# The Aftermath of Hurricanes *Katrina* and *Rita* on South Louisiana

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## ABSTRACT

*Betsy*, *Camille*, *Georges*, *Lili*, and *Ivan* are benchmark storm events in Louisiana's history. They are etched in the minds of the state's coastal citizens. In 2005 the benchmark changed. *Katrina* and *Rita* are now the state's premier storms. The accumulative tragedy overwhelms the senses. It is hard to visit the affected areas and not shed a tear; it is a surreal landscape. New Orleans is the cultural soul of Louisiana and it has been devastated. Thousands of homes went under water; more than 300,000 cars were flooded; the largest mass exodus from an urban center since the Civil War; tens of thousands are homeless; New Orleans' music legends displaced; several universities closed-perhaps permanently; nearly every home in one parish (county) were destroyed along with every school, hospital, and church; more than 1,000 people died; perhaps the largest urban spill in this country's history affected more than 1,000 homes; and some reports put the volume of oil spilled at near that of the Exxon Valdez. Wind gusts reached at least 209 km (130 mi) an hour during Hurricanes *Ivan*, *Katrina*, and *Rita*. These storms severely testing the limits of many offshore platforms' 100-year design specifications. In addition, the associated 9.1 m (30 ft) storm surge tested many ancillary structures that parallel the Mississippi. Several failed. This paper will address a broad range of issues associated with Hurricanes *Katrina* and *Rita* on Louisiana. The focus will be on the Mississippi River, oil spills, and the damage done to greater New Orleans.

## INTRODUCTION

The 2005 Atlantic/Gulf of Mexico hurricane season refused to die. Tropical Storm *Zeta*, the 6th storm named using the Greek alphabet, formed on the last day of 2005 and in the process became the 27th named storm. *Zeta* ended the worst hurricane season in United States' history. A hurricane season that shattered records that have stood for decades—most named storms, most hurricanes, and most Category 5 storms. *Katrina*, *Rita*, and *Wilma*—the strongest hurricane on record— were, at sea, Category 5 storms. Considering the scope of its impacts, *Katrina* was one of the most devastating natural disasters in United States' history.

During *Katrina*, floodwaters carrying nearly 1.1 million gallons (4.1 million liters) of oil from a nearby refinery stained the exterior and, in some cases, the interior of at least 1,800 homes—perhaps the largest urban oil spill in this country's history, but the initial, primary, concern was responding to the human tragedies. More than 8.0 million gallons (30.2 million liters) of oil was discharged in Louisiana's coastal zone—11.0 million gallons (41.6 million liters) were discharged in Prince Williams Sound from the Exxon Valdez—and the televised rescue of thousands trapped in water that was rising 1 in (2.5 cm) every 7 minutes, representing the largest rescue mission in the United States' Coast Guard's history. Like the Coast Guard, the Environmental Protection Agency (EPA) also was involved in the rescue effort safely evacuating more than 900 New Orleans' citizens from flood waters in the first week after *Katrina.*

With sustained winds exceeding 155 mi/hr (250 km/hr), offshore waves that were more than 80 ft

high (24 m), and a storm surge that exceeded 30 ft (10 m), Hurricanes *Katrina* and *Rita* will not soon be forgotten. Moreover, the costs associated with these storms are staggering; short-term relief $15 to $20 billion; damage to infrastructure $73 to $90 billion; levees $23 to $30 billion; five-year economic loss $50 to $70 billion; and five-year government revenue loss $8 to $10 billion. And, these are only the preliminary estimates.

**HURRICANES**

Coastal Louisiana's climate is generally described as humid and subtropical. As the region borders the Gulf of Mexico, this water body plays a significant role in moderating local climatic patterns. Hot summers and mild winters are the rule. Winter extremes, when they occur, are a product of cold fronts that quickly change the daily weather pattern when the temperature can plummet 30 degrees F (-1.1 C) to 40 (2.2 C) in just a few hours. Summer and fall warm-humid-wet conditions can be dramatically altered by the periodic arrival of hurricanes that have a dramatic effect on coastal ecosystems because of high storm surges and often increased freshwater inflow from intense precipitation. Although summers are hot, with July and August being the warmest months, the temperature rarely exceeds $100^{O}$F (37.7 C). For six months hurricanes are a constant threat and a reminder of how fragile living and working in south Louisiana can be.

Australians call them *willy-willy*, Filipinos *baquios*, Chinese *tai-fun*, Indians *typhoon*, and in the United States they are identified as hurricanes. On Christopher Columbus' last voyage he encountered a severe hurricane. Caribbean history has been punctuated by tropical depressions. Even

the name is derived from the Caribbean Indian's storm-god *Huracan*—with lips puckered for blowing, he created the circular tempest we know as a hurricane.

These tropical cyclones originate off the west African coast and have their own distinct personalities and unpredictable routes. Between May and October they move in a north-northwest direction across the Atlantic Ocean and are always of some concern because they carry high winds, extreme low pressure, and vast quantities of precipitation. In 1722, 1779, 1780, 1856, 1893, 1915, 1919, 1920, 1956, and 1965 hurricanes raked havoc across Louisiana's coastal lowlands.

In profile, counterclockwise winds move out from the hurricane's center or eye, where there is a relatively calm space. As the storm crosses land, the greatest surge heights occur in the right front, or northeast quadrant, where the onshore winds are strongest. In the final analysis, a hurricane is essentially a massive turbine that generates enormous. In more recent history, hurricanes *Andrew* (1992), *Lili* (2002), *Ivan* (2004), *Katrina* (2005), and *Rita* (2005) are certainly vivid reminders of the massive force contained in one of these storms. These storms, have become part of the regional folklore and are reference benchmarks in time. All are etched into the regional psyche. Although the death toll was relatively small in the post-1950s storms, radios, aircraft, and a general better working knowledge about weather improved the warning system and thus most certainly limited the death and destruction. The exception is *Katrina,* where the final death toll may never be learned. The aftermath of this storm, along with *Rita* revealed the complex set of social problems associated with dealing with storms of this magnitude

***KATRINA AND RITA***

*Katrina* made its first landfall in the United States as a Category 1 hurricane near the border of Miami-Dade County and Broward County in Florida and spend only about six hours over land, mostly over the water-laden Everglades. The storm made landfall in Louisiana on August 29th, 2005. Offshore the hurricane was easily a Category 5 storm. As the center of the eye made its closest approach to the east of downtown New Orleans, the strongest winds were likely present only over water to the east of the eye in Breton Sound, Lake Borgne and Mississippi Sound, and the hurricane was downgraded to a Category 3.

Twenty-seven days (September 25th) after *Katrina* came ashore in southeast Louisiana, *Rita*—the seventeenth named tropical storm and ninth hurricane— made landfall along the Texas/Louisiana border. The storm prompted a massive evacuations—more than 1.0 million people evacuated Houston—the forth largest city in the country. The traffic was a mess, but damage in east Texas was minimal compared to coastal Louisiana. Just weeks after *Katrina*, Louisiana had to respond to another major storm. *Rita* was the second-most powerful hurricane of the season (behind *Wilma*) and the fourth most intense hurricane ever in the Atlantic Basin. A day prior to landfall, the resultant storm surge reopened some of the levee breaches caused by *Katrina*. Parts of New Orleans reflooded; in addition, post-landfall damage was extensive in the coastal areas in southwestern Louisiana and extreme southeastern Texas—a geographic area that supports a great deal of the country's refining capacity.

**ENVIRONMENTAL ISSUES: WHITE GOODS, CARS, HOUSES, AND ORGANIC MATTER**

The multi-agency effort to investigate the environmental damage associated with Hurricanes *Katrina* and *Rita*, often involved yeoman efforts, punctuated by armed escorts. Even though more post hurricane work will be required in 2006. The waste stream is unprecedented and has been systematically managed. Simultaneously, EPA's task included: drinking water and wastewater assessment; reconnaissance and assessment of industry and associated oil spills; collection and processing of household hazardous waste; processing of refrigerants from white goods; removal of orphaned drums and hazardous debris; emergency response for spills and special sampling assessment; cleaning of school laboratories; and the collection and removal of ammunition and other types of ordnance. In southeast Louisiana this cleanup effort involved 837 contractors.

With this list as the charge, clean up crews have effectively managed to dispose of 8.0 million tons of the estimated 22.0 million tons of debris. The cleanup involved: more than 1.3 million containerized hazardous materials (cleaners, pesticides, paints and batteries); more than 230,000 damaged white goods (refrigerators, freezers, washers, dryers, water heaters, air conditioners, stoves, ovens, microwave ovens and dishwashers), with the refrigerant extracted from these appliances sent to local vendors for recycling; and nearly 43,000 damaged electronic goods (televisions, computer, and audio equipment. In addition, more than 3,400 samples of water, soil, and air has been collected. About 75 school's chemistry laboratories were inspected; and an additional 1,500 emergency assessments of potential chemical releases were investigated. Further, it is estimated that

1.5 to 2.0 million $yd^3$ (1.15 to 1.53 $m^3$ ) of debris is within Mississippi Sound and the associated waterways. In 2006, EPA will continue: environmental monitoring; water and wastewater recovery; hazardous materials handling; technical assistance to communities; and long-term impact assessment.

**THE MISSISSIPPI RIVER AND THE ONSHORE AND OFFSHORE OIL AND GAS INDUSTRY**

The Mississippi drains 31 states and two Canadian provinces and runs through, or borders, ten states before discharging its freshwater and sediment load into the Gulf of Mexico about 2,320 miles (3,733 km) from its headwaters in Lake Itasca. From New Orleans to the Mississippi bird's foot delta, perched at the end of a lolly-pop-shaped mass of bifurcating distributary channels, is about 100 miles (160 km). Flanking both sides of the river's channel's are narrow natural levees that have been elevated to protect the region from natural flooding. Beyond the levees are Louisiana's near sea level marshes and a vast array of oil and gas fields and associated infrastructure. Some of these areas more than 70 years old and still producing, but some of their equipment is a bit weather-worn. Nine fields support nearly 6,000 oil wells. In one delta field—Garden Island Bay—there are more than 760 wells. With this as a backdrop, the industry is always concerned when a hurricane enters the Gulf of Mexico.

During the 2002 hurricane season, Hurricanes *Isidore* and *Lili* moved onshore within a two-week period and caused considerable damage to the industry. *Isidore* was responsible for more than $120

million in damages. Refineries shut down, as did the Louisiana Offshore Oil Port, or LOOP. A similar sequence of events was repeated during the 2004 hurricane season, when Hurricanes *Charley*, *Frances*, and *Ivan* moved through the Gulf of Mexico. Like Hurricanes *Isidore* and *Lili*, *Ivan* shut down about 10 million barrels of production. In 2005 the industry had to deal with *Katrina*, *Rita*, and *Wilma*. The damage associated with *Katrina* and *Rita* make them benchmark storm events. Therefore, before the state and federal regulators could begin to focus on oil spill cleanup, human issues had to be addressed. It took a week before the state initiated a flyover of the damaged areas along the Mississippi River. Eleven sites were investigated. Communications, logistics and transportation were issues that took time to resolve. With New Orleans under an emergency evacuation, command centers were established in Baton Rouge (130 miles [210 km] from the delta) and other areas.

Chevron, for example, managed its spill response from Lafayette—160 air miles [258 km] from their lower Mississippi River spills. The company responded to three separate *Katrina* incidents in coastal Louisiana. The incidents involved crude oil releases from a well, a pipeline and a tank, respectively. Cleanup operations focused on minimizing marsh impacts and hastening recovery. The shallow-water marsh site used booming, skimming, and low-flow washing. The marsh adjacent to a channel site employed booming, skimming, and tidal flushing. The intermediate marsh site used *in-situ* burning. All sites are recovering nicely.

**OIL SPILLS**

In southeast Louisiana, the Louisiana Oil Spill Coordinator's office responded to: six major, three medium, and 131 minor events. The Coast Guard responded to one more medium spill and an additional 13 minor events. Nearly half of the 8.0 million gallons (30.2 million liters) discharged in Louisiana's coastal zone was recovered. The hurricane happened during the height of the annual bird migration and waterfowl was an issue. Even though a great deal of oil was spilled a relatively small number of birds were reported, found, cleaned, and released. Although it is highly likely thousands of birds were impacted. Migration patterns changed and few birds were in the effected area.

All of these incidents were attributed to storm-damaged facilities. Approximately half of the oil reported spilled was recovered. The remaining oil was naturally dispersed, evaporated, or burned. In addition, pollution investigation teams responded to more than 160 spill reports. Intermediate marsh was burned. Black mangrove (*Avicennia germinans*) was oiled as well.

In southwest Louisiana, between September and the end of 2005's calendar year, the Louisiana Oil Spill Coordinator's Office logged in 81 spill events involving 22,000 bbls of crude. A description of these events included: leaking tank batteries with sheen visible inside the containment berm, gas and/or oil bubbling up along pipelines; displaced tank batteries; multiple sheens in various waterbodies; and oil in the marsh. In southwest Louisiana the storms were responsible for two major, two medium and 174 minor involving 4,200 gallons.

Offshore, nearly 3,000 platforms were shut down or damaged by hurricanes *Katrina* and *Rita* and

the U.S. regulatory agency, the Minerals Management Service, Gulf coast offices were closed and their personnel scattered. The offshore spills were relatively minor and would have to wait. There were no people or equipment available to respond to these spill events.

**MURPHY OIL**

This site is located in Meraux, Louisiana at mile marker 87 on the Mississippi River. Water from Katrina's storm surge flooded St. Bernard Parish and Murphy Oil's entire tank battery went under water. Initial overflights revealed no release from the facility; however sheens were evident throughout the region. On September 2nd, as the water receded and the hydrostatic pressure changed, oil began to leak and float off the site into the community of Meraux. A tank (250-2) with a carrying capacity of 250,000 barrels floated off its foundation. This tank was punctured from the storm surge. About 819,000 gallons of Arabian medium crude were discharged, of which 305,000 were recovered. One hundred and ninety six thousand gallons were contained and 312,000 gallons evaporated. Some 6,000 gallons were not recovered. As a result of the release, coupled with the high water the oil floated throughout the community staining, in a one square mile area, at least 1,800 homes. Twenty-six class action lawsuits have been filed.

Since a waterway was involved, the Coast Guard assumed responsibility for oversight and began to work at containing the spill. The EPA was responsible for oversight in the clean up on land. This agreement worked well. After the initial footprint of the spill was determined and the water drained from the area, Murphy began the on-land clean up. Public areas and streets were sanded and oil

removed. Boom was maintained in canals for residual oil capture

From Murphy's perspective the clean up involves two phases. Phase one includes: property owners contact Murphy and request clean up; Murphy obtains a signed access form from the property owner; wipe samples are taken for oil signature; sediment samples are obtained on interior and exterior of home to determine levels of TPHE; and exterior surfaces of homes washed. In this phase EPA conducts oversight of all Murphy actions and obtains a 10% split of sediment samples. Samples are run independently of Murphy samples and are run looking for diesel range organics, oil range organics and PAH using Louisiana Department of Environmental Quality TPH standards.

Phase two involves: home owner pays to gut house to studs; Murphy removes oiled debris and , transports to industrial landfill; home owner calls Murphy and requests interior cleaning and grants second access to the property; Murphy power washes interior, exterior and replaces the yard. Reoccupation is determined by a final air sample program.

**Major oil spills (over 100,000 gallons)**

*Bass Enterprises Production Company (Cox Bay)*: About 3.78 million gallons discharged, of which 960,000 gallons were recovered. Two million gallons were contained and 982,000 gallons evaporated.

*Shell (Pilot Town)*: About 1.05 million gallons discharged, of which about 718,000 gallons were

recovered. One hundred twenty nine thousand gallons were contained and 105,000 gallons evaporated or dispersed. Some 87,000 gallons was not contained.

*Chevron (Empire)*: About 991,000 gallons were released, of which 983,000 gallons were naturally dispersed or evaporated. Four thousand gallons were recovered and 3,600 gallons were contained.

*Bass Enterprises (Point a la Hache)*: About 461,000 gallons of oil discharged, of which half was contained and half evaporated.

**Medium oil spills (10,000 to 100,000 gallons)**

*Chevron (Port Fourchon)*: About 53,000 gallons were released, of which 21,000 gallons were naturally dispersed, 26,000 gallons were recovered and 420 gallons were contained. The Port Commission had the road cleared of debris immediately after the storm. Clean-up crews could get to the site quickly and begin the containment, assessment, and cleanup process. Other spills required a much longer response time, as roads were impassable.

*Venice Energy Services Company (Venice)*: About 840,000 gallons of potential discharge are enclosed in bermed and boomed area, but only 25,000 gallons were actually discharged, of which 4,800 gallons were recovered.

*Shell Pipeline Oil (Nairn)*: About 13,440 gallons discharged, of which 126 gallons were recovered,

2,940 gallons were contained and 10,500 gallons reached shoreline.

*Sundown Energy (West Potash)*: About 13,000 gallons discharged, of which 153 gallons were recovered, 2,000 gallons were contained, and 5,000 gallons reached shoreline.

**THE LESSONS LEARNED**

The aftermath of Hurricanes *Katrina* and *Rita* resulted in a multi-faceted regional crisis that went well beyond anything the nation has faced in living memory. Oil spills associated with these storm events required on-the-spot innovation and fresh ideas. Consequently, the work done by the spill community will result in better response plans, as the lessons learned continue to unfold. The next generation of spill drills will incorporate real hurricane-related experiences in the plans. These exercises will help better prepare the responsible parties and trustee agencies in meeting the challenges of storm-induced spill incidents.

The region needs rebuilding and oil spills are simply one element in the equation. Two factors that caused mobility problems were logistics and communications. High water, debris, barricades by the National Guard or local police, downed telephone lines, and no satellite phones slowed the initial response. Cleanup operations had to be coordinated from remote locations and the responsible parties had to mobilize their equipment from sties that were not convenient. These two issues need to be revisited and discussed with all parties involved. In retrospect, under the worst of circumstances, the responsible parties and trustee agencies are to be commended on working through

long hours, dealing with tasking issues, and meeting their duties in a responsible and professional manner. A good job was done by all.