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), 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 as 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, snowpack, lake, reservoir, and groundwater levels. There is usually a delay between a 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 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 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 the spring dormant season following winter precipitation.

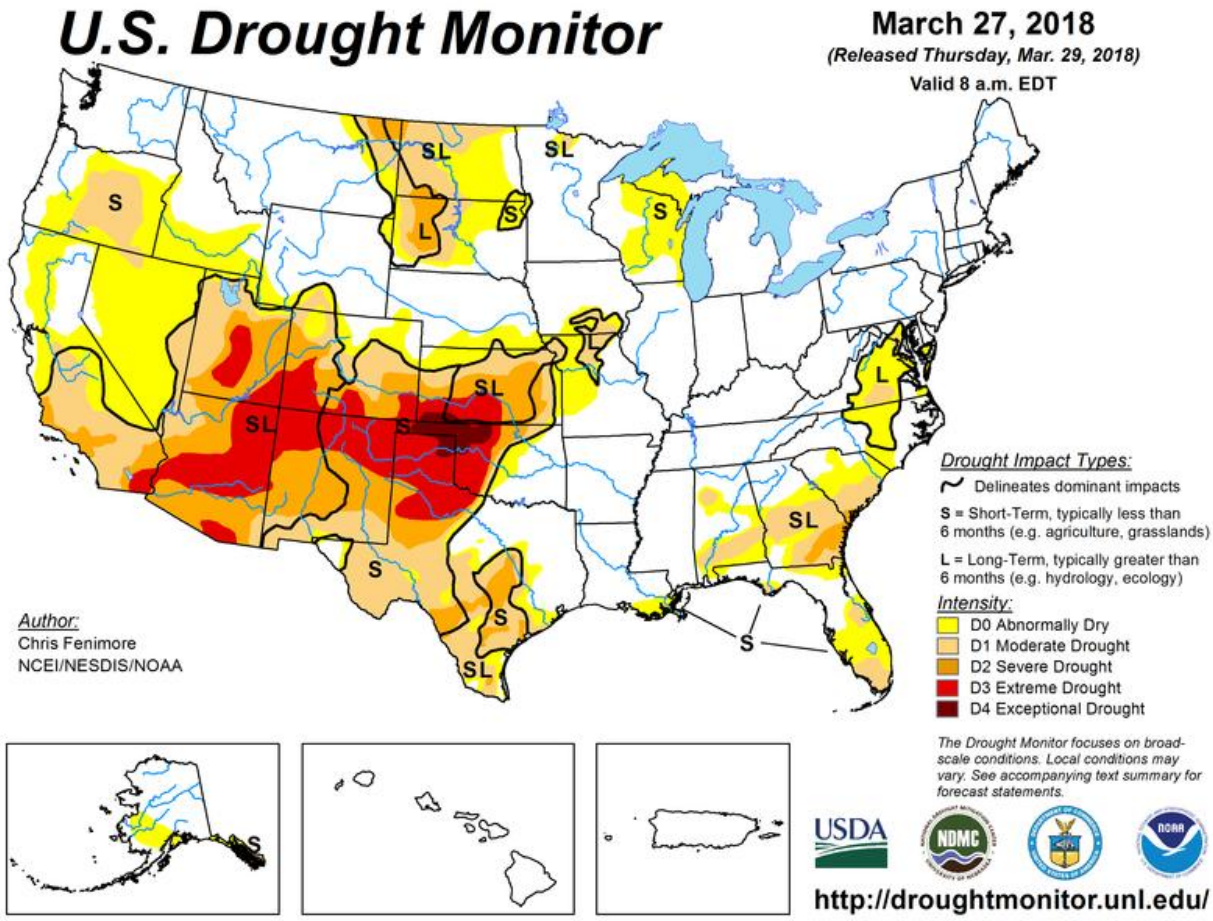
- 200 - 400: Typical of late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.

- 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.

Figure 3.8.1 provides another illustration of drought potential by using the Keetch-Bryam index for a similar 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

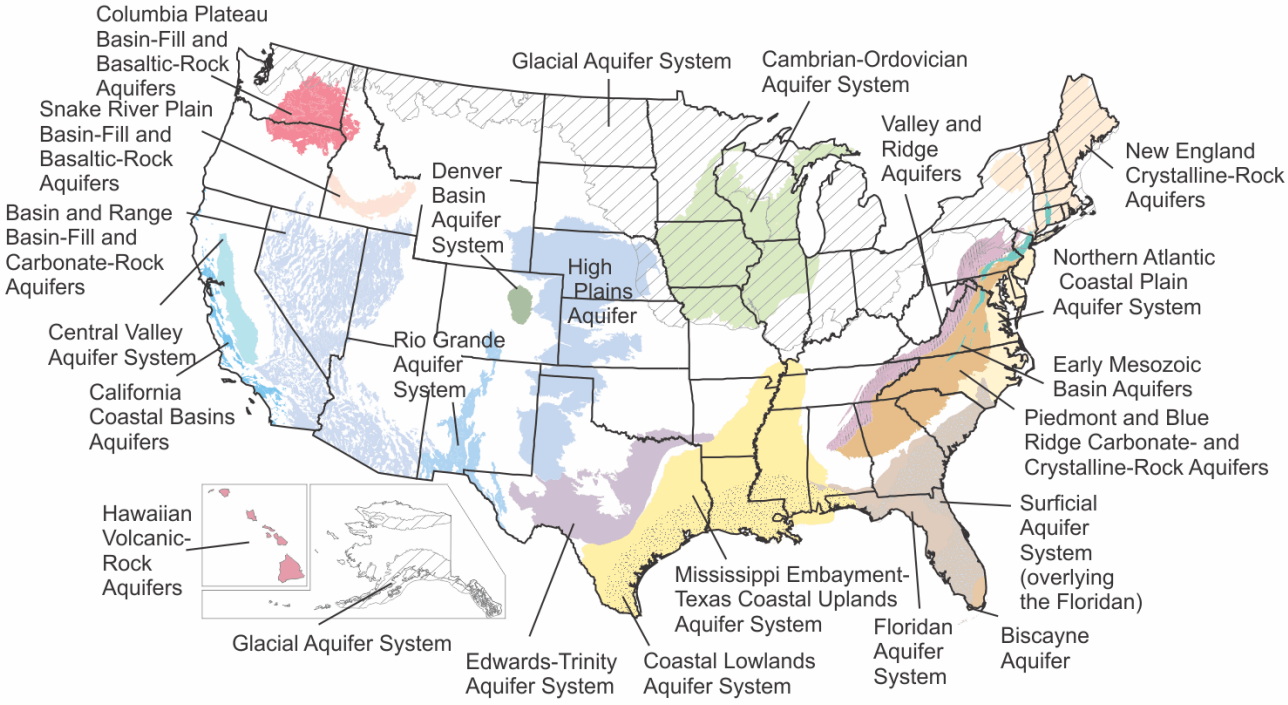


(Source: USDA)

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)

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 the 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
12/01/2022	Tate, Tunica, Coahoma	$0	$0
11/01/2022	Tate, Tunica, Coahoma	$0	$0
10/25/2022	Tunica, Coahoma, Tate	$0	$0
8/01/2022	Alcorn, Lee, Pontotoc, Union, Tishomingo, Chickasaw, Monroe, Itawamba, Prentiss, Tippah, Benton	$0	$0
7/05/2022	Benton, Monroe, Chickasaw, Itawamba, Lee, Pontotoc, Union, Prentiss, Tishomingo, Alcorn, Tippah	$0	$0
12/1/2021	Warren, Issaquena	$0	$0
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

Date	Counties Affected	Property Damage	Property Damage
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, Oktibbeha, 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, Tishomingo, 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

Mississippi Emergency Management Agency

Date	Counties Affected	Property Damage	Property Damage
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,	$0	$0

Mississippi Emergency Management Agency

Date	Counties Affected	Property Damage	Property Damage
	Panola, Quitman, Tallahatchie, Tate, Tunica, Yalobusha		
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, Quitman, 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, Oktibbeha, Panola, Pontotoc, Prentiss, Rankin, Scott, Sharkey, Simpson, Smith, Tallahatchie, Tippah,	$2,650,000	$0

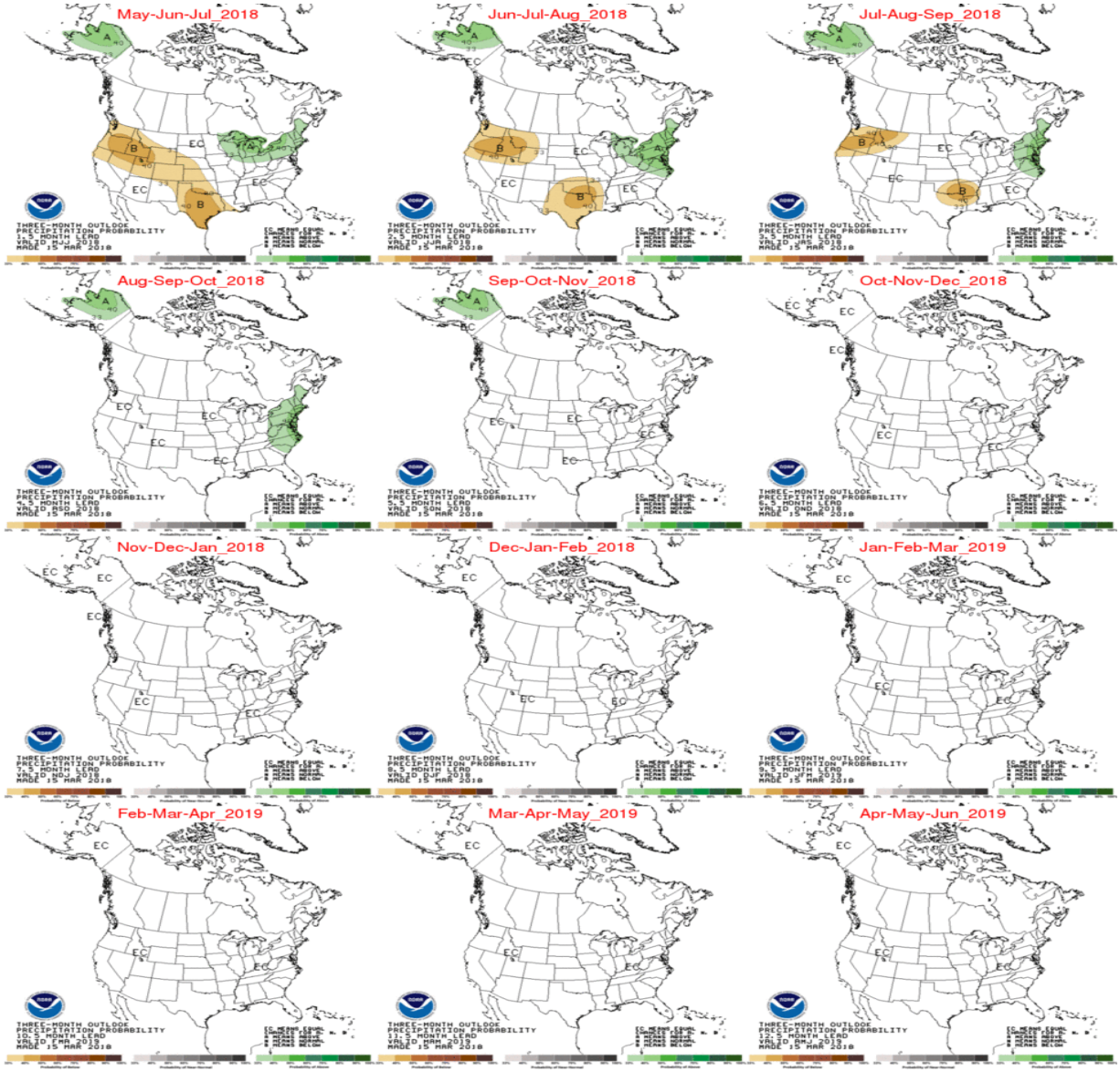
Date	Counties Affected	Property Damage	Property Damage
	Tishomingo, Union, Warren, Webster, Winston, Yalobusha, Yazoo		
06/01/2007	Alcorn, Attala, Benton, Calhoun, Carroll, Chickasaw, Choctaw, Claiborne, Clarke, Clay, Copiah, Covington, Forrest, Franklin, Grenada, Hinds, Holmes, Humphreys, Issaquena, 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, Neshoba, Newton, Noxubee, Oktibbeha, Rankin, Scott, Smith, Webster, Winston	$0	$0
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 make estimating the 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 the 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 the most vulnerable. Drought would have a negligible impact on 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 local vulnerability assessments.

Being that Mississippi is primarily an agricultural state, the most obvious primary impact of 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				