

Event Recap Report:
04/30/10 - 05/03/10
Severe Weather and Flooding
U.S. Tennessee and Mississippi
Valleys

Introduction

A slow-moving weather pattern brought tornadoes, damaging winds, large hail and extremely heavy rainfall leading to major flooding to portions of the Mississippi and Tennessee Valleys in the United States. At least 32 people were killed and dozens of others sustained injuries between Friday, April 30th and Monday, May 3rd. In Nashville, Tennessee, widespread flooding occurred and the United States Army Corps of Engineers declared it a 1,000-year flood event.



Meteorological Recap

On Friday, April 30th, a cold front slowly began to cross the Plains and enter the Mississippi Valley. Due to a strong ridge of high pressure centered just off of the U.S. Southeast coastline, the cold front struggled to progress eastward as the ridge acted as a block (Figure 1). With the main area of low pressure shifting northward into the Upper Midwest, the attached frontal boundary became nearly stationary across the Mississippi Valley and into the Midwest. Atmospheric conditions became very unstable along the front due to the combination of daytime heating, an abundance of tropical moisture surging northward out of the Gulf of Mexico (see Appendix A) and several upper-level disturbances traversing along the boundary.

On Saturday, May 1st, the main frontal boundary meandered slightly eastward as the active weather moved into the Tennessee Valley. Due to the extreme levels of atmospheric instability, the Storm Prediction Center (SPC) issued a rare high risk forecast for severe weather for Friday and Saturday (Figure 2) for the first time since 2006.

By Sunday, May 2nd, the front began to slowly push eastward as the ridge of high pressure began to shift further eastward out to sea. The atmosphere became less conducive for severe weather, though persistent rainfall continued to occur along the boundary across the Tennessee and Ohio Valleys. On Monday, May 3rd, the storm system fully exited the Mississippi and Tennessee Valleys as a new high pressure ridge developed behind the front and brought an end to the precipitation.

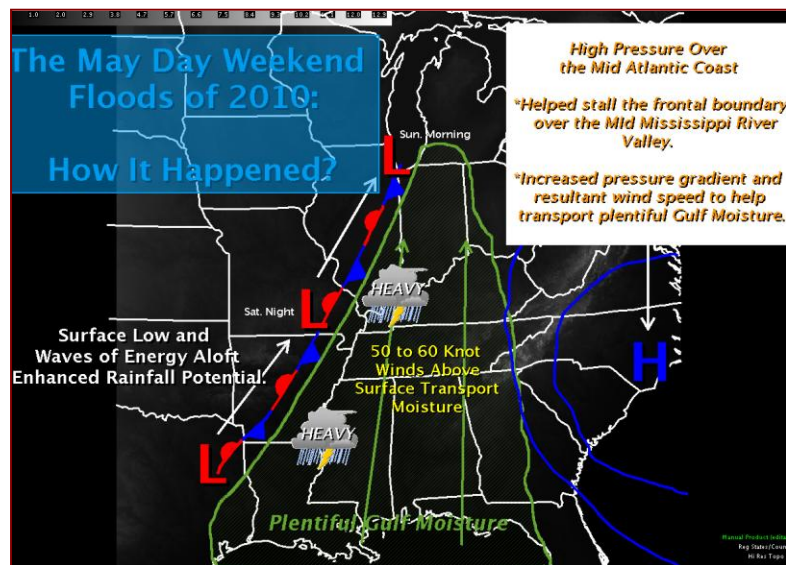


Figure 1: Meteorological setup for flooding in Tennessee Valley.
Source: National Weather Service – Nashville.

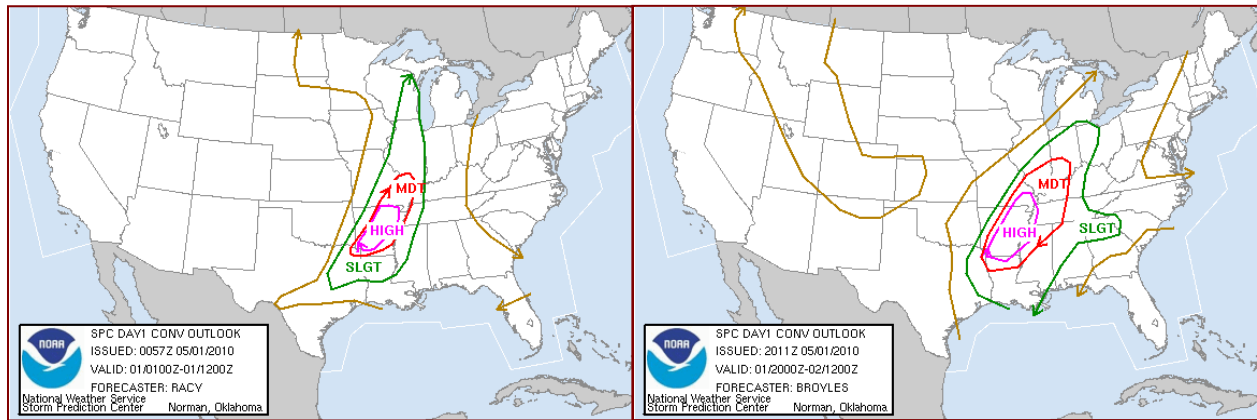


Figure 2: Severe weather forecasts for Friday, May 1st and Saturday, May 2nd, 2010. Rare high risk forecasts were issued for both days, the first time since 2006 in which consecutive days contained high risk severe weather forecasts. Source: Storm Prediction Center.

Severe Weather Recap

Reports of severe weather for this event began on the afternoon of Friday, April 30th and extended into early morning Saturday, May 1st. At least 31 tornadoes were spawned and left damage across parts of Arkansas, Missouri, Kentucky, Tennessee and Wisconsin. At least 61 reports of damaging winds and 54 reports of large hail were reported to the SPC. Arkansas was hardest hit by severe thunderstorms, as widespread damage was reported from near the Arkansas-Missouri border southward into Saline County, located approximately 20 miles (32 kilometers) south of Little Rock. According to the Arkansas Emergency Management Agency (AEMA), hundreds of homes and businesses were heavily damaged or destroyed and at least one person in Van Buren County was killed. A second fatality occurred in Scott County due to drowning. A statewide state of emergency was declared Saturday morning as the scope of the damage was assessed. In all, Arkansas recorded 15 tornadoes that comprised of three EF-0 tornadoes, five EF-1 tornadoes, five EF-2 tornadoes and two EF-3 tornadoes. An additional 16 tornadoes touched down in Missouri, Kentucky, Tennessee and Wisconsin, sporadically damaging homes, businesses and vehicles.



From Saturday, May 1st into early morning on Sunday, May 2nd, the atmosphere rapidly destabilized and caused at least 38 additional tornado touchdowns in the Mississippi and Tennessee Valleys. The SPC recorded at least 57 reports of damaging winds and large hail. Tornado damage to homes, businesses, roads, bridges, vehicles and high voltage transmission systems was reported in Arkansas, northern Mississippi, western Tennessee, western Kentucky and extreme southeastern Missouri. The most significant damage from this group of tornadoes came from Mississippi, where at least six people were killed in storm-related fatalities. According to the Mississippi Emergency Management Agency (MSEMA), over 200 homes and businesses were damaged or destroyed after nearly a dozen tornadoes touched down across 13 separate counties. Benton, Lafayette, Panola, Tippah and Union counties were the hardest-hit areas, where states of emergency were declared by the governor. See Figure 3 for a graphical representation of the severe weather occurrences from Friday, April 30th and Saturday, May 1st.

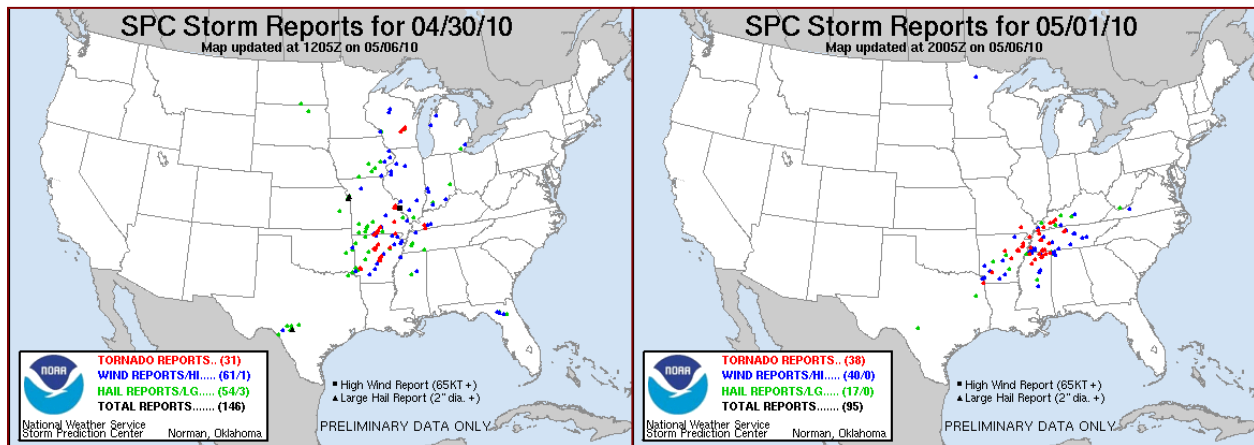


Figure 3: Severe weather reports from Friday, April 30th and Saturday, May 1st.
Source: Storm Prediction Center.

Flooding Recap

Due to the slow movement of the storm system in general and many areas receiving copious amounts of rain in a short period of time, flooding in central and western Tennessee led to the drowning deaths of at least 21 people. According to the Tennessee Emergency Management Agency (TEMA), the fatalities primarily occurred in Stewart, Davidson, Williamson and Carroll counties. Widespread flash flooding was reported throughout the state, including the greater Memphis and Nashville areas. National Weather Service offices recorded record rainfall totals ranging between eight and 20 inches (20 and 50 centimeters) in a 72-hour period (Figure 4). The rains caused several rivers to overflow their banks and crest at levels that had not been seen in decades or, in some cases, centuries. All-time record crests were observed on the Cumberland River at Clarksville, the Duck River at Centerville and Hurricane Mills, the Buffalo River at Lobelville, the Harpeth River at Kingston Springs and Bellevue and the Red River at Port Royal. Floodwaters ranged between two and 15 feet (0.6 to 4.5 meters) in depth across the state as vehicles were left submerged along various roads and highways across the state, including on Interstates 24 and 40. In Nashville, the floods were declared to be a 1,000-year event.

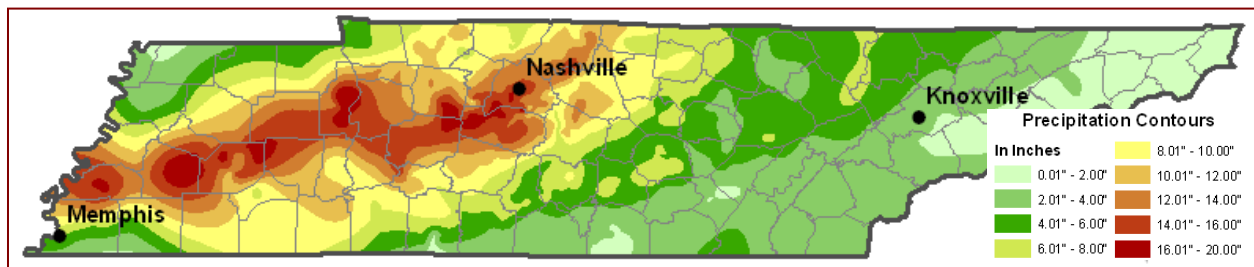


Figure 4: Rainfall totals from Friday, April 30th to Sunday, May 2nd.
Source: National Weather Service – Nashville.

At least four people were killed in Kentucky as flooding occurred throughout western, central and southern sections of the state. Rainfall amounts ranging from two to seven inches (five to 18 centimeters) led to widespread river flooding and ponding. A state of emergency was declared in 78 counties, and damage was reported to hundreds of homes, businesses, vehicles and agricultural crops in cities such as Frankfurt, Boston, Paducah, Danville and Paradise. Officials from the U.S. Coast Guard said that rural parts of the state had seen some of the worst flooding in over 200 years. Recreational boating on the Tennessee and Cumberland rivers as well as Kentucky Lake and Lake Barkley was banned due to hazardous conditions. Several locations along the Kentucky, Licking, Green and Ohio rivers also reported flooding. The rains affected the 136th running of the Kentucky Derby at Churchill Downs in Louisville.

In northern Mississippi, significant rainfall led to widespread flooding. At least three fatalities in the state were attributed to drowning. Rainfall totals of five to ten inches (12 to 25 centimeters) caused major flooding in the towns of Corinth, Ashland and Tupelo. Several rivers overflowed their banks including the Little Talahatchie River, which crested at an all-time record height on Monday, May 3rd in the town of Etta. States of emergency were declared for at least ten counties, primarily due to flood damage.

See Appendix B for a graphical representation of rain totals across the Mississippi and Tennessee Valleys.

Property Effects

Greater Nashville, TN area

In Nashville, floodwaters affected large sections of the immediate downtown area and caused significant damage. Major flood damage was reported (but not limited to) at the following popular downtown Nashville locations: the Grand Ole Opry House, Gaylord Opryland Resort & Convention Center, Opry Mills Mall, Bridgestone Arena, LP Field, Schermerhorn Symphony Center, the Gaylord Opryland Hotel, the Country Music Hall of Fame and Museum, The Pinnacle at Symphony Place, Vanderbilt University and the University School of Nashville. Much of the downtown damage occurred after the Cumberland River burst its banks. See Figure 5 for a partial look at damage locations and reports from the downtown area.

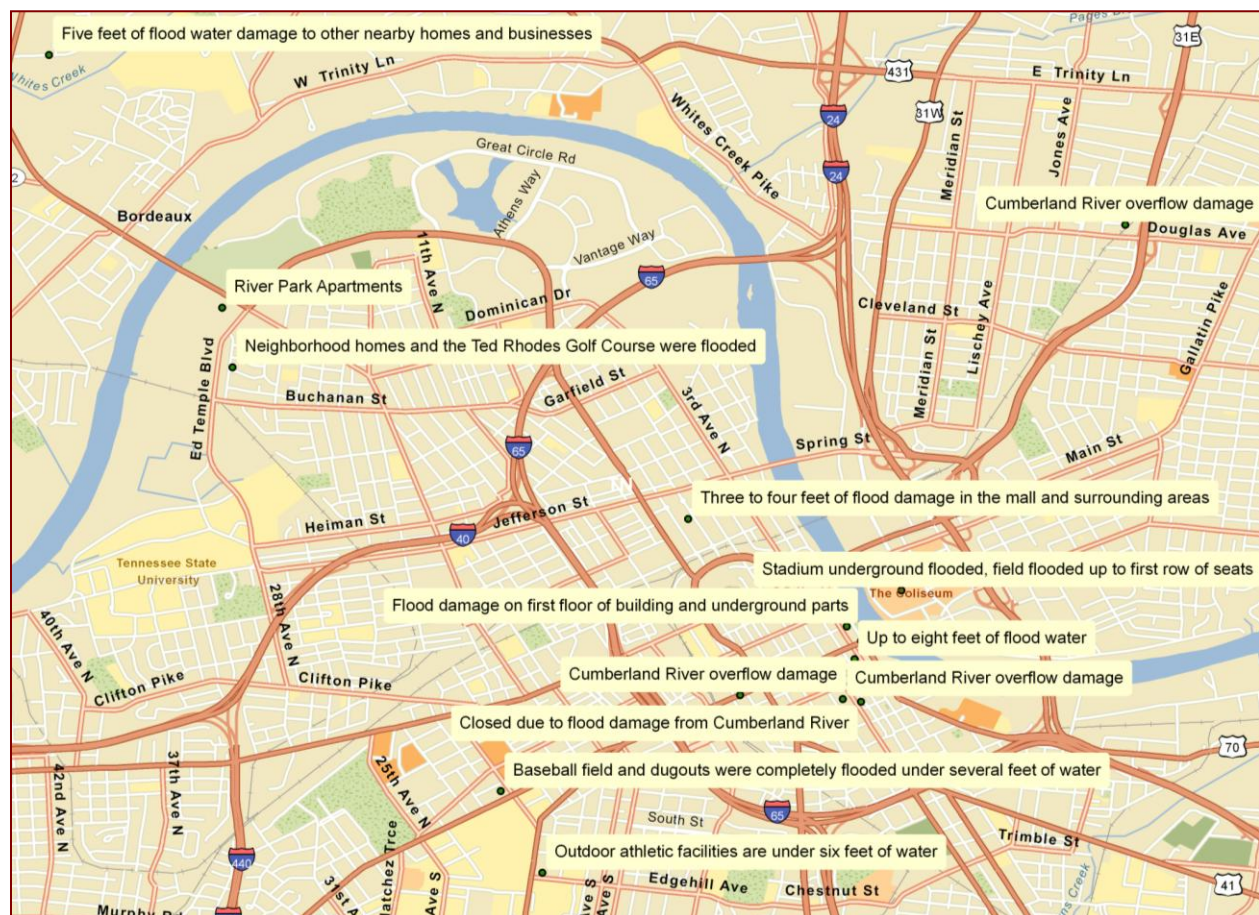


Figure 5: Partial listing of damage reports and locations from downtown Nashville.
Source: Local media sources, Impact Forecasting.

Outside of the immediate downtown Nashville area, additional significant flooding was reported in the nearby communities of Bellevue, Hartsville, Mt. Juliet, Belle Meade, North Nashville, Antioch, Goodlettsville, Murfreesboro, Franklin, Leiper's Fork, Fairview, Nolensville, Spring Hill, Thompson's Station and Ashland City. Dozens of entire neighborhoods and businesses experienced several feet (meters) of water as local rivers and manmade lakes overflowed their banks. Damage due to ponding also occurred. See Figure 6 for a graphical representation of damage reports in the surrounding communities of Nashville.

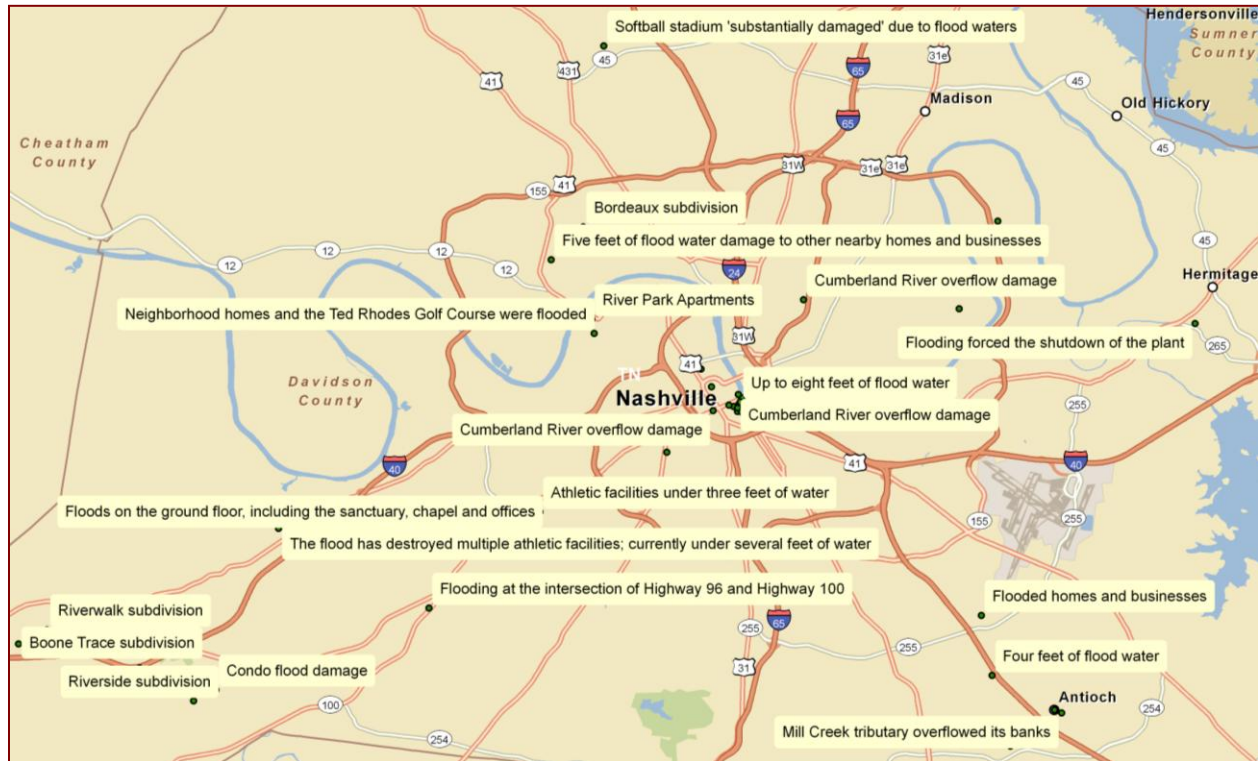


Figure 6: Regional view of damage reports and locations outside of the greater Nashville area. Source: Local media sources, Impact Forecasting.

Clarksville, TN

Outside of Nashville and its surrounding suburbs, major flooding was reported in the town of Clarksville along both the Cumberland and Red rivers. According to published newspaper reports, over 1,000 homes, apartments, duplexes, schools, businesses and vehicles sustained flood damage. Overflow flooding from the Cumberland River also severely impacted the headquarters of the local Red Cross, which was forced to relocate their organizational meetings for rescue, recovery and relief efforts.

Greater Memphis, TN area

Major flooding was also prevalent on the western side of the state in the greater Memphis region. In the town of Millington, the U.S. Army Corp of Engineers noted that two separate levees were breached along the Big Creek River. At the local Naval Support Activity base, up to five feet (1.5 meters) of water flooded at least 300 on-site homes. At least two neighborhoods surrounding the naval base were inundated by the floodwaters. Further north of Millington in the town of Dyersburg, at least 800 homes and businesses were damaged after the North Fork of the Forked Deer River burst its banks on Tuesday, May 4th.

Kentucky

While flood damage was not as catastrophic as in Tennessee, several parts of Kentucky sustained major flood damage after multiple rivers overflowed their banks. More than half of all counties in the state were under states of emergency due to flood damage. An estimated 1,000 homes and businesses sustained flood damage in the state. Some of the towns reporting damage included the capital city of Frankfort, Paducah, Cynthiana, Boston, Danville and Paradise. Additional rain in the days following the primary event enhanced flooding in south-central and western parts of the state as rivers continued to rise. State farmers were asking the U.S. government to declare an agricultural disaster after major losses occurred to the state's crops and livestock. According to officials from the Kentucky Division of Emergency Management, the floods across the state were the worst in over 200 years.



Source: Kentucky EMA

Northern Mississippi

The heavy rains caused extensive flooding across ten northern counties of Mississippi. The towns of Corinth, Tupelo, New Albany, Ashland, Booneville, Etta and Holly Springs all reported flood damage. The Mississippi Emergency Management Agency noted that hundreds of homes, businesses and vehicles were affected. At least two people were confirmed dead across the state due to drowning.

Utility Effects

Tennessee

At least 150,000 residents temporarily lost electricity due to tornadoes, high winds and floods damaging utilities during the event. Electric companies in the state including Meriwether Lewis Electric Cooperative, Nashville Electric Service, the Jackson Energy Authority, Southwest Tennessee Electric Company and the Middle Tennessee Electric Membership Corporation all reported outages. The Tennessee Valley Authority reported that several substations had been flooded and were forced to shutdown. State officials urged residents to conserve fresh water as several major water treatment plants were damaged and forced to close, including the K.R. Harrington Water Treatment Plant in downtown Nashville. Underground electrical wiring and cables were severely damaged in multiple cities across the state.



Source: Kentucky EMA

Kentucky

Widespread power outages were reported throughout the state, including customers of Kentucky Power, Louisville Gas & Electric, Duke Energy and Kentucky Utilities. Numerous water and sewage treatment plants were also damaged, which prompted the governor to ask residents to conserve clean water.

Mississippi

Residents throughout northern sections of the state suffered from electrical outages from both the severe weather and the flooding. Thousands of customers from Mississippi Power Company, Dixie Electric Power Association and the Electric Power Association of Mississippi reported outages. Several locations also reported gas line and water main breaks.

Infrastructure Effects

Tennessee

Roads, major highways and interstates throughout the state were severely impacted by the floods. According to the Tennessee Department of Transportation (TDOT), almost every major road in the state was affected by flooding at the height of the event. Interstates 24 and 40 headed both in and out of Nashville were closed for several days due to water submerging the roadways. At least 600 water rescues occurred on Nashville-area roads as vehicles became overwhelmed by the floods. Dozens of bridges across the state were impacted, particularly those that crossed rivers well above flood stage. As initial assessments were taken by TDOT officials, it was discovered that possibly hundreds of miles (kilometers) of roads and bridges were either been completely washed away, partially damaged or had suffered drainage failure.

Air transportation was affected at state airports. Just outside of downtown Nashville, the privately-owned Cornelia Fort Airpark was submerged by four to six feet (1.2 to 1.8 meters) of water after the Cumberland River burst its banks. In addition to the flooding at the airport, a large landslide fell on top of an on-site aircraft parts warehouse. At least 20 planes on the tarmac sustained major damage. Air traffic at Nashville International Airport was completely unaffected and no known flights were cancelled.



Kentucky

According to the Kentucky Emergency Management Agency, over 400 roads, highways and interstates were closed across 76 counties during the height of the flood event. The agency further reported that significant damage occurred to the transportation infrastructure. Over 1,000 state road employees were working to repair large chunks of broken pavement, washed-out culverts and to clear debris from roads that experienced mudslides. There was no known damage at any of the state airports.

Mississippi

Both flood and tornado damage to the transportation infrastructure forced road closures in northern sections of the state during the event. According to the Mississippi Department of Transportation (MDOT), U.S. Highways 346, 4, 72 and 370 were all closed due to floodwaters, while a four-mile (6.4-kilometer) section of State Route 370 was closed due to tornado damage.

Economic and Insured Loss Estimates and Effects

Tennessee

According to the mayor of Nashville on May 7th, the first official damage estimate was USD1.5 billion. An initial assessment from Davidson County (which includes Nashville) indicated that over 9,300 parcels of private property were submerged and at least 1,952 homes suffered flood damage. However, city officials noted that the USD1.5 billion figure did not include damage to any public buildings or infrastructure. The total also does not include any damage to the contents inside buildings or the prospect of business interruption. Due to the widespread nature of damage to homes, businesses and the transportation infrastructure, economic losses were also anticipated to be high across the state of Tennessee. Total economic losses for Tennessee alone are anticipated to reach well into the single-digit billions of dollars (USD).

As of May 10th, there has yet to be any definitive indication as to a specific insured loss total. According to data from the Federal Emergency Management Agency (FEMA), fewer than 4,000 homes in Davidson County were covered by flood insurance. When expanding to the surrounding counties, approximately 9,100 homes have flood insurance. With the most recent census data estimating an average of 2.5 people per home, flood insurance coverage amounts to only about 1.5 percent of all homes in the region. At the Gaylord Opryland Resort, a company official noted that damage was likely to exceed the company's USD50 million flood insurance coverage, as 800,000 square feet (74,322 square meters) of the facility's 4,000,000-square foot (371,612-square meter) space had been flooded.

Kentucky

Based on various initial estimates from several of the dozens of counties declared as disaster areas, total economic losses are anticipated to reach at least the several hundreds of millions of dollars (USD). In Kentucky, a large portion of the insured losses was expected to derive from the widespread agricultural losses to crops and livestock. According to the Kentucky Department of Agriculture, at least half of the state's entire corn crop was destroyed in several locations.

Mississippi

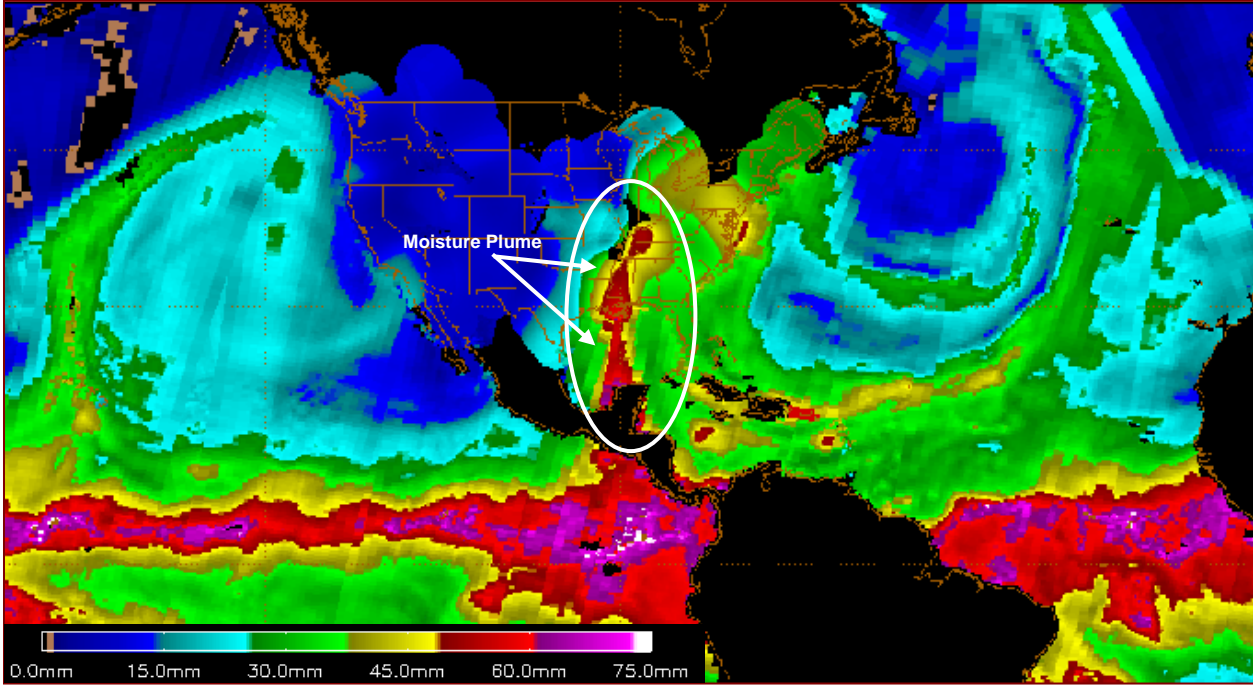
Based on various assessments from state officials, economic losses were expected to enter at least the tens of millions of dollars (USD).



Appendix

Appendix A

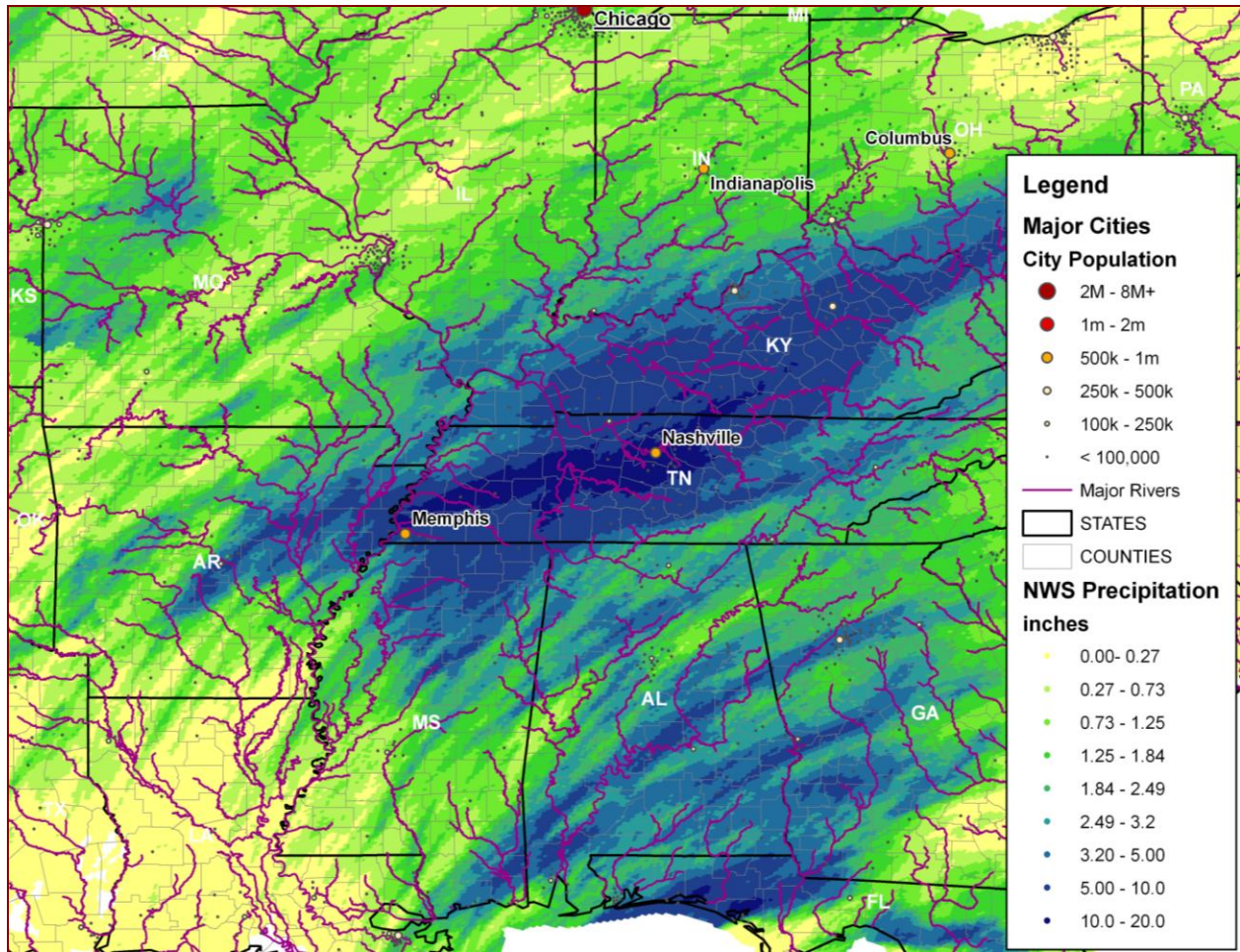
This graphic shows the abundance of tropical moisture surging out of the Gulf of Mexico ahead of and along an advancing frontal boundary across the Mississippi and Tennessee Valleys between Friday, April 30th and Monday, May 3rd. The moisture plume provided the atmosphere ample ingredients to trigger persistent rains over the region.



Source: NOAA

Appendix B

The graphic below shows the scope of the rain totals across the Mississippi and Tennessee Valleys as well as the Southeast between Friday, April 30th and Monday, May 3rd.



Source: Advanced Hydrologic Prediction Center, Impact Forecasting.

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