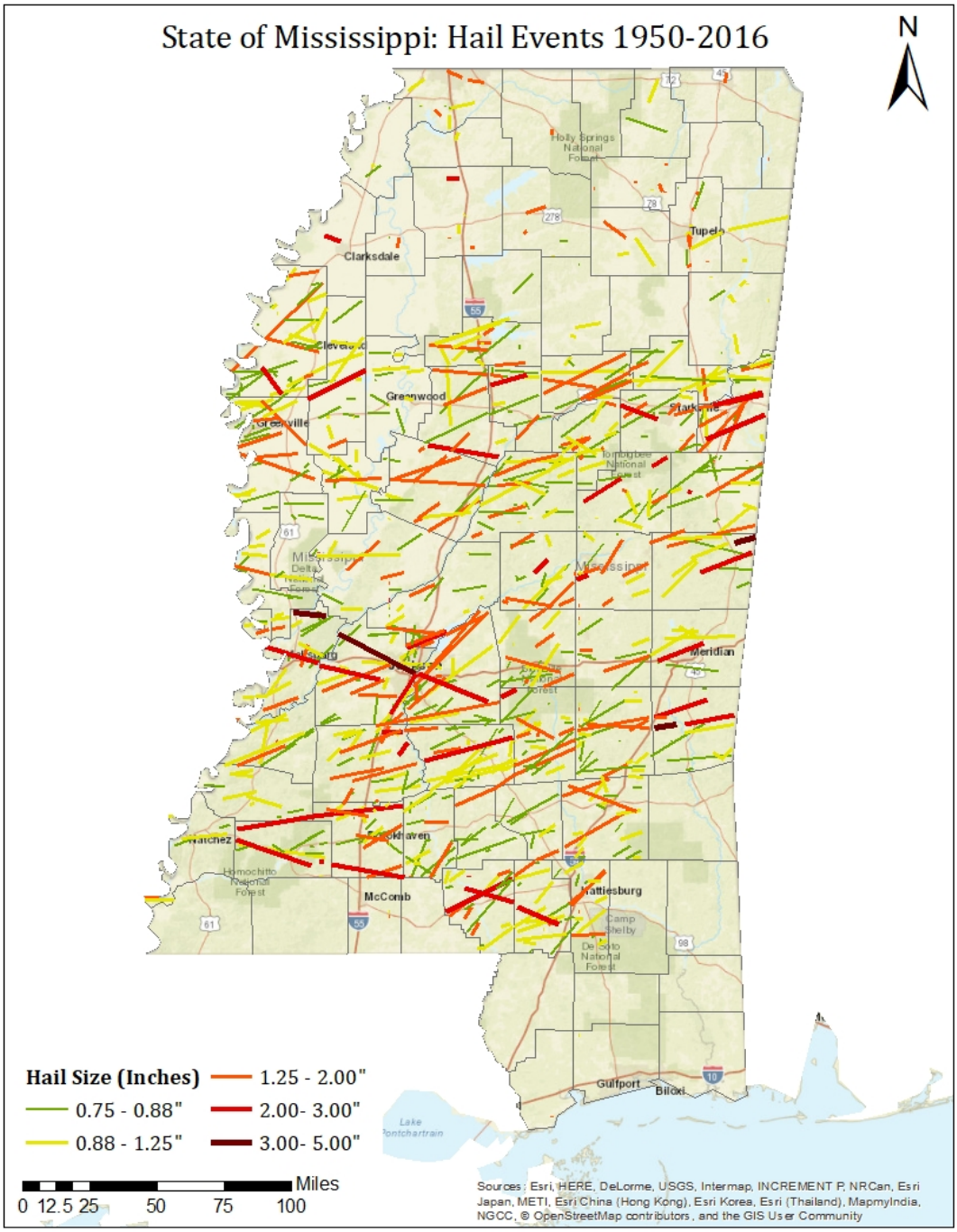


Figure 3.13.2
Hail



Previous Occurrences

High Wind, Thunderstorm Winds and Strong Wind Events

High winds, thunderstorm winds and strong winds are spatially and geographically undefined. Every year these events occur and can occur in any and all Mississippi counties at some point. The specific number of events as well as their corresponding effects are recorded in the NCDC database. Events from the past 15 years are presented. Based on the sheer numbers of incidences, each county is susceptible to winds of any type. It would be helpful if more effort relating to further analysis of the issue were assessed. It is still the assertion of the Hazard Mitigation Council that mitigation activities should be identified on the local planning level. It is important to note that the three categories of winds are profiled in Tables 3.13.2, 3.13.3, and 3.13.4.

Table 3.13.2
High Wind Events 2002 – 2017

Year	No. of Events	No. of Counties Affected	Death	Injury	Property Damage ($)	Crop Damage ($)
2017	4	4	0	0	$50,000	$0
2016	0	0	0	0	$0	$0
2015	0	0	0	0	$0	$0
2014	0	0	0	0	$0	$0
2013	3	2	0	0	$30,000	$0
2012	0	0	0	0	$0	$0
2011	8	8	0	0	$500,000	$485,000
2010	0	0	0	0	$0	$0
2009	15	15	0	0	$490,000	$0
2008	23	23	0	0	$1,074,000	$0
2007	0	0	0	0	$0	$0
2006	0	0	0	0	$0	$0
2005	0	0	0	0	$0	$0
2004	0	0	0	0	$0	$0
2003	0	0	0	0	$0	$0
2002	20	19	0	0	$115,000	$0
Totals	**73**		**0**	**0**	**$2,259,000**	**$485,000**

Source: NCDC 2018

Table 3.13.3
Thunderstorm Wind Events 2002 – 2017

Year	No. of Events	No. of Counties Affected	Death	Injury	Property Damage ($)	Crop Damage ($)
2017	437	75	1	0	$8,686,000	$0
2016	473	73	0	3	$6,579,000	$0
2015	362	69	1	1	$2,662,000	$0
2014	424	74	1	7	$5,859,000	$0
2013	261	75	0	5	$4,394,000	$0
2012	518	74	1	12	$6,437,000	$0
2011	697	81	4	5	$20,272,000	$356,000
2010	489	74	0	0	$5,898,000	$106,000
2009	519	78	2	6	$11,721,025	$2,303,000
2008	829	79	0	5	$104,354,000	$9,698,000
2007	416	78	0	2	$7,050,000	$480,000
2006	403	76	0	10	$46,968,000	$30,000
2005	411	75	1	7	$19,445,000	$1,280,000
2004	420	78	1	9	$3,330,000	$0
2003	552	77	0	0	$12,059,050	$0
2002	414	75	0	0	$11,115,000	$0
Totals	**7,625**		**12**	**72**	**$276,829,075**	**$14,253,000**

Source: NCDC 2018

Table 3.13.4
Strong Wind Events 2002 – 2017

Year	No. of Events	No. of Counties Affected	Death	Injury	Property Damage ($)	Crop Damage ($)
2017	33	4	0	1	$617,000	$0
2016	17	13	0	0	$3,000	$0
2015	46	22	0	0	$365,600	$0
2014	14	11	0	0	$184,500	$0
2013	16	13	0	0	$108,500	$0
2012	40	23	1	0	$1,066,000	$0
2011	21	15	0	0	$144,000	$0
2010	15	12	0	0	$127,000	$0
2009	31	27	0	0	$985,200	$0
2008	29	21	0	0	$1,036,000	$200
2007	19	16	0	0	$179,110	$0
2006	18	14	0	0	$253,600	$0
2005	0	0	0	0	$17,000	$0
2004	4	3	0	0	$0	$0
2003	4	4	0	0	$165,000	$0
2002	0	0	0	0	$0	$0
Totals	**307**		**1**	**1**	**$5,251,510**	**$200**

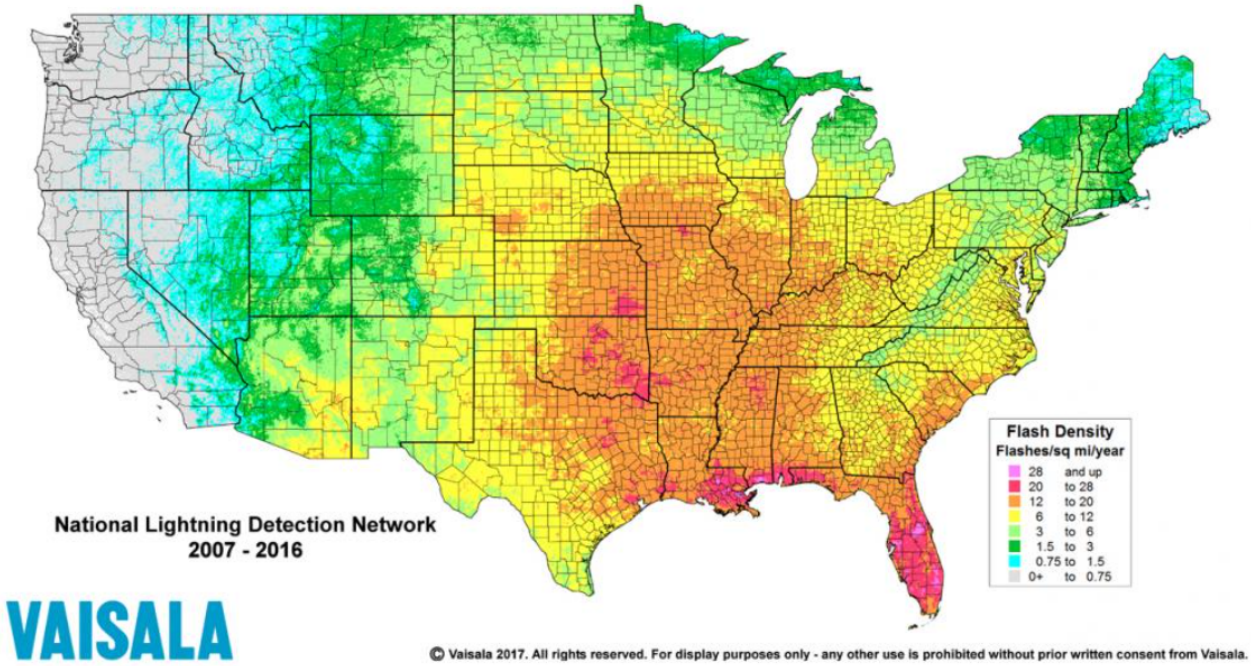
Source: NCDC 2018

Lightning

Lightning, once one of nature's biggest killers, is claiming far fewer lives in the United States, mostly because we have learned to get out of the way. More people are subscribing to, “When the thunder roars, get in doors.” According to NOAA, in the United States, over the past decade, an average of 27 people are killed each year by lightning. People struck by lightning often report a variety of long-term, debilitating symptoms, including memory loss, attention deficits, sleep disorders, numbness, dizziness, stiffness in joints, irritability, fatigue, weakness, muscle spasms, depression, and an inability to sit for long periods.

According to Vaisala’s National Lightning Detection Indicator, on average 16.5 flashes per square mile hits Mississippi.

Figure 3.13.4



Records found in the NCDC database (Table 3.13.5) indicate 14 reported deaths and 19 reported injuries in Mississippi were caused by lightning in the past 16 years (2002 to 2017). It should be noted not all lightning events are reported, therefore the context should be considered when applying further analysis. The main point is each county is susceptible to lightning, and further analysis and mitigation activities should be identified on the local plan level. The table below provides a summary of the events from 2002 to 2017 and their impact.

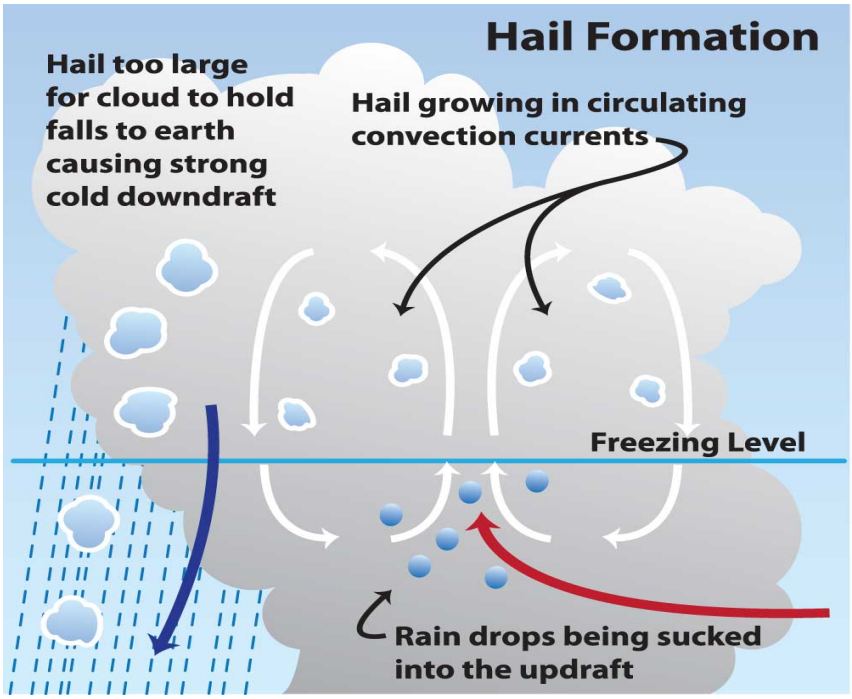
Table 3.13.5
Lightning Events 2002 – 2017

Year	No. of Events	No. of Counties Affected	Death	Injury	Property Damage ($)	Crop Damage ($)
2017	8	7	0	2	$550,000	$0
2016	15	11	3	1	$942,000	$0
2015	13	11	0	0	$648,600	$0
2014	8	8	1	0	$220,000	$0
2013	9	8	0	0	$334,000	$0
2012	26	14	0	1	$1,943,000	$0
2011	24	18	1	2	$1,403,000	$0
2010	17	13	0	1	$1,849,000	$0
2009	15	11	1	3	$254,000	$0
2008	24	17	1	1	$990,000	$7,000
2007	13	12	0	0	$975,000	$0
2006	20	14	2	4	$1,080,000	$2,000
2005	21	16	2	0	$4,696,000	$0
2004	12	11	1	3	$145,000	$0
2003	12	8	0	1	$388,000	$0
2002	16	12	2	0	$115,250	$0
Totals	**309**		**14**	**19**	**$16,532,850**	**$9,000**

Hail

Many strong severe storms produce hail, with more frequent hailstorms occurring in the late spring and early summer. Hail forms when thunderstorm updrafts are strong enough to carry water droplets well above the freezing level. This freezing process forms a hailstone, which can grow as additional water freezes onto it. Eventually, the hailstone becomes too heavy for the updrafts to support it and it falls to the ground. Figure 3.13.5 shows how hail is formed.

Figure 3.13.6
Hail Formation



Source: NASA

Large hail, plus the glass it may break, can cause serious injury. Hail can be smaller than a pea, as large as a softball, which can be very destructive to automobiles, glass surfaces (*e.g.* skylights and windows), roofs, plants, and crops. The size of hailstones is a direct result of the severity and size of the storm. The land area affected by individual hailstorms is not much smaller than a parent thunderstorm, an average of 15 miles in diameter around the center of a storm.

Most of the incidents reported hail between .75 and 1 inch in diameter. There were a few incidences where hail reached 2 and 2.75 inches in diameter. Thousands of hail incidents were reported since 1950 according to the NCDC and shown in Figure 3.13.2. It should be noted that not all hail events are reported so the context should consider when applying further analysis. The main point is each county is susceptible to hail, and further analysis and mitigation activities should be identified on the local plan level. A summary of the events from 2002 to 2017 as reported to the NCDC and their impacts is listed in Table 3.13.5.

Table 3.13.5
Hail Events 2002 – 2017

Year	No. of Events	No. of Counties Affected	Death	Injury	Property Damage ($)	Crop Damage ($)
2017	128	53	0	0	$634,000	$0
2016	209	66	0	0	$404,800	$0
2015	93	29	0	0	$101,600	$0
2014	183	65	0	0	$2,469,000	$0
2013	146	61	0	1	$557,019,000	$0
2012	202	63	0	0	$812,500	$0
2011	368	74	0	1	$3,050,000	$0
2010	290	67	0	0	$1,354,000	$50,000
2009	323	76	0	0	$157,000	$4,000
2008	469	78	0	0	$2,014,000	$0
2007	223	74	0	0	$321,250	$80,000
2006	344	78	0	0	$17,767,000	$6,600,000
2005	447	75	0	2	$29,743,000	$600,000
2004	153	59	0	0	$41,750	$0
2003	363	76	0	0	$3,423,000	$0
2002	136	61	0	0	$230,440	$0
Totals	**4,077**		**0**	**4**	**$592,773,640**	**$7,334,000**

Severe Storm Vulnerability Discussion

Typically, damage associated with these hazards includes structural fires, broken glass, dented automobiles or siding, and personal injuries or even death. Wind damages typically include broken branches, uprooted trees, roofs blown off, walls blown down, small structures leveled, and in extreme cases, boats and airplanes being overturned.

People, buildings, and property are at risk from the effects of high wind and lightning. Buildings, automobiles, and infrastructural components (such as electrical feed lines) can suffer damage from high wind and lightning; outdoor populations are vulnerable to injury or death from lightning. High winds can cause debris to strike people, animals, buildings and property, which in turn causes significant injuries, fatalities, and property damage.

Critical infrastructure associated with power transmission, telecommunications and road signage are vulnerable to hail. Manufactured homes are particularly susceptible to hail events due to construction types (vinyl siding, lesser gauge metal roofs). People and animals are also being impacted by hail if they are caught outdoors with no protection.

Although no specific areas of the state can be designated as having a higher risk of being affected by severe storms, there are a number of factors that contribute to a particular area's vulnerability to damages. Certain characteristics of an area or of a structure, increase its resistance to damages due to high wind events, lightning and hail. Many of these factors are extremely specific to the particular location or the particular structure in question. Areas of higher population can be expected to experience more damage from hail, whereas more rural areas might be more vulnerable to fire from lightning due to longer response time for fire suppression. For these reasons, the state of Mississippi feels it is important to include these hazards in local mitigation plans, as they are best able to be mitigated at that level.

Coastal/Beach Erosion

Hazard Description

As defined by NOAA, coastal erosion is a process whereby large storms, flooding, strong wave action, sea level rise, and human activities, such as inappropriate land use, alterations, and shore protection structures, erodes the beaches and bluffs along the U.S. coasts. Erosion undermines and often destroys homes, businesses, and public infrastructure and can have long-term economic and social consequences.

In the U.S., coastal erosion is responsible for roughly $500 million per year in coastal property loss, including damage to structures and loss of land. To mitigate coastal erosion, the federal government spends an average of $150 million every year on beach nourishment and other shoreline erosion control measures.[i] In addition to beach erosion, more than 80,000 acres of coastal wetlands are lost annually—the equivalent of seven football fields disappearing every hour of every day.[2] The aggregate result is that the United States lost an area of wetlands larger than the state of Rhode Island between 1998 and 2009.[3]

While coastal erosion affects all regions of the United States, erosion rates and potential impacts are highly localized. Average coastline recession rates of 25 feet per year are not uncommon on some barrier islands in the southeast. In a single event, severe storms can remove even wider beaches. In undeveloped areas, these high recession rates are not likely to cause significant concern, but in some heavily populated locations, one or two feet of erosion may be considered catastrophic.

The Gulf of Mexico is impacted by the development of oil, gas and mineral resources. The Gulf accounts for over 95% of the U.S.'s outer continental shelf oil and gas production, and processes over two-thirds of the nation's oil imports. Invasive species are a serious threat to native biota in many gulf coast ecosystems, and aquatic nuisance species pose severe economic problems; interfering with transportation, energy production, reservoir capacity and recreational uses. The effect of oil breaches on coastal erosion is deter- mined by how much oil reaches the coastal regions and how long it remains. Oiled plants can die, along with roots that bind and stabilize the soil, leading to erosion.

Location and Extent

The issue of beach erosion applies to three counties in Mississippi: Hancock, Harrison and Jackson. Each of these counties had comprehensive beach maintenance and protection programs in place for many years.

These programs utilized locally budgeted funds and were occasionally supplemented with state and federal funds. Hurricane Katrina damaged many of the beaches as well as the beach protection facilities.

Researchers from the USGS Woods Hole Coastal and Marine Science Center are studying the influence of wave action and sediment supply on wetland vulnerability and ecosystems. Over the course of 6.5 months, the group developed a time lapse video showing lateral erosion of a salt marsh in the Grand Bay National Estuarian Reserve, which is part of an embayment near the City of Pascagoula. The results were 1.5 meters of erosion from wave action, which is a rate of more than three meters, or ten feet, per year.[ii]

The Mississippi River is also susceptible to erosion. As Louisiana continues to experience erosion to it will increase erosion along the Mississippi River as the current land mass of Louisiana provides somewhat of a buffer to. The United States Army Corps of Engineers completed an investigative report identifying major restoration and mitigation projects. This project received a supplemental appropriation for implementation and is being tracked as Mississippi Mitigation Action – Hurricane 6, USACOE Mississippi Coastal Improvements Program. The Mississippi Department of Marine Resources serves as the lead agency for beach erosion initiatives and is represented on the State Hazard Mitigation Council.

The Mississippi Department of Marine Resources (DMR) Coastal Preserves Program was developed in 1992 by authority of the Wetlands Protection Act. The Coastal Preserves Programs objective is to acquire, protect, and manage sensitive coastal wetland habitats along the Mississippi Gulf Coast, therefore ensuring the ecological health of Mississippi's coastal wetland ecosystems. The state currently has title to approximately 30,000 acres of the designated 72,000 acres of crucial coastal wetland habitat within Mississippi's 20 coastal preserve sites.

Probability of Future Occurrences

The USGS National Assessment of Coastal Change Hazards provides an interactive map that displays hurricane-induced coastal erosion hazards for sandy beaches along the U.S. Gulf of Mexico and Atlantic (Florida to New York) coastlines. The analysis is based on a storm-impact scaling model that uses observations of beach morphology combined with sophisticated hydrodynamic models to predict how the coast will respond to the direct landfall of category 1-5 hurricanes. Hurricane-induced water levels resulting from both surge and waves are compared to beach and dune elevations to determine the probabilities of three types of coastal change: collision (dune erosion), overwash, and inundation.

Probabilities of coastal erosion hazards are based on estimating the likelihood that the beach system will experience erosion and deposition patterns consistent with collision, overwash, or inundation regimes. The regimes are calculated by using values of dune morphology and mean and extreme water levels for each 1 kilometer section, such that probability of collision occurs when extreme water levels reach the dune toe; overwash when extreme water levels reach the dune crest; and inundation when mean water levels reach the dune crest. Sections with no dune toe (berms instead of dunes) do not have a defined probability of collision.

Figure 3.13.3
U.S. 12 Month Climate Forecast 2013
(Source: USGS)

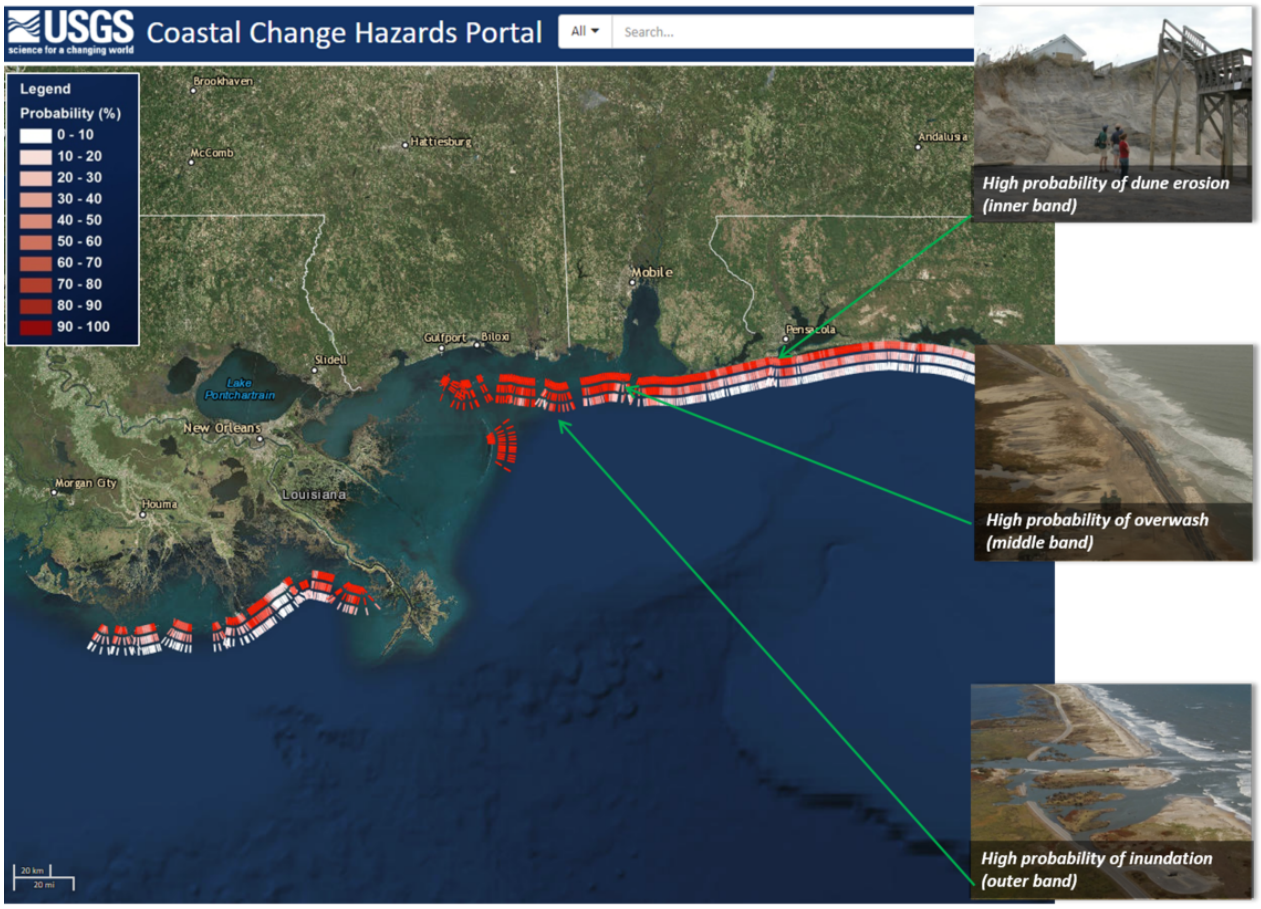
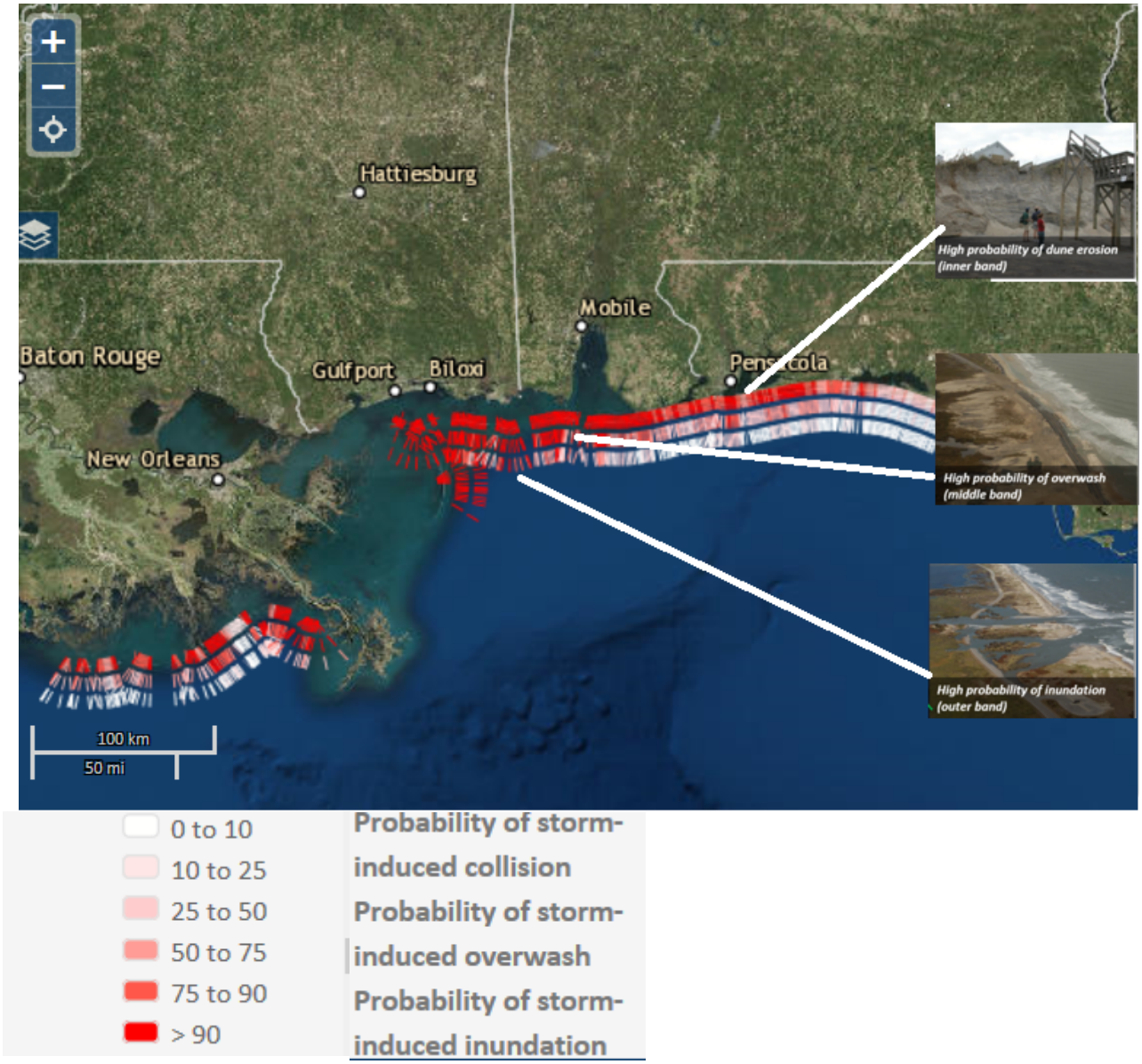


Figure 3.13.4
Hurricane Nate Assessment of Potential Coast Change Impacts- 2017
(Source: USGS)



Comparing the 12-month forecast from the 2013 plan to the Hurricane Nate coast change impacts from 2017, there is a noticeable increase in collision, overwash, and inundation along the Gulf Coast.

Source: **John Fitzhugh** jcfitzhugh@sunherald.com

A family walks Thursday, June 22, 2017, on the boardwalk near Hewes Avenue in Gulfport where the beach has eroded to the seawall. A project to replenish the beach in Harrison County will start in October.

U.S. Climate Resilience Toolkit. Retrieved 04.27.18 from, https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion

[2] U.S.G.S. Rapid Salt-Marsh Erosion in Grand Bay, Mississippi. Retrieved 04.19.18, from https://www.usgs.gov/media/videos/rapid-salt-marsh-erosion-grand-bay-mississippi

3.14: Growth and Development Trends

44 CFR §201.4(c)(3)(i) – [The State risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events.

Update Requirement 201.4(d): Plan must be reviewed and revised to reflect changes in development.

As part of the plan update process, trends in growth and development were analyzed to determine how changing development and socioeconomic trends could influence loss and vulnerability especially in Mississippi's hazard-prone areas. Historic, estimated and projected population, population density, housing units and housing unit density were studied at the state, regional and county level. Specific counties and regions of the state that experienced significant changes are discussed in this section, as well as the long-term effects of Hurricane Katrina on population and housing units. A special section on social vulnerability is also included. State-owned assets and locations are identified in Section 3.2.1 and the appendices.

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Population

Mississippi is a relatively sparsely populated state. According to the 2010 U. S. Census among the 50 states, Mississippi ranked 31st in population and housing density; 34th in population density; and 40th in the population growth rate between 2000 and 2010. The state has 46,906 square miles and a population of 2,967,297, according to the 2010 census. Historic population figures from the decennial census illustrate Mississippi's growth trends for the past six decades (see Table 3.14.1). Table 3.14.2 presents certain "quick facts" about the demographics of the state.

Table 3.14.1
Mississippi's Population Growth

Census	Total Population	Percent Change
2010	2,967,297	4.00%
2000	2,848,753	10.50%
1990	2,575,475	2.18%
1980	2,520,638	13.70%
1970	2,216,994	1.79%
1960	2,178,000	--

Table 3.14.2
Mississippi's Quick Facts

Population, 2017 estimates	**2,984,100**
Population, 2016 estimates	2,988,726
Population, 2010 (April 1, 2017) estimate base	2,968,103
Population, 2010 (April 1, 2016) estimate base	2,968,103
Population, percentage change, April 1, 2010 or July 2017	0.5%
Population, percentage change, April 1, 2010 or July 2016	0.7%
Population, 2010	2,967,297
Persons per square mile, 20	63.2
Number of Incorporated Cities, Towns, and Villages	362
Number of Counties	82
Urban / Rural Population	48.75/51.2%
Counties with a Population of 100,000 or Greater	6
Counties with a Population of 50,000 – 99,000	8
Counties with a Population of 10,001 – 49,000	55
Counties with a Population of 10,00 or less	12

Source: U.S. Bureau of Census

Between 2000 and 2010, 39 of Mississippi's 82 counties gained in population and 13 of these gained by ten percent or more. This growth was concentrated primarily in three areas of the state (coastal-south, central and extreme north-west).

Mississippi's ten most populous counties are listed in Table 3.14.3 and the ten least populous counties are listed in Table 3.14.4. Counties declining or growing in population are listed in Table 3.14.5; those growing or declining by the greatest numbers and percentages are listed in Tables 3.12.6 and illustrated in Figure 3.14.1. A demographic worksheet by county is provided in Appendix 7.3.12-A with complete information on all counties.

Table 3.14.3
Ten Most Populous Counties
2010 Census

Ranking/County		2010 Population	Ranking/County		2010 Population
1.	Hinds	250,802	6.	Lee	75,755
2.	Harrison	189,606	7.	Lauderdale	78,161
3.	Jackson	131,420	8.	Forrest	72,606
4.	DeSoto	130,694	9.	Jones	64,961
5.	Rankin	115,328	10.	Lowndes	61,586

Source: U.S. Bureau of Census

Table 3.14.4
Ten Least Populous Counties
2010 Census

Ranking/County		2010 Population	Ranking/County		2010 Population
1.	Wilkinson	10,312	6.	Tunica	9,227
2.	Webster	10,294	7.	Franklin	8,448
3.	Quitman	10,115	8.	Benton	8,026
4.	Choctaw	9,758	9.	Sharkey	6,580
5.	Jefferson	9,740	10.	Issaquena	2,274

Source: U.S. Bureau of Census

Forty-one counties experienced a population decline between 2000 and 2010 and 12 counties experienced double digit decline. The Delta region of the state, located in the western portion of the state and extending to within fifty miles of Memphis, TN, was most affected by declining populations.

Table 3.14.5
Counties with Greatest Population Loss/Gain
2000 - 2010

County	Population Loss 2000 - 2010
Washington	-11,840
Bolivar	-6,488
Leflore	-5,630
Hinds	-5,515
Sunflower	-4,919
Coahoma	-4,471
Harrison	-2,496
Holmes	-2,411
Claiborne	-2,227
Chickasaw	-2,048

Source: U.S. Census Bureau

County	Population Gain 2000 - 2010
DeSoto	54,053
Rankin	26,290
Madison	20,529
Lamar	16,588
Lafayette	8,607
Jackson	8,248
Pearl River	7,213
Lee	7,155
Oktibbeha	4,769
Stone	4,164

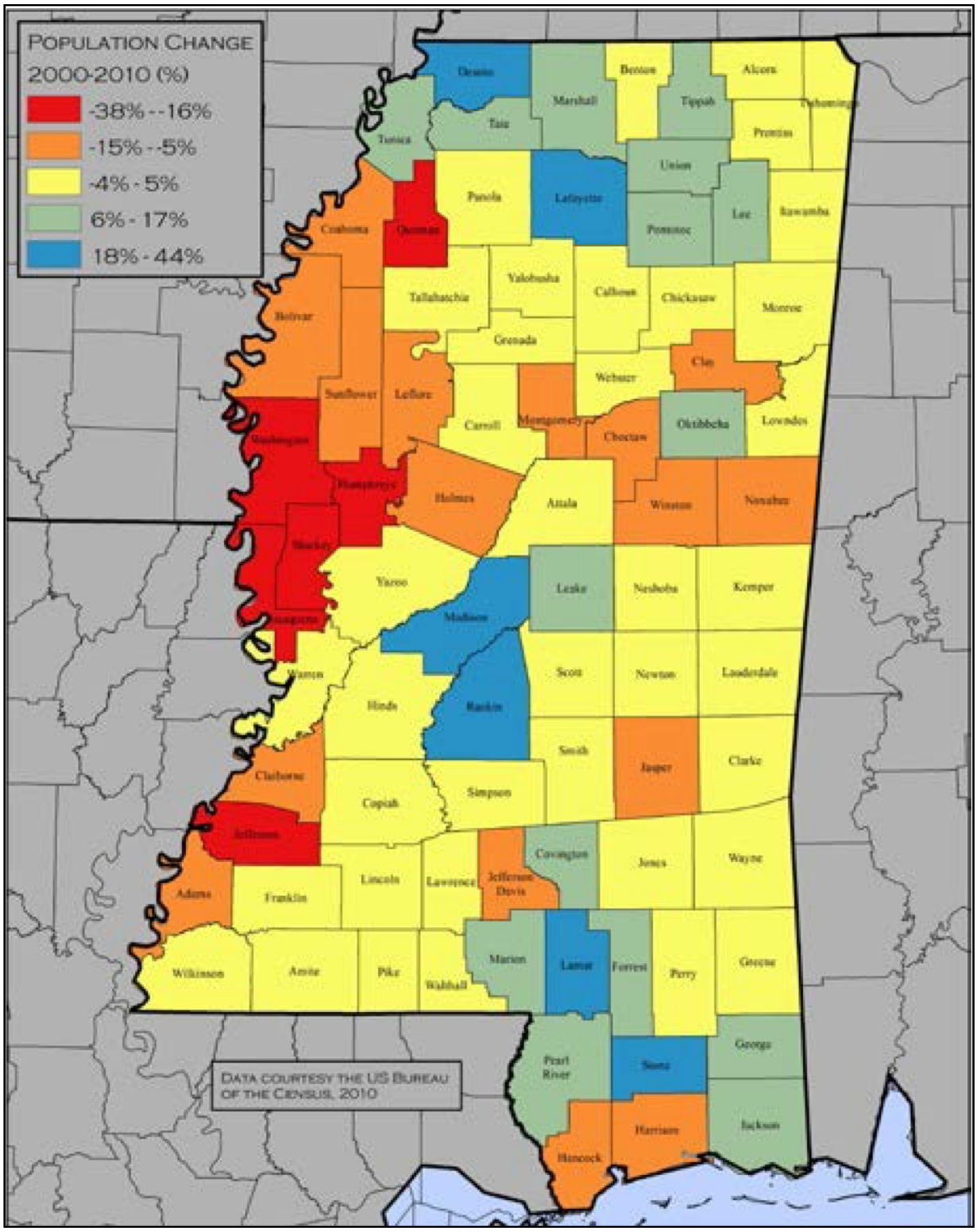
Source: U.S. Census Bureau

Table 3.14.6
Mississippi's Population Growth
(Loss/Gain by Percentage)

County	% Change	County	% Change
Issaquena	-38.20%	DeSoto	50.40%
Sharkey	-25.30%	Lamar	42.50%
Jefferson	-20.70%	Stone	30.60%
Claiborne	-18.80%	Madison	27.50%
Washington	-18.80%	Rankin	22.80%
Quitman	-18.70%	Lafayette	22.20%
Humphreys	-16.30%	George	17.90%
Bolivar	-16.00%	Tunica	16.80%
Jefferson Davis	-9.45%	Pearl River	14.80%
Jefferson	-8.95%	Tate	13.90%

Source: U.S. Census Bureau

Figure 3.14.1
Counties Projected to have the Greatest
Population Loss and Gain Percent) 2000 – 2010



The U. S. Census Bureau released interim population projections prior to the 2010 census using interim 2005 population numbers and revised numbers for 2006 through 2030. Table 3.14.7 summarizes these projections. Based on these projections, Mississippi will experience a slower than historic rate of growth through 2030. The Census Bureau does not have updated projections available nor do they plan to provide these in the immediate future.

Table 3.14.7
Interim Mississippi Population Projections
2005 - 2030

Year	Estimated Population	Percent Change
2005	2,915,696	2.50%
2006	2,910,540	-0.18%
2010	2,971,412	2.09%
2015	3,014,409	1.45%
2020	3,044,812	1.01%
2025	3,069,420	0.81%
2030	3,092,410	0.75%

Source: U.S. Census Bureau

Population Migration

According to Forbes, close to 40 million Americans move from one home to another every year. It is important for Mississippi to track what states people are moving from as they relocate here. To visualize the migration data, Forbes American Migration interactive map uses IRS data to develop their migration tool.

For planning purposes, the top three counties with migration, Desoto, Rankin and Harrison, have been mapped and are presented as Figure 3.14.2 to 3.14.4. The blue lines indicate where migrants are moving from which can be useful in developing and/or identifying preparedness messaging and activities.

Figure 3.14.2
Desoto County Inbound Migration

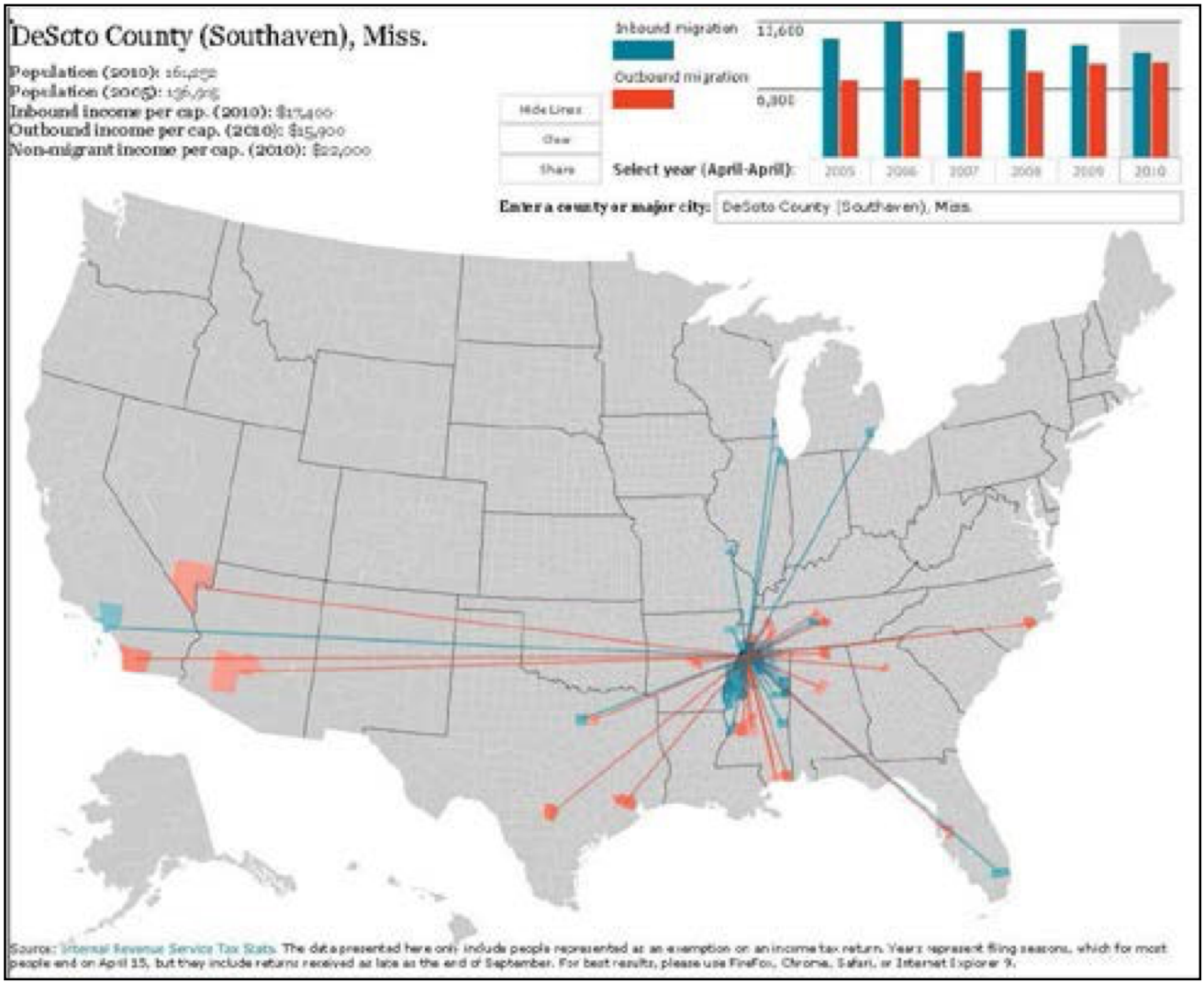


Figure 3.14.3
Rankin County Inbound Migration

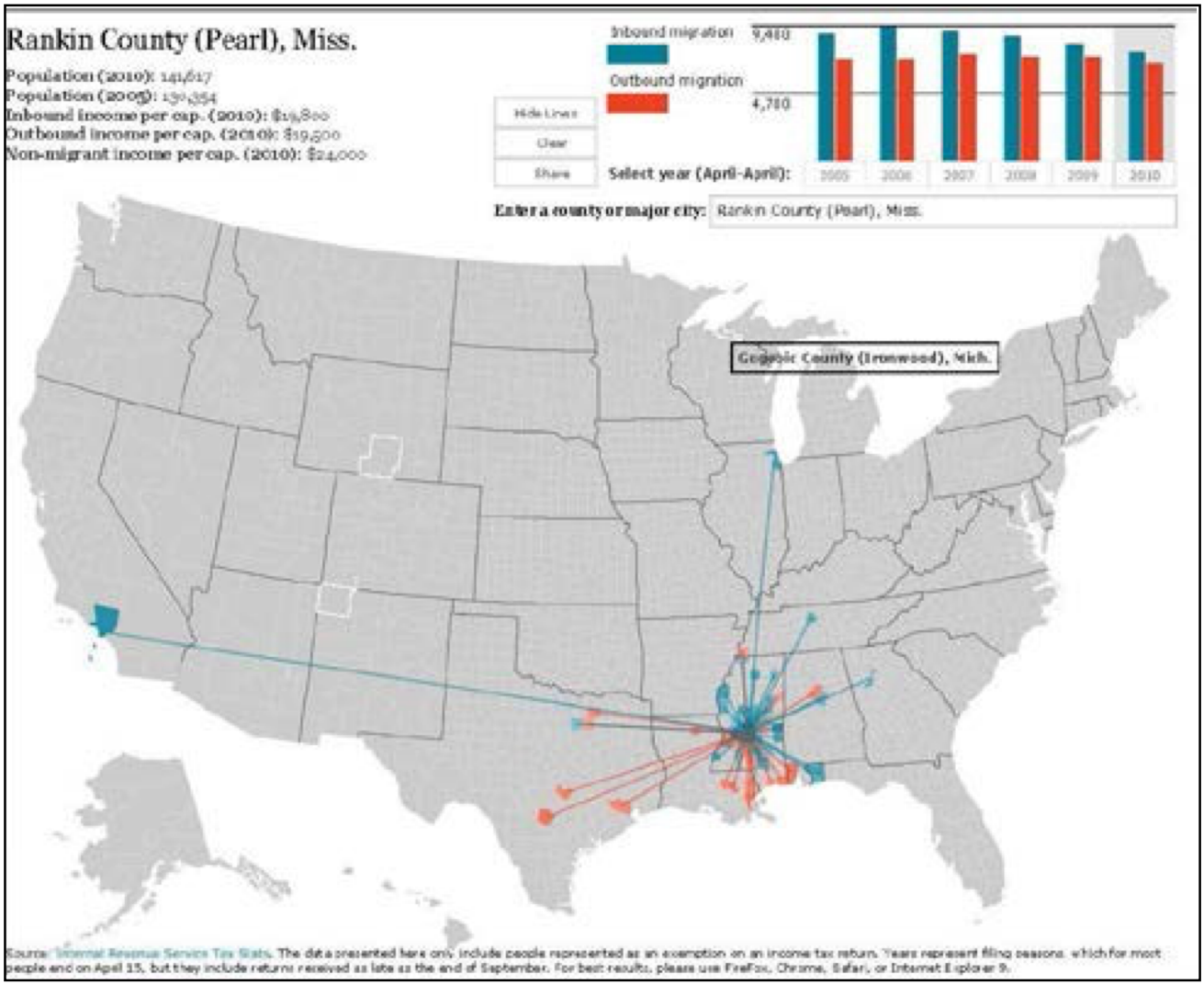
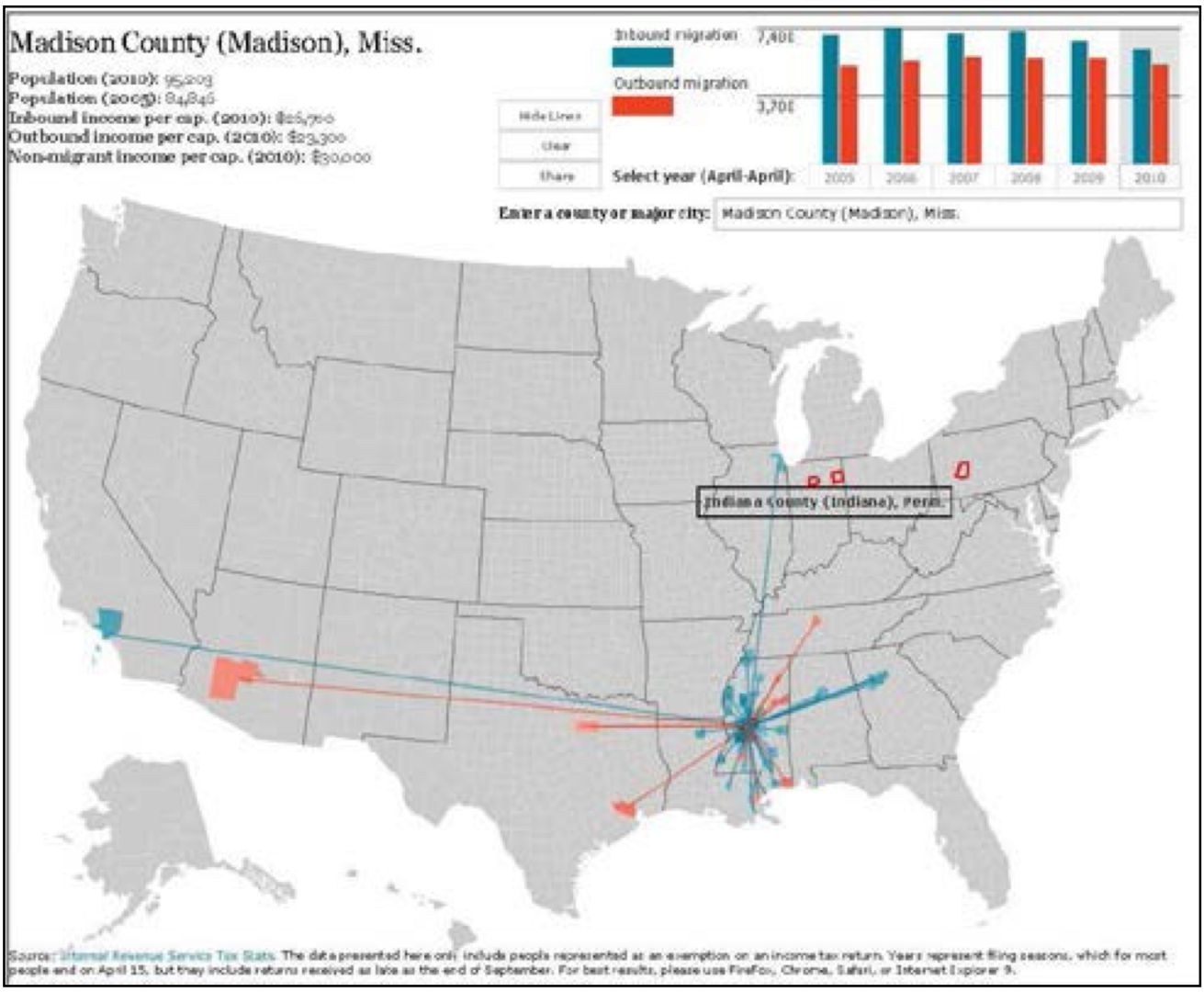


Figure 3.14.4
Madison County Inbound Migration



Housing Units

The total number of housing units is another indicator of growth or decline and helps identify the geographical location of new development occurring based on increases within discrete areas. According to the US Census Bureau, the number of housing units in Mississippi increased 9.7% between 2000 and 2010. Desoto County experienced the greatest percentage of increase (51.08%) during the ten-year period. Rankin and Madison Counties were second and third with a 25.33% and 33.97% increase respectively. Tables 3.14.8 and 3.14.9 list the counties having grown the most in terms of housing units by number and percent respectively. Table 3.14.10 lists the top ten counties with the most housing units according to the latest census. Figure 3.14.5 (percent change) illustrates the results statewide.

Table 3.14.8
Counties with the Greatest Housing Gains (Numeric) 2000 - 2010

County	2000	2010	Net Gain
DeSoto	40,795	61,634	20,839
Rankin	45,070	56,487	11,417
Madison	28,781	38,558	9,777
Lamar	15,433	24,070	8,637
Jackson	51,678	60,067	8,389
Lafayette	51,678	22,729	6,142
Harrison	79,636	85,181	5,545
Lee	31,887	35,872	3,985
Oktibbeha	17,344	20,947	3,603
Pearl River	20,610	23,968	3,358

Source: U.S. Census Bureau

Table 3.14.9
Counties with the Greatest Housing Unit Gains (Percent) 2000 – 2010

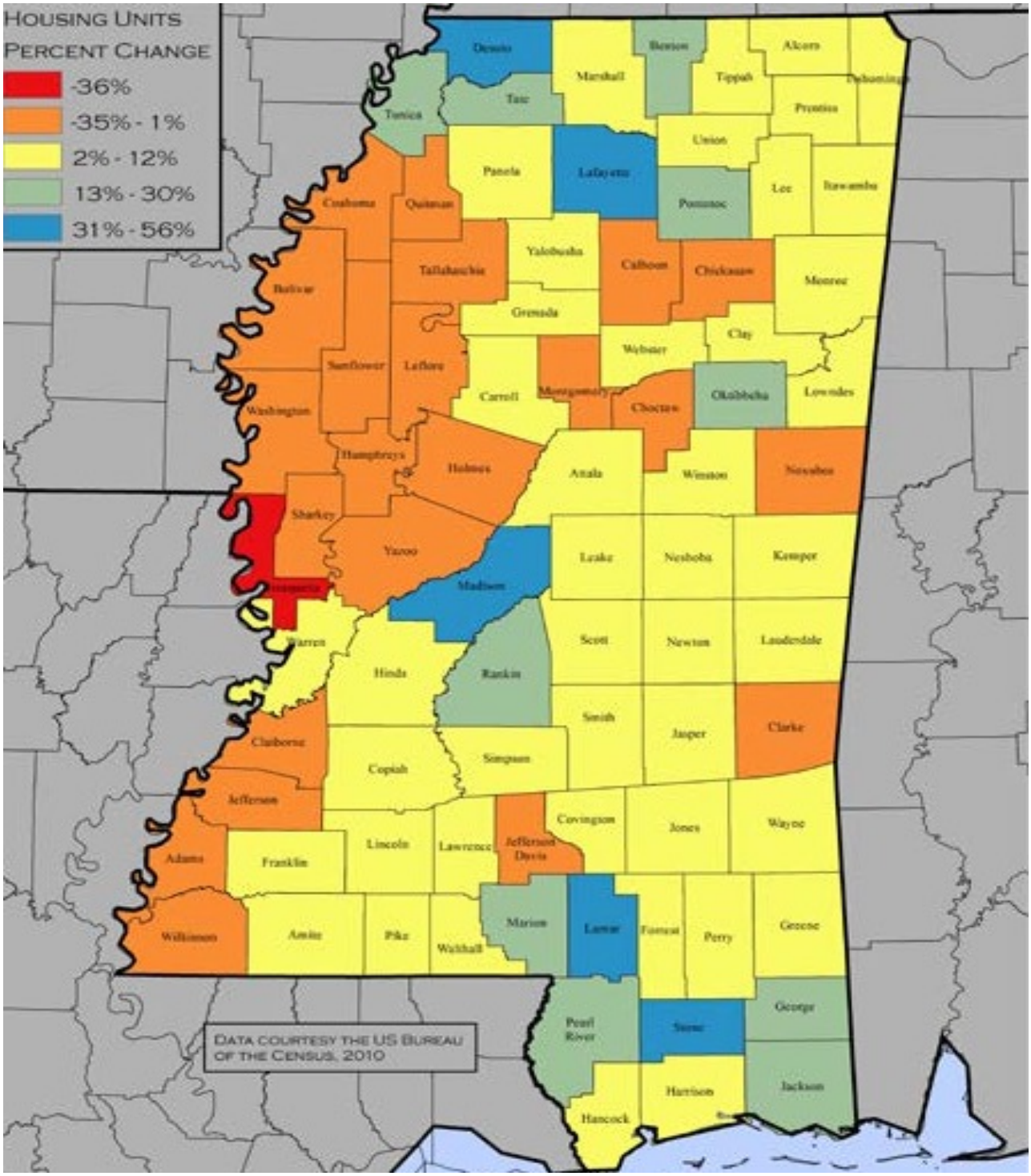
County	2000	2010	Percent Change	County	2000	2010	Percent Change
1. Lamar	15,433	24,070	55.96%	6. Tunica	3,705	4,803	29.64%
2. Desoto	40,795	61,634	51.08%	7. Rankin	45,070	56,487	25.33%
3. Lafayette	16,587	22,729	37.03%	8. George	7,513	9,330	24.18%
4. Stone	5,343	7,161	34.03%	9. Benton	3,456	4,186	21.12%
5. Madison	28,781	38,558	33.97%	10. Oktibbeha	17,344	20,947	20.77%

Source: U.S. Census

Table 3.14.10
Top 10 Counties Ranked by Number of Housing Units 2010

County	2010	County	2010
1. **Hinds**	103,421	6. Lee	35,872
2. **Harrison**	85,181	7. Lauderdale	34,690
3. **Desoto**	61,634	8. Forrest	32,289
4. **Jackson**	60,067	9. Jones	28,424
5. **Rankin**	56,487	10. Lowndes	26,556

Figure 3.14.5
Counties with the Greatest Housing
Loss and Gain (Percent) 2000 – 2010



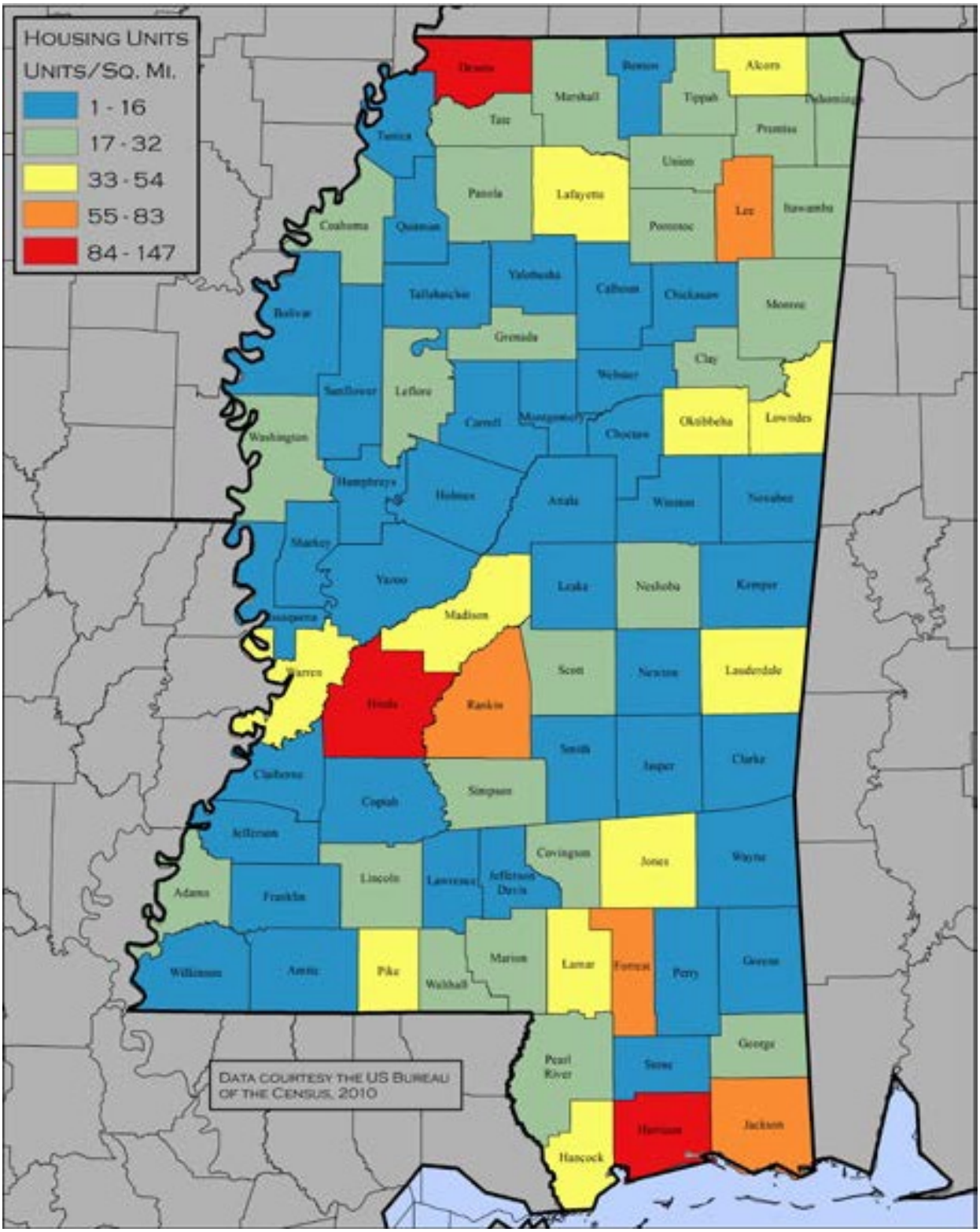
Density

Density is a ratio between the total land area and the total population (population density) or the total land area and the number of housing units (housing unit density). As previously stated, Mississippi has a surface land area of 46,914 square miles and in 2010 had a population of 2,967,297. The overall population density in the state is 63.2 per square mile and 27.2 housing units per square mile. Eleven counties were among the top ten in Housing Density and Population Density (see Table 3.14.11) Figure 3.14.6 illustrates density by county.

Table 3.14.11
Top 10 Counties Ranked by
Population/Housing Density - 2010

Geographic Area	2010 Housing Unit Density Per Square Mile		Geographic Area	2010 Population Density Per Square Mile
Harrison	146.62		Desoto	337.446
Desoto	128.98		Harrison	322.051
Hinds	118.99		Hinds	282.203
Jackson	82.63		Jackson	192.142
Lee	79.79		Lee	184.412
Rankin	72.93		Rankin	182.845
Forrest	69.20		Forrest	160.603
Madison	54.22		Madison	133.879
Lowndes	52.87		Lowndes	119.011
Lauderdale	49.31		Lauderdale	114.087

Figure 3.14.6
Housing Unit Density per Square Mile 2010

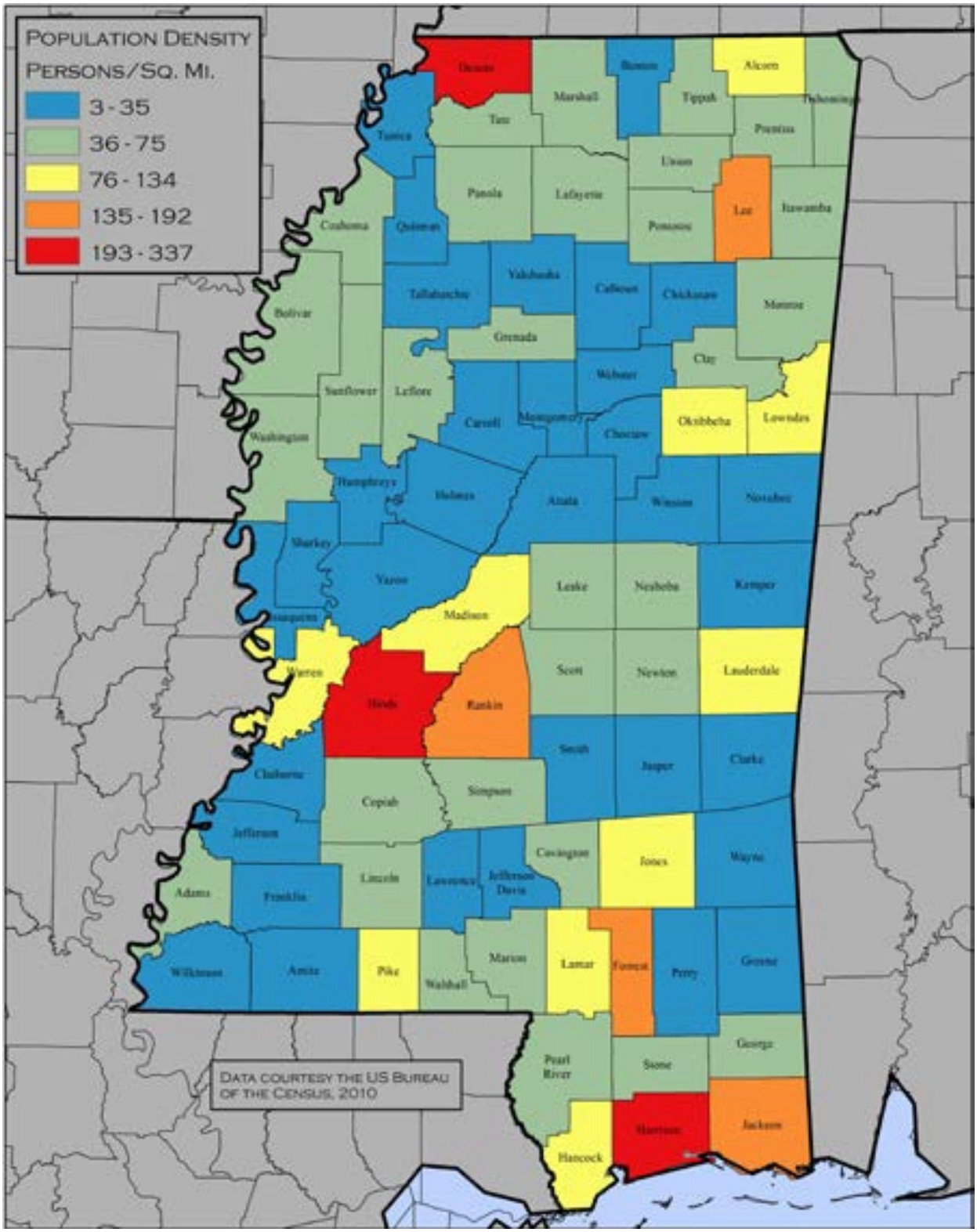


Typically, the fastest growing counties experience an increase in population density and housing density as new housing units are built to accommodate the increased growth, although this may not always be the case due to the varying land area located within each county (see Table 3.14.12 and Figure 3.14.7). The 10 most densely populated counties in Mississippi also have the most housing units (Table 3.14.11). Increases in the total number of housing units usually tracks population growth.

Table 3.14.12
Counties with Greatest Estimated Population Density Gains
2000-2010

Population Density per Square Mile of Land Area				
Geographic Area	2000	2010	Difference/Sq. Mile	% Change
Mississippi	**60.3**	**63.2**	**1.9**	**.04%**
Desoto	224.3	337.4	113.1	.50%
Rankin	148.9	182.8	33.9	.22%
Lamar	78.6	112.0	33.4	.42%
Madison	105.0	133.9	28.9	.27%
Lee	168.5	184.4	15.9	.09%
Lafayette	61.4	75.0	13.6	.22%
Jackson	180.8	192.1	11.3	.06%
Oktibbeha	93.7	104.2	10.4	.11%
Stone	30.6	39.9	9.3	.30%
Pearl River	59.9	68.8	8.9	.14%

Figure 3.14.7
Population Density Per Square Mile 2010



Effect of Hurricane Katrina on Population and Housing Units

Prior to the devastation of Hurricane Katrina in August 2005, the coastal counties of Hancock, Harrison and Jackson were experiencing steady population growth. According to the Census Bureau the combined population in 1970 was 239,944 and by 2000 the population increased to 363,988, a net increase of 124,044. Significant population shifts, and the damage inflicted on the residents of Mississippi were seen as immediate responses to Hurricane Katrina. The Census Bureau estimated the coastal counties lost 40,334 people immediately after the Hurricane. Figure 3.14.2 identifies the Mississippi Counties experiencing the most significant population shifts as a result of Hurricane Katrina.

Post-Katrina, the population changes and shifts continued with population growth in this region. In July 2007 the population was estimated to be 345,890, and by July 2009 the population was estimated to have increased to 349,294. The 2010 census shows a population of 363,995 which is essentially the same as the 2000 census.

Re-building efforts in the Gulf Coast region have been significant with federal, state and non-profit funding channeled toward critical infrastructure, housing and major employment centers. As evidenced by the stabilization of the population, it is expected this region will continue to be one of the most economically viable of the state.

Social Vulnerability

The University of South Carolina's College of Arts and Sciences Hazards and Vulnerability Research institute compiled a Social Vulnerability index which measures the social vulnerability of U.S. counties to environmental hazards. The purpose of this measure is to examine the differences in social vulnerability among counties. Based on national data sources, the index analyzed 42 socioeconomic and built environment variables that may contribute to the community's ability to prepare for, respond to and recover from hazards (i.e. social vulnerability).

Social vulnerability is partially a product of social inequalities – those social factors and forces that create the susceptibility of various groups to harm, and in turn affect their ability to respond and bounce back (resilience) after the disaster, (Susan L. Cutter, Bryan J. Boruff, and W. Lynn Shirley, 2003. "Social Vulnerability to Environmental Hazards," Social Science Quarterly 84(1):242-261.) .

Eleven composite factors were identified that differentiate counties according to their relative level of social vulnerability. These eleven factors include: personal wealth, age, density of the built environment, single sector economic dependence, housing stock and tenancy, race, ethnicity, occupation and infrastructure dependence.

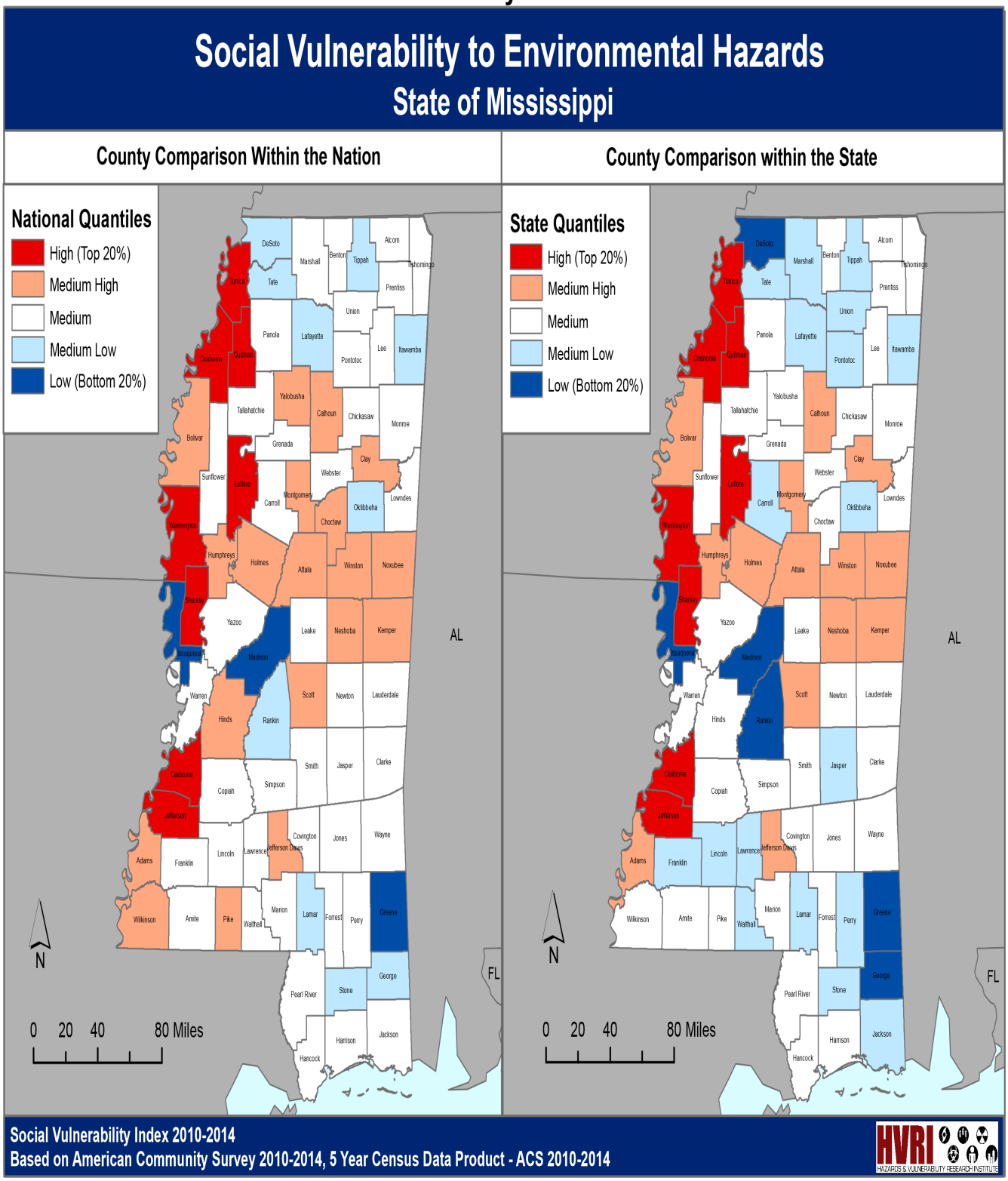
When applied to the state of Mississippi demographics, a determination can be made as to where social vulnerability and exposure to hazards overlap and how and where mitigation resources might best be invested. Figure 3.14.8 displays Mississippi's geographic variation in social vulnerability. According to the index, the following twenty Mississippi counties (Table 3.14.13) are the most vulnerable counties in the state.

Table 3.14.13
Top Twenty Counties Based on Social Vulnerability to Environmental Hazards

Ranking/County		SOVI*	National Percentile Ranking**	Ranking/County		SOVI*	National Percentile Ranking**
1.	Sharkey	7.15	98.30%	11.	Humphreys	3.95	93.20%
2.	Jefferson	5.21	96.20%	12.	Noxubee	3.67	92.10%
3.	Claiborne	5.17	96.10%	13.	Kemper	3.48	91.50%
4.	Coahoma	4.98	95.80%	14.	Neshoba	2.85	88.80%
5.	Leflore	4.789	95.50%	15.	Calhoun	2.69	87.50%
6.	Quitman	4.780	95.50%	16.	Montgomery	2.53	86.50%
7.	Tunica	4.69	95.20%	17.	Jefferson Davis	2.48	85.70%
8.	Washington	4.63	95.10%	18.	Adams	2.39	84.90%
9.	Bolivar	4.19	94.10%	19.	Attala	2.35	84.70%
10.	Holmes	4.05	93.70%	20.	Winston	2.19	83.20%

***SoVI® Score (42): The score using the previous version of SoVI® with 42 variables. This calculation includes built environment variables.**
****National Percentile (42): Where the county's SoVI® 42 score ranks in comparison with the rest of the nation.**
Source: Hazards & Vulnerability Research Institute. College of Arts & Sciences, University of South Carolina.

Figure 3.14.8
Social Vulnerability Index 2014



Summary

Mississippi is a relatively sparsely populated state. According to the 2010 U.S. Census among the 50 states, Mississippi ranked 31st in population and housing density; 34th in population density; and 40th in population growth rate between 2000 and 2010. The state has 46,906 square miles and a population of 2,967,297 according to the 2010 census.

Growth patterns in Mississippi are similar to those in other states with the most pronounced growth being in counties close to major cities or within Metropolitan Statistical Areas. Examples include Rankin and Madison counties within the Jackson MSA, adjacent to the capital city, and Desoto County within the Memphis MSA. Areas located close to universities such as Lamar County (University of Southern Mississippi) and Lafayette County (Mississippi State University) also show significant growth. Coastal counties including Pearl River, Stone, Hancock, Harrison and Jackson also experienced positive population growth. Population growth is often concentrated along economically desirable coastal areas that are at high risk of coastal flooding or storm surge.

Between 2000 and 2010, 39 of Mississippi's 82 counties gained in population and 13 of these gained by ten percent or more. The following counties experienced the most growth (numerical and/or percentage) during the 2000 decade: Desoto, Rankin, Madison, Lamar, Lafayette, Jackson, Pearl River, Lee, Oktibbeha, Stone, and Tate. The six most southerly counties all gained in population and the coastal counties of Harrison, Hancock, and Jackson have rebounded to pre-Katrina population numbers. Counties that experienced a loss of population are primarily located in the Mississippi Delta region where the economic base has historically been heavily reliant on agriculture. The following counties experienced double digit population loss: Sharkey, Jefferson, Claiborne, Washington, Quitman, Humphreys, and Bolivar.

Recent natural disasters heightened interest in consistent building codes, flood control, storm water control and protection of wetlands. Sustainable development, especially in the most populous counties, gained momentum. FEMA recently completed new flood maps for Mississippi and all six gulf coast counties adopted building codes including hurricane-resistant construction standards. Manufactured homes, mobile homes and recreational vehicle areas are considered vulnerable. There are also concentrations of older homes that remain a concern.

Future growth trends are predicted to range from .75% to 1.56% each decade. It is expected areas which have experienced the most significant growth during the first decade of this century will continue to lead the state with some "spill-over" into adjacent areas.

4.0 Comprehensive State Hazard Mitigation Program

It is essential that State and local mitigation policies be directed to reduce or eliminate the risk of future devastation and the corresponding impact on the citizens of the State of Mississippi. This can only be accomplished by establishing workable goals and objectives that integrate the efforts of state and local governments into one cohesive mitigation strategy that also takes full advantage of public-private partnerships.

Development of a sound mitigation strategy provides a focus that assists State and local governments in identifying priorities and channeling limited resources toward critical mitigation projects. This process helps government at all levels make the most effective use of available resources. "Local governments" include any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and an rural community, unincorporated town or village, or other public entity. Eligible governmental entities would also include all institutions, authorities, bodies or boards created under Federal, state or local authority to manage, oversee or regulate for a public purpose such as, but not limited to, special water/sewer districts, levee boards, floodplain management authorities, and agricultural or forestry boards.

The State of Mississippi will enhance its ability to complete its goals and objectives by taking maximum advantage of the mitigation resources available, both present and future, to reduce the impact of natural and human caused disasters on the citizens and infrastructure. The State will also vigorously pursue methods to augment existing state and local programs by involving other opportunities, such as public-private partnerships. Involvement of a wide range of participants in mitigation efforts, increases the feasibility of implementing mitigation projects as resources become available.

The State will provide, promote, and support education and training on the benefits of a comprehensive statewide hazard mitigation program for state agencies, local governments, and private enterprises. Throughout the process, Mississippi's citizens will remain a priority. With a comprehensive overview of the hazards that threaten Mississippi, goals and objectives have been developed to mitigate potential losses from those hazards.

Summary of Changes – 2018 Comprehensive State Hazard Mitigation Program

In updating the 2004 State of Mississippi Hazard Mitigation Plan, a total of 60 local plans were reviewed. An additional 32 approved local hazard mitigation plans were reviewed for the 2010 plan. For the 2013 plan update, a total of 104 local hazard mitigation plans were reviewed. For the 2018 plan update, a total of 34 local plans were reviewed. The decrease in local plans is due to the state moving more toward regional hazard mitigation plans. This section was updated with a commitment to improve on ways to reduce losses from natural/manmade hazards and to adequately reflect changes in development. A summary of changes is listed below:

Goals and Objectives (section 4.1) – Goals and objectives are described based on the updated hazard identification risk assessment and reconsideration of goals and objectives from the previously approved plan. One objective was added to Goal 1. The goals and objectives of local plans were reviewed. All tables and graphics/figures were updated with new data.

State Capabilities (section 4.2) – State agencies reviewed their capabilities and provided updates describing how their means and resources can aid mitigation efforts. All information was updated based on agency response. The Mitigation Programs Table was reviewed for update.

Local Capabilities Assessment (section 4.3) – Local capabilities were reviewed, analyzed, and evaluated for effectiveness and for improvement. All tables and graphics/figures were updated with new data.

Mitigation Measures (section 4.4) – Three new mitigation projects were added. These actions are noted as "New Mitigation Actions for 2018" in Table 4.4.2. One project was completed. All tables and graphics/figures were updated with new data.

Table 4.5.1 has been updated from the 2013 plan to include funding sources that are still active for the "2018 Plan Update".

4.1 Goals and Objectives

44 CFR §201.4(c)(3)(i) – The State mitigation strategy shall include the following elements:

A mitigation strategy that provides the State's blueprint for reducing the losses identified in the risk assessment. This section shall include:

A description of State goals to guide the selection of activities to mitigate and reduce potential losses.

This section describes the mission, goals, and objectives of the Mississippi State Hazard Mitigation Plan and the process used to update the goals and objectives in the 2018 update planning process. The state is tracking progress toward accomplishing the plan goals and improving alignment with local mitigation strategies (goals, objectives, and actions). The framework of the state's mitigation strategy has four parts: mission, goals, objectives, and actions, which are defined as the following:

- The mission is a philosophical or value statement that states the purpose and primary function of the plan.
- The goals describe the overall direction that the State will take to reach their mission.
- The objectives link the goals and actions and help organize the plan for efficient implementation and evaluation.

- The actions describe the activities or projects used to support the accomplishment of the goals and mission.

During the 2018 update process, the Hazard Mitigation Council reviewed the mission statement and the goals and objectives from the previously approved 2013 hazard mitigation plan. The Hazard Mitigation Council determined that the mission statement would be updated. The goals remain valid and were reaffirmed, and one objective would be added to Goal 1. The 2018 mission, goals, and objectives are the following:

Mission: To develop and maintain a disaster-resilient, sustainable Mississippi through perpetual planning and review of a comprehensive statewide mitigation strategy.

Goal 1 – Minimize loss of life, injury, and damage to property, the economy, and the environment from natural hazards

Objective 1.1 Protect critical facilities, infrastructure, and systems

Objective 1.2 Reduce the number of at-risk and repetitive loss and SRL properties

Objective 1.3 Reduce potential damage to future buildings and infrastructure

Objective 1.4 Develop and maintain hazards-related research, modeling, data, and analysis to support program and project implementation

Objective 1.5 Identify needs and appropriate projects from post disaster damage assessments

Objective 1.6 Preserve, create, and restore natural systems to serve as natural mitigation functions

Objective 1.7 Protect historic and cultural resources

Objective 1.8 Provide state and local agencies with a statewide communications network with an Interoperable, highly reliable, fast access, public safety-grade communication system for use during events that threaten the health and welfare of the citizens of Mississippi.

Objective 1.9 Promote State identified mitigation initiatives, such as saferooms, storm shelters and severe weather warning systems.

Goal 2 – Build and enhance local mitigation capabilities

Objective 2.1 Support and provide guidance for local hazard mitigation planning and projects

Objective 2.2 Encourage the adoption, improvement, and enforcement of local

codes, ordinances, and land use planning

Objective 2.3 Provide and promote technical assistance and training to local governments

Objective 2.4 Identify and provide financial incentives and funding opportunities

Goal 3 – Improve public education and awareness

Objective 3.1 Develop and improve outreach programs and materials to increase awareness to the public and private sector about risk and mitigation in Mississippi

Objective 3.2 Promote and utilize existing hazard mitigation education programs from state, federal, and nonprofit sources

Objective 3.3 Develop tailored outreach strategies for vulnerable populations, such as tourists, disabled persons, children and the elderly, non-English speakers, and low-income residents

Goal 4 – Sustain and enhance a coordinated state mitigation program

Objective 4.1 Strengthen coordination, communication, capabilities, and partnerships with levels of government, the private sector, and nonprofit organizations

Objective 4.2 Institutionalize hazard mitigation as integrated state policy

Objective 4.3 Implement, monitor, and assess the effectiveness of the mitigation strategy and promote successes

Process for Updating Goals and Objectives

The goals and objectives of the 2004 plan were a compilation of previous goals and objectives from the Mississippi 409 plan, as well as those being implemented through other state agencies involved in the mitigation planning process. As part of the 2007 plan update, the goals and objectives from the 2004 plan were reviewed and revised to addressed current and anticipated future conditions. On April 22, 2010 the Hazard Mitigation Council met to assess the goals and objectives from the previously approved 2007 hazard mitigation plan. The Council determined that the goals and objectives still remain valid and would not be changed in the 2010 update. On January 23, 2013 the Hazard Mitigation Council met to assess the goals and objectives from the 2010 hazard mitigation plan. The Mitigation Council determined that the goals and objectives still remain valid and would remain the same for the 2013 plan hazard mitigation plan. On March 8, 2018 the Hazard Mitigation Council met to assess the goals and objectives from the 2013 hazard mitigation plan. The Mitigation Council determined that the goals remain valid, but one objective would be added to Goal 1. The review for the 2018 update was based on the following:

- The updated statewide risk assessment, which includes changes in growth and development, recent state and federal declared events, enhanced vulnerability assessments, and analysis of local risk assessments;
- Assessment of changes and challenges in state and local capabilities since the 2013 plan;
- Types and status of mitigation actions from the 2013 state plan;
- Analysis of the similarities and differences of the state mitigation plan goals with local mitigation plan goals and objectives; and
- The development of a more integrated strategic plan framework for aligning goals, objectives, and actions.

As a result of this review, the Hazard Mitigation Council updated the mission statement and reaffirmed the goals and updated the objectives from the 2013 hazard mitigation plan.

The key issues identified in the statewide risk assessment and the analysis of local risk assessments can be found in Section 3 Risk Assessment. Information on the changes in state and local mitigation capabilities is summarized in Sections 4.2 State Capability Assessment and 4.3 Local Capability Assessment. The following section describes how the local mitigation plan goals and objectives were reviewed and considered during the 2018 update. Section 4.4 Mitigation Actions includes detailed and updated mitigation measures designed to meet the designated goals and objectives. Progress on these actions is evaluated in Sections 4.4 and Section 4.5 Effective Use of Available Mitigation Funding.

Review of Local Goals and Objectives

The Hazard Mitigation Council analyzed the goals and objectives of FEMA-approved local hazard mitigation plans in Mississippi to assess their consistency with state goals and objectives. The analysis involved calculating the percentage of local plans (out of a total of 34 plans) that have a similar goal or objective to each of the goals and objectives in the 2013 Mississippi State Hazard Mitigation Plan. There were 70 less plans to review since the 2013 update due to the state moving toward regional plans. The data collection involved some interpretation because many local goals and objectives addressed multiple issues. The results of the analysis are presented in Table 4.1.1

Table 4.1.1
Local Plans with a Goal or Objective Similar To State Plan Goals and Objectives

2013 Mississippi State Mitigation Goals (G) and Objectives (O)	Local Plans with Similar Goal	Local Plans with Similar Objective	Local Plans with Similar Goal or Objective	Relation to 2018 Updated Goals and Objectives
G1 Minimize loss of life, injury, and damage to property, the economy, and the environment from natural hazards	97%	61%	97%	Goal is the same
G2 Build and enhance local mitigation capabilities	68%	65%	74%	Goal is the same
G3 Improve public education and awareness	79%	64%	91%	Goal is the same
G4 Sustain and enhance a coordinated state mitigation program	73%	52%	73%	Goal is the same
O1.1 Protect critical facilities, infrastructure, and systems	97%	64%	97%	Objective is the same
O1.2 Reduce the number of at-risk and repetitive loss properties	55%	61%	68%	Objective is the same
O1.3 Reduce potential damage to future buildings and infrastructure	70%	55%	76%	Objective is the same
O1.4 Develop and maintain hazards-related research, modeling, data, and analysis to support program and project implementation	45%	61%	67%	Objective is the same
O1.5 Identify needs and appropriate projects from post disaster damage assessments	0%	0%	0%	Objective is the same
O1.6 Preserve, create, and restore natural systems to serve natural mitigation functions	9%	0%	9%	Objective is the same

O1.7 Protect historic and cultural resources	6%	0%	6%	Objective is the same
O1.8 Provide state and local agencies statewide communications with an interoperable, highly reliable, fast access, public safety-grade communication system for use during events that threaten the health and welfare of the citizens of Mississippi	6%	30%	33%	Objective is the same

2013 Mississippi State Mitigation Goals (G) and Objectives (O)	Local Plans with Similar Goal	Local Plans with Similar Objective	Local Plans with Similar Goal or Objective	Relation to 2018 Updated Goals and Objectives
O2.1 Support and provide guidance for local hazard mitigation planning and projects	55%	58%	67%	Objective is the same
O2.2 Encourage the adoption, improvement, and enforcement of local codes, ordinances, and land use planning	6%	3%	6%	Objective is the same
O2.3 Provide and promote technical assistance and training to local governments	36%	48%	52%	Objective is the same
O2.4 Identify and provide financial incentives and funding opportunities	0%	0%	0%	Objective is the same
O3.1 Develop and improve outreach programs and materials to increase awareness to the public and private sector about risk and mitigation in Mississippi	73%	67%	91%	Objective is the same
O3.2 Promote and utilize existing hazard and mitigation education programs from state, federal, and nonprofit sources	6%	18%	48%	Objective is the same
Q3.3 Develop tailored outreach strategies for vulnerable populations, such as tourists, disabled persons, children and the elderly, non-English speakers, and low-income residents	0%	3%	3%	Objective is the same
O4.1 Strengthen coordination, communication, capabilities, and partnerships with all levels of government, the private sector, and nonprofit organizations	61%	58%	73%	Objective is the same
O4.2 Institutionalize hazard mitigation as	0%	0%	0%	Objective is the

integrated state policy				same
O4.3 Implement, monitor, and assess the effectiveness of the mitigation strategy and promote successes	61%	15%	48%	Objective is the same

The state goals most represented in local plans are Goal 1 and Goal 3. State Goal 1: Minimize loss of life, injury, and damage to property, the economy, and the environment from natural hazards. When compared to local goals and objectives, ninety-seven percent of local plans had a goal or objective to minimize loss from natural hazards.

Seventy-nine percent of local plans have a goal similar to State Goal 3: Improve public education and awareness. In addition, the state objective 3.1 to develop and improve outreach programs and materials to increase awareness to the public and private sector about risk and mitigation in Mississippi received the highest percentage of similar objectives in local plans (67 percent). Objectives 1.5 identify needs and appropriate projects from post disaster damage assessments, 1.6 preserve, create, and restore natural systems to serve natural mitigation functions, 1.7 protect historic and cultural resources, 2.4 identify and provide financial incentives and funding opportunities, and 4.2 institutionalize hazard mitigation as integrated state policy received the lowest percentage of all the objectives (0 percent).

The Hazard Mitigation Council also analyzed other goals and objectives that occur commonly in local plans; some differ from state goals and objectives. Table 4.1.2 lists common goals and objectives in local plans and the percent of plans that contain the similar goal or objective.

Protect/improve critical facilities was the issue most common in local plans. Objective 1.1 in the state plan also addresses this issue. Increasing local capacity for mitigation and emergency management was another common issue (78 percent). Involving and/or educating public officials in natural hazards mitigation and enhancing public warning and information systems were also common. State Goal 3 and Objective 3.1 and Objective 2.3 share this common issue. Promoting local hazard mitigation plans was a frequent goal or objective in local plans (72 percent). Sixty percent of local plans seek to support state identified initiatives.

Table 4.1.2
Other Goals and Objectives Common in Local Plans

Common Goals and Objectives in Local Plans	Percentage of Local Plans with Goal or Objective
Protect/improve critical facilities	97%
Promote local hazard mitigation plans	67%
Improve emergency response operations	31%
Increase local capacity for mitigation and emergency management	74%
Involve and/or educate public officials in natural hazards mitigation	73%
Enhance public warning and information systems	33%
Monitor effectiveness of measures and initiatives	61%
Identify and address repetitive loss properties	68%
Reduce damage to future buildings and infrastructure	76%
Increase property acquisitions	13%
Integrate mitigation in land use planning	13%
Promote the National Flood Insurance Program	9%
Encourage jurisdictions to implement and share GIS system	67%
Improve and retrofit public buildings	97%
Protect business continuity and economic vitality	25%
Improve sheltering capabilities	6%
Plan for continuity of local government operations	31%
Plan for vulnerable populations	31%
Develop or improve storm water/drainage programs	0%
Improve communications systems	63%
Support State identified initiatives	16%
Improve evacuation capabilities	3%
Seek funding for mitigation	0%

4.2 State Capabilities

44 CFR §201.4(c)(3)(ii) – The State mitigation strategy shall include the following elements:

A mitigation strategy that provides the State's blueprint for reducing the losses identified in the risk assessment. This section shall include:

A discussion of the State's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas

4.2.1 State Policy and Programs

The State of Mississippi authorizes local governments to regulate development in flood-prone hazard areas. The State has not assumed authority to oversee development in flood-prone or hazard areas. Similarly, while the State has passed enabling legislation for local governments to zone and to adopt building codes, it has not sought the authority to do so

All state agencies with state-owned or leased buildings that are located in a special flood hazard area are required to carry the maximum amount of flood insurance. The premiums are paid out of the agencies operating budget.

State funding capabilities for hazard mitigation projects: mitigation projects require a non-federal match of 25% or more. Mitigation projects do not have a State identified funding source. Projects throughout the State are implemented with a non-federal match from budgeted funds, CDBG funds or in-kind match. The applicant or sub-grantee will be provided administrative and technical assistance to implement a proposed project. Administrative and management cost are available to the state and local governments that participate in federal mitigation grant programs.

The following are eligible federal funds available to contribute to the 75 / 25 local matches for overall funding:

- U.S. Department of Housing and Urban Development Community Development Block Grant Funds,
- Appalachian Regional Commission Funds
- Indian Health Service Funds
- Increased Cost of Compliance (ICC) to fund elevation, relocation, demolition, and floodproofing costs,
- Small Business Administration funds, and
- Federal Housing Administration loan funds.

Each State agency from the 2013 plan was afforded the opportunity to review their mitigation capabilities from the existing standard plan and provide updates to their current agency capabilities. This was accomplished by personal contact with agencies represented at the Hazard Mitigation Council meetings.

For those agencies who were not physically present at these events, an email which included a copy of their 2013 capability response and instructions as to how to evaluate their 2013 capabilities requesting them to review for update. The agencies who did not have changes are noted as no change from the 2013 submittal in the agency capabilities listed below.

Mississippi Emergency Management Agency (MEMA)

Authority for mitigation: Miss. Code 1972, Annotated. 33-15-7 Et. Seq.

The Office of Mitigation is responsible for coordinating disaster loss reduction programs, initiatives, and policies throughout the State of Mississippi. Disaster loss reduction measures are carried out through disaster reduction programs, initiatives, and policies through the development of State and local Hazard Mitigation plans and the implementation of strategies identified in the plans.

The Office of Mitigation administers the Hazard Mitigation Grant program, the National Flood Insurance Program's Community Assistance Program and Risk Map Program, the Flood Mitigation Assistance Program, and the Pre-Disaster Mitigation program, and Severe Repetitive Loss Program. The Office of Mitigation's Staff has grown from six to currently fourteen personnel. Floodplain Management, Grants and Planning Staff are assigned to all six districts in the state. Mitigation Bureau Staff have been extensively trained in Benefit Cost Analysis, Grants Management, National Flood Insurance Program, Plan review, CAV, CAC, environmental, project application review, HAZUS and NEMIS Entry.

The Mitigation Grants\Plans Bureau administers hazard mitigation grants to State and local governments. These grants include mitigation planning grants, drainage projects, acquisition of high-risk flood structures, retrofitting critical facilities, warning systems, saferooms and storm shelters, and other cost-effective measures identified in the State and local government's Hazard Mitigation Plan. The Mitigation Grants\Plans Bureau has developed a web site, www.MitigationMS.org that allows local governments/eligible applicants to submit applications online.

The Mitigation Planning Division within the Bureau of Mitigation Grants\Plans is responsible for maintaining and updating the State of Mississippi Standard Hazard Mitigation Plan, which documents statewide hazard risk and the capability to mitigate the risk. The Planning Division also works with other state agencies, regional planning authorities, and local governments in the development of mitigation plans and strategies. The Mitigation Plans Division also provides technical assistance and training to local governments and state agencies in the development of their local hazard mitigation plans and keeps the local governments apprised of any new advances or policy changes in hazard mitigation planning.

The Floodplain Management Bureau serves as the only compliance/regulatory focused bureau within the Agency. It is charged with the management of the Community Assistance Program – State Support Services Element (CAP-SSSE) which consists of providing oversight for the 330 participating National Flood Insurance Program (NFIP) communities and the 29 Community Rating System (CRS) members within the state.

A compliant community membership in the NFIP provides both the citizens and their communities with the opportunity to utilize the federal flood policies to protect their property and qualify for various grant and disaster assistance programs. As of 4/3/2018, this program has resulted in 64,320 individual flood insurance policies that equate to an insured flood damage coverage of $ 15.6 billion dollars. There have been 61,055 claims paid since 1978, in the amount of $3.0 billion dollars. There were 1600 substantially damaged structures. Those actions resulted in payments of $30.2 million dollars which resulted in the approximate 1,600 flood damaged structures being elevated or demolished (mitigated) within two years of damage.

The Bureau's staff conducts an average of 50 Community Assistance Visits (CAV) compliance inspections per year. These inspections ensure the compliance of the communities with the NFIP, which enables them to participate in the five Hazard Mitigation Assistance (HMA) programs, the state's Hazard Mitigation Planning process, and the various disaster assistance programs administered by the federal government. Additionally, there is an average of 10 FPM training sessions or workshops conducted per year, as well as numerous technical assistance actions to state and local associations and to community governments.

The FPM Bureau is tasked with coordinating the agency's portion of the Risk Map Program. Risk Map expands traditional flood mapping to include risk assessment and mitigation planning. Risk Map is meant to better inform communities as they make decisions related to reducing flood risk by implementing all mitigation actions. This project calls for 4 meetings: Discovery, Flood Risk Review, Resilience, and Final/COO and Public. This bureau will support meeting for technical information. If flood map work occurs in the community, then the FPM will help by guiding local official with map adoption. The FPM Bureau will assist MDEQ on performing project outreach activities.

The Floodplain Management Bureau continues to conduct specialized training for state and local officials, such as offering the national Certified Floodplain Manager examination as a tool to both increase the professionalism and knowledge base within the floodplain management field. Since the inception of the CFM program within the United States, there have been 160 Mississippians certified as floodplain managers (as of 4/3/2018).

Department of Agriculture and Commerce

(No change from the 2013 submittal)

Authority for Mitigation: Miss. Code 1972, Annotated. 69-1-1 (19720 Et. Seq.

The Department performs a regulatory function in the areas of sanitary inspections of grocery stores; agriculture theft; meat inspection; fruit and vegetable inspection; feed, seed, fertilizer and soil and plant inspection; weights and measure. The Department operates a seed testing laboratory, a metrology laboratory, and a grain moisture testing laboratory. The mitigation function of the agency is to ensure a sanitary food supply where the Department has authority.

Department of Archives and History

(No change from the 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 39-5-1.

This agency has custody of and maintains care of all state records and material pertaining to the history of Mississippi. It also administers the State Records Management Program. It aids mitigation by supplying information on the frequency and severity of past disasters and the effectiveness of recovery efforts. It also supplies historical information on sites of proposed mitigation projects. Archives and History is a first response agency and is responsible for responding after a disaster to retrieve and stabilize record recovery for government offices. According to Federal Section 106 Review – Archives and History is required to make comment on debris removal on any project involving federal funding. The agency is collaborating with MEMA to develop a GIS data system in order to have that data (what is in place/existing) prior to a disaster.

Department of Audit

(No change from 2013 submittal)

Authority for mitigation: Miss. Constitution, 1890. Art. V, 134.

The State Auditor's Office conducts and maintains inventories of all state property. It aids mitigation by providing information on the state's physical and financial resources and their locations.

Information Technology Services

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 25-53-5.

This agency is responsible for: the cost-effective acquisition of data processing equipment and services for use by state agencies; computer communication facilities to provide necessary services to state government; engaging in the long-term planning of equipment acquisition for state agencies, and training state personnel in the use of equipment and programs. Information Technology Services (ITS) aids mitigation by maintaining communication and information networks and ensuring adequately trained personnel to operate them.

As a member of the Mississippi Coordinating Council for Remote Sensing (RS) and Geographic Information Systems (GIS), ITS maintains the Mississippi Geospatial Clearinghouse, which is designed to house the Mississippi Digital Earth Model (MDEM). The MDEM is comprised of the following GIS data layers: Geodetic Control, Elevation and Bathymetry, Orthoimagery, Hydrography, Transportation, Government Boundaries, and Cadastral. The Mississippi Geospatial Clearinghouse will be accessible to local governments, state and federal agencies, planning and development districts, and private entities in support of disaster mitigation, planning, and recovery.

Mississippi Development Authority

(No change from the 2013 submittal)

Marketing and Communications Division

Authority for mitigation: Miss. Code 1972, Annotated 33-15-2

Timely communication during and after a disaster to prevent loss of life and to mitigation public danger and property damage. Specifically, mitigation of business-related damage.

The MDA Communications Director serves also as the State's CIO/Public Information Officer (PIO) acting as a key member of the agency's emergency response team to perform essential functions including handling all media inquiries, organizing press conferences and press releases, and responding to information inquiries from Mississippi businesses and industries.

Under MEMA ESF 11 and 15, the PIO coordinates where appropriate with the Joint Information Center at MEMA and may provide communication support to MEMA during and after a disaster. When needed, the agency may activate a call center. The PIO will assist in the staffing and operation of the call center.

Mitigation and minimization of damage through timely communication is a key objective of this function.

Community Services Division

Authority for mitigation: Miss. Code 1972, Annotated. 57-1-5 (1984 supplement).

Administration of Community Development Block Grant (CDBG) Program funding for the non-Federal share of mitigation projects.

The Community Services Division creates a climate favorable to community growth and development. It administers the Community Development Block Grant Program (CDBG) and aids mitigation by funding the non-Federal share of hazard mitigation projects.

Department of Environmental Quality

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 49-2-9 Et. Seq.

The Department of Environmental Quality promulgates rules and regulation; receives and expends state and federal funds, conducts studies on alternate uses of natural resources; and responds to incidents that threaten them. It aids mitigation by protecting the state's natural resources and regulating their use. The Dam Safety Division is housed in the agency. MDEQ and MEMA serve as State Technical Partners in the Risk Map Program and in active participants in the Mississippi Digital Earth Model and Remote Initiative.

MDEQ in collaboration with MDA, is administering the use of HUD CDBG funds designated for the development and enhancement of new water, wastewater and storm water infrastructure on the Gulf Coast. Key in the development of the Master Plan for this program was providing infrastructure in areas less likely to be impacted by storms. Additionally, MDEQ has expanded ability to respond and collaborate with our State and Federal Partners in natural disaster related impacts such has debris disposal management, hazardous material management and wastewater treatment system recovery.

Department of Marine Resources

(No change from 2013 submittal)

Authority for Mitigation: Miss Code 1972, Annotated. 49-15-11 (1972)

This agency aids hazard mitigation through (1) buyout programs, (2) preservation, creation, restoration, and enhancement activities, (3) education and outreach programs, and (4) our Mississippi Coastal Preserves Program. With buyouts, we partner with federal and state agencies, environmental organizations, and the private sector to identify susceptible, repetitive-loss properties and move them into public ownership through donation, purchase, or other means. F These partnerships also facilitate our preservation, creation, restoration, and enhancement programs. DMRs current plan, which was endorsed by Governor Barbour, is to preserve, create, restore, or enhance over 15,000 acres of coastal marsh, wetlands, or forests, to double the footprint of Deer Island, and to restore our offshore barrier islands (Petit Bois, Horn, Ship, and Cat Islands) to their pre-Camille footprint and functionality. Our education and outreach programs are through partnerships with local academic institutions, other state and federal agencies, and the private sector. We focus on environmental conservations, principles and practices of smart growth and smart code, sustainable development, and sound environmental stewardship. Our Coastal Preserves Program is a partnership with the MS Secretary of State and the MS Legislature through which parcels of land are identified as complimentary to increased environmental protection and conversation, those parcels are acquired through purchase, donation, or other means, and funds are provided to manage and enhance those properties.

Department of Public Safety

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972

The Department of Public Safety (DPS) aids mitigation by enforcing traffic laws and regulations on Mississippi highways and roads. It issues and renews driver's licenses, furnishes qualified personnel to take part in investigations, and provides assistance to communities during emergencies and disasters.

This department also houses the Office of Homeland Security. The Mississippi Office of Homeland Security assists by providing funding to state and local agencies. This funding is used to purchase preparedness equipment, provide training and certification to first responders, develop plans and standard operation guidelines for agencies and response teams, and to exercise and evaluate these response plans.

DPS also works with MDOT and Louisiana State Police during emergencies to provide logistical and security support consistent with contraflow operations on our Interstates. DPS also now has the capability to feed and fully support our first responders when deployed to a disaster area. DPS has also added an additional helicopter designated to assist in search and rescue operations as well as having a heavy lift capability.

Department of Wildlife, Fisheries, And Parks

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. §49-1-29; §49-4-1, Et. Seq.

The Department of Wildlife, Fisheries and Parks aids in hazard mitigation through its conservation and protection of wildlife habitats, and freshwater and estuarine fisheries and ecosystems.

Institutions of Higher Learning

Authority for mitigation: Miss. Code 1972, Annotated. 37-101-1.

Mississippi Institutions of Higher Learning, through its eight universities, continues mitigation efforts to provide safe environments for its employees, faculty, students, and guests. Additionally, Mississippi Institutions of Higher Learning contributes to statewide hazard mitigation efforts though education, research, technical assistance, community service, and facilities.

Mississippi Insurance Department

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 83-1-1 Et. Seq.

The Insurance Department executes all laws relative to insurance companies, corporations, associations, and their agents and adjusters. It aids mitigation by licensing and regulating manufacturers and dealers of mobile homes; enforcing the LP gas inspection program; and administering the Standard Fire Code. The State Fire Marshal's office is located in the Department of Insurance.

Since 2005, the following changes have been created, made, or supported by the Mississippi Insurance Department (MID) which support hazard mitigation:

- The creation and continued progress of the MID Hurricane Katrina Mediation Program which can now be used to mediate future disaster claims.
- The creation and continued progress of the MID Hurricane Katrina Arbitration Program which may also be used in arbitration of future claims.

- The development and continued use of a Flood Insurance Outreach program.
- The development and continued use of an updated Storm Preparedness web site.
- Support from MID and the State Fire Marshal's office of the state legislation which created the Building Codes Council which advocates stronger building codes for coastal communities.
- Regulation which now requires the licensing of public adjusters in Mississippi
- Policy holder Bill of Rights regulation which will assist consumers in completely understanding homeowner policy coverage
- Working with Governor's office in securing CDBG grant funds to assist funding for the Mississippi Windstorm Underwriting Association, which will aid in lowering premium costs for both homeowner's and businesses
- Championed passage of the Wind Pool Bill which sets in place future state funding for the program

*NOTE: The State Fire Academy, a sub-agency of the Mississippi Insurance Department, submitted its plans separately.

Mississippi Library Commission

(No change from 2013 submittal)

Authority for mitigation: Mississippi Code 1972, Annotated, 39-3-107.

The Library Commission gives advice to libraries and communities on establishing and maintaining libraries; accepts and uses funds to establish, stimulate, increase, improve, and equalize library services; adopts rules/regulations relative to the allocation of state aid funds to public library systems; and operates a library to support libraries, state government, and the public. The agency's mission is "Commitment – through leadership, advocacy, and service d- to strengthening and enhancing libraries and library services for all Mississippians."

To accomplish this mission, the Library Commission:

1. Operates a secure, state-of-the-art 62,000 sq. ft. facility at 3881 Eastwood Drive in Jackson, MS.

   The five-story building, of poured concrete and steel, includes: one below-ground level; wired and wireless high-speed Internet connectivity; a natural gas-powered generator to support basic functions, including data center, in power outages; 100+ windows throughout the building that open; meeting rooms equipment with distance learning capabilities and kitchen facilities; computer training facilities; public access computers; large parking lots; large, open research facilities; and a state-of-the-art data center to support Internet services to Mississippi public libraries & the agency's networking needs.

2. Operates a large library with traditional and electronic information resources and a highly qualified research staff to respond to requests for information and in-depth research. Provides interlibrary loan services for specific titles and loans materials on a short-term and long-term basis to libraries, state

government, and the general public. Serves as the only library for the blind and physically handicapped in the state. Is the only patents and trademarks library in the state. Is a depository for federal publications and the depository of all publicly-released publications of state government.

3. Provides consulting services to library staffs, trustees, and local governments on establishing and maintaining library services.

4. Provides grant funds, federal and state, to public libraries.

5. Works with public libraries statewide.

   People have access to public library services in all 82 MS counties. All 241 public libraries are managed by trained, dedicated staff with local community knowledge, skills to assist the public and high-speed Internet capabilities available through multiple public access computers. Most have meeting room facilities with kitchen facilities, large reading rooms, comfortable seating, study tables, etc.

6. Is a member of the statewide cultural alliance comprised of the MS Arts Commission, the MS Department of Archives & History, the MS Humanities Council, and the Library Commission.

   The purpose of the "Culture Club" is to coordinate responses in case of an emergency; to encourage local cooperation among cultural organizations (i.e. libraries, museums, visual & performing arts groups, etc.); to secure funds, supplies, manpower, and facilities to protect cultural heritage such as local histories, city & county records, art works, buildings, etc. before and after a disaster.

In case of an emergency the Library Commission:

- Serves as clearinghouse for evacuated or stranded public library employees and public library systems to ensure communication outside disaster area.
- Provides public library systems with access to remote office space/equipment/supplies to ensure business continuity.
- Secures and delivers needed resources (supplies, equipment, labor, library materials, etc.) to affected libraries.
- Identifies and seeks outside funding and assistance.
- Connects affected libraries with funders, opportunities, suppliers, vendors, counselors, etc.
- Advocates for libraries at local, state, and national levels on:
    - Central community roles of libraries including communications; connectivity; comfortable, safe environment; staff trained to assist; meeting facilities; etc.
    - Funding needs.
    - Role of libraries as early responders in times of disaster.

- Modifies rules & regulations to accommodate affected libraries & libraries serving the affected public (evacuees, law enforcement, military, relief workers, volunteers, etc.).
- Serves as spokesperson with state, national, and international media.
- Seeks speaking opportunities to tell library story and story of lessons learned.
- People turn to libraries in times of emergency for information, for access, for comfort, and for a place of refuge. After Katrina, this fact was validated as evacuees sought shelter further inland or returned to affected areas.
- Supports work of libraries serving the affected public in many ways including:
    - Reestablishing public library service as quickly as possible.
    - Setting up alternate ways to deliver services through temporary facilities, donated bookmobiles, information kiosks, satellite Internet connectivity, etc.
    - Using trained library staff to assist people, relief workers, city/county government, etc.
    - Serving as communication centers; volunteer coordination centers; relief centers and early responders.
    - Expanding library hours to accommodate people in need;
    - Issuing library cards to anyone temporarily living in community;
    - Designating library computers for relief-efforts-only to for completion of FEMA and insurance forms online, to contact friends and family, and to search for assistance;
    - Offering free photocopy and fax services.
    - Using library facilities to accommodate relief workers and relief efforts. Serving as relief centers for water/ice, blue tarp distribution, makeshift shower facilities, food stamp card distribution, etc.

The Mississippi Library Commission and the Mississippi library community have a great deal to contribute to mitigation before and after an emergency. The library garners public trust: despite being a public institution, it is not perceived as "the government". Several factors make libraries ideal as early responders to emergencies: the library staff is trained to assist the public; libraries have multiple points-of-access to high speed connectivity, which facilitates communication; and in many instances, the facilities can accommodate larger groups of people.

Mississippi Automated Resource Information Systems (MARIS)

Authority for mitigation: Miss. Code 1972, Annotated. 57-13-23.

Mitigation capability: MARIS stores, processes, extracts, and disseminates useful information on the state's natural and cultural resources. The Policy Committee is made up of representatives from 22 state agencies. The agency aids mitigation by developing and promoting use of uniform standards for geographic information systems used in state agencies.

Mississippi Department of Transportation

(No change from the 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 65-1-13.

The following is a brief description of the Mississippi Department of Transportation's (MDOT) on-going Hazard mitigation capabilities.

1. Construction, reconstruction and maintenance of transportation facilities vital to evacuation, response, and re-entry. This includes but is not limited to seismic retrofitting of bridges, the upgrading of traffic control devices after destruction, construction of transportation facilities to avoid flood prone areas whenever possible, and other precautionary design work – including wetlands mitigation – which reduces risk before, during and after an emergency.

2. Education and communication outreach programs to include information provided to the general public concerning Contraflow, pet evacuation, and general preparedness.

3. Training for MDOT response personnel at all levels for a wide range of natural and man-made hazards.

4. In-house emergency coordination staff increased from 4 in 2005 to 15 today; this group is MDOT's ESF-1 representative at the State Emergency Operations Center.

5. Maintenance of a Comprehensive Emergency Transportation Response Plan which is updated regularly.

6. Emergency preparedness for a 72-hour window of self-sufficient after a disaster. This is accomplished through improvements made to emergency supplies, storage facilities, acquiring sufficient fuel reserves, as well as housing, food and water for transportation emergency workers.

7. Improvements in communication capabilities through the purchase of additional satellite radio units to serve as redundant communications backup. In addition, a mobile communications platform and a command/control center have been made operational.

8. Evaluation of standard operating procedures in all areas, but specifically within procurement to enable the agency to function more efficiently and quickly in the purchase of emergency supplies.

9. Provision of remote traffic sensing, which will aid in traffic management during evacuations and re-entries.

10. Development of partnerships with various state, federal and/or local agencies to save lives and reduce future losses. These include:

    a) The GIS Coordinating Council in the development of the Mississippi Digital Earth Mapping Initiative.

    b) Key emergency response agencies to aid in providing fuel. These agencies include the Mississippi Emergency Management Agency, Mississippi Department of Health, and Wildlife, Fisheries and Parks.

11. Acquiring travel trailers to provide housing accommodations for transportation emergency workers during extended events.

12. Placement of three Mobilization Centers in northwest Mississippi to provide for command/control and serve as a base of operations to support earthquake emergency response activities.

Mississippi Authority for Educational Television (d/b/a Mississippi Public Broadcasting)

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 37-63-1 Et. Seq.

Mitigation capability: Mississippi Public Broadcasting (MPB) is a public service agency, providing the citizens of the state with Educational, Public Service and Informative programming. Mississippi Public Broadcasting adds mitigation by serving as the primary source for statewide Emergency information utilizing its network of Radio and Television transmitters and towers. MPB supports MEMA with technical and production staff and broadcast equipment to offer video and audio to all outside news organizations from MEMA's Press Room and aids in the operation of the Joint Information Center. The Mississippi Department of Transportation, in partnership with MPB, had identified MPB FM frequencies on evacuation route signs. When a mandatory evacuation is ordered, MPB is required to provide updates every 15 minutes via its statewide Radio network. In the event of a state of emergency, MPB Radio will broadcast crucial information as long as a need for information exists.

Mississippi Forestry Commission

Authority for Mitigation: Miss. Code 1972, Annotated § 49-19-3(b).

The Mississippi Forestry Commission, by statute, has the responsibility "To take such action so as to provide and maintain the organized means, as deemed necessary and expedient, to prevent, control and extinguish forest fires…"

Established in 1926, the Mississippi Forestry Commission (MFC), protects the state's valuable forest resources from wildfire, manages approximately 480,000 acres of forested 16th Section Public School Trust Lands, and delivers quality forest management services and assistance to both rural and urban landowners. Their mission is to provide active leadership in forest protection, forest management, forest inventory, and effective forest information distribution, necessary for Mississippi's sustainable forest-based economy. There are approximately 19.8 million forested acres in Mississippi.

The MFC has apportioned Mississippi into four (4) administrative regions, each with full complements of staffed bulldozer/plow units utilized to suppress wildfires. The MFC's central dispatch center and aerial detection resources provide the capability of coordinating wildland fire mitigation efforts. The MFC uses the Incident Command System when engaged in wildland fire suppression efforts (and other natural disaster response situations) to determine where the MFC's resources are needed to support mitigation and recovery efforts.

The Public Outreach Division of the MFC's Forest Information Department provides the capability to inform and educate the public and private sectors. The Forest Information Department supports all Mississippi Forestry Commission program areas by providing information dissemination, educational presentations, and public relations support. A variety of mass media delivery methods are used in order to reach the public in the most effective manner. The MFC's Firewise Coordinator is actively engaged in promoting the means by which individuals and communities can take measures to protect personal property from wildfires.

Office of The Attorney General

(No change from the 2013 submittal)

Authority for mitigation: Miss. Constitution, 1890. Art. VI, 173.

The Attorney General's Office has a staff of attorneys to represent state agencies and officials in the areas of litigation, opinion processing, governmental affairs, public integrity investigations, and public interest advocacy. It aids mitigation by interpreting state law and providing legal counsel to state agencies.

Office of the Governor

(No change from 2013 submittal)

Authority for mitigation: Miss. Constitution, 1890. Art. V, 116.

In response to Hurricane Katrina, the Governor created the Governor's Commission on Recovery, Rebuilding and Renewal. The commission brought together citizens, community officials, business leaders, non-profits, and other experts to formulate plans and make recommendations to establish a framework for rebuilding areas damaged by Hurricane Katrina. Recovery plans and recommendations dealt with

mitigation issues and redevelopment that avoids the impact of hurricanes and other natural disasters. Publications issued by the Governor's Commission include "After Katrina: Building Back Better Than Ever", "Mississippi Renewal Forum Summary Report", and "A Pattern Book for Rebuilding Gulf Coast Neighborhoods." These publications and the commission's mass planning effort ensured the smart redevelopment of damaged areas and encouraged planning that considered the impact of future natural disasters.

After the commission issued its final report in December 2005, the Governor created the Office of Recovery and Renewal within the Governor's Office. The office coordinates government recovery assistance at all levels and offers advisory help to state agencies and local jurisdictions. The office is assigned four overarching tasks:

1. Obtaining the maximum amount of disaster assistance funds and maximizing the use of credit in-lieu of cash

2. Providing policy advice to the Governor, his staff, other state agencies, and local governments

3. Providing technical assistance, educations, and outreach to organizations tasked with recovery

4. Identifying responsible entities and facilitating the implementation of the recommendations in the Governor's Commission final report as directed by the Governor

The Governor is coordinating both the distribution and use of Hurricane Katrina disaster funds and overall recovery policy in a manner that is cognizant of the threat of future hurricanes and other natural disasters.

Office of the Lieutenant Governor

(No change from the 2013 submittal)

Authority for mitigation: Miss. Constitution, 1890. Art. V, 128.

The Lieutenant Governor will preside over the Senate, rule on points of order, assign bills to committees, nominate standing committees of the senate, and appoint all select and conference committees as passed by the Senate. An ex officio member of the Senate Rules Committee and member of the Legislative Budget Committee. May vote only in the case of a tie, may speak from the floor while the Senate is in Committee of the Whole, and signs all finally adopted bill and resolutions.

Public Service Commission

(No change from 2013 submittal)

Authority for Mitigation: Miss. Code 1972, Annotated. 77-1-1 (1990).

The duty and responsibility of the Public Service Commission is to regulate communication, electric, gas, water and sewer utilities that are under the supervision and regulation of the commission. Primary mitigation responsibility is to ensure that the facilities constructed or acquired are required for the convenience, safety and necessity of the public. The Public Service Commission also helps to identify threats to public utilities by natural hazards.

Soil and Water Conservation Commission

(No change from the 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 69-27-2 (1984 supplement)

This agency is responsible for coordinating the programs of soil and water conservation districts. It aids mitigation by securing cooperation and assistance from Federal and other State agencies. The agency studies, evaluates, and classifies land use problems and needs; distributes funds, and manages the agricultural and non-point source pollution program. The Commission's contribution to hazard mitigation is to develop an awareness and to mitigate local pollution problems.

Mississippi Community College Board

Authority for mitigation: Miss. Code 1972, Annotated. 37-4-3 (1986 supplement).

These institutions can contribute to hazard mitigation through their educational programs to prepare for and overcome natural disasters. This could be accomplished through community service programs and career technical programs in the various districts. Due to the many locations statewide, community colleges could also provide facilities for the delivery of shelter and supplies to victims.

State Department of Health

(No change from the 2013 submittal)

Authority for Mitigation: Miss. Code 1972, Annotated. 41-3-15 (1972).

Providing protection to the public from threats to health and safety from unsanitary conditions relating to food, drinking water and sewage, unnecessary exposure to radiation and unhealthy and unsafe conditions in health care facilities, childcare facilities, and the workplace. Helps identify threats to potable water supply caused by natural hazards.

State Fire Academy

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 45-11-7 (1988 supplement).

The Fire Academy trains and educates persons engaged in municipal, county, and industrial fire protections and trains local law enforcement officers in arson investigation.

The Fire Academy is in compliance with the National Incident Management Systems (NIMS) under the Presidential Directive. Also, the Academy offers NIMS courses state-wide to all emergency response personnel through a federally funded grant.

Water Development Districts

(No change from 2013 submittal)

Pat Harrison Water Management District, Pearl River Valley Water Supply District and Tombigbee

River Valley Water Management District

Authority for mitigation: Miss. Code 1972, Annotated. 51-13-103, 51-15-103, 51-9-105.

These watershed management districts are responsible for regulating the waters within their jurisdictions in order to conserve, protect, and develop them to provide adequate, sanitary water supply, control flooding, and ensure irrigation water when needed.

Board of Animal Health

(No change from the 2013 submittal)

Authority for Mitigation: Miss. Code of 1972, Annotated. § 69-15-1.

To deal with all contagious and infectious diseases of animals in the opinion of the Board as may be prevented, controlled, or eradicated with power to make, promulgate, and enforce such rules so as to prevent the introduction and spread of those diseases.

Department of Finance and Administration

(No change from 2013 submittal)

Authority for mitigation: Miss. Code 1972, Annotated. 33-15-307(5)

The Department of Finance and Administration (DFA) is responsible for managing and administering state finances and programs. Its primary mitigation responsibility is to ascertain if amounts requisitioned by the Mississippi Emergency Management Agency (MEMA) from the Disaster Assistance Trust Fund are within the limits set forth in statute and transfer appropriate amounts from the Working Cash Stabilization Fund to the Disaster Assistance Trust Fund. DFA also administers the Disaster Recovery Fund and the Emergency Aid to Local Government Loans and Grant Program, provides administrative support to the Governor's Authorized Representative (GAR)/MEMA in connection with the Special Community Disaster Loan Program (SCDL), and provides daily support to MEMA insofar as routine and extraordinary fiscal, budget and procurement activities.

Post-Katrina, DFA has developed and is in the process of finalizing, its forma Continuity of Operations Plan (COOP) and Business Continuity Plan (BCP), both of which will interface with its successful pre-Katrina Business Resumption Plan (BRP).

4.2.2: Evaluation of Mitigation Actions and Activities

The Hazard Mitigation Council will review the mitigation actions and activities included in the 2018 Plan on a semiannual basis. The evaluation process will include updates on such items as time-line, funding source, responsible entity, and project status. In addition, the Council will also review current programs and initiatives listed in Table 4.2.2.1 (Details of these programs are outlined in Section 2.3.3 of this Plan). Any desired or necessary changes to the mitigation actions or programs will be communicated to MEMA and other stakeholders.

Table 4.2.2.1
Mitigation Programs

Center for Community Earthquake Preparedness	Emergency Management Preparedness Grant	Hazard Mitigation Technical Assistance Program	Pre-Disaster Mitigation-Competitive
Community Development Block Grants	Forestry-Disaster Hazard Mitigation and Preparedness Plan	Homeland Security Plan	Pre-Disaster Mitigation Planning Program
Comprehensive Emergency Management Plans	Federal Dam Safety Program	National Flood Insurance Program	Pre-Disaster Mitigation Loans for Small Businesses
Consolidated Plan for Housing and Community Development	Hazard Mitigation Assistance	Natural Hazards Plan	State Emergency Response Commission

As events dictate; such as a pre- and post-disaster review and other situations that may affect the progress of the mitigation actions, the Council will conduct additional meetings. The Council may determine new actions and/or funding opportunities that may develop upon the course of events. The Council will communicate to MEMA any necessary changes they deem necessary.

The Administrative Plan for the Hazard Mitigation Grant Program (Section 404) defines applicant eligibility criteria, describes the application process, and outlines the resources and procedures for management of Hazard mitigation Grant Program (HMGP) projects and their associated program funding. Although the HMGP funding is disaster declaration-dependent, many mitigation projects are identified through the local hazard mitigation plans and may be implemented with available funding as determined by the State. The

Administrative Plan provides the process in which to manage post-disaster programs. The State will manage and administer FEMA funding in accordance with applicable Federal statutes and regulations.

4.2.3: Hazard Management Capabilities

MEMA has responded to the challenges that Hurricane Katrina brought forth by increasing their hazard management capabilities. For example, MEMA completed construction of a state-of-the-art facility to house their headquarters. This facility provides the resources necessary in preparing and responding to impending disasters. They also recognized the need for additional, trained staff to accommodate the increase in mitigation projects and developed a website, www.MitigationMs.org, to assist local governments and eligible applicants in completing mitigation applications online. A complete description of MEMA's and other state agencies capabilities can be reviewed in Section 4.2.1.

4.3: Local Capabilities Assessment

44 CRF 201.4(c)(3)(ii) – The State mitigation strategy shall include the following elements:

A mitigation strategy that provides the State's blueprint for reducing the losses identified in the risk assessment. This section shall include:

A general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

The local capability assessment provides a general description of local mitigation capabilities in Mississippi, including examples of successful policies and programs, and an analysis of the effectiveness of these capabilities based on local evaluations. Local capabilities are the existing programs and policies through which local governments implement mitigation actions to reduce potential disaster losses. The assessment concludes with a discussion of challenges and opportunities to implementing and strengthening local capabilities.

Methodology

The State analyzed the local capabilities identified in FEMA-approved local hazard mitigation plans in Mississippi to provide an updated general description of local mitigation capabilities and to assess the challenges and opportunities to improving local capabilities. Additional information on the effectiveness of local mitigation capabilities and opportunities and challenges for building local capabilities was gathered through a survey distributed at the Mississippi Preparedness Summit, "Partners in Preparedness" on May 7-10, 2018, the annual conference of the Association of Floodplain Managers of Mississippi, May 22-24, 2018, the Building Association of Mississippi on June 3-8, 2018, and the Mississippi Civil Defense Emergency Management Association May 8, 2018.

Local Policies, Programs, and Capabilities

Planning, building, zoning, floodplain management, and fire codes are functions of local government. State law authorizes local governments to undertake these activities, but does not require them to do so. Regulations and their enforcement will vary between communities throughout the state. The effectiveness of local mitigation policies, programs, and capabilities is directly related to the level of adoption and degree of enforcement. The State has encouraged communities to adopt codes and ordinances and has provided Model A and Model B-E ordinances for this purpose. Through mitigation planning, local governments can identify the strengths and weaknesses in their mitigation capabilities and implement strategies to improve these. A general description of the types of local mitigation capabilities in Mississippi follows.

Land Use Planning

Authority: Miss Code 1972, Annotated. 17-1-11 et. Seq.

Title 17, Chapter 1 permits municipal and county governments to adopt zoning regulations for the

purpose of ensuring the most appropriate use of community lands and to provide for the preparation, adoption, amendment, extension, and carrying out of a comprehensive plan for the purpose of bringing about coordinated physical development in accordance with present and future needs. Chapter 1 also authorizes the establishment of local planning commissions to advise municipal and county governments in matters pertaining to physical planning, subdivision of land, zoning ordinances, building set back lines, and enforcement of regulations. Title 17 further authorizes any two or more counties or municipalities to establish regional planning commissions composed of representatives from the participating counties and municipalities. Regional planning commissions are established to advise local governments on problems related to acquisition, planning, construction, development, financing, control, use, improvement, and disposition of buildings and other structures, facilities, goods, and services.

No local land use plans are mandated by state law. State law does specify that the city or county legislative body must legally adopt a comprehensive plan to put it into effect. The state also requires that the zoning be based upon and consistent with the legally adopted plan. If a local government chooses to develop and adopt a comprehensive plan, the law does specify a list of elements that must be included, but no natural hazards element is required.

Building, Fire, and Other Codes

Authority: Miss. Code 1972, Annotated. 19-5-9.

Title 19, Chapter 5 authorizes certain counties to adopt, as minimum standards, building codes published by a nationally recognized code group.

Authority: Miss Code 1972, Annotated. 21-19-25.

Under Title 21, Governing authorities of any municipality are authorized to adopt building, plumbing, electrical, gas, sanitary, and other codes to protect the public health, safety, and welfare.

Authority: Miss Code 1972, Annotated. 21-19-21.

Title 21, Chapter 19 authorizes municipal authorities to pass fire safety regulations relating to structures and buildings used as residences or businesses. Chapter 19 further permits local authorities to inspect all buildings and land and take down, remove, or rehabilitate, at the owner's expense, properties found to be unsafe with respect to fire hazard.

Mississippi does not adopt or enforce a statewide building code for all structures, nor does it mandate a code for residential construction. It is up to local jurisdictions to adopt and enforce building codes.

House Bill 1406, passed in 2006, creates the Mississippi Building Code Council. It also requires five coastal counties, Jackson, Harrison, Hancock, Stone, and Pearl River, and the municipalities located there, to enforce all the wind and flood mitigation requirements prescribed by the 2003 International Residential Code and the 2003 International Building Code. The Mississippi Building Codes Council adopted the 2003 International Building Code and 2003 International Residential Code for the state, but does not require local jurisdictions to adopt building codes, but requires that

they use the International Codes if they do adopt codes.

Local Emergency Management

Authority: Miss Code 1972, Annotated. 33-15-17

Local governments are authorized to establish organizations for emergency management with a director having responsibility for the organization's administration and operation. Local emergency management organizations may be composed of a single county or municipality or two or more counties or municipalities. Local emergency management organizations are further authorized to enter into mutual aid agreements with other public and private agencies in the state.

Authority: Miss Code 1972, Annotated. 2 1-19-23.

The Statewide Mutual Aid Compact, or SMAC, began in 1995 by MEMA to provide a more effective use of resources in times of disaster. It provides a way for cities and counties to request and receive help from each other when local resources are exhausted. SMAC provides a mechanism for assistance to come from different parts of the state. It addresses the issues of liability, compensation, direction and control in a uniform manner. SMAC allows members of the compact to have a mutual aid agreement with both the state and other compact members.

All 82 counties and the Mississippi Band of Choctaw Indians (MBCI) in Mississippi now have a full or part-time emergency management program as well as a designated emergency management or civil defense director. In addition, all 82 counties are in the process of updating their Comprehensive Emergency Management Plan (CEMP) and they will be on file with the Mississippi Emergency Management Agency (MEMA).

Water Management and Flood Control Districts

Authority: Miss Code 1972, Annotated. 51-29-1 et. Seq.; 51-31-1 Et seq.

Counties may form drainage districts for the purpose of developing, maintaining, and improving drainage systems to prevent flood-related damage.

Authority: Miss Code 1972, Annotated. 51-35-101 Et seq.

Counties may form flood control districts for the purpose of cooperating with the federal government in the construction, maintenance, and operation of dams, reservoirs, and other flood control projects.

Authority: Miss Code 1972, Annotated. 51-35-301.

Municipalities of 100,000 or more and urban counties of 100,000 or more and adjacent areas are authorized to establish urban flood and drainage districts.

Authority: Miss Code 1972, Annotated. 5 1-8-1 Et seq.

Chapter 8 authorizes the formation of master water management districts composed of two or more existing drainage or water management districts, parts of existing districts, or territory not included in any district. Formation of a master water management district is contingent on the approval of a certain percentage of landowners within the proposed district. Master water management districts may cooperate with federal agencies in projects designed to prevent flood damage, improve drainage, and foster conservation of water resources.

Flood Insurance

Authority: Miss. Code 1972, Annotated 43-41-11.

The National Flood Insurance Program (NFIP) has identified flood hazards in Mississippi communities. Presently, 81 counties, one water supply district (Pearl River Valley), and 248 municipalities participate in the NFIP, for a total of 330 "communities". Authority was granted at the local level by the state legislature to administer the NFIP using the local government's "police power" to regulate land use.

Mississippi continues to rank high in the nation for NFIP payments. The State Floodplain Manager and local jurisdictions maintain detailed data on properties classified as repetitive flood claims or severe repetitive flood loss. These structures strain the National Flood Insurance (NFIP) Fund. The State of Mississippi is committed to mitigate its repetitive and severe repetitive loss properties, to that end the state plan has previously been amended to take advantage of the SRL Program with the 90/10 share cost. The State encourages communities to restrict development in flood prone areas by implementing stricter building codes, zoning and ordinances. The State places a higher priority for applications inclusive, but not limited to, developing a floodplain management program, restricting development in flood prone areas, acquiring flood prone properties, elevating structures that have been deemed repetitive loss and severe repetitive loss structures, and flood proofing businesses that meet the criteria of repetitive loss and severe repetitive loss structures. The State of Mississippi does not adopt or enforce a statewide building code for all structures, nor does it mandate a code for residential construction. It is up to local jurisdictions to adopt and enforce building codes.

Tables of Community Mitigation Capability Assessment

Table 4.3.1 in the previously-approved 2013 Mississippi Hazard Mitigation Plan displayed local capabilities related to existing planning and policy mechanisms. The table provided status for each county and city on the following capabilities:

- National Flood Insurance Program (NFIP) participation
- Number of Flood Insurance Policies within NFIP participating jurisdictions
- Community Rating System (CRS) participation

- Comprehensive/master/general plan
- Hazard mitigation plan
- Residential building code
- Commercial building official
- Building Code Effectiveness Grading System (BCEGS) rating for residential buildings
- Building Code Effectiveness Grading System (BCEGS) rating for commercial buildings
- Zoning code
- Subdivision regulations
- Fire code rating

During the 2018 update process, information was collected from 34 approved local hazard mitigation plans and was used to update the table and provide additional information on capabilities. These fields were updated, and additional information was collected on CRS participation and rating and building code type. Some local plans did not provide information on each of these capabilities. Table 4.3.1 displays the number of counties and cities that reported whether they had each capability or not, and of those counties and cities, the percent with each capability.

Table 4.3.1
Mitigation Capabilities of Counties and Cities
Identified in Local Plans

Capability	Counties		Cities	
	Number with Reporting Capability	Percent	Number With Reporting Capability	Percent
Comprehensive Plan	33	40%	274	90%
Building Code	16	20%	115	38%
Building Official	26	32%	192	63%
Zoning Ordinance	28	34%	228	75%
Subdivision Ordinance	27	33%	153	50%
Floodplain Ordinance*	82	100%	250	82%

*Adoption of floodplain ordinance is assured based on participation in the NFIP, as calculated from the NFIP Community Status Book Report, April 26, 2018.

As shown in Table 4.3.1, a greater percentage of cities have each of the capabilities in place than counties, with the exception of floodplain ordinance. Besides comprehensive emergency management plans, floodplain ordinances are the capability, of those tracked, that the highest percentage of counties (100 percent) and cities (82 percent) have in place. In approved local plans that identified whether building codes had been adopted or not, 20 percent of counties and 38 percent of cities had adopted building codes.

All 82 counties have adopted comprehensive emergency management plans, and all counties have FEMA-approved hazard mitigation plans. There is a total of 34 hazard mitigation plans. By reviewing and incorporating these local hazard mitigation plans with the state plan, a more comprehensive approach to reducing future losses from natural hazards is implemented. All levels of government can effectively prepare for, respond and recover from emergency and disasters.

Table 4.3.2 shows the changes in local participation in the NFIP, CRS, and BCEGS from 2013 to 2018. The NFIP Participation total for communities remain the same. BCEGS Rating increased from 44 cities and counties to 45 cities and counties.

Table 4.3.2
Change in Select Capabilities since the 2013 Plan

Capability	2013	2018
NFIP Participation Total	330	330
NFIP Participation Suspended	1	0
NFIP Not in Program with Hazard Area Identified	0	35
CRS Participation	29,0 rescinded	32,0 rescinded
BCEGS Rating	44 cities and counties	85 cities and counties

NFIP Community Status Book Report as of April 26, 2018; CRS report current as of October 1, 2016.

Effectiveness of Local Mitigation Capabilities

At the Mississippi Preparedness Summit, the Building Association of Mississippi conference, the annual Mississippi Civil Defense Emergency Management Association conference, and the annual conference of the Association of Floodplain Managers of Mississippi, MEMA distributed a paper survey. The survey was also placed on state agencies websites. The survey was designed to gather information about options on the effectiveness of local mitigation capabilities. Seventy completed surveys were evaluated. It is important to note that this data is limited by the small sample size.

The survey asked respondents to give their opinion on the level of effectiveness of different types of local capabilities (e.g., tools, policies, programs) for implementing mitigation actions in their community or region. Respondents ranked local capabilities on a scale from one to four, with one being the least effective and four being the most effective. The capability among those listed, which was ranked as the most effective by the highest number of respondents (83 percent) was emergency operations plan. This was followed by floodplain ordinance/NFIP participation (77 percent), comprehensive plan (75 percent), geographic information system program (73 percent), and building codes and public information/education programs (72 percent). The capability that the most number of respondents (61 percent) ranked as least effective for mitigation was subdivision ordinance. Figure 4.3.1 shows the average ranking of each capability.

Figure 4.3.1
Average Ranking of Effectiveness of Local Capabilities

Capabilities	Effectiveness on a Scale from One to Four
Emergency Operation Plan	83%
Floodplain Ordinance/NFIP Participation	77%
Comprehensive Plan	75%
Geographic Information System Program	73%
Building Codes	72%
Public Information/Education Programs	72%
Zoning Ordinance	69%
Local/Regional Emergency Planning	69%
Storm Water Management	68%
Capital Improvement Plan	65%
Subdivision Ordinance	61%

Challenges and Opportunities for Improving Local Capabilities

Survey respondents were asked three open-ended questions about 1) manmade hazards that concerned them 2) the challenges or weaknesses in hazards mitigation capabilities in their region and 3) the opportunities for improvement in local capabilities. The most common response to the question about manmade hazards of concern was terrorism (use of hazardous materials or biological weapons). It was

followed by the hazard commonly included with natural hazard events, dams or levees, then cyberterrorism and distracted drivers. The most common response to the question about challenges or weaknesses was lack of funding. It was followed by communication. The most common response to the question about improvement opportunities for local capabilities was education. It was followed by on hands training, then building codes.

Collaboration with all agencies, better infrastructure, ability to hire more law enforcement and emergency response personnel, obtaining different methods of warning public of hazard incidents, flood assessment conducted in the field adoption, and more information to public on plans were also listed as improvement opportunities by respondents.

Based upon the survey data and the analysis of local programs, policies, and capabilities from local plans and state resources, the following challenges and opportunities for strengthening local capabilities were identified:

Regional Hazard Mitigation Plans

To be more efficient with the available funding, the State moved away from having more than 100 mitigation plans to regional hazard mitigation plans. This has proven to be more cost effective and efficient. Contractors go through the state bidding process. Through this process, the locals are involved with selecting the successful bidder. Important planning and technical resources are available to the local governments.

Regional planning efforts also are an opportunity to coordinate land use issues to prevent one jurisdiction from adversely affecting the other and to integrate the mitigation plan with other regional plans. There is a total of nine regional hazard mitigation plans covering the state.

Intergovernmental Assistance and Coordination

Support from the state and the federal government is critical to improving local mitigation capabilities. Training and workshops may be the most important types of assistance the state and federal government can provide, particularly related to planning and program grant applications and in developing effective mitigation projects. When survey respondents identified factors that contributed to the successful implementation of mitigation projects, all responses were related to incentive programs and partnerships with the state and federal government.

Coordination with other Planning Efforts

Some local plans describe other planning projects that implement mitigation measures. These include watershed plans and coastal impact assistance plans. Coordination with these other planning efforts can improve local governments' capabilities through accomplishing multiple objectives and leveraging additional funding sources.

Adoption and Enforcement of Codes and Ordinances

Codes and ordinances may be the greatest opportunity and challenge for local governments. With the exception of floodplain ordinances, less than half of approved plans identify the adoption of land use ordinances. Although many plans emphasize the importance of land use planning and

regulations for mitigation, many also comment on the unlikelihood of getting them adopted due to the rural nature of their area and the perceived stigma attached to zoning by many rural residents. Several plans describe the difficulty in inspecting buildings and enforcing codes due to lack of staffing and funding capabilities.

An example of an implementation program that has been successful is in Pearl River County, Mississippi. After Hurricane Katrina, Mississippi Legislature mandated the adoption of the International Building Code and International Residential Code in five coastal counties including Pearl River County. The cities of Picayune and Poplarville have also adopted building codes. They are working toward consolidating building permits and inspections as a mitigation tool to ensure uniform enforcement of standards for construction in flood hazard zones, wind construction standards, and building codes. The three jurisdictions and the Lower Pearl River Valley Foundation contributed funding for a comprehensive and coordinated step-by-step guide to implement the International Building Codes countywide to protect lives and minimize damage to property.

Floodplain Management

The state and many local governments recognize floodplain management and the NFIP as highly effective location mitigation capabilities and as primary opportunities to strengthen local capabilities. The State can do this through continuing to enhance its program that provides information and support for new communities to participate in the NFIP and CRS and for existing participants to promote and enforce their floodplain management programs.

Local Funding

Funding for mitigation planning and projects remains one of the greatest challenges for improving local capabilities. Local plans indicate that most local governments use federal funds for mitigation and have met match requirements through in-kind services or their general operating fund. A dedicated tax revenue source for mitigation is difficult to implement as tax increases are unpopular with the public. A tax designated to targeted, tangible benefits, such as funding an emergency manager position and/or an advance warning system, may be more acceptable to the public. The state can improve local success with federal funding programs by efficiently managing the programs and providing assistance to local governments with applications, ideas for meeting match requirements, and continued eligibility.

One approach communities are using to overcome the funding obstacle is improving integration with other local plans and programs, such as capital improvement plans and storm water management programs, to help achieve mitigation through other community objectives. Improved public education and awareness of hazard vulnerabilities and mitigation options also may help to garner more funding for mitigation through tax dollars and private sources. The best time to implement this approach is often in the window of opportunity after a disaster.

Impact of Hurricane Katrina

Many local plans were written prior to Hurricane Katrina and have had several updates since that time. Most local jurisdictions are now covered by regional hazard mitigation plans. Since

Hurricane Katrina, the following changes have been made:

- Intergovernmental agency communication has improved.
- Additional emergency generators to operate critical facilities during and after a disaster.
- Increased emergency sheltering capabilities.
- Redundancy on local communications.
- Hardening of emergency shelters.
- Widening of road systems and development of unincorporated areas to smart codes.
- Hardening infrastructure, sewer systems, etc.
- Adoption of higher standards for reconstruction to create more disaster-resistant structures.

4.4: Mitigation Measures

44 CFR §201.4(c)(3)(iii) – State plans shall include an identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified.

The State of Mississippi through the Mississippi Standard Mitigation Plan has identified and prioritized mitigation measures. These measures are grouped by the following types:

- Dam
- Earthquake
- Flood
- Tropical Cyclone (Hurricane/Tropical Cyclone)
- Multi-Hazard
- Tornado
- Wildfire
- Extreme Winter Storm
- Drought
- Climate Change/Sea Level Rise
- Cyberterrorism

These measures are classified in the following strategies:

- Prevention
- Property Protection
- Public Education and Awareness
- Technical Assistance
- Natural Resource Protection
- Emergency Services

- Structural Projects

After each profile was identified, prioritized and classified, it was evaluated against the goals and objectives adopted by the Hazard Mitigation Council as described in Section 4.1. In order to warrant a mitigation action profile, the project had to address one or more of the goals and tie specifically to an objective within the goal. Listed below is a recap of the goal reassessed and adopted by the Hazard Mitigation Council for the 2018 update.

- **Goal 1** – Minimize loss of life, injury, and damage to property, the economy, and the environment from natural hazards
- **Goal 2** – Build and enhance local mitigation capabilities
- **Goal 3** – Improve public education and awareness
- **Goal 4** – Sustain and enhance a coordinate state mitigation program

Table (4.4.2) gives updated information about these measures with each measure uniquely identified by the following parameters:

Project Number – Each measure is numbered sequentially within each type.

Type – Each measure is listed by type of hazard with general measures or those addressing more than one hazard listed by type "multi-hazard".

Project Name – Each measure has been given a name that briefly describes the measure.

Agency – A State agency with primary responsibility has been identified even though more than one Federal, State or Local agency may be involved. Each agency identified is a member of the Mississippi Hazard Mitigation Council.

Funding Strategy – A primary funding source has been identified. Additional funding sources may be utilized to supplement the primary funds. Section 4.5 provides information regarding the funding sources including type of assistance and agency/contact in Table 4.5.1. The table has been updated from the 2013 plan to include programs not identified or available in the 2013 plan. These programs include the reference "2018 Plan Update" in the Program/Activity column.

Completion – The year of completion has been identified. Some measures are completed on an annual basis, meaning continuous or occurring every year. Table 4.4.1 identifies the mitigation strategies and the status of each project from the 2013 plan, and Table 4.4.2 identifies the updated 2018 mitigation strategies.

Priority – Each measure has been ranked as high, medium or low priority. The basis of the rankings is identified below:

- **High** – Activities for which funding sources are readily available or are vital to the state's reconstruction or recovery efforts.

- **Medium** – Assigned to activities that are identified as long-range in nature or for which funding is not presently available but may be in the relatively near future.

- **Low** – Assigned to activities for which there is not clear method of funding, or may not ever be funded, and are not critical to the state's reconstruction and recovery efforts.

Status – Projects noted in Table 4.4.1 with an ongoing status mean that the action is being completed, but the project has not ended. The project continues each year as funding is available.

Table 4.4.2 is not intended to capture all the pertinent data regarding the mitigation action. Project profile/progress reports are provided in Appendix 7.3.1, which gives additional data including goals and objectives referenced in Section 4.1. These project profile/progress reports serve as an interactive information sheet to communicate the latest information regarding the mitigation action. The project managers update project profile/progress reports showing the current status and progress made in the implementation of a mitigation project. Appendix 7.3.1 and Section 5.3 Funding Priority and Prioritizing Alternatives also describe prioritization process for mitigation actions.

During the 2018 update of the state hazard mitigation plan, the hazard mitigation council reviewed the actions in the previous plan to provide status updates and to identify actions completed or not completed. Table 4.4.1 provides a summary of the results. One projects was completed; no projects were deleted. Table 4.4.2 provides the updated actions for the 2018 plan. Three mitigation projects were added and are noted in Table 4.4.2 as "New Action for 2018". There were no changes in priorities.

The mitigation tables and project profiles will be used interchangeably to assist with implementation of the projects. The sorted tables include a summary of each mitigation action. Details are given in the project profiles which include the goals and objectives of each mitigation profile. MEMA maintains a Mitigation Action Notebook that includes updated information as it is available. This information is being incorporated into each of the 67 project profiles, which are updated with information from MEMA and other lead agencies.

Local Mitigation Actions

The state has developed a database of all mitigation actions identified in FEMA-approved local hazard mitigation plans. Because of the large size of the database, it is not incorporated as part the plan document but is available at MEMA.

The database allows the state to sort local actions by hazards addressed, project type, funding source, cost estimate, and additional variables. It will be used to link state actions to local actions and to help identify new state actions. For instance, the state has an action to promote the National Weather Service's StormReady certification program for local communities. The local actions database can be used to quickly identify which local governments have identified mitigation actions related to the StormReady program.

The state also plans to use this database as part of a more comprehensive system of prioritizing local projects for funding, tracking those projects that have been funded, and monitoring the effectiveness of implemented local projects. As local hazard mitigation plans are approved, the identified mitigation

actions will be added to the database, so that it remains current.

The mitigation actions compiled in this database have been identified and prioritized by local governments based upon their unique processes for determining actions that are technically feasible, cost effective, and environmentally sound. Prior to any funding from state or federal sources, more detailed benefit-cost analysis of actions will occur during the project development and grant application phases. In addition to the review of local mitigation actions, the Mississippi Hazard Mitigation Council used the STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) criteria to analyze the cost-effectiveness of each project. Mitigation actions were screened for implementation with consideration that they must comply with federal and state requirements. Each project was reviewed to determine if it was environmentally sound, and technically feasible. The updated projects resulted from a number of council meetings. Some projects have been more effective than others. Based upon progress on mitigation actions, updated risk assessment, and review of mitigation priorities, effective mitigation actions have been identified. For the 2018 update, three new mitigation actions were added.

Table 4.4.1
Status of Mississippi Mitigation Actions from 2013 Plan

Project No.	Type	Strategy	Project Name	Agency	Project Cost ($)	Funding Strategy	Completion	Priority	Status
1	Dam Safety	Prevention	Permitting New Dams and Regulatory Compliance	MDEQ	$332,500	Budget	Annual	H	Ongoing status
2	Dam Safety	Outreach and Education	Public Education and Outreach	MDEQ	$17,500	Budget	Annual	H	Ongoing status
3	Dam Safety	Prevention	Inundation Maps/EAPs for High Hazard Watershed Dams	MDEQ	$80,000	Budget	2015	H	Ongoing status
5	Dam Safety	Structural	Repair and Rehab Dams	MDEQ	$1,000,000	Private	Annual	H	Ongoing status
7	Dam Safety	Prevention	Enforce Implementation of 2006 Dam Safety Legislation	MDEQ	$250,000	Budget	Annual	H	Ongoing status
9	Dam Safety	Technical Assistance	Information Management for Inundation Area Vulnerabilities	MDEQ	$100,000	HMGP	Annual	H	Ongoing status
1	Earthquake	Technical Assistance	Review and Update HAZUS-MH Data Base	MEMA	$70,000	HMGP	2016	H	Ongoing status
2	Earthquake	Prevention	HAZUS-MH Project Implementation for Local initiatives	MEMA	$10,000,000	HMGP	2017	H	Ongoing status
3	Earthquake	Technical Assistance	Compile New Soil Evaluations	MDEQ	$40,000	Budget	Annual	M	Ongoing status
5	Earthquake	Technical Assistance	HAZUS-MH Update with Pipeline Locations	MEMA	$10,000	Budget	2016	M	Ongoing status

6	Earthquake	Outreach and Education	Partnership Programs for Collaborating Programs with other States	MEMA	$10,000	Budget	Annual	H	Ongoing status
10	Earthquake	Technical Assistance	Monitor State of Comprehensive Infrastructure Retrofit	MDOT	$10,000	Budget	Annual	H	Ongoing status
11	Earthquake	Technical Assistance	Information Management System for Critical Infrastructure	MDEQ	$50,000	HMGP	2016	H	Ongoing status
1	Flood	Outreach and Education	Map Modernization: New Firm Adoption by Communities	MEMA	$20,000	CAP	Annual	H	Ongoing status
4	Flood	Technical Assistance	Community Rating System: Program Implementation	MEMA	$7,000	CAP	Annual	M	Ongoing status
5	Flood	Property Protection	Repetitive Loss Structures: Target Group Mitigation	MEMA	$10,000,000	FMA	2017	M	Ongoing status
6	Flood	Technical Assistance	NFIP Implementation: Model Ordinance Adoption	MEMA	$7,000	CAP	Annual	M	Ongoing status
7	Flood	Outreach and Education	NFIP Implementation: Floodplain Management Workshops	MEMA	$7,000	CAP	Annual	M	Ongoing status
8	Flood	Technical Assistance	NFIP Implementation: Certified Floodplain Manager Accreditation	MEMA	$7,000	CAP	Annual	H	Ongoing status
9	Flood	Outreach and Education	NFIP Implementation: State Floodplain Management Association	MEMA	$7,000	CAP	Annual	M	Ongoing status
11	Flood	Technical Assistance	NFIP Implementation: Community Assistance Contact and Visit	MEMA	$7,000	CAP	Annual	H	Ongoing status
12	Flood	Outreach and Education	NFIP Implementation Education and Outreach	MEMA	$7,000	CAP	Annual	H	Ongoing status
13	Flood	Technical Assistance`	Assessing Vulnerability by Jurisdiction	MEMA	$100,000	FMA	2016	H	Ongoing status
15	Flood	Technical Assistance	Information Management System for Critical Infrastructure	MEMA	$100,000	FMA	2016	H	Ongoing status
16	Flood	Structural	Community Assistance for Flood Warning Systems	MEMA	$1,000,000	FMA	2017	H	Ongoing status
21	Flood	Property Protection	Continue to Support floodproofing and hardening of water/wastewater systems	MDEQ	$100,000,000	CDBG	2017	H	Ongoing status
23	Flood	Technical Assistance	Support updating of storm water ordinances to address future development	MEMA	$7,000	CAP-SSSE	Annual	H	Ongoing status
24	Flood	Technical Assistance	Support Local Capital Improvement Infrastructure Planning	MDEQ	$7,000	CAP-SSSE	Annual	H	Ongoing status
26	Flood	Technical Assistance	GIS Inventory of Hazardous Waste/Materials	MDEQ	$150,000	HMGP	2016	H	Ongoing status

			Storage Facilities						
28	Flood	Technical Assistance	Provide HAZUS flood runs to each county	MEMA	$7,000	Budget	2016	H	Ongoing status
30	Flood	Technical Assistance	Develop a comprehensive GIS based inventory of levees	MDEQ	$50,000	PDM	2016	H	Ongoing status
31	Flood	Property Protection	Implementation Flood Mitigation Projects	MEMA	$10,000,000	USACOE	2017	H	Ongoing status
2	Hurricane	Outreach and Education	Public Information Forums and Fairs Statewide	MEMA	$7,000	Budget	Annual	H	As of June 2017, Kids Campaign and Adult Campaign included 3 mascots that reached out to children, the community, and elected officials with mitigation activities. Project is ongoing status.
4	Hurricane	Technical Assistance	Local Review of Building Codes and Flood Protection Ordinances	MEMA	$7,000	Budget	Annual	H	Ongoing status
5	Hurricane	Technical Assistance	State Modernization Team Review of Coastal Flooding	MEMA	$50,000	CAP	2016	H	Ongoing status
6	Hurricane	Structural	USACOE Mississippi Coastal Improvements Program	MDMR	$160,000,000	USACOE	2017	H	Ongoing status
7	Hurricane	Technical Assistance	USACOE Mississippi Coastal Comprehensive Plan	MDMR	$3,000,000	USACOE	2016	H	Ongoing status
11	Hurricane	Structural	Implement Regional Utility Systems	MDEQ	$200,000,000	CDBG	2017	H	Ongoing status
12	Hurricane	Structural	Support Mitigation with Natural Barriers	MDMR	$100,000	USACOE	2017	H	Ongoing status
14	Hurricane	Structural	Construction of Gulf Coast Regional Office/First Responders' Building	MDOT	$3,963,128	Budget	2015	H	Ongoing status
2	Multi-Hazard	Outreach and Education	HMA Grant Application Training	MEMA	$7,000	Budget	Annual	H	As of June 2017, reaching out to Hospital Association to schedule webinars in effort to get private nonprofit hospitals more involved with mitigation grants. Project is ongoing
4	Multi-Hazard	Outreach and Education	"Storm Ready" Community Education	MEMA	$27,000	Budget	Annual	H	Ongoing status
6	Multi-Hazard	Technical Assistance	Develop Local Hazard Mitigation Planning	MEMA	$7,000	HMGP	Annual	H	Ongoing status

9	Multi-Hazard	Emergency Services	Provide Auxiliary Power Source for All Critical Facilities	MEMA	$10,000,000	HMGP	2017	H	Ongoing status
11	Multi-Hazard	Technical Assistance	Coordinated Emergency Action Plans for Health Care Facilities	MSDH	$10,000	HMGP	Annual	H	Ongoing status
13	Multi-Hazard	Natural Resources Protection	Wet Debris Management for Access, Water Quality and Environmental	MDMR	$10,000,000	USACOE	2017	H	Project cost and funding strategy updated for 2018 update; ongoing status
15	Multi-Hazard	Technical Assistance	Complete/enhance inventory of state owned/operated facilities	MDFA	$500,000	HMGP	2013	H	As of Dec 2015, database of state owned buildings created, providing lat/long and replacement contents. Project is ongoing.
18	Multi-Hazard	Emergency Services	Increase Shelter Capacity in each County	MEMA	$1,000,000	HMGP	Annual	H	Ongoing status
20	Multi-Hazard	Technical Assistance	Prepare Information Management System for Plan Updates for 2013	MEMA	$20,000	Budget	Annual	H	Ongoing status
21	Multi-Hazard	Emergency Services	Track Project Implementation Progress for Mitigation Actions	MEMA	$20,000	Budget	Annual	H	Ongoing status
22	Multi-Hazard	Emergency Services	Develop GIS Database for Archives and History on Cultural Resources	MEMA	$100,000	HMGP	2016	H	Ongoing status
25	Multi-Hazard	Structural	Encourage Use of Non-Hazardous Materials in Critical Facilities	MDEQ	$7,000	Budget	Annual	H	Ongoing status
26	Multi-Hazard	Outreach and Education	Yearly Information Meetings for Medical Community	MSDH	$50,000	Budget	Annual	M	Ongoing status
27	Multi-Hazard	Technical Assistance	Sheltering Needs Assessment	MDHS	$50,000	HMGP	2010	H	Ongoing status
29	Multi-Hazard	Prevention	Mitigation Grants to Eligible Applicants for Emergency Warning Systems	MEMA	$196,836	HMGP	Annual	H	Ongoing status
30	Multi-Hazard	Structural	Individual Assistance for “Safe Room” Program	MEMA	$500,000	HMGP	2017	H	Ongoing status
31	Multi-Hazard	Technical Assistance	Stone County Special Needs Shelter	MSDH	$7,773,065	HMGP	2014	H	Completed July 2016
1	Tornado	Technical Assistance	Implement Wind Retrofit Projects	MEMA	$29,888,707	Budget	Annual	H	Ongoing status
7	Tornado	Outreach and Education	Public Outreach and Education for Homebuilders and Developers	MEMA	$7,000	Budget	Annual	H	Ongoing status
1	Wildfire	Outreach and	FireWise Program Workshops	MFC	$100,000	USFC	Annual	H	Ongoing status

		Education							
2	Wildfire	Technical Assistance	Community Wildfire Protection Plans	MFC	$240,000	USFC	Annual	H	Ongoing status
3	Wildfire	Outreach and Education	Train Local VFD's in FireWise	MFC	$100,000	USFC	Annual	H	Ongoing status
4	Wildfire	Outreach and Education	Communication and Partnership Initiatives with VFD's	MFC	$100,000	USFC	Annual	H	Ongoing status
5	Wildfire	Outreach and Education	Public Education and Outreach	MEMA	$7,000	Budget	Annual	H	Ongoing status
2	Winter Storm	Outreach and Education	Public Education and Outreach	MEMA	$7,000	Budget	Annual	H	Ongoing status

Table 4.4.2
Mississippi Mitigation Actions 2018 – 2023 Sorted by Type

Project No.	Type	Strategy	Project Name	Agency	Project Cost ($)	Funding Strategy	Completion	Priority
1	Dam Safety	Prevention	Permitting New Dams and Regulatory Compliance	MDEQ	$332,500	Budget	Annual	H
2	Dam Safety	Outreach and Education	Public Education and Outreach	MEDQ	$17,500	Budget	2021	H
3	Dam Safety	Prevention	Inundation Maps/EAPs for High Hazard Watershed Dams	MDEQ	$80,000	Budget	2022	H
5	Dam Safety	Structural	Repair and Rehab Dams	MDEQ	$1,000,000	Private	Annual	H
7	Dam Safety	Prevention	Enforce Implementation of 2006 Dam Safety Legislation	MDEQ	$250,000	Budget	2022	H
9	Dam Safety	Technical Assistance	Information Management for Inundation Area Vulnerabilities	MDEQ	$100,000	HMGP	Annual	H
10	Dam Safety	Prevention	**New Action for 2018**: Probable Maximum Precipitation Update Study	MDEQ	$500,000	HMGP	2023	H
1	Earthquake	Technical Assistance	Review and Update HAZUS-MH Data Base	MEMA	$70,000	HMGP	2021	H
2	Earthquake	Prevention	HAZUS-MH Project Implementation for Local Initiatives	MEMA	$10,000,000	HMGP	2023	H
3	Earthquake	Technical Assistance	Compile New Soil Evaluations	MDEQ	$40,000	Budget	2022	M
5	Earthquake	Technical Assistance	HAZUS-MH Update with Pipeline Locations	MEMA	$10,000	Budget	2021	M
6	Earthquake	Outreach and Education	Partnership Programs for Collaborating Programs with other States	MEMA	$10,000	Budget	2022	H
10	Earthquake	Technical Assistance	Monitor State of Comprehensive Infrastructure Retrofit	MDOT	$1,000,000	Budget	2022	H
11	Earthquake	Technical Assistance	Information Management System for Critical Infrastructure	MDEQ	$50,000	HMGP	2022	H

1	Flood	Outreach and Education	Map Modernization: New Firm Adoption by Communities	MEMA	$20,000	CAP	Annual	H
4	Flood	Technical Assistance	Community Rating System: Program Implementation	MEMA	$7,000	CAP	2023	M
5	Flood	Property Protection	Repetitive Loss/Severe Repetitive Loss Structures: Target Group Mitigation	MEMA	$10,000,000	FMA	2023	M
6	Flood	Technical Assistance	NFIP Implementation: Model Ordinance Adoption	MEMA	$7,000	CAP	2023	M
7	Flood	Outreach and Education	NFIP Implementation: Floodplain Management Workshops	MEMA	$7.000	CAP	2023	M
8	Flood	Technical Assistance	NFIP Implementation Certified Floodplain Manager Accreditation	MEMA	$7,000	CAP	2023	H
9	Flood	Outreach and Education	NFIP Implementation: State Floodplain Management Association	MEMA	$7,000	CAP	2023	M
11	Flood	Technical Assistance	NFIP Implementation: Community Assistance Contact and Visit	MEMA	$7,000	CAP	2023	H
12	Flood	Outreach and Education	NFIP Implementation Education and Outreach	MEMA	$7,000	CAP	2023	H
13	Flood	Technical Assistance	Assessing Vulnerability by Jurisdiction	MEMA	$100,000	FMA	2023	H
15	Flood	Technical Assistance	Information Management System for Critical Infrastructure	MEMA	$100,000	FMA	2023	H
16	Flood	Structural	Community Assistance for Flood Warning Systems	MEMA	$1,000,000	FMA	2023	H
21	Flood	Property Protection	Continue to Support floodproofing and hardening of water/wastewater systems	MDEQ	$100,000,000	CDBB	2023	H
23	Flood	Technical Assistance	Support updating of storm water ordinances to address future development	MEMA	$7,000	CAP-SSSE	2022	H
24	Flood	Technical Assistance	Support Local Capital Improvement Infrastructure Planning	MDEQ	$7,000	CAP-SSSE	2022	H
26	Flood	Technical Assistance	GI Inventory of Hazardous Waste/Materials Storage Facilities	MDEQ	$150,000	HMGP	2023	H
28	Flood	Technical Assistance	Provide HAZUS flood runs to each county	MEMA	$7,000	Budget	2023	H
30	Flood	Technical Assistance	Develop a comprehensive GIS based inventory of levees	MDEQ	$50,000	PDM	2020	H
31	Flood	Property Protection	Implement Flood Mitigation projects	MEMA	$10,000,000	USACOE	2023	H
2	Hurricane	Outreach and Education	Public Information Forums and Fairs Statewide	MEMA	$7,000	Budget	Annual	H
4	Hurricane	Technical Assistance	Local Review of Building Codes and Flood Protection Ordinances	MEMA	$7,000	Budget	2023	H
5	Hurricane	Technical Assistance	State Modernization Team Review of Coastal Flooding	MEMA	$50,000	CAP	2020	H
6	Hurricane	Structural	USACOE Mississippi Coastal Improvements Program	MDMR	$160,000,000	USACOE	2023	H

7	Hurricane	Structural	USACOE Mississippi Coastal Comprehensive Plan	MDMR	$3,000,000	USACOE	2023	H
11	Hurricane	Structural	Implement Regional Utility Systems	MDEQ	$200,000,000	CDBG	2023	H
12	Hurricane	Structural	Support Mitigation with Natural Barriers	MDMR	$100,000,000	USACOE	2023	H
14	Hurricane	Structural	Construction of Gulf Coast Regional Office/First Responders' Building	MDOT	$3,963,128	Budget	2023	H
2	All	Outreach and Education	HMA Grant Application Training	MEMA	$7,000	Budget	2023	H
4	Multi-Hazard	Outreach and Education	"Storm Ready" Community Education	MEMA	$27,000	Budget	Annual	H
6	All	Technical Assistance	Develop Local Hazard Mitigation Planning	MEMA	$7,000	HMGP	Annual	H
9	Multi-Hazard	Emergency Services	Provide Auxiliary Power Source for All Critical Facilities	MEMA	$10,000,000	HMGP	2023	H
11	Multi-Hazard	Technical Assistance	Coordinated Emergency Action Plans for Health Care Facilities	MSDH	$400,000	Budget	Annual	H
13	Multi-Hazard	Resources Protection	Wet Debris Management for Access, Water Quality and Environmental	MDMR	$10,000,000	USACOE	2023	H
15	Multi-Hazard	Technical Assistance	Complete/enhance inventory of state owned/operated facilities	MDFA	$500,000	HMGP	2023	H
18	Multi-Hazard	Emergency Services	Increase Shelter Capacity in each County	MEMA	$1,000,000	HMGP	Annual	H
20	Multi-Hazard	Technical Assistance	Prepare information Management System for Plan Updates for 2013	MEMA	$20,000	Budget	Annual	H
21	Multi-Hazard	Prevention/Property Protection	Track Project Implementation Progress for Mitigation Actions	MEMA	$20,000	Budget	Annual	H
22	Multi-Hazard	Resources Protection	Develop GIS Database for Archives and History on Cultural Resources	MDAH	$100,000	HMGP	2020	H
25	Multi-Hazard	Structural	Encourage Use of Non-Hazardous Materials in Critical Facilities	MDEQ	$7,000	Budget	Annual	H
26	Multi-Hazard	Outreach and Education	Yearly Information Meetings for Medical Community	MSDH	$50,000	Budget	2020	M
27	Multi-Hazard	Technical Assistance	Sheltering needs assessment	MDHS	$50,000	HMGP	2023	H
29	Multi-Hazard	Prevention	Mitigation Grants to Eligible Applicants for Emergency Warning Systems	MEMA	$196,836	HMGP	Annual	H
30	Multi-Hazard	Structural	Individual Assistance for "Safe Room" Program	MEMA	$500,000	HMGP	2023	H
32	Multi-Hazard	Structural	**New Action for 2018**: FEMA 361 Safe Rooms and Continuity of Government Shelters	MEMA	$20,000,000	HMGP	2020	H
1	Sea Level Rise	Outreach and Education	**New Action for 2018:** Education and Outreach for Coastal MS on impacts of Sea Level Rise	MEMA	NA	NA	2023	L

1	Tornado	Technical Assistance	Implement Wind Retrofit Projects	MEMA	$29,888,707	Budget	2022	M
7	Tornado	Outreach and Education	Public Outreach and Education for Homebuilders and Developers	MEMA	$7,000	Budget	2022	H
1	Wildfire	Outreach and Education	FireWise Program Workshops	MFC	$100,000	USFC	Annual	H
2	Wildfire	Technical Assistance	Community Wildfire Protection Plans	MFC	$240,000	USFC	Annual	H
3	Wildfire	Outreach and Education	Train Local VFD's in FireWise	MFC	$100,000	USFC	Annual	H
4	Wildfire	Outreach and Education	Communication and Partnership Initiatives with VFD's	MFC	$100,000	USFC	Annual	H
5	Wildfire	Technical Assistance	Information Management for Areas at Risk Based on County Wildfire Plans	MFC	$100,000	USFC	Annual	H
2	Winter Storm	Outreach and Education	Public Education and Outreach	MEMA	$7,000	Budget	Annual	H
TOTAL PROJECT COSTS							**$675,404,671**	

4.5: Funding Sources

44 CFR §201.4(c)(3)(iv) – The State mitigation strategy shall include the following elements: A mitigation strategy that provides the State's blueprint for reducing the losses identified in the risk assessment. This section shall include:

Identification of current and potential sources of Federal, State, local or private funding to implement mitigation activities

The State of Mississippi is well on its way to full recovery from the effects of Hurricane Katrina, the most destructive hurricane to hit the United States. As a result of Hurricane Katrina, the State of Mississippi received $434 million in Hazard Mitigation Assistance (HMA) funds and $4 billion in Community Development Block Grant (CDBG) funds to mitigate the effects. Since Hurricane Katrina made landfall, Mississippi has had ten smaller federally declared disaster which has resulted in approximately $33 million in HMA funds. The remaining Katrina funds and the HMA funds from the more recent declared disasters will continue to fund the mitigation initiatives that began because of Hurricane Katrina.

Statewide Initiatives Generated by Hurricane Katrina

The following statewide initiatives were funded through HMGP funds:

- The Statewide Generator Initiative – provides funding for generators for critical facilities.
- The Statewide College/University and Municipality Siren Initiative – provides funding for warning systems on junior and senior colleges as well as funding for counties and cities.
- The Statewide Saferoom/Storm Shelter Initiative – provides funding for individual and community storm shelters so that during a tornado or severe thunderstorm, the citizens of Mississippi have a safe place to go.

Since the previous plan was approved, the State under MEMA's guidance, has funded in addition to the statewide initiatives, the following projects:

- Acquisition Projects
- Drainage Projects
- Planning Grants
- Retrofits and Codes
- Standards Projects

Under the Flood Mitigation Assistance, the State has provided funding for the following:

- Acquisition Projects
- Planning Grants

MEMA has also provided funding for Mitigation.MS.Org, a web-based program that allows eligible applicants to submit project applications online.

The State Hazard Mitigation Plan Update is being funded under the Pre-Disaster Mitigation Program.

As can be seen from a review of the successful mitigation projects in Mississippi, it is very typical to leverage projects with multiple sources of funding. Table 4.5.1 provides a matrix that addresses the current and potential sources of funding for federal/state/local hazard mitigation programs, activities, and initiatives. The matrix identifies the program activity, type of assistance, and the responsible agency and point of contact.

The following "Programs/Activities" are addressed in the matrix on the following pages:

- General Emergency grants, loans, and assistance;
- Floods/Flood Control grants, loans, and assistance;
- Earthquake grants, loans, and assistance;
- All-Hazard Mapping grants, loans, and assistance;
- Ancillary Flood & Natural Resource Projects grants, loans, and assistance;
- Basic and Applied Research/Development grants, loans, and assistance;
- Other Planning Information, including Demographics, Societal Data, Transportation, Agricultural, Industrial, and Other Commercial Economic Statistics;
- Business Continuity Planning;
- Grants, loans, and technical assistance in addressing rehabilitation, health, safety, and emergency (fire, ambulance, sirens, etc.) Facilities and equipment needs in primarily low income rural areas.

This table has been updated from the 2013 plan to include programs/activities that were not defined or available and are designated with the notation of 2018 Update.

Table 4.5.1
Funding Sources

Program / Activity	Type of Assistance	Agency & Contact
General Emergency Grants, Loans & Assistance	**Pre/Post Disaster Mitigation, Relief, Recovery, Training, & Technical Assistance**	
Hazard Mitigation Grant Program	Provides grants to states and communities for the implementation of long-term hazard mitigation measures following a major disaster declaration.	FEMA Region IV NFIP & Mitigation (770) 220-5200 MEMA, Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Disaster Mitigation Planning and Technical Assistance	Provides technical and planning assistance for capacity building and mitigation project activities focusing on creating disaster resistant jobs and workplaces	Department of Commerce (DOC), Economic Development Administration (EDA) www.doc.gov/eda N. Mississippi (404) 730-3020 S. Mississippi (859) 224-7426 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Pre-Disaster Mitigation	Provides funding and technical assistance to communities and states to implement pre-disaster mitigation projects and planning.	FEMA Region IV NFIP & Mitigation (770) 220-5200 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Emergency Management I Mitigation Training	Offers training in disaster mitigation, preparedness, planning.	FEMA Region IV NFIP & Mitigation (770) 220-5200 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Post-Disaster Economic Recovery Grants and Assistance	Provides grant funding to assist in the long-term economic recovery of communities, industries, and firms adversely impacted by disasters.	Department of Commerce (DOC), Economic Development Administration (EDA) N. Mississippi (404) 730-3020 S. Mississippi (859) 224-7426
Development Infrastructure Grant Program (DIP)	DIP is a grant program that is available to fund publicly owned infrastructure. Funding from this program can be used by municipalities and counties to assist with the location or expansion of businesses. Usage of the funds must be directly related to the construction, renovation, or expansion of industry.	Mississippi Development Authority CDBG Program Tel: (601) 359-3179

Job Protection Grant Program	Provides “at risk” industries that have been operating in the state for at least three years and that have lost jobs or are at risk to lose jobs because such jobs have been outsourced. Funding from this program can be used by “at risk” industries that retain jobs in Mississippi and improve productivity.	Mississippi Development Authority CDBG Program Tel: (601) 359-3552
Mississippi Rail Grant Program (RAIL)	RAIL is designed for making grants to railroads to finance projects to promote economic growth in the state of Mississippi. Funding for this program is derived from appropriations or funds otherwise made available by the State Legislature.	Mississippi Development Authority-Financial Resources Tel: (601) 359-3552
Community Disaster Loan Program	Provides funds to any eligible jurisdiction in a designated disaster area that has suffered a substantial loss of tax and other revenue.	FEMA (800) 621-3362 www.fema.gov
Rural Business Enterprise Grants (RBEG)	Creates jobs and stimulate rural economics by providing real estate improvements, equipment, and working capital.	U.S. Department of Agriculture (USDA) State Office (601) 965-4316
Economic Development Initiative (EDI) Program	Provides grants to communities and counties for the purpose of providing infrastructure to support economic development.	HUD National Office Community Planning and Development Office of Economic Development (800) 998-9999
Brownfields Economic Development Initiative (BEDI) Program	Assists local governments with the redevelopment of abandoned, idled, and underused industrial/commercial facilities where expansion and redevelopment is burdened by real or potential environmental contamination	HUD National Office Community Planning and Development Office of Economic Development (800) 998-9999
Rural Business Opportunity Grants (RBOG)	Provides technical assistance, business development, and planning in rural communities with exceptional need	U.S. Department of Agriculture (USDA) State Office (601) 965-4316
Rural Impact Fund Grant Program	Provides grants to construct or improve public infrastructure to promote job creation in rural areas.	Mississippi Development Authority-Financial Resources Tel: (601) 359-3179
Small Municipalities and Limited Population Counties Grant Program	Provides grants to promote economic growth by improving public infrastructure.	Mississippi Development Authority-Financial Resources Tel: (601) 359-3179

Program / Activity	Type of Assistance	Agency & Contact
Water Resources, Flood Control, Pollution Abatement, and Soil Conservation Programs	Acts as local sponsor for member counties on federal projects and programs associated with water resources, flood control, pollution abatement, and soil conservation. Provides limited financial assistance on such projects	Pearl River Basin Development District (601) 354-6301
Capital Improvements Revolving Loan (CAP) Program	Makes loans to counties or municipalities to construct or improve public infrastructure.	Mississippi Development Authority Tel: (601) 359-3179
Mississippi Economic Redevelopment Program	Provides funding to counties or municipalities to remediate and develop an environmentally contaminated site.	Office of the Governor (601) 359-3150
Delta Regional Authority Grant Program	Helps economically distressed communities in the DRA area to leverage other funds focused on improving infrastructure, transportation, and business development.	Mississippi Development Authority Office of Strategic Initiatives (601) 359-6656
Appalachian Regional Commission	Provides matching funds for communities in the ARC area for making infrastructure improvements to encourage economic development and a higher quality of life.	Mississippi Development Authority Appalachian Regional Office (662) 842-5413
Fire Management Assistance Grant Program	Provides assistance for mitigation, management, and control of fires which threaten such destruction as would constitute a major disaster.	FEMA (8001) 621-3362 www.fema.gov
Reimbursement for Firefighting on Federal Property	Provides reimbursement to states and localities only for direct costs and losses over and above normal operating costs.	FEMA (800) 621-3362 www.fema.gov
Dry Fire Hydrant Program	Assists communities within the district through funding assistance to increase rural fire protection where by dry fire hydrants are constructed at known water sources to fill up the equipment tanks of a rural fire department.	Pat Harrison Waterway District (601) 264-5951
Repetitive Flood Claims Program	Provides funding to states and communities to reduce or eliminate long-term risk of flood damage to structures insured under the NFIP	FEMA (800) 621-3362 www.fema.gov
Program / Activity	**Type of Assistance**	**Agency & Contact**
Mosquito Control Grant Program	Provides funding to counties and communities in the Go Zone for the start-up or enhancement of an existing mosquito control program.	Mississippi Department of Health Office of Epidemiology (601) 359-7025
Transportation Enhancement Program	Provides funding for various activities that enhance existing or historic transportation facilities including	Mississippi Department of Transportation Office of Intermodal Planning

	environmental mitigation of run-off pollution	(601) 359-7025
Public Library Capital Improvement Subgrant Program	Provide grants to public libraries for capital improvements, renovation and/or repair of existing facilities	Mississippi Library Commission (800) 647-7542
Public Assistance Program (Infrastructure)	Provides grants to states and communities to repair damaged infrastructure and public facilities and to help restore government or government-related services. Mitigation funding is available for work related to damaged components of the eligible building or structure.	FEMA Region IV NFIP & Mitigation (770) 220-5200 MEMA, Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Community Development Block Grant (CDBG) Program State-Administered Public Infrastructure Grants	Public Facilities: Provides grants to counties and municipalities to improve infrastructure to eliminate an existing health threat to residents, primarily of low- and moderate-income households. (Includes water and sewer facilities, flood and drainage facilities, fire protection, roads and bridges.) Economic Development: Provides grants to counties and municipalities to provide infrastructure on behalf of a business/industry that commits to job creation or job retention.	Mississippi Development Authority CDBG Program Community Services Division Tel: (601) 359-3179
Community Development Block Grant (CDBG) Program	Provides grants to entitled cities to improve public infrastructure, primarily benefiting low- and moderate-income persons.	US Department of Housing and Urban Development (HUD) Entitlement Communities Division Office of Block Grant Assistance (202) 708-1577
Entitlement Communities Program	Entitlement Communities include Jackson, Hattiesburg, Pascagoula, Moss Point, Biloxi, and Gulfport.	State Field Office Community Planning and Development (601) 965-4700, ext. 3140
Program / Activity	**Type of Assistance**	**Agency & Contact**
Disaster Recovery Initiative	Provides grants to fund gaps in available recovery assistance after disasters (including mitigation).	HUD State Field Office Community Planning and Development (601) 965-4700, ext. 3140 HUD National Office Community Planning and Development Office of Block Grant Assistance (202) 708-3587, ext. 4538 MEMA, Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Public Housing Modernization Reserve for Disasters and	Provides funding to Public Housing Agencies for development, financing,	HUD Director, Office of Capital Improvements:

Emergencies	and modernization needs resulting from natural disasters (including elevation, flood proofing, and retrofit).	(202) 708-1640 MEMA, Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Indian Housing Assistance (Housing Improvement Program)	Provides grants and technical assistance to substantially eliminate sub-standard Indian housing.	Department of Interior (DOI) – Bureau of Indian Affairs (BIA) Division of Housing Assistance, Office of Tribal Services: (202) 208-3100
Section 504 Loans for Housing	Offers repair loans, grants and technical assistance to very low-income senior homeowners living in rural areas to repair their homes and remove health and safety hazards	US Department of Agriculture (USDA) – Rural Housing Service (RHS) State RHS Field Office (601) 965-4325 (800) 548-0071 Or National RHS Headquarters Housing and Community Facilities Programs (202) 720-4323
Section 502 Loan and Guaranteed Loan Program	Provides loans, loan guarantees, and technical assistance to very low and low-income applicants to purchase, build, or rehabilitate a home in rural area	USDA – RHS State RHS Field Office (601) 965-4325 (800) 548-0071 Or National RHS Headquarters Housing and Community Facilities Programs (202) 720-4323
Farm Ownership Loans	Provides direct loans, guaranteed/insured loans, and technical assistance to farmers so that they may develop, construct, improve, or repair farm homes, farms, and service buildings, and to make other needed improvements	USADA-Farm Service Agency (FSA) FSA State Field Office (601) 965-4300 Or FSA National Office (601) 720-3865
Program / Activity	**Type of Assistance**	**Agency & Contact**
HOME Investments Partnerships Programs	Provides grant funding to States, local governments and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.	HUD Community Planning and Development Office of Affordable Housing (877) 833-2483 (800) 225-5342 Home Corporation
Self-Help Homeownership Opportunity Program (SHOP)	Provides grants to non-profit organizations to purchase home sites and improve infrastructure needed for volunteer-based homeownership programs for low-income families	HUD Community Planning and Development Office of Affordable Housing (877) 833-2483 (800) 225-5342
Homeownership Zone (HOZ) Program	Provides grants to communities to reclaim vacant and blighted properties, to increase homeownership and to promote economic revitalization	HUD Community Planning and Development Office of Affordable Housing (877) 833-2483

		(800) 225-5342
Rural Development Assistance – Housing	Provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.	USDA – RHS State RHS Field Office (601) 965-4325 (800) 548-0071 Or National RHS Headquarters Housing and Community Facilities Programs (202) 720-4323
Rural Development Assistance – Utilities	Provide direct and guaranteed rural economic loans and business-enterprise grants to address utility issues and development needs	USDA-Rural Utilities Service (RUS) Program Support National Headquarters (202) 720-9540 State Rural Development Office (601) 965-5460
Rural Development Assistance – Community Facilities Loans and Grants Program	Provides grants and loans in addressing rehabilitation, health, safety, and emergency (fire, ambulance, sirens, etc.) facilities and equipment needs in rural communities and primarily in low income areas	USDA – RHS State RHS Field Office (601) 965-4325 (800) 548-0071 Or National RHS Headquarters Housing and Community Facilities Programs (202) 720-4323
Program / Activity	**Type of Assistance**	**Agency & Contact**
Rural Community Fire Protection	Provides grants for rural fire projects, truck acquisition, or other assistance.	Mississippi State Fire Marshal (601) 359-3569 (888) 648-0877
Section 108 Loan Guarantee Program	Provides loan guarantees to public entities for community and economic development (including mitigation measures).	HUD State Field Office Community Planning and Development (601) 965-4757 HUD National Headquarters Section 108 Office (202) 708-1871
Program/Activity	**Type of Assistance**	**Agency & Contact**
Floods/Flood Control Grants, Loans & Assistance	**Floods/Flood Control Technical/Planning Assistance and Program Support**	
National Flood Insurance Program	Makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements.	FEMA Region IV NFIIP & Mitigation (770) 220-5200 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Flood Mitigation Assistance	Provides grants to States and communities for pre-disaster mitigation	FEMA Region IV NFIP & Mitigation

	to help reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program. Requires flood mitigation plan to be developed by the applicant.	(770) 220-5200 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Flood Control Planning Assistance	Provides technical and planning assistance for the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Floodplain Management Staff of Appropriate Regional Office: N. MS – Memphis District: (901) 544-3401 C. MS – Vicksburg District: (601) 631-5126 S. MS – Mobile District: (334) 690-2495
Floodplain Management Services	Provides technical and planning assistance at the local, regional, or national level needed to support effective floodplain management.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Floodplain Management Staff of Appropriate Regional Office: N. MS – Memphis District: (901) 544-3401 C. MS – Vicksburg District (601) 631-5126 S. MS – Mobile District (334) 690-2495 MEMA, Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Works Projects Grants Flood Control and Water Management	Assists communities within the district to eliminate long and short-term flooding and drainage problems.	Pat Harrison, Waterway District (601) 264-5951
Land Protection	Provides technical assistance for run-off retardation and soil erosion prevention to reduce hazards to life and property.	USDA – Natural Resources Conservation Service (NRCS) Conservation Planning and Technical Assistance Division National NRCS Office (202) 720-8851 State NRCS Conservationist (601) 965-5196
Earthquake Grants, Loans & Assistance	**Earthquake Mitigation, Relief, Recovery, Technical/Planning/Training Grant/Loan Assistance and Program Support.**	
National Earthquake Hazard Reduction Program	Provides technical and planning assistance for activities associated with earthquake hazards mitigation	FEMA, Dept. of the Interior (DOI), U.S. Geological Survey (USGS), National Institute of Standards and Technology FEMA Region IV NFIP & Mitigation

		Earthquake Program Manager (770) 220-5426 MEMA, Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Geological Survey Program	Acquires, maintains and manages basic geological data; identifies and evaluates geological hazards. The Geological Survey program assists citizens, industry, and government in the wise use of the state's minerals, land, and water resources.	Mississippi Department of Environmental Quality Office of Geology (601) 961-5500
Other Earthquake Hazards Reduction Programs	Provides training, planning and technical assistance under grants to States or local jurisdictions.	FEMA Region IV NFIP & Mitigation Earthquake Program Manager (770) 220-5426 DOI-USGS Earthquake Program Coordinator (888) 275-8747 Central U.S. Earthquake Consortium (901) 544-3570 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Program / Activity	**Type of Assistance**	**Agency & Contact**
All-Hazard Mapping Grants, Loans & Assistance & Technical Assistance	**All-Hazard Analysis & Mapping of Flood Plains, Watersheds, Earthquake Areas, At-Risk Populations.**	
National Flood Insurance Program: Flood Mapping:	Offers flood insurance rate maps and flood plain management maps for all NFIP communities;	FEMA Region IV NFIP & Mitigation (770) 220-5200 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
National Flood Insurance Program: Technical Mapping Advisory Council	Offers technical guidance and advice to coordinate FEMA map modernization efforts for the National Flood Insurance Program.	DOI-USGS National Mapping Division (573) 308-3802 MDEQ Office of Geology and Geospatial Resources Division Remote Sensing and GIS (601) 961-5506

		MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Stream Gaging and Flood Forecasting Network	Operates a network of over 7,000 stream gaging stations that provide data on river flood characteristics and issues flood warnings and river forecasts to reduce flood damages.	USGS National Office of Surface Water (703) 648-5977 USGS State Office (601) 933-2900 National Weather Service Office of Hydrology (301) 713-0006
Mapping Standards Support	Provides expertise in mapping and digital data standards to support the National Flood Insurance Program	DOI-USGS USGS National Mapping Division (573) 308-3802 MDEQ Office of Geology Geospatial Resources Division (601) 961-5506
Program / Activity	**Type of Assistance**	**Agency & Contact**
National Earthquake Hazards Reduction Program	Provides seismic mapping for U.S	DOI-USGS Earthquake Program Coordinator (703) 648-6785 FEMA, Region IV Mitigation Division Earthquake Program Manager (770) 220-5426 MEMA Office of Mitigation Tel: (601) 933-6362 Fax: (601) 933-6815 www.msema.org
Program / Activity	**Type of Assistance**	**Agency & Contact**
Ancillary Flood & Natural Resource Projects Grants, Loans & Assistance	**Watershed Management, Clean Water, Conservation, Environmental, Forestry, Grant/Loan Assistance, Technical Aid, and Program Support**	
Natural Resources Financial Assistance	Assist communities with funding for projects that protect the natural environment.	MDEQ Tel: (601) 961-5158
Environmental Quality Incentives Program (EQIP)	Provides technical, educational, and loan and grant assistance to encourage environmental enhancement	NRCS EQIP Program Manager (202) 720-8851 www.nrcs.usda.gov NRCS State Office

	Air Pollution Control Environmental Services Hazardous Substance Emergency Relief Hazardous Waste Brownfields Pilot Projects, Fees and Taxes, Leaking Underground Storage Tank Cleanup, Natural Resources Damage Assessments, Petroleum Storage Tank Cleanup, Voluntary Cleanup Program Financial Incentives Solid Waste Management Technical Assistance Water Pollution Control State Construction Wastewater Grant Program State Revolving Loan Fund (SRF)	(601) 965-5196 Or NRCS County Offices Mississippi Department of Environmental Quality (601) 961-5171
Clean Water Act Section 319 Grants	Provides grants to states to implement non-point source programs, including support for non-structural watershed resource restoration activities	US Environmental Protection Agency (EPA) Office of Water Chief, Non-Point Source Control Branch (202) 566-1155 Mississippi Department of Environmental Quality (601) 961-5171
Clean Water State Revolving Funds	Provides loans at actual or below-market interest rates to help build, repair, relocate, or replace wastewater treatment plants.	EPA, Office of Water State Revolving Fund Branch (202) 260-7359 A list of Regional Offices is available upon request
Program / Activity	**Type of Assistance**	**Agency & Contact**
Wetlands Protection – Development Grants	Provides grants to support the development and enhancement of State and tribal wetlands protection programs.	EPA National Wetlands Hotline (800) 32-7828 Or EPA Region IV Chief, Wetlands Section (404) 562-9900 Mississippi Department of Environmental Quality (601) 961-5171
Watershed Protection, Flood	Provides technical and financial	US Department of Agriculture (USDA) –

Prevention, and Soil and Water Conservation Program	assistance for installing works of improvement to protect, develop, and utilize land or water resources in watersheds under 250,000 acres.	National Resources Conservation Service (NRCS) Conservation Planning and Technical Assistance Division National NRCS Office (202) 720-8851
Watershed Surveys and Planning Small Watershed Protection Act (PL 566)	Provides surveys and planning studies for appraising water and related resources and formulating alternative plans for conservation use and development. Provides grants and advisory counseling services to assist with planning and implementing improvement.	USDA-NRCS Conservation Planning and Technical Assistance Division National NRCS Office (202) 720-8851 State NRCS Conservationist (601) 965-5196
Emergency Watershed Protection Program	Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by natural hazard events.	USDA-NRCS Conservation Planning and Technical Assistance Division National NRCS Office (202) 720-8851 State NRCS Conservationist (601) 965-5196
Wetlands Reserve Program	Provides financial and technical assistance to protect and restore wetlands through easements and restoration agreements.	USDA-NRCS Conservation Planning and Technical Assistance Division National NRCS Office (202) 720-8851 State NRCS Conservationist (601) 965-5196
Project Modifications for Improvement of the Environment	Provides for ecosystem restoration by modifying structures and/or operations or water resources projects constructed by the USACE, or restoring areas where a USACE project contributed to the degradation of an area	DOD-USACE Chief of Planning @ appropriate USACE Regional Office (212) 264-7813
Aquatic Ecosystem Management and Restoration	Provides direct support for carrying out aquatic ecosystem restoration projects that will improve the quality of the environment.	DOD-USACE Chief of Planning @ appropriate USACE Regional Office (U.S. Army Corps of Engineers) (212) 264-7813
Program / Activity	**Type of Assistance**	**Agency & Contact**
Beneficial Uses of Dredged Materials	Provides direct assistance for projects that protect, restore, and create aquatic and ecologically-related habitats, including wetlands, in connection with dredging an authorized Federal navigation project.	DOD-USACE Chief of Planning @ appropriate USACE Regional Office (U.S. Army Corps of Engineers) (212) 264-7813
National Cooperative Soil Survey	Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes.	USDA-NRCS Soil Survey Division (202) 720-4593
Land Acquisition	Acquires or purchases easements on high-quality lands and waters for inclusion into the National Wildlife Refuge System	DOI-Fish and Wildlife Service (FWS) Southeast Region Division of Realty (404) 679-7199

Transfers of Inventory Farm Properties to Federal and State Agencies for Conservation Purposes	Transfers title of certain inventory farm properties owned by FSA to Federal and State agencies for conservation purposes (including the restoration of wetlands and floodplain areas to reduce future flood potential)	US Dept. of Agriculture (USDA) – Farm Service Agency (FSA) Farm Loan Programs National Office (202) 720-3467 State Field Office (601) 965-4300
Federal Land Transfer / Federal Land to Parks Program	Identifies, assesses, and transfers available Federal real property for acquisition for State and local parks and recreation, such as open space.	DOI-National Parks Service (NPS) Federal Lands to Parks Office Southeast Region (404) 562-3172 Federal Lands to Parks Leader NPS National Office: (202) 354-6915
Partners for Fish and Wildlife	Provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.	DOI – FWS Southeast Regional Ecological Services (404) 679-7138 State Field Office (601) 965-4900
Forest Tree Seedlings	Produces and distributes quality seedlings to assure forest regeneration and to sustain Mississippi's forest resources.	Regeneration Forester Mississippi Forestry Commission (601) 359-2825
Mississippi Reforestation Tax Credit	Promotes reforestation on private, non-industrial lands. A Mississippi Tax Credit on up to 50% of the cost of approved hardwood and pine reforestation practices.	Mississippi Forestry Commission Tel: (601) 359-1386 Fax: (601) 359-1349 www.mfc.state.ms.us
Program / Activity	**Type of Assistance**	**Agency & Contact**
Forest Health	Assists timber owners in forest pest management by conducting forest pest surveys and evaluation. Recommendations on practices to salvage lumber, reduce and prevent damage from pests, will be provided to landowners upon request.	Mississippi Forestry Commission Tel: (601) 359-1386 Fax: (601) 359-1349 www.mfc.state.ms.us
Forest Land Enhancement Program	Promotes long-term sustainability of private, no-industrial forestlands. Cost-share assistance is available.	Contact your County Forester
Landowner Services	Offers a variety of forest management services to private non-industrial owners of relatively small acreages. Most technical assistance and forestry advice is free to the landowner. Direct services, such as plowing fire lanes, tree planting, and timber-marking are available for a fee.	Contact your County Forester
Forest Resource Development	Provides financial assistance to	Mississippi Forestry Commission

Program	eligible landowners for establishing and improving a crop of trees. This program helps offset a landowner's expense by sharing the cost implementing one or more forestry practices.	Tel: (601) 359-1386 Fax: (601) 359-1349 www.mfc.state.ms.us/landownerassistance
Conservation Contracts	Assists debt reduction for delinquent and non-delinquent borrowers in exchange for conservation contracts placed on environmentally sensitive real property that secures FSA loans.	USDA-FSA Farm Loan Programs FSA National Office: (202) 720-3467 FSA State Office (601) 965-4300
Historic Preservation Fund Grants	Provides grants to assist communities in carrying out historic preservation activities.	DOI-National Park Service Mississippi Department of Archives and History (601) 576-6940
The Foundation Directory	Provides annual source of information about grants & loans from federal and private sources. Available for a fee.	The Foundation Center (800) 424-9836 www.foundationcenter.org
Federal and Foundation Assistance Monitor	Provides semi-monthly reports on federal and private grants. Available for a fee	CD Publications 8204 Fenton Street Silver Springs, MD 20910 Tel: (301) 588-6380 www.cdpublications.com
Program / Activity	**Type of Assistance**	**Agency & Contact**
Environmental Grantmaking Foundations	**Provides a comprehensive list of foundations that support environmental nonprofit activities and programs. Available for a fee.**	
Environmental Grantmaking Foundations	Provides a comprehensive list of foundations that support environmental nonprofit activities and programs. Available for a fee.	Resources for Global Sustainability, Inc. Cary, North Carolina (800) 724-1857
Basic & Applied Research/Development Grants, Loans & Assistance	**Research and Educational Assistance Information, Grants / Loans and Technical Assistance**	
Center for Integration of Natural Disaster Information	Develops and evaluates technology for information integration and dissemination	Department of Interior (DOI) US Geological Survey (USGS) (888) 275-8747 www.usgs.gov
Hazard Reduction Program	Provides funding for research and related educational activities on hazards	National Science Foundation (NSF), Directorate for Engineering, Division of Civil and Mechanical Systems (703) 292-8360
Decision, Risk, and Management Science Program	Provides funding for research and related educational activities on risk, perception, communication, and management (primarily technological hazards)	NSF Directorate for Social, Behavioral and Economic Science, Division of Social Behavioral and Economic Research, Decision, Risk, and Management Science Program (DRMS) (703) 292-7263 www.nsf.gov/sbe.drms

Societal Dimensions of Engineering, Science, and Technology Program	Provides funding for research and related educational activities on topics such as ethics, values, and the assessment, communication, management, and perception of risk	NSF Directorate for Social, Behavioral and Economic Science, Division of Social, Behavioral and Economic Research, Societal Dimensions of Engineering, Science and Technology Program (703) 292-7279
National Earthquake Hazard Reduction Program (NEHRP) in Earth Sciences	Research into basic and applied earth and building sciences	NSF Directorate for Geosciences Division of Earth Sciences (703) 292-8550
Program / Activity	**Type of Assistance**	**Agency & Contact**
Other Planning Information, Including Demographics Societal Data, Transportation, Agricultural, Industrial & Other Commercial Economic Statistics	**Low and/or No Cost Information Helpful for Determining At-Risk Populations and Potential Economic Damages & Information to Help Determine Avoidance of Losses.**	
Demographics, Societal Statistics and Economic Statistics	Provides free Planning Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e. statistics, maps, reports, etc.), State Government, etc. Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information provided in those subject areas.	U.S. Census Bureau Washington, D.C. 20233 General telephone inquiries: (800) 923-8282 www.census.gov Bureau of Economic Analysis (BEA) 1441 L Street NW Washington, D.C. 20230 Public Information Office (202) 606-9900 BEA Order Desk (800) 704-0415 Bureau of Labor Statistics Division of Information Services 2 Massachusetts Avenue, N.E. Room 2860 Washington, D.C. 20212 (800) 877-8339 (202) 691-5200 www.bls.gov
University of Mississippi Center for Population Studies	Disseminates U.S. Census data, provides technical assistance in the collection and analysis of Census and other demographic and social data, and undertakes research on population issues.	University of Mississippi College of Liberal Arts Center for Population Studies (662) 915-7288
Program / Activity	**Type of Assistance**	**Agency & Contact**
National Climactic Data	Maintains the largest active archive of national weather data, produces numerous climate publications, and	U.S. Dept. of Commerce National Climactic Data Center (828) 271-4800

	responds to data requests	
State Climactic Data	Provides current weather information and forecasts, maintains an active archive of weather data for the state, and responds to data requests	Office of the Mississippi State Climatologist Dr. Charles L. Wax (662) 325-3915

5.0: Local Mitigation Planning

A key element of the Disaster Mitigation Act of 2000 is the strengthening of interactions between the state and local communities, particularly in coordination of implementation strategies. It is thought that most significant mitigation occurs at the local level. Thus, it is beneficial to all concerned to make sure that local plans are as effective in identifying hazards and developing action plans.

The Mitigation staff at Mississippi Emergency Management Agency works with counties and local jurisdictions to encourage and support local hazard mitigation planning. By developing the State Hazard Mitigation Plan, MEMA is assisting communities in updating local mitigation strategies by initiating a number of activities designed to integrate objectives consistent at both the State and local levels. These activities include funding and technical support, as well as educational opportunities.

Summary of Changes

Technical Support (Section 5.1) Planning Assistance for Local Governments were updated. Recipients, funding source and amounts changed. Technical Assistance for Local Governments were updated. Recipients, funding source and amounts changed. CAV's and CAC numbers were updated along with applicant briefings conducted 2013-2018. Regional district plans are now included

Removal of Methodology and Analysis of Local Plans (Section 5.2) Vulnerability Assessment Methodology by Planning and Development District (Table 5.2.1) Updates To Severe Repetitive Loss Property Analysis and Repetitive Loss Amounts

5.1: Local Mitigation Planning Coordination

44 CFR §201.4(c)(4)(i) – To be effective, the plan must include the following elements:

A section of the Coordination of Local Mitigation Planning that includes the following:

A description of the State process to support, through funding and technical assistance, the development of local mitigation plans

Funding Support

The State has met its goal to have an approved hazard mitigation plan. The State has 9 regional plans; DRU plans, and single jurisdictional plans. The majority of the local jurisdictions are covered by regional hazard mitigation plans. All 82 counties have an approved hazard mitigation plan. The State will continue the process to support the development of local mitigation plans through funding and technical assistance as follows:

Mississippi local communities continue to develop and implement a regional district hazard mitigation plan. Many of these communities have existing regional mitigation plans that are being updated to ensure that the effective implementations of mitigation initiatives are realized.

Also, these plans are being updated to identify potential utilization of funds for projects in these communities. MEMA assists with the planning application and meets with locals to determine scope of work. Once funding is awarded, the contract goes through the state bidding process. The State share of funding has been maintained at 90% and the Local share at 10% of the total cost.

Technical Support

Technical Support is provided to local jurisdictions and the Planning and Development Districts (PDD) in developing mitigation plans, identifying mitigation action strategies, and applying for assistance through various funding sources. This support is provided primarily by the MEMA Mitigation Bureau and FEMA Region IV.

The State has a Memorandum of Understanding (MOU) with the ten PDDs to develop local hazard mitigation plans. Under that MOU, the State provided technical assistance funded by FEMA's Technical Assistance Program. The Hazard Mitigation Grant Program and Pre-Disaster Mitigation Program funding are currently being used to develop plans for the local jurisdictions. The State continues to use the FEMA Technical Assistance Program for funding the National Flood Insurance Program, Hazard Mitigation Grant Program, and Hazard Mitigation Planning training workshops for local governments as needed and requested.

MEMA has conducted 40 Applicants' Briefings in support of federally declared disasters since 2013 plan update. MEMA is also a member of Mississippi Civil Defense/Emergency Management Association (MCDE- MA), Building Officials Association of Mississippi (BOAM), and an affiliate of the Mississippi Municipal League (MML) and the Mississippi Association of Supervisors (MAS). MEMA representatives

attend the annual and semi-annual meetings of these organizations and provides updates on all mitigation activities taking place throughout the state.

MEMA's Floodplain Management Specialist conducted a total number of 128 CACs from 2013-2018 and 198 CAV's from 2013-2018

Planning Assistance for Local Governments					
Recipients	**Program Type**	**Amount ($)**	**Recipients**	**Program Type**	**Amount ($)**
District 1	State	$74,322.00	DRU- MS Valley	State	$16,000.00
District 2	State	$89,944.00	DRU- Ole Miss	State	$83,304.00
District 3	State	$97,999.00	DRU- MUW	State	$33,000.00
District 4	State	$99,000.00	DRU- MS State	State	$15,000.00
District 5	State	$46,000.00	DRU-MS Delta CC	State	$35,000.00
District 6	State	$78,768.00	DRU- East Central CC	State	$30,000.00
District 7	State	$81,456.00			
District 8	State	$101,000.00			
District 9	State	$65,326.00			
DRU-Jackson State	State	$12,000.00			
DRU-Alcorn State	State	$33,000.00			

Mitigation Assistance for Local Governments	
Class	**Recipient of Training**
FPM 101 Workshop	AFMM Conference
L273 Workshop	Pearl, MS Quarterly
FPM 101 Workshop	Philadelphia, MS
RSDE/EC Workshop	State Farm Insurance Agents
CEO Briefing	Louisville, Hattiesburg, Columbia
Planning Workshop	North East PDD
Planning Workshop	North Delta PDD
Planning Workshop	East Central PDD
Planning Workshop	Pearl River County
Planning Workshop	North East MS PDD

5.2: Local Plan Integration

44 CFR 201.4(c)(4)(i) – To be effective, the plan must include the following elements:

A section on the Coordination of Local Mitigation Planning that includes the following:

A description of the State process and timeframe by which the local plans will be reviewed, coordinated, and linked to the State Mitigation Plan.

Review and Approval of Local Plans

Federal mandate 44 CFR Sec. 201.4 requires that states and local jurisdictions must have an approved mitigation plan in order to receive grant funding. Once a local jurisdiction has applied for and received grant funding for a local hazard mitigation plan, they have one year in which to complete it. Applicants are not eligible to receive mitigation grant funds unless their plan has been approved. During plan development, technical assistance is provided by MEMA upon request, in addition to any plans training already provided.

The Mitigation Planning Division of MEMA reviews all local hazard mitigation plans based on the FEMA local plan review tool. MEMA and FEMA planners developed a plan review methodology to expedite the plan review process. As a result, the State now has over 370 jurisdictions with approved hazard mitigation plans. Once MEMA receives a plan from a local jurisdiction, MEMA planners will review the plan within 30-45 days of receipt and either return the local plan for required revisions or forward the plan to FEMA for final review.

Plans that pass the state review are forwarded to the FEMA Region IV Mitigation Division for conditional approval. Once the local jurisdiction(s) adopts the plan, the State forwards the adoption resolution(s) to FEMA for final approval. FEMA encourages the adoption of local hazard mitigation plans within 90-days of the federal approval.

For local plans that do not pass State review and require additional work, MEMA's Mitigation Planning Division provides a review tool with explanations of the actions and or changes that must occur in order to bring the plan into compliance with FEMA planning guidance and the Code of Federal Regulations (CFR). Furthermore, each jurisdiction is provided technical assistance through the Mitigation Planning Division Director and the two mitigation planners assigned to regions within the State. Eighteen months prior to plan expiration, local jurisdictions are notified to begin looking at the plan update process and made aware of any available funding sources. The local jurisdictions are again notified at twelve, six and three months before plan expiration.

There are some barriers to updating and adopting mitigation plans. At this time, several college plans are due for update. The Mitigation Planning Division will continue to send plan expiration notices. Some communities are slow to adopt their hazard mitigation plan. The Mitigation Planning Division will continue to contact communities that need to adopt through letters, calls, and emails. The Mitigation Planning Division will continue to use this review and educational process to assist local jurisdiction leaders in developing and updating plans.

Methodology and Analysis of Local Plans

The plan developers analyzed the risk assessments of FEMA-approved local hazard mitigation plans in Mississippi to assess their consistency with the state plan's risk assessment and to determine if the ranking of the state's hazards should be revisited and if any additional hazards should be profiled in the state plan. All of Mississippi 82 counties have FEMA approved plans. The 9 approved regional plans were reviewed to determine which hazards each county was vulnerable to and to what degree (city-level plans were examined for consistency with the county-level determinations, but information presented is summarized to the county level).

Linking Local Plans to the State Plan

During the 2018 plan update process, the State gathered information from local plans to integrate this data into the State plan. The Hazard Mitigation Council reviewed and summarized information from the local plans on the following categories:

- Hazard identification and risk assessment
- Goals and objectives
- Local capabilities
- Mitigation actions

The process in 2018 involved reviewing all of the district-level plans and capturing the information related to the four categories above in spreadsheets for further review and comparison purposes. (For more details on this process, and how the information was collected and incorporated, see Section 3.0 Risk Assessment, Section 4.1 Hazard Mitigation Goals and Objectives, Section 4.3 Local Capability Assessment, and Section 4.4 Mitigation Actions.)

This information was used to inform the planning process and to reassess the plan for the following purposes:

- To improve the alignment of the state mitigation strategy with local goals, objectives, and actions;
- To update the statewide risk and vulnerability assessments;
- To identify and promote initiatives proven successful at the local level;
- To review state initiatives to determine if they meet the overall mitigation needs of the state and to change those that have not produced anticipated results; and
- To link local action with the state's mitigation strategy.

New and updated plans will be incorporated into the state plan during the five-year update cycle. Should state priorities change, these plans may be incorporated sooner.

The Mitigation Planning Division of MEMA makes a copy of the State plan and a summary of state prioritized strategies available to each local community. It was evident in the local plan review that some jurisdictions did incorporate information from the State plan's risk assessment and goals and objectives into

their local plan. Upon approval of this plan update, the State would like to further promote the use of the updated risk assessment and mitigation strategy in local government mitigation planning.

This 2018 update reflects the successful integration of the plans from all 82 counties in the state. MEMA has encouraged local governments to participate in regional district plans, DRU plans and single jurisdictional plans to maximize the number of communities covered by mitigation plans and to help develop more coordinated, regional approaches to mitigation. Now that all the counties have a FEMA approved plan, MEMA's priority is to ensure timely updates of the local jurisdictions plans. As local plans are updated, the local governments will be encouraged to develop more tailored actions to their specific community. MEMA's priority will be facilitating the completion of remaining local plans, followed by technical assistance on plan implementation and updates.

5.3: Prioritizing Local Technical Assistance

44 CFR §201.4(c)(4)(i) – To be effective, the plan must include the following elements:

A section on the Coordination of Local Mitigation Planning that includes the following:

Criteria for prioritizing communities and local jurisdictions that would receive planning and project grants under available funding programs, which should include consideration for communities with the highest risks, repetitive loss properties, and most intense development pressures. Further, that for non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs.

Funding Priority

The state has established the following types of projects for funding priority:

- Hazard Mitigation Planning.
- Retrofit of critical facilities and critical infrastructure.
- Repetitive flood properties and severe repetitive flood loss areas.
- Projects that would result in a general improvement of regional or local mitigation capability.
- State Identified Mitigation Initiatives such as saferooms and storm shelters, severe weather warning systems for universities and colleges, and severe weather notification systems for local communities.
- Post-disaster identified mitigation needs.
- Other projects initiatives identified in the state and local mitigation plan.

Prioritizing Alternatives

STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) criteria to select and prioritize the most appropriate mitigation alternatives for the plan. This methodology requires that social, technical, administrative, political, legal, economic, and environmental considerations be taken into account when reviewing potential actions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on the state's capabilities. Appendix 7.3.1 provides additional information regarding the review and selection criteria for alternatives

For non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs.

Prioritization of Communities / Jurisdictions for Planning Grants

This section provides a description of the criteria by which the State will prioritize communities and local jurisdictions that would receive planning grants under the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), Pre-Disaster Mitigation (PDM), and other available funding programs.

Federal and State funding for mitigation planning will be limited and in some instances, may not be available. There will always be more requests for mitigation planning funds than there will be available funds. Approval of funds for mitigation planning will be based on the availability of funds and the determination as to whether the requesting jurisdiction has demonstrated the desire and ability to complete the plan and follow through on the strategies identified in the plan. This desire to comply with the initiatives in the local mitigation plan should not be dependent on the availability of state or federal funds. Local jurisdictions should develop mitigation plans based on their unique capabilities and needs.

In an effort to allow some flexibility in the distribution of mitigation planning funds, the following general guidelines have been developed. These guidelines are not all inclusive and compliance with all of the issues listed below may not be required for approval of a planning grant.

- The community must meet the criteria for the specific source of funds referenced in Section 5.1 (Funding Support).
- MEMA will consider its past experience in dealing with the community on other grants (such as disaster grants, mitigation projects, etc.).
- MEMA may contact the Mississippi Development Authority (MDA) Community Development Block Grant (CDBG) program, other State agencies/departments, and/or the Planning & Development District (PDD) to check on their past experiences with the requesting community.
- The State and local risk assessment will be reviewed to determine the susceptibility of the community to natural and human caused disasters.
- MEMA will review previous presidential disaster declarations to determine the number of times the requesting community has been impacted by declared disasters and the magnitude of damages resulting from those disasters. This review would consider impact on community infrastructure, as well as families and businesses.
- MEMA will also consider the number of non-declared disasters that have impacted the community. This review would consider impact on community infrastructure, as well as families and businesses.
- MEMA will consider whether or not the community participates in the National Flood Insurance Program (NFIP).
- MEMA will consider the number of insured, repetitive loss structures in the community.
- MEMA will also consider the community's status as a small-impoverished community and communities with special developmental pressures, if applicable.
- The community has identified natural disaster hazards in areas under its jurisdiction

Prioritization of Non-Planning Grants

This section provides a description of the criteria by which the State will prioritize communities and local jurisdictions that would receive non-planning grants under the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), Pre-Disaster Mitigation, and other available funding programs.

- The extent and nature of the hazards to be mitigated;
- The degree of commitment of the local government to reduce damages from future natural disasters;
- The degree of commitment of the local government to support the hazard mitigation measures to be carried out using the technical and financial assistance;
- The extent to which the hazard mitigation measures to be carried out using the technical and financial assistance contribute to established State/Local mitigation goals and priorities;
- The extent to which prioritized, cost-effective mitigation activities that produce meaningful and definable outcomes are clearly identified;
- If the local government has submitted a mitigation plan, the extent to which the activities identified under paragraph (5) above are consistent with the mitigation plan;
- The opportunity to fund activities that maximize net benefits to society;
- The extent to which assistance will fund activities in small impoverished communities;
- The extent of development pressure particularly in those areas experiencing unexpected growth as a result of the post-Katrina evacuation and relocations;
- Communities with the highest risk; and
- Small and Impoverished Community Provisions

As used in pre-disaster mitigation, a small-impoverished community means a community of 3,000 or fewer individuals that is economically disadvantaged, as determined by the State. Additional criteria may be determined by FEMA. The President may increase the federal cost share to 90% of the total cost of mitigation activities carried out by small impoverished communities; however, all other requirements will be the same as any other community participating in pre-disaster mitigation activities.

In order for a project to be considered for funding, it has to have a benefit cost ratio of a minimum of 1.0 that is technically feasible and cost-effective in accordance to FEMA requirements. Only projects that meet this criterion along with the other bulleted elements listed above are considered eligible, this ensures that the benefits are maximized from the projects. In accordance with the Hazard Mitigation Plan and the Administrative Plan, the Hazard Mitigation Council approves projects that meet the goals and objectives of the state plan and based also on the recommendations of the State Hazard Mitigation Officer. Mississippi Gulf Coast communities have received more grant funding than the other areas of the state because of the higher risks associated with the coastal area.

Mississippi is classified as a mostly rural state. Sixty-three percent of the state is classified as rural and thirty-four percent urban. At the time of this plan update, the Hazard Mitigation Council is unaware of any significant development pressures within the state's communities. None of the communities have identified any development pressures in their local plans and was not addressed in the state plan. Should the state's communities identify any development pressures in the future, they will be addressed at the appropriate time.

The State of Mississippi amended its plan to participate in FEMA's Severe Repetitive Loss Program to take advantage of the 90/10 cost share to help mitigate RL properties. The state is committed to mitigating these properties.

Evaluation of Prioritizing Planning and Non-Planning Grants

The Hazard Mitigation Bureau's Administrative Plan for the Hazard Mitigation Grant Program provides an evaluation process for approval of grant applications as stated in Section VI – Program Administration. In addition, this plan presents a process to ensure benefits are maximized according to a cost benefit review of proposed projects.

Repetitive and Severe Repetitive Loss

Section 3 provides details about hazard assessments in Mississippi and appropriate mitigation actions to increase safety and reduce losses. One of the most revealing facts is the repetitive and severe repetitive losses that occur to structures and infrastructures. Mitigation Actions have been identified to address these repetitive and severe repetitive losses. These actions were developed from an historical, as well as a vulnerability, perspective.

The National Flood Insurance Program shows 63,994 policies with a total coverage of 15,671,951,500. Total claims since 1978 is 61,136 and a total paid since 1978 is 3,039,248,331 and over $332 million repetitive losses paid with 1,423 repetitive loss properties mitigated. The State of Mississippi has shown to a high priority on assisting local communities in reducing future losses through defined mitigation actions. Our goal is to continue to increase the mitigation of repetitive and severe repetitive loss properties. The State of Mississippi is committed to mitigate its repetitive and severe repetitive loss properties; to that end we have previously amended the state plan to take advantage of the SRL Program with the 90/10 share cost. With that being said, the State of Mississippi does not adopt or enforce a statewide building code for all structures, nor does it mandate a code for residential construction. It is up to local jurisdictions to adopt and enforce building codes.

- We do encourage communities to restrict development in flood prone areas by implementing stricter building codes, zoning and ordinances.
- Placed and continue to place higher priority for applications inclusive of, but not limited to, developing a floodplain management program, restricting development in flood prone areas, acquiring flood prone properties, elevate structures that have been deemed repetitive loss and severe repetitive loss structures, and flood proofing businesses that meet the criteria of repetitive loss and severe repetitive loss structures.

Hurricane Katrina mitigated a large number of repetitive loss properties, the exact number is unknown at this time and the state is continuing to make mitigating RL properties a priority.

6.0: Plan Maintenance Process

A formal process is required to ensure that the Plan will remain an active and relevant document. This section, Plan Maintenance, includes a schedule for monitoring and evaluating the Plan annually, and for revising the Plan every five years. It describes how the Hazard Mitigation Council and individual member institutions will receive public input throughout the process. Finally, this section explains how institutions will transform the mitigation strategies outlined in this plan into existing planning mechanisms.

Summary of Changes - 2018 Plain Maintenance

- Plan Monitoring, Evaluating, and Updating (Section 6.1.1) Mitigation action appendix numbers updated
- Plan Evaluation (Section 6.1.2) semi-annual meetings that involved periodic reports from other agencies.
- The projects were worked on and narrowed down to 67 projects.
- Staffing (Section 6.2.3) Updates were done on staff titles and duties.
- Three-year to five-year plan review

6.1: Monitoring, Evaluating, and Updating the Plan

44 CFR §201.4(c)(5)(i)(ii) – The State mitigation strategy shall include the following elements: A Plan Maintenance Process that includes:

An established method and schedule for monitoring, evaluating, and updating the plan. This is a system for monitoring implementation of mitigation measures and project closeouts.

6.1.1: Plan Monitoring, Evaluating, and Updating

The Mississippi Hazard Mitigation Council participants will review the goals, objectives, and action items listed in the plan on a semi-annual basis. They shall be responsible for communicating any desired or necessary changes to the Mississippi Emergency Management Agency and other stakeholders. The Hazard Mitigation Council will convene semi-annual meetings to conduct the following activities:

- Review existing action items to determine appropriateness of funding;
- Identify issues that may not have been identified when the plan was developed;
- Prioritize potential mitigation projects using the methodology described in the plan; and
- Assist in development of funding proposals for priority action items.

The project status will be evaluated and such items as time-line, funding source, and responsible entity will be reviewed for update. The Mississippi Emergency Management Agency Office of Mitigation will be responsible for updating the plan on a five-year cycle. A memorandum, describing needed changes and progress on implementation, will be provided annually to MEMA, FEMA Region IV, and the Hazard Mitigation Council.

The previously approved State of Mississippi Standard Mitigation Plan dated August of 2013, dealt with monitoring, evaluating, and updating the plan in section 6.1. This section called for review in three ways:

- Annual review of mitigation actions and identified projects,
- Review after each major disaster to determine the need for Plan refocus, and
- Review every five years before resubmission to FEMA for approval.

The State focused its priorities on sustaining those communities most affected by Hurricane Katrina, however; from this point forward in an effort to make the updated plan a living document that will be constantly reviewed and utilized to track projects, the new plan will be evaluated at each semi-annual Hazard Mitigation Council Meeting. This change will provide an opportunity for effective utilization of the Plan and will involve stakeholders from State agencies with responsibility for mitigation actions and projects.

6.1.2: Plan Evaluation

In addition to semi-annual reviews, the Hazard Mitigation Council and each participating agency will perform a more comprehensive review of the Plan every two years, or as deemed necessary by the Council and MEMA. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, and success of coordination efforts. They will then evaluate the content of the plan using the following questions:

- Are these programs effective?
- Have there been any changes in development that affect our mitigation priorities?
- Do our goals, objectives, and action items meet STAPLE/E criteria?
- Are our goals, objectives, and action items relevant, given any changes in our Agency?
- Are our goals, objectives, and action items relevant given any changes to State or Federal regulations and policy?
- Is there any new data that affects the risk assessment portion of the Plan?

The Hazard Mitigation Council meets semi-annually. During our semi-annual meetings, the following occurred:

- Review updates of risk assessment data and findings, as well as new events and data
- Discuss methods of continued public and stakeholder participation, and
- Document successes and lessons learned based on actions that were accomplished during the past two years.

Any resulting updates or changes will be included in the Plan. Again, the Hazard Mitigation Council and the Mississippi Emergency Management Agency Office of Mitigation will be responsible for making any changes and will provide the updates via a memorandum, as described earlier, and will keep files of changes needed for the five-year re-submittal.

The 2018 Standard Mitigation Plan contained project profiles; these profiles are regularly updated and reviewed by all State agencies that have assigned projects using State's intra-site. During the semi-annual Hazard Mitigation Council meetings, these projects were discussed and evaluated to make sure that projects remained relevant and viable.

The State began with a total of 110 projects assigned to different state agencies to monitor and implement. Based on evaluation and feedback of the mitigation actions/projects, the projects that were found too redundant or obsolete were combined or deleted. The State started out with 110 and narrowed it down to 67 actions to date.

The process for monitoring the mitigation actions has been modified. A tabular summary of all projects referenced to a profile will be available and will detail each mitigation action. The monitoring process will be organized in an information management system, which will be maintained and updated by MEMA. The

new process will provide for efficient and effective updates of the mitigation actions. Since the Hazard Mitigation Council will now meet semi-annually, review of the mitigation action will result in timely updates.

6.1.3: Plan Updates

The Hazard Mitigation Council is responsible for making updates to the Plan, and the Agency participants are responsible for the content of the updates. The council meets semi-annually and will continue to contribute input and periodically reporting on agency projects. The Agencies will provide institutional-level updates to the Plan when necessary. At the time of review, the following key questions will be addressed:

- Are the plan goals still applicable?
- Are there new partners or stakeholders who should be targeted for involvement?
- Do existing actions need to be re-evaluated or re-prioritized for implementation?
- Are the actions still appropriate given current resources?
- Have changes in construction and development influenced the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Have the Agencies been affected by any disasters, and did the plan accurately address the impacts of the events?

The Plan will be submitted for review to MEMA and FEMA every five years.

6.1.4: Implementation through Existing Programs

The multi-institutional participants can use the Plan as a baseline of information on the natural hazards that impact their institutions.

6.1.5: Continued Public Involvement

The public, as well as State and Local communities, will be directly involved in reviewing and updating the Plan. The Hazard Mitigation Council and its representatives should solicit feedback from the public during monitoring, evaluating, and updating the Plan as described above. The State Plan is accessible on our MEMA website for the public to view and give feedback to the state plan.

6.2: Monitoring Progress of Mitigation Actions and Assessments of Mitigation Actions

44 CFR §201.4(c)(5)(iii) – The State mitigation strategy shall include the following elements: A Plan Maintenance Process that includes:

A system for reviewing progress on achieving goals as well as activities and projects identified in the Mitigation Strategy

The plan maintenance process should include:

- A system for monitoring implementation of mitigation measures and project closeouts.
- A system for reviewing progress on achieving goals as well as activities and projects in the Mitigation Strategy.

6.2.1: Monitoring Implementation of Mitigation Measures and Project Closeouts

Mississippi Emergency Management Agency (as grantee) recognizes the responsibilities laid out in 44 CFR 206.438(a): The State, serving as grantee, has primary responsibility for project management, accountability of funds as indicated in 44 CFR part 13, and is responsible for ensuring that sub-grantees meet all program and administrative requirements.

The State Hazard Mitigation Grant Administrative Plan outlines the administrative procedures that the state employs for meeting these requirements.

6.2.2: Progress Review for Mitigation Goals and Objectives

In order for any program to remain effective, the goals and objectives of that program must be reviewed periodically. That review should address, as a minimum, the following issues:

- Are the established goals and objectives realistic? Take into consideration available funding, staffing, and state/local capabilities, and the overall State mitigation strategy.
- Has the State clearly explained the overall mitigation strategy to local governments?
- Are proposed mitigation projects evaluated based on how they help the State and/or local government meet overall mitigation goals and objectives?
- How have approved mitigation projects complemented existing State and/or local government mitigation goals and objectives?
- Have completed mitigation projects generated the anticipated cost avoidance or other disaster reduction result?

A thorough and realistic evaluation of the benefits of a mitigation project may be delayed until the area of the project is impacted by another disaster. The lack of realized benefits from a completed mitigation project may result in the disapproval or modification of similar projects in the future. At the same time, mitigation projects that have proven their worth may be repeated in other areas of the State.

Based on the results of the review/evaluation mentioned above, the State may need to adjust its goals and objectives to meet the current and future mitigation needs of the State and local governments. A semi-annual mitigation status report will be prepared by the MEMA Mitigation Planning Division. This report will be provided to the MEMA Director and Chief of Staff for review and distribution, as needed. The report will address, as a minimum, the following items:

- Mitigation goals, objectives and strategies
    - Brief description of the project
    - Linkage of the project with goals and objectives
    - Linkage of project with strategies.
    - Linkage of the project with funding priorities
- Completed mitigation projects
    - Affected jurisdiction
    - Brief description of the project
    - Source of funding
    - Brief summary of any problem areas, with proposed solution
    - Brief summary of effectiveness (cost-avoidance) of project, if available
- Mitigation projects in progress
    - Affected jurisdiction
    - Brief description of the project
    - Source of funding
    - Brief summary of project status
    - Anticipated completion date
- Pending (under review) mitigation projects
    - Affected jurisdiction
    - Brief description of the project
    - Source of funding
    - Brief summary of project status

6.2.3: Staffing

The Mississippi Emergency Management Agency will implement the State Plan and administer the mitigation programs by utilizing the following positions:

Mitigation Office Director

The Mitigation Office Director has overall management responsibility for the program and is responsible for ensuring that the state properly carries out its Section 404 and Section 406 responsibilities subsequent to a Presidential Disaster Declaration. In this regard, the Mitigation Office Director will monitor the activities of the mitigation staff and the State Hazard Mitigation Team. Responsibilities include, but are not limited to:

- Ensuring the Administrative Plan is updated, outlining how the state will administer the Hazard Mitigation Grant Program and other applicable hazard grant programs.
- Ensuring that the State Hazard Mitigation Plan is active and identifies potential hazard mitigation projects, as well as establishes priorities among those projects.
- Ensuring that all potential applicants are notified of the program and receive the assistance to which they are entitled.
- Ensuring that a proper initial application and any necessary supplemental applications including SF-424's, are submitted in a timely fashion to the FEMA Region IV Director.
- Ensuring that technical assistance is provided to potential applicants and/or eligible sub-grantees.
- Ensuring that adequate procedures are developed for the distribution of financial assistance to eligible sub-grantees by the technical assistance staff.
- Ensuring development of a system to monitor completion of approved projects in federally required time frames.
- Ensuring that a system exists to monitor sub-grantee accounting systems and is in compliance with 44 CFR parts 13 and 14.
- Ensuring that appropriate state agencies are on the State Hazard Mitigation Team and are involved as necessary with the hazard mitigation process.
- Ensuring participation of the appropriate local agencies in the administration and implementation of the hazard mitigation process.
- Coordinating with the GAR on all policy/regulatory issues. Reviewing and making appropriate recommendation to the GAR regarding appeals, cost overruns/underruns and all other program issues is also included.

NFIP State Coordinator/ Floodplain Management Bureau Director

The National Flood Insurance Program (NFIP) State Coordinator is responsible for the direction, evaluation, oversight, planning, and promotion of the 330 + local floodplain management programs within the state of Mississippi. Work also involves advising MEMA staff of floodplain management requirements; as they

pertain to emergency preparedness, response, and recovery actions. Successful oversight of the local communities' floodplain management programs enables the MEMA hazard mitigation assistance, mitigation planning, public assistance, and individual assistance bureaus to effectively administer their programs.

The FPM Bureau is the only compliance/regulatory focused staff element within MEMA. Accordingly, its compliance and enforcement actions include frequent contacts/inspections with state and local officials, public agencies; community and civic groups, etc. Other duties include, but are not limited to the following:

- Planning and conducting the Agency's portion of the Risk MAP initiative.
- Oversight of the 31 Community Rating System (CRS) communities within the state.
- Advising and assisting local officials on floodplain management and NFIP training, workshops, conferences, and emergency test exercises.
- Planning and participating in floodplain management and NFIP training, workshops, conferences, and emergency test exercises
- Making public appearances before civic and community groups to promote the floodplain management program.
- Corresponding with local officials, government agencies, federal floodplain management representatives, etc., and preparing reports as required.
- Assisting local communities throughout the state in preparation of flood damage prevention ordinances, pamphlets, training, and education documents.
- Traveling extensively throughout the state to conduct both Community Assistance Visits (CAV) and Community Assistance Contact (CAC) visits.
- Reviewing local regulations and FPM programs for compliance with federal regulations.
- Providing staff to the State Emergency Response and FPM programs for compliance with federal regulations.
- Providing staff to the Emergency Response and to the logistics element within the State Emergency Operations Center during times of state emergencies and activations.

Floodplain Management Specialist

The duties of the Floodplain Management Specialist include providing regulatory and programmatic oversight, technical assistance, and floodplain management training to communities within an assigned district (of counties) that participate in the NFIP. All actions are based on the 44 CFR 60.1 – 60.3, Executive Order 11988, and other Federal/State regulations. Other duties include, but are not limited to the following:

- Providing technical assistance with local community governments.
- Conducting Community Assistance Visits (CAV) and Community Assistance Contact (CAC) actions per FEMA and MEMA guidelines.

- Responsible for inputting and tracking all floodplain management actions through the use of the FEMA community Information System (CIS)
- Responsible for inputting and tracking all actions through the use of the FEMA Community Information System (CIS).
- Assisting the State Coordinator in facilitating the Risk Map which includes delivery, review, and adoption of new Digital Flood Insurance Rate Maps (DFRIMS).
- Notifying appropriate officials of meetings through correspondence.
- Performing follow-up actions as required.
- Facilitating the DFIRMS adoption process by the community.
- Coordinating and scheduling "Discovery" and any other follow-up meetings with local communities.
- Procuring training site locations.
- Providing floodplain review letter for request received
- Provide Substantial Damage Estimates Assistance per request from community

Mitigation Grants/Plans Bureau Director

The Mitigation Grants/Plans Bureau Director is responsible for the grants program coordination, implementation and administration. He/She will assure the necessary work required to deliver the Mitigation Grant Programs to eligible sub-grantees. He/She also formulates, controls, and directs the Mitigation Planning Division Director's operations in regard and in compliance with mandates by the Federal Emergency Management Agency. In addition to assisting the Office Director in all aspects of mitigation, the Mitigation Grants/Plans Bureau Director's responsibilities include, but are not limited to:

- Develop the Administrative Plan which outlines how the State will administer the Hazard Mitigation Grant Program and implement the plan in a Presidential Disaster Declaration.
- Develop and implement a process for identifying potential hazard mitigation projects and setting priorities among those projects.
- Works with the Division Director performing a variety of administrative tasks consisting of fiscal management, strategic planning, legal compliance, and required reports.
- Maintain a management system for hazard mitigation activities and products.
- Notify potential applicants of the program and brief them, with appropriate handout material on elements of the program.
- Coordinate with Federal, State and local officials to ensure that they understand the involvement of the Hazard Mitigation effort in the Public Assistance program.
- Provide technical assistance to potential applicants and /or eligible sub-grantees in developing and submitting applications and in completing projects.

- Implement departmental procedures to monitor the status of approved projects, for processing extension requests and appeals, and for closing out completed projects
- Coordinate with the Administrative and Finance Bureau staff in monitoring sub-grantee accounting systems to meet requirements of Code of Federal Regulations (CFR) 44 Part 13 and Part 14.
- Help update the State Hazard Mitigation Plan.
- Conduct site visits to monitor progress and provide technical assistance.
- Assist the Mitigation Office Director in conducting mitigation conferences and / or public meetings.

Grants Management Specialist

The Grants Management Specialist is responsible for program coordination, implementation and administration. The specialist will accomplish the necessary work required to deliver the Hazard Mitigation Grant Program to eligible sub-grantees. In addition to assisting the Bureau Director of Grants/Plans in all aspects of mitigation, the Grants Specialist responsibilities include, but are not limited to:

- Developing the Administrative Plan, this outlines how the State will administer the Hazard Mitigation Grant Program, and implementing the plan in a Presidential Disaster Declaration.
- Developing and implementing a process for identifying potential hazard mitigation projects and for setting priorities among those projects.
- Maintaining a management system for hazard mitigation activities and products.
- Notifying potential applicants of the program and briefing them, with appropriate handout material, on elements of the program.
- Coordinating with Federal, State and local officials to ensure that they understand the involvement of the Hazard Mitigation effort in the Public Assistance program.
- Providing technical assistance to potential applicants and/or eligible sub-grantees in developing and submitting applications and in completing projects.
- Implementing departmental procedures to monitor the status of approved projects for processing extension requests and appeals, and for closing out completed projects.
- Coordinating with the Administrative & Finance Bureau staff in monitoring sub-grantee accounting systems to meet requirements of Code of Federal Regulations (CFR) 44 Part 13 and Part 14.
- Helping update the State Hazard Mitigation Plan.
- Conducting site visits to monitor progress and provide technical assistance.
- Assisting the Mitigation Office Director in conducting mitigation conferences and or public meetings.

Division Director, Mitigation Plans

The Division Director, Mitigation Plans, formulates, controls, and directs the Mitigation Planning Division's operations in regard and in compliance with mandates by the Federal Emergency Management Agency. These duties include the following:

- Supervising the activities of the Planning Division Staff in performing specific functions and duties.
- Performing a variety of administrative tasks consisting of fiscal management, strategic planning, legal compliance, and required reports.
- Serving as liaison to various government agencies, other public/private agencies, and/or the general public in matters related to hazard mitigation planning.
- Coordinating plans and budgets with other Bureau Directors to ensure that they meet the stated goals of the office and the agency.
- Coordinating with FEMA on any necessary training requirements and/or providing technical assistance for the local communities concerning mitigation planning.
- Submitting reports to the Office of Mitigation in reference to any accomplishments and/or any deviations from bureau-stated goals.
- Using FEMA mandated guidelines, develop the state hazard mitigation plan.
- Overseeing the development of the state hazard mitigation plan.

Mitigation Planner

The Mitigation Planner assists the Division Director in formulating and controlling the Mitigation Planning Division's operations in regard and in compliance with mandates by the Federal Emergency Management Agency. In addition, the Mitigation Planner's duties include the following tasks:

- Performing specific functions and duties including a variety of administrative tasks consisting of strategic planning, legal compliance, and required reports.
- Serving as liaison to various government agencies, other public/private agencies, and/or the general public in matters related to hazard mitigation planning.
- Reviewing plans and assisting local communities, consultants and other state agencies to ensure that developed plans meet or exceed FEMA standards.
- Reviewing and monitoring plan updates.
- Coordinating with FEMA on any necessary training requirements and/or providing technical assistance for local communities concerning mitigation planning.
- Submitting reports to the Office of Mitigation in reference to any accomplishments and/or any deviations from division-stated goals.
- Using FEMA mandated guidelines, assisting the Division Director with development and update of the state hazard mitigation plan.

- Overseeing and procuring training sites and venues.
- Facilitating mitigation planning training with local officials and state agencies. Coordinating administrative requirements for workshops and training seminars.
- Attending conferences to furnish various audiences with programmatic advice and assisting with planning matters.
- Enhancing public understanding of mitigation planning programs through presentations

Administrative Assistant

The Administrative Assistant performs skilled clerical work and provides secretarial services for mitigation staff. This work involves making independent decisions concerning the procedure or process to be followed and the actions to be taken. Examples of tasks performed include, but are not limited to:

- Supervising and participating in the receipt and processing of correspondence, preparing coding and typing of personnel, purchasing, supply, financial, and other documents; and the checking and posting of program transactions.
- Organizing work and coordinating workflow; establishing priorities, setting deadlines and reviewing work for adequacy, accuracy, timeliness, and conformance with instructions and standard practices.
- Receiving visitors and answering calls, ascertaining the purpose of calls and visits, and furnishing information from knowledge of agency policies, rules and procedures.
- Performing a variety of supportive secretarial duties for administrative staff.

An up-to-date copy of the plan will reside within the Mississippi Emergency Management Agency web site, and on a home page devoted to Hazard Mitigation and Emergency Preparedness. Annual and biennial status memorandums will also be posted there.

A copy of the Plan will be publicized and available for review at the Mississippi Emergency Management Agency offices and additional copies of the plan will be catalogued and made available at pertinent State Agencies. The existence and locations of these copies will also be posted on the Mississippi Emergency Management Agency web site. The site will contain contact information for members of the Hazard Mitigation Council to which the public may direct comments and concerns. All public feedback will be forwarded to the appropriate institution for review.

In addition to these activities, many of the educational and outreach activities will support continued public involvement in the Plan implementation process.

[i] U.S. Climate Resilience Toolkit. Retrieved 04.27.18 from, https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion

[ii] U.S.G.S. Rapid Salt-Marsh Erosion in Grand Bay, Mississippi. Retrieved 04.19.18, from https://www.usgs.gov/media/videos/rapid-salt-marsh-erosion-grand-bay-mississippi