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## Myths of Katrina

Field Notes from a Geoscientist

In the years that have passed since the devastation of Hurricane Katrina on August 29, 2005, as a geoscientist and educator I have spent a good deal of time helping people understand exactly what happened in New Orleans during Katrina and why it happened. Much of this effort has been spent leading field trips for groups of people that have come to New Orleans as students in my classes, as volunteers helping to rebuild the city, or as attendees at various conventions held in the city. Since 2005, I have led over three hundred such field trips for over four thousand people. On these field trips, we travel to some of the major levee breach sites to explore the factors that led to the devastation of the city (Nelson 2013). Talking with participants, as well as watching and listening to media reports about Katrina, has made it evident that there are still widespread misconceptions about what happened during Katrina. This short essay is an attempt to clarify some of these misconceptions, referred to herein as myths.

### Myth 1: Levees Breached the Day after Katrina

On the morning of Sunday, August 28, 2005, after watching Hurricane Katrina approach the Louisiana coast and attain category 5 intensity, my family and I evacuated and headed for Houston, where my wife has family. We left New Orleans at 7 a.m. and arrived in Houston about midnight, a seventeen-hour drive that normally takes about six hours. After a trying day of sitting in traffic, listening to radio reports about the storm, and worrying about its effects on my city and property, we were exhausted and immediately retired. On awaking around noon the next day, we immediately began to look at the news reports on television. Surprisingly, the news was fairly optimistic. The reports stated that there was much wind damage and minor flooding in New Orleans, but overall the city had survived quite well. With this assurance, we started to pack, thinking that the next day we would be on the road again for the return home.

By Tuesday, however, the news was not so good. Media reports stated that levees had failed and the city of New Orleans was filling with water as a result of these levee failures. The impression given to

me, and to most of the viewers watching these reports, was that the levees had failed nearly a day after Katrina had passed. The truth, however, was that all levees that failed did so before or during the time that Katrina was passing to the east of the city on the morning of August 29 (ILIT 2006; IPET 2009; Sills et al. 2008). The media was not aware of this, as they were located on high ground near the French Quarter. Although the French Quarter never did flood, it took most of the day of August 29 for the floodwaters to reach near enough that they could be easily observed by the media.

Thus, it was perceived by most people that the levee failures occurred after Katrina had passed and were only a secondary result of the storm. From my contact with hundreds of people since the storm, it seems that this myth still is widely believed, and it is difficult to convince them otherwise.

### **Myth 2: Levees on the Mississippi River Failed**

Most people realize that the city of New Orleans is built on the banks of the Mississippi River. Furthermore, they know that levees protect the city from floods on the Mississippi River. Since the river levees are the only levees of which they are aware, they automatically assume that it was the river levees that failed during Katrina. In fact, there are hundreds of miles of levees in south Louisiana that are not on the Mississippi River. Some of these levees provide protection from flooding on bayous, but most are hurricane protection levees designed to protect from flooding due to hurricane storm surge.

The truth is that no Mississippi River levees failed in the New Orleans area during Katrina (ILIT 2006; IPET 2009). All of the failed levees were on human-made navigation canals, such as the Mississippi River–Gulf Outlet (MR-GO), the Gulf Intracoastal Waterway, and the Industrial Canal (all in the eastern part of the city), or drainage canals, such as the 17th Street and London Avenue Canals, which were designed to remove rainwater by pumping it into the canals that drain to Lake Pontchartrain to the north of the city.

### **Myth 3: The “Corrupt” Orleans Levee Board Was Responsible for the Failed Levees**

In 1965, Hurricane Betsy sent storm surge through the recently completed MR-GO and the Intracoastal Waterway and into the Industrial Canal, a navigation canal that connects the Mississippi River to Lake Pontchartrain. This resulted in flooding portions of eastern New Orleans, the Upper and Lower Ninth Wards, and Gentilly. In response,

Congress authorized the Lake Pontchartrain and Vicinity, Louisiana Hurricane Protection Project in the Flood Control Act of 1965. The US Army Corps of Engineers was charged with the responsibility of designing and constructing a flood protection system, and thus the system was a federal rather than a local project. That is not to say that the local levee boards did not have a role. They paid for 30 percent of the cost, had input into decisions made by the Corps of Engineers, and were responsible for maintenance after levee construction was completed. The project was designed to protect the New Orleans region from a fast-moving category 3 storm (like Betsy) that would be expected to strike once every two hundred to three hundred years. Such a storm was designated as the “Standard Project Hurricane” (Rogers 2008). The project was expected to take thirteen years to complete and cost \$85 million. By the time Katrina hit, the estimated cost had grown to \$757 million, and the expected completion date was projected to be 2017 (Woolley and Shabman 2008).

The hurricane protection system consisted mostly of levees and floodwalls. A levee is a mound of dirt piled along the banks of a stream or canal to prevent the inflow of water to the protected side. The levee should be well engineered to prevent erosion and underseepage during high-water events. Raising the height of a levee requires widening the levee because no matter how well engineered, dirt levees with steep slopes cannot hold up. In an urban environment like New Orleans, widening a levee would require buyouts of property along the levee and would have been prohibitively expensive. Instead, concrete floodwalls, which can be built with steep slopes, were constructed on top of the levees to provide a higher level of protection. The main types of floodwalls used in the New Orleans hurricane protection system were I-walls. These are vertical concrete panels that are attached to sheets of three-quarter-inch-thick steel, called sheet piles, driven into the levee. The sheet piles are supposed to hold the floodwall in place in the levee if high water places large lateral forces on the floodwall. They also provide an impermeable barrier for water forced under the levee during high-water events.

In 1985, the Corps of Engineers research branch conducted a test on sheet pile floodwalls with the same design that was being used for the New Orleans hurricane protection system (Jackson 1988). The results of the study were misinterpreted, and the Corps determined that shorter sheet pile penetration depths could be used, resulting in a cost savings for constructing the floodwalls of approximately \$100 million (Woolley and Shabman 2008). Later analyses of the test

results found that the floodwalls would likely fail as a result of deflection of the sheet pile (Oner et al. 1997). During Katrina such failures occurred on the London Avenue and 17th Street drainage canals before water levels reached the top of the floodwalls (ILIT 2006; IPET 2009; Duncan et al. 2008; Sills et al. 2008; Seed et al. 2008b; Ubilla et al. 2008). Levees also failed in areas to the east on the MR-GO, Intracoastal Waterway, and Industrial Canal.

Again, all of the levees that failed during Hurricane Katrina were part of the hurricane protection system authorized by Congress in 1965 and constructed under the supervision of the Corps of Engineers. Were the local levee boards corrupt? As a geologist I have no direct knowledge to answer this question (although I suspect they were). Nevertheless, the Corps of Engineers had the ultimate responsibility. The commission appointed to investigate what went wrong during Katrina, the Interagency Performance Evaluation Task Force (IPET 2009), concluded the following in their final report:

The System did not perform as a system: the hurricane protection in New Orleans and Southeast Louisiana was a system in name only. . . . The system's performance was compromised by the incompleteness of the system, the inconsistency in levels of protection, and the lack of redundancy. Incomplete sections of the system resulted in sections with lower protective elevations or transitions between types and levels of protection that were weak spots. Inconsistent levels of protection were caused by differences in the quality of materials used in levees, differences in the conservativeness of floodwall designs, and variations in structure protective elevations due to subsidence and construction below the design intent due to error in interpretation of datums.

#### **Myth 4: Katrina Was Such a Large Storm That It Overwhelmed New Orleans**

On Sunday, August 28, 2005, Hurricane Katrina was approaching the Louisiana coast and had attained category 5 status, with sustained winds near the eye of the storm at 175 mph. Everyone fears such a storm, as it is the maximum category known. Over the next twenty-four hours, the intensity of the storm changed substantially, and wind speed dropped to category 3 status. When Katrina made its first landfall in Louisiana, near Burras at the mouth of the Mississippi River, at 6:10 a.m. local time on Monday, August 29, it had wind speeds of 127 mph. When it made another landfall near the Louisiana/

Mississippi border at 11:45 a.m. the wind speed had dropped to 120 mph. Thus, New Orleans was not hit by a category 5 hurricane: Knabb, Rhome, and Brown (2005) estimate that the New Orleans area was subject only to winds corresponding to a category 1 to 2 hurricane and that the highest winds occurred only over water to the east of New Orleans. In fact, the highest storm surge of twenty-eight feet above sea level overwhelmed the Mississippi Gulf Coast, devastating such cities as Long Beach, Biloxi, and Gulfport, Mississippi.

Because Katrina was a category 5 storm the day before it made landfall, the general impression has been that it was such an intense hurricane that it overwhelmed New Orleans, resulting in massive flooding. But, unlike the Mississippi Gulf Coast, New Orleans had in place a hurricane protection system. It was the failure of this hurricane protection system that resulted in the extensive flooding of New Orleans.

Indeed, for areas to the east of New Orleans, storm surge in Lake Borgne (an estuary connected to the Gulf of Mexico) reached eighteen feet above sea level, overtopped the protection levees, and flooded most of the populated portion of St. Bernard Parish. Water entering the Industrial Canal from the MR-GO and Gulf Coast Intracoastal Waterway (both connected to Lake Borgne and the Gulf of Mexico) reached fifteen feet above sea level and overtopped the floodwalls twelve feet above sea level along the Industrial Canal. Both of these events might be considered to have overwhelmed the flood protection system, but there is a large difference between just overtopping of levees and failure of levees. Yes, overtopping events will flood the area on the protected side of the system, but a levee/floodwall failure, in which the failure results in an elevation lower than the normal water level on the unprotected side, will result in continued flooding of the protected side until the water levels on both sides of the levee/floodwall are the same.

Levees and floodwalls on the Industrial Canal were overtopped by Hurricane Katrina's storm surge. But here, water flowing over the top of the floodwall resulted in erosion and removal of the levee that supported the floodwall. This led to catastrophic failure of large sections of the floodwall and flooding of the Lower Ninth Ward. Again, deeper sheet piles could have prevented these failures, but the ultimate reason these levees and floodwalls failed was the lack of any kind of armoring that would have protected the top of the levees from erosion (IPET 2009; Seed et al. 2008c).

Levees on the MR-GO along St. Bernard Parish were overtopped and eroded. It turns out that they were not well-engineered

levees, consisting mostly of material dredged out of the swamp during the construction of the MR-GO shipping canal (IPET 2009; Seed et al. 2008a).

On the 17th Street and London Avenue Canals, storm surge entering the canals from Lake Pontchartrain never reached an elevation higher than about ten feet above sea level. The floodwalls that failed had top elevations twelve to thirteen feet above sea level and thus failed before the water reached levels for which the floodwalls were designed. In these cases the system was clearly not overwhelmed, but the resulting levee/floodwall failures caused flooding throughout central New Orleans.

In summary, Katrina was an overwhelming storm for the Mississippi Gulf Coast, but for New Orleans, had the hurricane protection system not failed, it would not have been considered an overwhelming storm.

### **Myth 5: New Orleans Is a City below Sea Level**

In the years since Katrina, it has often been stated by the media, politicians, and many others that New Orleans is a city below sea level. The context of this statement is usually some kind of diatribe against spending money and effort on rebuilding the city after Hurricane Katrina. The problem with this statement is that it is not entirely true. In reality, roughly half of metropolitan New Orleans is above sea level, as documented by Campanella (2006). Furthermore, the half that is now below sea level has not always been so.

New Orleans was originally founded in 1718 on the banks of the Mississippi River at what is now called the French Quarter at an elevation roughly seventeen feet above sea level. This lofty elevation is due to periodic floods occurring over hundreds of years depositing sediments along the river bank to build a natural levee. The city grew from its original location in the French Quarter along the natural levee of the crescent-shaped bend in the river to the west of the French Quarter, thus giving the city its other name—the Crescent City. Land sloped away from the natural levee toward the north, eventually reaching near, but not below, sea level. This gentle slope is interrupted by another set of natural levees on former distributary channels of the river that trend roughly west to east and form the Metairie and Gentilly Ridges that make up the other “high” portions of the city, two to three feet above sea level (Dunbar and Britsch 2008). North of the ridges toward Lake Pontchartrain was an area at or slightly above sea level that consisted mostly of swamp.

Two things changed over the last hundred years, both of them the result of human activity. First, the sediment forming the foundation of the city was all river-deposited sediment containing high proportions of water in the pore space between the silt and clay particles. This sediment naturally compacts due to the weight of the overlying sediment, but in the natural setting, subsidence would be compensated by new sediment added by the periodic floods from the Mississippi River. Humans, however, have built levees along the river to prevent such flooding and thus have cut off the supply of replenishing sediment.

Second, as the population of the city grew, it became desirable to find new land on which to expand. So, beginning in the early twentieth century the swamps were drained and water was removed from the pore spaces in the soil. The soils responded by collapsing into the now vacated pore space, resulting in subsidence of the land surface. Thus, today, many of the areas that were once swamps are now at elevations as much eighteen feet below sea level. These areas in the neighborhoods of Lakeview and Gentilly were where the deepest floodwaters accumulated after levee breaches on the 17th Street, London Avenue, and Industrial Canals allowed water from Lake Pontchartrain and the Gulf of Mexico to enter the city. The floodwaters inundated and incapacitated the pumps that would normally pump rainwater out of the city, but since the levee breaches were on drainage canals, even if the pumps had continued to operate they would have been pumping water into the same canals whose levees had been breached, and thus the pumping would not have been effective.

So, although half the city is now below sea level, these parts are low owing to human interference with the landscape. The half above sea level, for the most part, did not flood during Katrina.

## Conclusions

Although it has been nearly ten years since Hurricane Katrina made landfall to the east of New Orleans and the city flooded as a result of the hurricane storm surge, many myths still surround the events that took place. Although there are more than five such myths, I have discussed here the ones that I most commonly encounter in my efforts to provide education about Katrina. Why these myths persist is worthy of study by social scientists. I am a geological scientist, and thus my emphasis has been on understanding the reasons the storm was so devastating to New Orleans, the city in which I live. I make no claim to knowing exactly why these myths persist but nevertheless will make some suggestions.

Some of the myths were likely generated in the first few days after Katrina, when much of the media coverage was incomplete. Myth 1 (“the levees failed the day after Katrina”) was almost certainly due to this, as the media were not really aware of the levee breaches until the day after Katrina and thus reported the next day that the levees had failed. Myth 3 (“the corrupt Orleans Levee Board was responsible for the failed levees”) and myth 4 (“Katrina was such a large storm that it overwhelmed the city”) also probably originated during the early days of media coverage when there was much speculation about the cause of the levee failures and before there was a complete understanding of the intensity of the storm at landfall. Constant coverage on the news networks and the printed press in those early days of reporting seem to have left an indelible mark in people’s minds. Much of the misinformation was corrected in later media reports, but these occurred after most minds were saturated with coverage of the storm and likely not paying as much attention.

Myth 2 (“the Mississippi River levees failed”) is likely due to a lack of understanding about the geography of New Orleans. Most people are aware of the fact that the Mississippi River has levees, and most just assume that those levees are the only ones and thus had to have been the ones that failed.

Some myths seem to persist for political reasons. Myth 3 deflects responsibility from the federal government that constructed the levees to the “corrupt levee boards” that had little to do with their construction. Myth 4 would shift blame to Mother Nature rather than the failed levees or would blame climate change (although there is no evidence available at present to support such a theory). Myth 5 (“New Orleans is below sea level”) attempts to blame the people of New Orleans for their ill-advised decision to live in a city below sea level or to argue against federal spending to protect an already “doomed” city.

One statement, based on facts presented here and in the cited references, serves to dispel all five of these myths: On August 29, 2005, Hurricane Katrina, a category 3 hurricane at landfall, created a storm surge that resulted that day in failures of federal levees constructed under the supervision of the Army Corps of Engineers on human-made navigation and drainage canals, resulting in flooding of New Orleans, a city with half of its area above sea level.

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