

A city become a lake, New Orleans
U.S. Coast Guard photo



Katrina Strikes

Louisiana

On August 23, 2005, Tropical Depression 12 developed about 200 miles southeast of Nassau. Within 24 hours, it was designated Tropical Storm Katrina.¹ Over the next two days, the storm strengthened and set a course for Florida. On August 25, Tropical Storm Katrina became a Category 1 hurricane, just hours before striking the Florida coast between Fort Lauderdale and Miami.² (See Chapter 3 for information about how hurricanes form and grow, and other relevant data.)

Katrina's six-hour march across land diminished its winds, but – atypically – left it with a more concentrated eye because it continued taking up heat and moisture as it passed over a marshy part of Florida's Everglades before entering the Gulf of Mexico.³ There, the storm strengthened further, turned north and headed for the Florida Panhandle.⁴

Friday, August 26

By early Friday morning, August 26, Katrina was well into the Gulf of Mexico, just off the Florida Keys, 365 miles southeast of the mouth of the Mississippi River. It continued to grow and became more powerful.⁵ Until now, the different modeling programs used by the National Weather Service's (NWS) National Hurricane Center (NHC) had projected the hurricane's track making landfall in the Florida Panhandle.⁶

By midday, however, the models began to converge on a course that showed a marked shift westward, toward Louisiana.⁷ The NHC did not immediately issue a new advisory, but it now appeared that the agency's long-time fear – that New Orleans would take a direct hit from a major hurricane – was increasingly likely to come true.⁸

The 5 p.m. NHC advisory made the new track official: Katrina, still growing, had shifted 170 miles west.⁹ It would soon become a major Category 3 hurricane, and, as reported by the NHC, conditions in the Gulf of Mexico “should allow the hurricane to reach Category 4 status before landfall occurs.”¹⁰

Max Mayfield, Director of the NHC, phoned Walter Maestri, an old friend and the Emergency Preparedness Director in Jefferson Parish, Louisiana. Maestri recalled Mayfield's words: “This is it. This is what we've been talking about all of these years. You are going to take it. ... It's a 30, 90 storm.” Maestri explained, “That's the longitude and latitude of the City of New Orleans.”¹¹ Other forecasters made similar calls to officials in Louisiana and Mississippi warning that Katrina was shifting their way.¹²

This new information was shared in a 5 p.m. CT (all subsequent times are Central Time) statewide conference call run by Colonel Jeff Smith, Deputy Director of the Louisiana Office of Homeland Security and Emergency Preparedness (LOHSEP). Katrina would be striking the eastern portion of the Mississippi coast in approximately 72 hours with Category 4 winds, a NWS forecaster informed officials.¹³

The forecaster reminded emergency managers that landfall was extremely difficult to predict with precision three days in advance.¹⁴ But, the forecaster added, referring to the computer model used to measure storm surge, “If you look at a Category 4 storm surge, looking at the SLOSH models, you'd get into the 15 to 20-foot range quite easily.”¹⁵



Katrina's storm track by day, time, and severity

Courtesy of University of Wisconsin Space Science and Engineering Center

Saturday, August 27

Throughout Saturday, August 27, Katrina nearly doubled in size. Its tropical storm-force winds extended outward about 160 miles from the center.¹⁶

At the NHC, officials were increasingly confident that Katrina would make landfall at or near New Orleans; a level of geographic precision was required for more accurate predictions of storm surge.¹⁷ On a 7:30 a.m. conference call, a federal forecaster told Louisiana Governor Kathleen Blanco and state and parish emergency officials that by 9 a.m. Monday, southeast Louisiana could expect hurricane-force winds and a storm surge of 15 to 18 feet. The latest track prediction put the hurricane “smack dab through the metropolitan New Orleans areas.”¹⁸

On Saturday evening, Max Mayfield made another round of telephone calls to assure himself that local and state officials understood what was coming. At approximately 7:25 p.m., he spoke with Governor Blanco, who suggested he call New Orleans Mayor C. Ray Nagin. Twenty minutes later, he spoke with Governor Haley Barbour in Mississippi. By 8 p.m., he had spoken with Mayor Nagin.¹⁹

Sunday, August 28

At 7 a.m., August 28, the NHC announced that Katrina was a “potentially catastrophic Category 5 hurricane.”²⁰ The storm’s tropical-force winds extended 230 miles from the center, “making Katrina not only extremely intense but also exceptionally large.”²¹ At that point, Katrina was twice as wide as 1992’s Hurricane Andrew. Superimposed over the United States, it would have reached from Boston to Washington, D.C.

Less than an hour later, at 7:50 a.m., a NWS forecaster advised the St. Bernard Parish Office of Emergency Management to expect a direct strike from the hurricane with “[m]ajor overtopping” of the levees. He advised officials that “Residents should leave now before the onset of tropical force winds and rising tides cut off evacuation routes.”²²

Throughout the afternoon and evening, local forecasters advised local emergency managers about the intensifying storm. At 4:45 p.m., Hancock County, Mississippi, emergency managers were warned that Category 5 winds could produce a 28-foot storm surge in Waveland, on the coast. The City of New Orleans was warned to expect 18 to 22 feet.²³

By early evening, storm-surge projections had grown more worrying. To underscore the danger, the NWS office in Slidell, Louisiana, issued a 5:45 p.m. advisory that called Katrina a “catastrophic” Category 5 hurricane and warned that “a few areas may experience storm surge flooding as high as 28 feet along with large and dangerous battering waves.”²⁴ For the first time, the weather agency publicly warned of levee overtopping.²⁵

The Geography of the Metropolitan New Orleans Region

While the New Orleans metropolitan area has been referred to as a “bowl,” it would be more accurately described as three distinct, large, urban bowls, and one very thin, elongated, predominantly rural bowl.

A flood-control system surrounds these four areas, known as “polders”: (1) Orleans East Bank, (2) New Orleans East, (3) Ninth Ward/St. Bernard, and (4) Plaquemines Parish.

The Orleans East Bank polder includes the downtown district, the French Quarter, the Garden District, and several other central New Orleans neighborhoods. It borders Lake Pontchartrain to the north and the Mississippi River to its south; the Industrial Canal forms its eastern border. Three large drainage canals penetrate the Orleans East Bank polder, emptying out into Lake Pontchartrain: the 17th Street, Orleans Avenue, and London Avenue Canals.

The New Orleans East polder also borders Lake Pontchartrain to the north; the Industrial Canal forms the west edge. To the south is the Gulf Intracoastal Waterway/Mississippi River Gulf Outlet (MRGO). Undeveloped swampland contained within the levee ring takes up the eastern edge. To the southeast is Lake Borgne.

The Ninth Ward/St. Bernard polder also borders the Industrial Canal to the west; the Gulf Intracoastal Waterway/MRGO channel is to the north and northeast. Lake Borgne is east, separated from the polder by the MRGO channel and undeveloped marshland. The polder's primary urban areas are in the south (St. Bernard Parish) and west (Ninth Ward).

Plaquemines Parish is a thin strip of land along the Mississippi River, which runs south-southeast from St. Bernard Parish to the mouth of the Mississippi River at the Gulf of Mexico. This strip, less than a mile wide in many areas, has levees fronting the Mississippi River and a second set of hurricane levees on its other side to protect against Gulf waters. The levees surround several small communities, utilities, and pipelines.²⁶

Monday, August 29

Late Sunday, August 28, hurricane-force winds reached more than 100 miles from Katrina's eye.²⁷ The winds and, later, the accompanying storm surge would strike land well before the official landfall event of the eye's arrival. By 5 a.m. on Monday, with the wind field already over land, but the eye's landfall an hour away, Katrina was at Category 4 strength with maximum sustained winds of more than 130 miles an hour.²⁸ The NHC reported that with the storm's radius of maximum winds extending out roughly 30 to 35 miles from its center, "It is possible that sustained winds of Category 4 strength briefly impacted the extreme southeastern tip of Louisiana in advance of landfall."²⁹

As the eye approached New Orleans, Katrina shoved a 14 to 17-foot storm surge up a "funnel" created by the hurricane protection levees at the convergence of the south bank of the MRGO and the north bank of the Gulf Intracoastal Waterway, and focused a torrent of water on the Inner Harbor Navigation Canal.³⁰ The eye of Hurricane Katrina made landfall at Buras, Plaquemines Parish, Louisiana, at 6:10 a.m. The storm was at the high end of Category 3 strength, with estimated maximum sustained winds of 127 miles an hour.³¹ It tore through the Mississippi River and hurricane protection levees of the Plaquemines Parish polder.³² By 10 a.m. the northward-moving eye had reached the mouth of the Pearl River at the Louisiana/Mississippi border.³³

As the storm continued north – just east of downtown New Orleans – its strongest winds likely existed over the Gulf of Mexico to the east of the eye. Winds over the greater New Orleans metropolitan area were most likely weaker than Category 3,³⁴ but were probably stronger several hundred feet above ground, where brutal wind punched out windows in hotels and office buildings.³⁵

As the counterclockwise-moving hurricane passed over Lake Borgne on the eastern side of the city with a storm surge estimated at 18 to 25 feet, it shoved water westward onto an edge of the levee that protected the northern edge of the Ninth Ward and St. Bernard Parish; 5 to 10 feet of excess surge easily slid over the levee walls.³⁶ Upon reaching Lake Pontchartrain, Katrina's winds produced a southward surge of lakewater along the northern edges of the

Orleans East Bank and New Orleans East polders, with overtopping and a breach in New Orleans East, adjacent to the Lakefront Airport.³⁷

The surge from Lake Pontchartrain and Lake Borgne streamed into the Industrial Canal and the MRGO channel. Here, too, the floodwaters easily overflowed the levees. In time, the erosion of the earthen levees by overtopping led to numerous breaches that added to the torrent of water quickly filling the “bowls” that included the New Orleans East and Ninth Ward/St. Bernard polders.³⁸

The inundation of New Orleans happened in two stages. A “surge funnel” that attacked the levees and floodwalls along the MRGO, the Gulf Intracoastal Waterway and the Inner Harbor Navigation Canal caused the first flooding. The second stage began when Katrina’s storm surge muscled into Lake Pontchartrain.³⁹ “Both events caused overtopping, or flow over intact levees and floodwalls, as well as breaching that resulted in flow under and through levees and floodwalls,”⁴⁰ according to a report by the Center for the Study of Public Health Impacts of Hurricanes at Louisiana State University. “In some cases, overtopping preceded or led to breaching, while in other places breaches opened before surge levels rose high enough to cause overtopping.”⁴¹

A report by the American Society of Civil Engineers and the National Science Foundation reached a similar conclusion, noting that “Most of the levee and floodwall failures were caused by overtopping, as the storm surge rose over the tops of the levees and/or their floodwalls and produced erosion that subsequently led to failures and breaches.”⁴²



First image of breaching, New Orleans

Courtesy of National Geographic Channel's "Explorer: Drowning New Orleans." Photo by Paul Hellmers © Paul Hellmers

Because the storm surge arrived ahead of the hurricane, some residential areas in the greater New Orleans area began to flood just after 4 a.m.⁴³ Between 4 and 5 a.m., minor breaches opened in the levees at the intersection of the CSX Railroad and the northern arm of the Industrial Canal (adjacent and parallel to I-10) sending water into the New Orleans East polder to the east and the Orleans East Bank polder to the west. The flooding continued for over 12 hours.⁴⁴ At approximately 6:50 a.m., the levees along all reaches of the Industrial Canal began to be overtopped and water started to pour into the city both to the east and the west.⁴⁵

Between 5 and 7 a.m., the storm surge coming through Lake Borgne struck and destroyed several levee reaches along the MRGO channel and the Industrial Canal, flooding portions of the New Orleans East, Orleans East Bank and the Ninth Ward/St. Bernard polders.⁴⁶ In some places, flooding continued for days.⁴⁷ Levees along several reaches of the Industrial Canal were overtopped, resulting in water gushing to the west into the Orleans East Bank polder and to the east into the New Orleans East and Ninth Ward/St. Bernard polders.⁴⁸

At about 7 a.m., the 18-foot Lake Borgne storm surge peaked and almost certainly caused the rapid flooding at the Louisiana National Guard’s Jackson Barracks in St. Bernard Parish.⁴⁹ For years, the Louisiana National Guard had used this compound to deploy a small group of soldiers and officers close to the area where a major hurricane was likely to strike. The facility had stood up to numerous strong storms, including 1965’s Hurricane Betsy. Brigadier General Brod Veillon, who was in command at Jackson Barracks on the night of August 28, said that, by dawn, Jackson Barracks had 6 to 12 inches of water in the parking lot, a typical amount from heavy rainfall. Within 30 minutes, however, the compound was engulfed by 10 feet of water. “It rose about a foot every 3 minutes. We watched it climb the stairs. ... I knew it was significant when the walls of Jackson Barracks, which are brick walls, began to collapse.”⁵⁰

By 7:30 a.m., levees along the west side of the Industrial Canal (at the railroad yard) failed and began a flood of the Orleans East Bank polder that continued for about 12 to 15 hours.⁵¹ By this time, there was massive flooding in much of the city, and the pumping stations had died.⁵²

At approximately 7:45 a.m., the levees along the east side of the southeastern section of the Industrial Canal failed, sending a wall of water into the neighborhoods of the Ninth Ward/St. Bernard polder, especially the Lower Ninth Ward.⁵³ The National Weather Service reported that 3 to 8 feet of flooding was possible.⁵⁴ Then, at 8:30 a.m., a continuous wave of storm surge poured over a one-mile section of levee along Lake Pontchartrain behind the Lakefront Airport. The water kept coming for another two to three hours.⁵⁵ In the Ninth Ward/St. Bernard polder,⁵⁶ floodwaters were reaching the second stories of bigger buildings and residents were fleeing to their attics.⁵⁷



A canal breached, New Orleans

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To the west – along the northern edge of the Orleans East Bank polder – the storm surge that hit the southern lakefront of Lake Pontchartrain did not produce waters high enough to overtop the concrete floodwalls lining the three major drainage canals: the 17th Street, Orleans Avenue, and London Avenue Canals. Nevertheless, three major breaches occurred along these canals. Based on two very detailed eyewitness accounts in the area, it is estimated that the initial breach on the east side of the 17th Street Canal occurred at approximately 6:30 a.m.,⁵⁸ and that the catastrophic failure of the levee took place somewhere between 9 and 10 a.m.⁵⁹ Similarly, sometime between 7 and 9:30 a.m., a section on the east side of the London Avenue Canal (close to the Mirabeau Bridge) failed;⁶⁰ sometime between 7:30 and 10:30 a.m., a section on the west side of the London Avenue Canal breached, “sen[ding] an 8 foot high wall of water cascading into the surrounding neighborhoods.”⁶¹ All three of these breaches caused catastrophic flooding in the Orleans East Bank polder, which includes (among others) the Central Business District, Lakeview, Mid City, and Lakewood areas of the city.

Captains Paul Hellmers and Joe Fincher, two New Orleans Fire Department firemen located at a department refuge in the Lakefront area of the city, videotaped the 17th Street Canal breach. In the video, which captures the breach at 11:11 a.m., Capt. Hellmers said:⁶²

You can ... see the water pouring through the [inaudible] wall. There’s a ... concrete wall on top of the dirt levee. And you can see that the ... wall is gone – you can see the water pouring through, it looks like about a 200-foot section of wall that’s gone! The water is continuing to rise – very slowly.⁶³

While Capt. Hellmers observed that the water in the entire area was rising “very slowly,” it is clear from the video that the water from the 17th Street Canal breach is pouring through the gaping hole with enormous pressure and speed.⁶⁴ A second video of the New Orleans

area, shot from a Coast Guard helicopter during the early afternoon of August 29, helps explain the different impressions.⁶⁵ From the vantage point of the helicopter's bay window, it is evident that the inflow from Lake Pontchartrain was spreading out rapidly into a vast area of land, so the water level rose slowly despite the power of the flow.

Later in the day, between approximately 5:15 and 7 p.m., Marty Bahamonde, a public-affairs official with the Federal Emergency Management Agency (FEMA) who had spent the night at the New Orleans City Hall Emergency Operations Center, joined a Coast Guard helicopter crew to conduct a visual inspection. The first of his two rides began with a quick pass over the 17th Street Canal. A second flight of approximately 45 minutes covered most of the metropolitan area of New Orleans. Bahamonde described the scene:

As far as the eye could see in either direction was completely covered with water. There was no dry land. I saw no dry land the moment I left, other than around the Superdome. ... It was varying in depth. There were houses that were completely under water. All you saw was rooftops. ... It was obvious that there was massive flooding throughout the city. ... And we went out and flew over the [I-10] twin span and it was completely destroyed. ... We flew over the canal area, may have even been the Mississippi, where a huge tanker had been run aground. ... Chalmette, the Ninth Ward, all completely flooded ... the Intracoastal Industrial Canal. You didn't really know it was a canal because it was just one sheet of water. ... And as we got back toward the city, it became obvious now that – it's close to 7 o'clock – that there are literally hundreds of people on rooftops, standing in balconies in apartments, and that there was a desperate need for a rescue mission because it was now getting dark.⁶⁶

Around the same time that Bahamonde was observing the devastation from a Coast Guard helicopter, Colonel Richard P. Wagenaar, Commander of the Army Corps of Engineers district office in New Orleans, was conducting a similar reconnaissance in a four-wheel-drive vehicle. Col. Wagenaar told the Committee that between 5 and 5:30 p.m. he reached an elevated overpass on Interstate 10 near downtown New Orleans:

Then we saw the water, and the water was – all you could see were the trees sticking out of the water. ... That's probably 10 or 15 feet of water ... a sight to behold, because, literally, I mean, you just drive on an interstate and there is a lake. I mean, it literally was a lake."⁶⁷

Mississippi

Hurricanes are part of life on the Mississippi Gulf Coast. Every year there are hurricane warnings, evacuations, and scares; some years the coast gets hit. Before Katrina, the gold standard for storms in the region was Hurricane Camille,⁶⁸ a Category 5 hurricane that struck Mississippi on August 17-18, 1969, killing 143 along the coast, bringing with it about 10 inches of rain and a storm tide as high as 24 feet.⁶⁹

The area's familiarity with hurricanes – and with the inevitable false alarms generated as the storms wander toward land – gives coastal residents both a healthy respect for storms and a degree of nonchalance toward dire warnings. False alarms during previous seasons – including an evacuation in 2004 before Hurricane Ivan, which ultimately veered away from the Mississippi coast – may have contributed to this attitude. Surviving Camille, widely viewed as the worst storm imaginable, may have led some to believe that future storms would be no worse.

Katrina changed all that. As Governor Barbour recounted at a February 2, 2006, hearing of the Senate Homeland Security and Governmental Affairs Committee:

On Aug. 29, 2005, Hurricane Katrina struck our state a grievous blow. Although the eye of the storm landed at the Mississippi-Louisiana line, that eye was more than 30 miles wide, and Katrina completely devastated our entire coastline, from Pearlinton to Pascagoula. The miles and miles of utter destruction is unimaginable. . . . But this hurricane wasn't just a calamity for the Mississippi Gulf Coast. Its impact extended inland with hurricane force more than 200 miles from the coast. In her wake, Katrina left literally tens of thousands of uninhabitable, often obliterated homes; thousands of small businesses in shambles; dozens of schools and public buildings ruined and unusable; highways, ports and railroads, water and sewer systems, all destroyed.⁷⁰

The Region

In 2005, the State of Mississippi had a population of approximately 2.9 million people. The state comprises 82 counties, with three (Hancock, Harrison, and Jackson) located directly on the Gulf of Mexico, and three directly to the north of them (Pearl River, Stone, and George). The three counties that lie directly on the Gulf are generally referred to as the Mississippi Gulf Coast, and have a combined population of approximately 374,000 people (with populations of 46,000 in Hancock, 193,000 in Harrison, and 135,000 in Jackson). The Mississippi Gulf Coast extends for some 90 miles between Louisiana and Alabama. With the three counties to the north (Pearl River has 52,000, Stone has 14,000, and George has 21,000), that number rises to 461,000.⁷¹

The largest cities of the southernmost six counties are Gulfport and Biloxi, both located in Harrison County. They are the second and third largest cities in the state after the capital, Jackson, with populations of 71,000 and 50,000 respectively. The next largest in the region are the cities of Pascagoula in Jackson County (26,000), Laurel in Jones County (18,000), and Long Beach in Harrison County (17,000). Other cities in Hancock County include Bay St. Louis (8,000) and Waveland (6,000).⁷²

The Mississippi coastal area had a varied economy before Katrina struck. Major sectors included oil-and-gas refining and distribution, light manufacturing, and tourism. The area's beaches and casino resorts were a mainstay of the tourism industry. Recent years had seen development of a number of casino/hotel complexes, including the Hard Rock Casino, the Beau Rivage, the Palace Casino, and the Grand Casino. To comply with Mississippi law, the casino operations were offshore, on barges arrayed along the coast.⁷³ The casino industry was an important source of jobs and tax revenue for the region.⁷⁴

Katrina Approaches

At about 10 a.m. on Wednesday, August 24, the Mississippi Emergency Management Agency (MEMA) activated the state Emergency Operations Center (EOC) in Jackson, Mississippi. At this point Katrina was just a tropical storm in the Atlantic.⁷⁵ By 4 p.m. the next day, Katrina was bearing down on Florida and its entry into the Gulf of Mexico was increasingly likely.⁷⁶

At 10 a.m. on Friday, August 26, MEMA's situation report reported that Katrina was likely to make a gradual turn to west-northwest and northwest from Florida and noted, "This longer westerly motion is significant in that it indicates an increasing threat farther west along

the northern Gulf Coast.”⁷⁷ By 4:30 p.m. that day, MEMA reported, “Landfall is now projected for near the Alabama/Mississippi border on Monday morning” as a Category 4 hurricane.⁷⁸ On August 26, the Governor declared a State of Emergency and signed Executive Order #939, activating the National Guard.⁷⁹ By 9 a.m. the next day, Katrina was forecasted to make landfall in the Mississippi Delta/New Orleans area as a Category 4 hurricane.⁸⁰

By noon on Saturday, August 27, Harrison County and the City of Pass Christian issued Proclamations of Local Emergency.⁸¹ These proclamations meant that these localities felt it was beyond their capacity to respond to the threat Hurricane Katrina posed and that they required help from other counties and the state.⁸² By 4 p.m., they had been joined by Hancock County and the City of Waveland.⁸³ By 8 a.m. the next day, Jackson County did as well.⁸⁴

On the morning of Sunday, August 28, MEMA issued a situation report describing Katrina as an “extremely dangerous” Category 5 storm and stating that the entire Mississippi coast was subject to a hurricane warning.⁸⁵ By noon that day, Katrina had been upgraded to “potentially catastrophic,” with expected storm surges of up to 25 feet.⁸⁶

As recounted more fully elsewhere in this report, federal, state, and local governments made various preparations and preliminary deployments in the days leading up to Katrina’s landfall on August 29. The Governor called up Mississippi National Guard units, which had begun deploying August 27, with some units positioned in the coastal counties while others formed up at Camp Shelby, near Hattiesburg, Mississippi. By noon on Sunday, August 28, MEMA’s State Emergency Response Team (SERT) had deployed to Camp Shelby.⁸⁷ FEMA representatives arrived as well.

The Storm Hits

Katrina weakened from a Category 5 to a Category 3 storm as it made landfall on the Mississippi Gulf Coast, but its magnitude was still extraordinary. No one the Committee staff spoke to had ever seen a comparable storm. On August 29, Katrina’s radius of maximum winds stretched out 25 to 30 nautical miles from its center, and hurricane-force winds extended out at least 75 nautical miles eastward from its center, making it a storm of unprecedented size on the Mississippi Gulf Coast.⁸⁸

The Surge: Witnesses from the Gulf Coast have told of the horrible, overwhelming storm surge driven ashore by Katrina, a surge that caused significant flooding the length of the coast. Yet, as the NWS has observed, “A precise measure of the storm surge . . . is complicated by many factors, including the widespread failure of tide gauges. Additionally, in many locations, most of the buildings along the coast were completely destroyed, leaving few structures within which to identify still-water marks.”⁸⁹

Whatever its exact surge level, Katrina battered Mississippi with a deadly and unprecedented wall of water. Unofficial measurements hint at its power. The Hancock County Emergency Operations Center recorded a 28-foot storm tide.⁹⁰ The Harrison County emergency director estimates that a tidal surge of 25 to 35 feet hit that part of the coast.⁹¹ Across the Mississippi Gulf Coast in Pascagoula, the Jackson County EOC recorded a high water mark of 16.2 feet.⁹²

The NWS reports that Katrina’s ferocity in the Gulf of Mexico, combined with its enormous size at landfall, caused the extraordinary surges. “Overall, Katrina’s very high water levels are attributable to a large Category 3 hurricane’s storm surge being enhanced by waves generated not long before by a Category 5 strength storm.”⁹³

Katrina's waves and high waters lasted for hours, compounding the destruction. D.J. Ziegler, the Gulfport Harbormaster, rode out the storm in a parking deck near the ocean:

The word "surge" irritates me a little. ... People want to act like there's one sudden ... surge that comes in, and it's not the case. The water just keeps getting deeper and the swells getting larger. So what you really have is a constant pounding. ... So it's more like somebody's got a sledge hammer ... and keeps hitting.⁹⁴

The surge penetrated at least six miles inland along many portions of coastal Mississippi, and up to 12 miles along bays and rivers.⁹⁵

The Rain: Even without the storm surge, Katrina's rain was enough to flood many communities along the coast. Eight to 10 inches of rain fell across a large swath of southwestern Mississippi.⁹⁶ Estimates gathered by the NWS indicate that Hancock County received more than 10 inches of rain. Even Jackson, almost 150 miles north of the coast, still received nearly four inches of rain.⁹⁷

The Wind: Katrina's winds were strong, broad in reach, and long-lasting. As a Category 3 hurricane, Katrina had sustained winds of 111 to 130 miles per hour. In Jackson County, the reported winds were even higher.⁹⁸

Katrina's Reach: Katrina remained a destructive storm well north of the Gulf Coast. It weakened to a tropical storm late in the day on August 29 just northwest of Meridian, Mississippi.⁹⁹ Winds of over 56 m.p.h. were registered in the state capital of Jackson, and as far north as Columbus, Mississippi, there were winds of over 50 m.p.h.¹⁰⁰ Mayor Bob Massengill of Brookhaven, Mississippi, located 135 miles northwest of the Mississippi Gulf Coast, recalled that his community received wind gusts of up to 85 miles per hour and had several hours of sustained winds of over 50 miles per hour. This resulted in hundreds of downed trees and dozens of severely damaged or destroyed homes.¹⁰¹

As if the destructive force of the hurricane winds alone were not enough, Katrina produced a total of 11 reported tornados in Mississippi during August 29 and 30.¹⁰²

Immediate Impact on Mississippi

Within hours, Katrina brought the coast to a halt. By 4 p.m. on Monday, all of Highway 90 along the Gulf Coast had flooded, along with parts of I-10.¹⁰³ The two main bridges on Highway 90, the Biloxi-Ocean Springs Bridge and the Bay St. Louis Bridge, collapsed. The Bay St. Louis Bridge fell into the bay, between supports that had withstood the storm. The storm rendered roads completely impassable, and rail service was discontinued.¹⁰⁴

The most basic of community services were totally disrupted, in some cases for weeks. Water and sewer service failed. Local schools closed. Gulfport Memorial Hospital and other hospitals along the coast were damaged and forced to relocate hundreds of patients.¹⁰⁵ Katrina knocked out power to hundreds of thousands of Mississippi residents. At its peak, as of August 30, almost one million energy customers were without power.¹⁰⁶



Devastated neighborhood,
Waveland, MS
Sun Herald news photo, Biloxi/Gulfport, MS

The physical damage was staggering. According to estimates, 65,380 homes were destroyed in southern Mississippi – over 95 percent of the statewide total of 68,641 destroyed homes. Katrina left 44 million cubic yards of debris and caused billions of dollars in property damage.¹⁰⁷

The impact on many communities along the coast is difficult to conceive. In Waveland and Bay St. Louis, communities of thousands of homes on the westernmost part of the Mississippi Gulf Coast, Katrina left only a few dozen habitable residences. Mayor Brent Warr of Gulfport estimates that 80 to 90 percent of the residential and commercial properties of his city sustained heavy damage or were destroyed.¹⁰⁸ In Gulfport and Biloxi, the big casino barges so significant to the region’s economy were destroyed. In many instances, the casinos were lifted off of their anchoring stanchions by the powerful water and dumped hundreds of yards away. At one casino, boats from nearby Gulfport Harbor were wedged between the girders of what was left of the structure, like nails hammered in by some unseen hand.¹⁰⁹

According to recent figures, 231 identified victims perished in Mississippi as a result of Katrina, with 5 other unidentified dead and 67 missing.¹¹⁰

Alabama

While Alabama did not suffer the same level of damage as Louisiana and Mississippi, Hurricane Katrina gave the state a battering, especially coastal Baldwin and Mobile counties. Dauphin Island, a barrier island, faced 100 m.p.h. wind gusts; Mobile had gusts exceeding 80 m.p.h.¹¹¹ An oil rig under construction along the Mobile River in Alabama was dislodged, floated 1.5 miles northward, and struck the Cochrane Bridge, causing significant damage just north of downtown Mobile.¹¹² Another offshore oil rig washed up near the beach of Dauphin Island.¹¹³ Katrina also reportedly caused significant beach erosion and significant tree damage throughout the state.¹¹⁴

Hurricane Katrina produced a large storm surge along the Alabama coast. A Dauphin Island town-council member described the damage:

The West End of our island ... was ravaged by Katrina. Visual inspections of this area show 190 homes totally swept away, another 96 homes totally destroyed or severely damaged, roads completely obliterated, and water, sewer, phone, and power are non-existent. No home was left unscathed by Katrina in this area.¹¹⁵

According to a study published by the National Hurricane Center, the storm surge was as high as 10 feet as far east as Mobile, Alabama, and caused flooding several miles inland from the Gulf Coast along Mobile Bay.¹¹⁶ In addition, the Alabama Emergency Management Agency (AEMA) reported that the highest storm surge, 15 feet, was in Bayou La Batre, approximately 30 miles south of Mobile on the Gulf Coast.¹¹⁷

In addition to the storm surge and wind damage, there were four confirmed tornadoes, in Montgomery, Macon, Tallapoosa, and Calhoun counties in the eastern half of the state. AEMA described rainfall during Katrina as “insignificant.”¹¹⁸

Two indirect fatalities occurred in Alabama during Hurricane Katrina as a result of a car accident in heavy rain during the storm. These fatalities, Alabama’s only fatalities in Katrina, occurred in Washington County, directly north of Mobile County on the Mississippi border.¹¹⁹ The Federal Emergency Management Agency (FEMA) registered a total of 25,454 evacuees in the state. Nearly 112,000 individuals registered for federal assistance in the state.¹²⁰

Texas

Despite ominous early signs, Katrina ultimately inflicted minimal direct damage on Texas.

¹²¹ In the days that followed, however, Texas took in an estimated 400,000 evacuees, stretching the capacity of shelters and relief workers across the state.¹²²

1 Richard D. Knabb, Jamie Rhome, and Daniel Brown, National Hurricane Center, “Tropical Cyclone Report, Hurricane Katrina,” Hurricane Katrina 23-30 August 2005,” Dec. 20, 2005, p. 1. http://www.nhc.noaa.gov/pdf/TCR-L122005_Katrina.pdf. Accessed on Mar. 30, 2006 [hereinafter NHC, “Tropical Cyclone Report, Hurricane Katrina,”] (“The complex genesis of Katrina involved the interaction of a tropical wave, the middle tropospheric remnants of Tropical Depression Ten, and an upper tropospheric trough” that created a “tropical depression by 1800 UTC 23 August over the southeastern Bahamas about 175 nautical miles (n mi) southeast of Nassau” that eventually became “designated Tropical Depression Twelve.”).

2 NHC, “Tropical Cyclone Report, Hurricane Katrina,” Hurricane Katrina,” p. 2 (“Further strengthening ensued, and Katrina is estimated to have reached hurricane status near 2100 UTC 25 August, less than two hours before its center made landfall on the southeastern coast of Florida.”).

3 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 2 (“In fact, the eye feature actually became better defined while Katrina moved inland, and it remained intact during its entire track across the peninsula. . . . Katrina continued west-southwestward overnight and spent only about six hours over land, mostly over the water-laden Everglades.”).

4 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 2 (“The center of Tropical Storm Katrina then emerged into the southeastern Gulf of Mexico at approximately 0500 UTC on 26 August just north of Cape Sable. Once back over water, Katrina quickly regained hurricane status at 0600 UTC with maximum sustained winds of 65 knots. . . . The center of Katrina continued west-southwestward over the southeastern Gulf of Mexico and away from the southern Florida peninsula.”).

5 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3 (On August 27, “Katrina became a Category 3 hurricane with 100 kt winds at 1200 UTC that morning about 365 n mi southeast of the mouth of the Mississippi River. . . . Accompanying the intensification. . . . was a significant expansion of the wind field on 27 August. Katrina nearly doubled in size on 27 August, and by the end of that day tropical storm-force winds extended up to about 140 n mi from the center.”).

6 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3 (“The strong middle- to upper-tropospheric ridge that had kept Katrina on a west-southwestward track over the Florida peninsula and southeastern Gulf of Mexico began to shift eastward toward Florida, while a mid-latitude trough amplified over the north-central United States. This evolving pattern resulted in a general westward motion on 27 August and a turn toward the northwest on 28 August when Katrina moved around the western periphery of the retreating ridge.”).

7 Committee staff interview of Max Mayfield, Ph.D., Director, National Hurricane Center, conducted on Jan. 27, 2005, transcript pp. 40-41 (“By that Friday afternoon, the models have come into much, much better agreement. . . . So when all these models started to finally converge – I mean, still not on top of each other; I mean, there’s still some scatter, but they were in much, much better agreement than we had seen up to that time, and they started converging towards the Mississippi and Southeast Louisiana coast, yeah, you bet the alarm bells started sounding.”).

8 Mayfield interview, Jan. 27, 2006, p. 40 (“At least for the 34 years that I’ve been at the National Hurricane Center, we’ve always been saying that the greatest concern from a hurricane anywhere in the Gulf of Mexico is Southeastern Louisiana and the great New Orleans area.”).

9 National Hurricane Center, Hurricane Advisory, Aug. 26, 2005, 5 p.m.

10 National Weather Service, Hurricane Katrina Discussion Number 14, Aug. 26, 2005, 5 p.m.

11 Committee staff interview of Walter Maestri, Ph.D., Director, Jefferson Parish Office of Emergency Management, LA, conducted on Oct. 25, 2005, transcript p. 119.

12 Mayfield interview, Jan. 27, 2006, pp. 35-36 (“And they were doing a very good job, in my opinion, of reaching out. . . . So they were indeed making their local officials aware that, hey, you’re in the cone.”).

13 Louisiana Office of Homeland Security and Emergency Preparedness (LOHSEP), Katrina Conference Call Number 1, Aug. 26, 2005, 5 p.m. CT, pp. 4-5. Provided to Committee.

14 LOHSEP, Katrina Conference Call Number 1, Aug. 26, 2005, 5 p.m. CT, p. 5. Provided to Committee. (“There is still a lot of uncertainty here, so I don’t want to really say what area has the highest landfall threat. Certainly with Plaquemines Parish sticking out into the Gulf, it typically has the highest threat, but I don’t want to focus on one specific region right now.”).

15 LOHSEP, Katrina Conference Call Number 1, Aug. 26, 2005, 5 p.m. CT, p. 6. Provided to Committee.

16 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3 (“Accompanying the intensification and the subsequent deterioration of the inner eyewall was a significant expansion of the wind field on 27 August. Katrina nearly doubled in size on 27 August, and by the end of that day tropical storm-force winds extended up to about 140 n mi from the center.”).

17 Mayfield interview, Jan. 27, 2006, p. 60 (“There is indeed a storm surge model that the National Weather Service runs. We have agreed to do that about 24 hours before landfall to let people see what might happen, what the storm surge might be, if we had that perfect forecast.”).

18 LOHSEP, Katrina Conference Call Number 2, Aug. 27, 2005, 7:30 a.m. CT, p. 10. Provided to Committee.

19 Mayfield interview, Jan. 27, 2006, pp. 56-57 (“I wanted to make sure that they understood the severity of the situation. ... And I should say, too, that when I called Governor Blanco, she’s the one that suggested that I call Mayor Nagin, which I did. I left a message, and he called me back very quickly. ... This is Saturday. The log here shows – the HLT log shows 7:25 Central daylight time, called Governor Blanco.”). See also: National Hurricane Center, Hurricane Katrina Forecast Timeline, 2006, p. 3. Provided to Committee [hereinafter NHC Timeline].

20 National Hurricane Center, Hurricane Advisory, Aug. 28, 2005, 7 a.m. CT. The New Orleans NWS office broadcast a similar warning at 8 a.m., stating “direct strike of catastrophic hurricane expected ... rush protective measures to completion and leave area as soon as possible.” National Weather Service, Hurricane Katrina Local Statement, New Orleans, Aug. 28, 2005, 8 a.m. CT.

21 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3 (“Katrina strengthened from a low-end Category 3 hurricane to a Category 5 in less than 12 h, reaching an intensity of 145 kt by 1200 UTC 28 August. Katrina attained its peak intensity of 150 kt at 1800 UTC 28 August about 170 n mi southeast of the mouth of the Mississippi River. The wind field continued to expand on 28 August, and by late that day tropical stormforce winds extended out to about 200 n mi from the center, and hurricane-force winds extended out to about 90 n mi from the center, making Katrina not only extremely intense but also exceptionally large.”).

22 National Oceanic and Atmospheric Administration, Briefing to Committee, Dec. 21, 2005 [hereinafter NOAA Briefing to Committee].

23 NOAA Briefing to Committee, Dec. 21, 2005.

24 National Weather Service, Hurricane Katrina Local Statement, New Orleans, Aug. 28, 2005, 5:45 p.m.

25 National Hurricane Center, Hurricane Advisory, Aug. 28, 2005, 4 p.m. CT.

26 R. B. Seed et al., ASCE/NSF, Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005, Nov. 2, 2005, pp. 1–2, 1–3 [hereinafter ASCE/NSF, Preliminary Report].

27 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3.

28 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 7.

29 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 7.

30 Ivor Ll. van Heerden, G. Paul Kemp, Wes Shrum, Ezra Boyd and Hassan Mashriqui, Louisiana State University, Center for the Study of Public Health Impacts of Hurricanes, Initial Assessment of the New Orleans’ Flooding Event during the Passage of Hurricane Katrina, p. 4 [hereinafter LSU, Initial Assessment of New Orleans Flooding] (“The ‘Funnel’ effects: As the eye of the storm approached the latitude of New Orleans a 14-17 foot surge was pushed into the western apex of a triangle known as the ‘Funnel’, so called because the hurricane protection levees that form the south bank of the MRGO and the north bank of the GIWW converge from being about 10 m miles apart to a few hundred yards as the banks of the GIWW where it separates the East Orleans and St. Bernard polders. The Funnel is a 6-mile long section of the GIWW where the cross-section was enlarged by a factor of three when the MRGO was built to expand it from a barge channel to accommodate ocean-going vessels. At the western end, the funnel focused a jet into the IHNC. The US Army Corps of Engineers had inadvertently designed an excellent storm surge delivery system – nothing less – to bring this mass of water with simply tremendous ‘load’ – potential energy – right into the middle of New Orleans.”).

31 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3.

32 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3.

33 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 3.

34 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 8.

35 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 8 (“[W]inds in a hurricane generally increase from the ground upward to a few hundred meters in altitude, and the sustained winds experienced on upper floors of high-rise buildings were likely stronger than the winds at the same location near the ground. For example, on average the 25th story of a building would experience sustained winds corresponding to one Saffir-Simpson category stronger than that experienced at the standard observing height of 10 m[eters].”).

36 ASCE/NSF, Preliminary Report, pp. 1–4, 1–5.

37 ASCE/NSF, Preliminary Report, pp. 1–4, 1–10 (Figure 1.4); See also: LSU, Initial Assessment of New Orleans Flooding, p. 7 (“Lake Pontchartrain levee overtopping: Between 8:30 and 11:00 am, flood water poured into Orleans East from Lake Pontchartrain where a section of concrete levee wall at the Lakefront Airport that strangely was almost two feet lower than the earthen walls it was attached to served as a spillway when it was overtopped. Otherwise, no significant overtopping occurred anywhere along the south shore of Lake Pontchartrain.”).

38 ASCE/NSF, Preliminary Report, p. 1–5.

39 LSU, Initial Assessment of New Orleans Flooding, p. 1.

40 LSU, *Initial Assessment of New Orleans Flooding*, p. 1.

41 LSU, *Initial Assessment of New Orleans Flooding*, p. 1.

42 ASCE/NSF, *Preliminary Report*, p. iv.

43 Ivor van Heerden, Ph.D., Timeline for Hurricane Katrina, 2006. Provided to Committee. There are numerous reports and oral reflections regarding the timing on Monday, August 29, 2005, of the overtopping and breaching of levees and floodwalls, and subsequent flooding, in the metropolitan New Orleans region. The Committee, through numerous interviews, copious documents, and scientific analyses received from experts, has done its best to construct a tentative timeline with respect to these events. To this end, the Committee has depended to a large degree on the information provided by van Heerden, and from information contained in the ASCE/NSF, *Preliminary Report* and U.S. Army Corps of Engineers, Interagency Performance Evaluation Task Force, *Performance Evaluation Status and Interim Results, Report 2 of a Series*, Mar. 10, 2006 [hereinafter IPET, *Report 2 of a Series*].

Van Heerden is the Deputy Director of the LSU Hurricane Center and the Director of the LSU Center for the Study of Public Health Impacts of Hurricanes. Van Heerden was also designated by the State of Louisiana to lead its Forensic Data Gathering Team in its efforts to learn more about the causes of the levee failures in the metropolitan New Orleans area. As part of his work, van Heerden and his colleagues at LSU have reviewed video camera footage and conducted several first-responder and survivor interviews. The team of LSU scientists also implemented the “stopped clock program,” in which they collected stopped battery-operated and mechanical hand-dial clocks from flooded homes, noting both the time and elevation. The data is compiled in a report provided to the Committee entitled, *Initial Assessment of the New Orleans’ Flooding Event During the Passage of Hurricane Katrina*.

It should also be noted that two scientists who testified before the Committee – Raymond Seed, Ph.D., who led the National Science Foundation sponsored forensic gathering and analysis team, and Peter Nicholson, P.F., head of the American Society of Civil Engineer’s data gathering team – stated that they not only funneled information regarding witnesses’ statements to Dr. van Heerden, but that “The time lines described by Dr. van Heerden would make sense with the geotechnical observations we see in the field . . . they are consistent.” Testimony of Raymond Seed, Team Leader, National Science Foundation, before the U.S. Senate, Committee on Homeland Security and Governmental Affairs, hearing on *Hurricane Katrina, Why Did the Levees Fail?*, Nov. 2, 2005.

Similarly, the IPET observed over 200 high-water marks, contacted over 600 people for eyewitness accounts and interviewed over 175 persons who observed flooding induced by Hurricane Katrina. See, IPET, *Report 2 of a Series*, p. V-5. The IPET also employed the use of stopped clocks in houses, and gathered videos and still photos. See, IPET, *Report 2 of a Series*, p. V-5.

44 LSU, *Initial Assessment of New Orleans Flooding*, p. 11; IPET, *Report 2 of a Series*, p. V-9.

45 LSU, *Initial Assessment of New Orleans Flooding*, p. 4.

46 Ivor van Heerden, Timeline for Hurricane Katrina, 2006. Provided to Committee; LSU, *Initial Assessment of New Orleans Flooding*, p. 3; IPET, *Report 2 of a Series*, pp. V-9 through V-11.

47 Van Heerden, Timeline for Hurricane Katrina, 2006. Provided to Committee.

48 Van Heerden, Timeline for Hurricane Katrina, 2006. Provided to Committee; LSU, *Initial Assessment of New Orleans Flooding*, pp. 3-7.

49 LSU, *Initial Assessment of New Orleans Flooding*, p. 4.

50 Committee staff interview of Brig. Gen. Brod Veillon, Assistant Adjutant General, Louisiana National Guard, conducted on Nov. 29, 2005, transcript p. 18.

51 LSU, *Initial Assessment of New Orleans Flooding*, p. 11.

52 Col. Terry Ebbert, LOHSEP, Katrina Conference Call Number 10, Aug. 29, 2005, 7:30 a.m. CT, p. 13.

53 Van Heerden, Timeline for Hurricane Katrina, 2006. Provided to Committee; LSU, *Initial Assessment of New Orleans Flooding*, pp. 5, 11.

54 Transportation Security Administration, Katrina Brief, Aug. 29, 2005, 9 a.m. Provided to Committee; files as Bates no. DHS-HSOC-0002-0000190.

55 LSU, *Initial Assessment of New Orleans Flooding*, pp. 7, 11.

56 At 9 a.m., the local weather office issued a “Hurricane Katrina Local Statement: “Levees overtopped in Orleans and St. Bernard Parishes....Extensive and life threatening storm surge flooding occurring along the Louisiana and Mississippi coast at this time....Significant and life threatening storm surge 18 to 22 feet above normal is occurring.” National Weather Service, Hurricane Katrina Local Statement, New Orleans, Aug. 29, 2005, 9 a.m. CT.

57 Michael Heath, e-mail to Michael Lowder, Aug. 29, 2005, 10:43 a.m. Provided to Committee; filed as Bates no. DHS-FEMA-0029-0002963.

58 IPET, *Report 2 of a Series*, pp. V-5 through V-7.

59 LSU, *Initial Assessment of New Orleans Flooding*, pp. 8, 11. See also: IPET, *Report 2 of a Series*, p. V-5 through V-7.

60 Van Heerden, Timeline for Hurricane Katrina, 2006. Provided to Committee; and LSU, *Initial Assessment of New Orleans Flooding*, p. 9. See also: IPET, *Report 2 of a Series*, p. V-5 through V-7.

61 LSU, *Initial Assessment of New Orleans Flooding*, p. 9. See also: IPET, *Report 2 of a Series*, pp. V-5 through V-7.

62 Moreover, the NOFD Hurricane Katrina Log (Fire Communications) produced to the Committee by the NOFD,

- reflects that at 11:15 a.m. CT, the “first report of levee either being breeched [sic] or topped at 17th Ave. Canal.” New Orleans Fire Department, Hurricane Katrina Fire Communications Log, 2005. Provided to Committee.
- 63 NOFD, Capt. Paul Hellmers, Lake Marina Towers Video, Aug. 29, 2005. Provided to Committee.
- 64 LSU, *Initial Assessment of New Orleans Flooding*, p. 8 (“Eye witnesses reported the flood waters rose rapidly.”).
- 65 U.S. Coast Guard, Initial Helicopter Overflight Video, Aug. 29, 2005. Provided to the Committee.
- 66 Committee staff interview of Marty Bahamonde, Region I Director, External Affairs, FEMA, conducted on Oct. 7, 2005, transcript pp. 106-110.
- 67 Committee staff interview of Col. Richard P. Wagenaar, U.S. Army, District Commander, New Orleans District, U.S. Army Corps of Engineers, conducted on Nov. 15, 2005, transcript pp. 56-58.
- 68 Written Statement of Robert Latham, Executive Director, Mississippi Emergency Management Agency, for the U.S. House Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina, hearing on *Hurricane Katrina: Preparedness and Response by the State of Mississippi*, Dec. 7, 2005, p. 1.
- 69 National Hurricane Center, “Hurricane History.” <http://www.nhc.noaa.gov/HAW2/english/history.shtml#camille>. Accessed on Mar. 30, 2006. Camille is only one of three Category 5 hurricanes to make landfall on the United States coast since records have been kept. National Hurricane Center, The Saffir-Simpson Scale. <http://www.nhc.noaa.gov/aboutsshs.shtml>. Accessed on Apr. 3, 2006.
- 70 Written statement of Gov. Haley Barbour, Mississippi, before the U.S. Senate, Committee on Homeland Security and Governmental Affairs, hearing on *Hurricane Katrina: The Role of Governors in Managing the Catastrophe*, Feb. 2, 2006, p. 1.
- 71 U.S. Census Bureau, American Factfinder, 2006. <http://factfinder.census.gov>. Accessed on Mar. 30, 2006.
- 72 U.S. Census Bureau, American Factfinder, 2006. <http://factfinder.census.gov>. Accessed on Mar. 30, 2006.
- 73 Richard Fausset, “Mississippi Casinos Trump Katrina,” *Los Angeles Times*, Feb. 25, 2006.
- 74 Committee staff interview of Mayor A.J. Holloway, City of Biloxi, MS, conducted on Jan. 5, 2006 (untranscribed).
- 75 Mississippi Emergency Management Agency (MEMA), Hurricane Situation Report: Tropical Storm Katrina, Aug. 24, 2005, 10 a.m. CT, p. 1. Provided to Committee; filed as Bates no. MEMA-0010808.
- 76 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 25, 2005, 4 p.m. CT, p. 1. Provided to Committee; filed as Bates no. MEMA-0010820.
- 77 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 26, 2005, 10 a.m. CT, p. 1. Provided to Committee; filed as Bates no. MEMA-0010824.
- 78 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 26, 2005, 4:30 p.m. CT, p. 1. Provided to Committee; filed as Bates no. MEMA-0010828.
- 79 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 27, 2005, noon CT, p. 2. Provided to Committee; filed as Bates no. MEMA-0010832.
- 80 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 27, 2005, 9 a.m. CT. Provided to Committee; filed as Bates no. MEMA-0010831.
- 81 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 27, 2005, noon CT, p. 2. Provided to Committee; filed as Bates no. MEMA-0010835.
- 82 Miss. Code Ann. § 33-15-5 (g).
- 83 MEMA, Hurricane Situation Report: Hurricane Katrina, Aug. 27, 2005, 4 p.m. CT, p. 2. Provided to Committee; filed as Bates no. MEMA-0010838.
- 84 MEMA, Hurricane Situation Report #5: Hurricane Katrina, Aug. 28, 2005, 8 a.m. CT, p. 2. Provided to Committee; filed as Bates no. MEMA-0010859.
- 85 MEMA, Hurricane Situation Report #5: Hurricane Katrina, Aug. 28, 2005, 8 a.m. CT, p. 1. Provided to Committee; filed as Bates no. MEMA-0010858.
- 86 MEMA, Hurricane Situation Report #6: Hurricane Katrina, Aug. 28, 2005, noon CT, p. 1. Provided to Committee; filed as Bates no. MEMA-0010864.
- 87 MEMA, Hurricane Situation Report #6: Hurricane Katrina, Aug. 28, 2005, noon CT. Provided to Committee; filed as Bates nos. MEMA-0010864 through 0010869.
- 88 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 9.
- 89 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 8. In an interview with Committee staff, Brian Adam, the Hancock County Director of Emergency Management, recounted that the Hancock County EOC sits 27 feet above sea level but was flooded by 3.5 feet of water during Katrina. Committee staff interview of Brian Adam, Director of Emergency Management, Hancock County, MS, conducted on Nov. 16, 2005 (untranscribed).
- 90 NHC, “Tropical Cyclone Report, Hurricane Katrina,” p. 8.
- 91 Testimony of Col. Joe Spraggins, Director of Emergency Management, Harrison County, MS, for the U.S. House, Se-

lect Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina, hearing on *Hurricane Katrina: Preparedness and Response by the State of Mississippi*, Dec. 7, 2005.

92 Committee staff interview of Butch Loper, Emergency Management Director, Jackson County, MS, conducted on Dec. 6, 2005, transcript pp. 64-65.

93 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 9. The expected storm surge for a Category 3 hurricane would normally be between 9-12 feet, according to the Saffir-Simpson Hurricane Scale. An introduction to the scale may be found at <http://www.nhc.noaa.gov/aboutsshs.shtml>.

94 Committee staff interview of D.J. Ziegler, Harbor Master, Gulfport Harbor, MS, conducted on Dec. 8, 2005, transcript, p. 30.

95 NHC, "Tropical Cyclone Report, Hurricane Katrina," pp. 8-9.

96 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 10.

97 NHC, "Tropical Cyclone Report, Hurricane Katrina," pp. 27-28.

98 Loper interview, Dec. 6, 2005, p. 64. This is consistent with wind speeds noted in the MEMA situation reports. MEMA, Hurricane Situation Report #13: Hurricane Katrina, Aug. 29, 2005, 4 p.m. CT. Provided to Committee; filed as Bates no. MEMA-0010924.

99 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 4.

100 NHC, "Tropical Cyclone Report, Hurricane Katrina," pp. 27-28.

101 Written Statement of Mayor Robert V. Massengill, Brookhaven, MS, for the U.S. Senate, Committee on Homeland Security and Governmental Affairs, hearing on *Recovering from Hurricane Katrina: Responding to the Immediate Needs of Its Victims*, Sept. 28, 2005, p. 1.

102 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 10.

103 MEMA, Hurricane Situation Report #13: Hurricane Katrina, Aug. 29, 2005, 4 p.m. CT, p. 6. Provided to Committee; filed as Bates no. MEMA-0010929.

104 MEMA, Hurricane Situation Report #19 Hurricane Katrina, Aug. 30, 2005 at 4:30 p.m. CT, p. 6. Provided to Committee; filed as Bates no. MEMA-0010989.

105 MEMA, Hurricane Situation Report #19 Hurricane Katrina, Aug. 30, 2005 at 4:30 p.m. CT, p. 8. Provided to Committee; filed as Bates nos. MEMA-0010990 through 0010991.

106 MEMA, Hurricane Situation Report #20 Hurricane Katrina, Aug. 31, 2005 at 1:30 a.m. CT, p. 9. Provided to Committee; filed as Bates no. MEMA-0011002.

107 "Mississippi's Invisible Coast," *Biloxi Sun-Herald*, Dec. 14, 2005. <http://www.sunherald.com/mld/sunherald/13402585.htm>. Accessed on Apr. 24, 2006; MEMA, Red Cross Damage Assessments. <http://www.msema.org/red-crossassessments.htm>. Accessed on Apr. 24, 2006.

108 Committee staff interview of Bret Warr, Mayor, City of Gulfport, MS, conducted on Jan. 9, 2006 (untranscribed).

109 Ziegler interview, Dec. 8, 2005, p. 27.

110 "Mississippi's Invisible Coast," *Biloxi Sun-Herald*, Dec. 14, 2005. <http://www.sunherald.com/mld/sunherald/13402585.htm>. Accessed on Apr. 24, 2006.

111 Alabama Emergency Management Agency, Hurricane Katrina Situation Report #7, Aug. 31, 2005, 7 p.m. CT.

112 Written Statement of Don Vaughn, Chief Engineer, Alabama Department of Transportation, for the U.S. House, Committee on Transportation and Infrastructure, hearing on *Rebuilding Transit Infrastructure in the Gulf Coast Area*, Oct. 27, 2005.

113 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 12.

114 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 12.

115 Jackie Previto, Dauphin Island, Alabama Town Council Member, letter to Governor Bob Riley, Alabama, Sept. 7, 2005.

116 NHC, "Tropical Cyclone Report, Hurricane Katrina," p. 9.

117 Alabama Emergency Management Agency, Hurricane Katrina Situation Report #7, Aug. 31, 2005, 7 p.m. CT.

118 Alabama Emergency Management Agency, Hurricane Katrina Situation Report #7, Aug. 31, 2005, 7 p.m. CT.

119 NHC, "Tropical Cyclone Report, Hurricane Katrina," pp. 10-11; Garry Mitchell, "Massive Storm Damage Found in Alabama," Associated Press Online, Aug. 30, 2005. Accessed on LexisNexis.

120 Garry Mitchell, "Katrina's painful blow to coast Alabama's top story in 2005," *Montgomery Advisor*, Dec. 21, 2005.

121 Texas State Operations Center, Hurricane Katrina Situation Report #10, Aug. 29, 2005, 4 p.m.

122 Final Report to the Governor, Governor's Task Force on Evacuation, Transportation, and Logistics, Texas, Feb. 14, 2006.