Sewerage and Water Board of New Orleans

Local Hazard Mitigation Plan
September 2010

DRAFT

Prepared by Lambert Engineers, LLC

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1. Introduction

The Sewerage and Water Board of New Orleans (S&WB) provides water and sewer services to the City of New Orleans and its public institutions as mandated by state law in accordance with R.S. 33:4096 and R.S. 33:4121, respectively. The operating units of the Sewerage and Water Board consist of four departments: Water Purification, Sewage Treatment, Water Pumping and Power, and Drainage and Sewerage Pumping.

The purpose of this Plan is to integrate Hazard Mitigation strategies into the day-to-day activities and programs of the Sewerage and Water Board of New Orleans (S&WB). This plan has been prepared to meet the Disaster Mitigation Act of 2000 (DMA 2000) requirements in order to maintain the S&WB's eligibility for the Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Programs (HMGP). More importantly, this plan and planning process lays out the strategy that will enable the S&WB to become less vulnerable to future disaster losses.

Figure 1 City Of New Orleans - NASA LandSat 7

1.1. What is a Hazard Mitigation Plan?

Hazard mitigation, also known as prevention, is described by FEMA and the Disaster Mitigation Act of 2000 (DMA 2000) as "any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event." The goal of mitigation is to save lives and reduce property damage. This, in turn, can reduce the enormous cost of disasters to property owners and all levels of government. In addition, mitigation can protect critical community facilities and minimize community disruption. Examples consist of a range of activities and actions that include: land use planning, adoption and enforcement of building codes, and construction projects (e.g., flood-proofing homes through elevation, or acquisition or relocation away from floodplains).

Hazard mitigation planning is one of the four phases of emergency management, followed by preparedness, response, and recovery. This prevention-related concept of emergency management often gets the least attention, yet it is one of the most important steps in creating a disaster-resistant community.

Figure 2 Four Phases of Emergency Management

Mitigation Plans form the foundation of a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to life, property, and the economy from future disasters. Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards. As shown in the following table, control of those hazards and risks are of critical importance.

The risks of natural or man-made disasters that could create catastrophic incidents in Louisiana were well known prior to Hurricane Katrina in 2005. However, it took the storms of 2005 and their aftermaths to bring about a new level of planning and engagement with disaster response, recovery, and hazard mitigation. The storms of 2005 confirmed Louisiana's extreme exposure to natural disasters and the compounding effect of engineered flood-protection solutions. In short, Louisiana in general, and New Orleans in particular are at significant risk for hazard events. Figure 3 shows the Presidentially Declared Disaster Declarations and their costs in Louisiana from 1997-2007. Recent studies have indicated that

every dollar spent on mitigation saves the U.S. an average of $3.65 in avoided post-disaster relief costs and increased federal tax revenues[1].

Disaster Event	Date	DR Number[4]	Parishes Affected	Total Federal Assistance [5] ($ Million)
Ice Storm	January 12, 1997	1169	3	$6.1
Hurricane Georges	September 9, 1998	1246	21	$370.0
Ice Storm	December 23, 1998	1264	16	$5.9
Tornadoes	April 3, 1999	1269	5	$11.7
Ice Storm	January 27, 2000	1314	8	$0.5
Ice Storm	December 11, 2000	1357	8	$6.0
Tropical Storm Allison	June 5, 2001	1380	27	$206.4
Tropical Storm Isidore	September 21, 2002	1435	16	$30.7
Hurricane Lili	October 3, 2002	1437	44	$274.7
Flood	May 12, 2004	1521	9	$6.1
Hurricane Ivan	September 13, 2004	1548	26	$20.5
Hurricane Cindy	August 23, 2005	1601	5	$3.6
Hurricane Katrina	August 29, 2005	1603	64	$22,826.0
Hurricane Rita	September 24, 2005	1607	64	$2,358.4
Severe Storms and Flooding	November 11, 2006	1668	19	$44.0
Severe Storms and Flooding	February 23, 2007	1685	3	$2.4
Total Federal Assistance 1997-2007				**$26,173.0**

Figure 3 Presidential Disaster Declarations in Louisiana 1997 - 2007

1.2. Benefits of Mitigation Planning

Natural hazard mitigation plans help communities reduce their risk from natural hazards by identifying vulnerabilities and developing strategies to lessen and sometimes even eliminate the effects of the hazard. Some of the benefits of mitigation planning are as follows:

Leads to judicious selection of risk reduction actions. Hazard mitigation planning is a systematic process of learning about the hazards that can affect the Sewerage and Water Board of New Orleans; setting clear goals; and identifying and implementing policies, programs, and actions that reduce losses from disasters.

Builds partnerships. Hazard mitigation planning enhances collaboration among a broad range of stakeholders to achieve a common vision for the Sewerage and Water Board of New Orleans. Increased collaboration also reduces duplication of efforts among organizations with similar or overlapping goals.

Creates a more sustainable and disaster-resistant city. There is an intrinsic link between the concept of sustainability and natural hazard risk reduction. An essential characteristic of a sustainable city is its resilience to disasters.

Establishes funding priorities. A mitigation plan allows the Sewerage and Water Board of New Orleans to better identify and articulate its needs to state and federal officials when funding becomes available, particularly after a disaster. With its Hazard Mitigation Plan (HMP) in place, the S&WB can propose

[1] GAO – August 2007 – Natural Hazard Mitigation http://www.gao.gov/cgi-bin/getrpt?GAO-07-403.

projects as an integral part of an overall, agreed-upon strategy, rather than as projects that exist in isolation. Mitigation planning coordinates existing and potential mitigation actions into a unified mitigation strategy. Only those states and communities with approved plans that meet the DMA 2000 criteria are eligible to receive HMGP funds for mitigation projects.

Increases public awareness of natural hazards. Mitigation planning serves to help residents better understand the threat to public health, safety, and welfare, economic vitality, and the operational capability of critical infrastructure.

1.3. Regulatory Requirements

This Hazard Mitigation Plan is created subject to the Federal Emergency Management Agency's (FEMA) Mitigation Planning regulations under the Code of Federal Regulations (CFR), Title 44, Part 201.

Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5165, as amended by the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390), provides for States, Tribes, and local governments to undertake a risk-based approach to reducing risks to natural hazards through mitigation planning. The National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq, reinforced the need and requirement for mitigation plans, linking flood mitigation assistance programs to State, Tribal and Local Mitigation Plans.

FEMA implemented the various hazard mitigation planning provisions through regulations in 44.CFR.201. The regulations that apply to local mitigation plans are published under 44.CFR.201.6. Under 44.CFR.201.6, local governments MUST have a FEMA approved Local Mitigation Plan in order to apply for and/or receive various federal project grants.

The planning processes are intended to facilitate cooperation between state and local authorities, prompting them to work together. It encourages and rewards local and state pre-disaster planning and promotes sustainability as a strategy for disaster resistance. This enhanced planning network is intended to enable local and state governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

Definition of Local Government per Section 201.2 of 44 CFR: "Local government is any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity."
Documentation of the Planning Process per Requirement §201.6(c)(1): "The [State] plan must include a description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated."
Coordination among Agencies per Requirement §201.6(b)(2): "An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process;
Program Integration per Requirement §201.6(b)(3): "Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
Plan Updates per 44 CFR §201.6(d)(3): "A local jurisdiction must review and revise its plan to reflect changes in development progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years in order to continue to be eligible for mitigation project grant funding."

Figure 4 Excerpts from 44.CFR.201

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2. About the Sewerage and Water Board of New Orleans

The Sewerage and Water Board (S&WB) has been serving citizens and protecting the environment since 1899. Originally formed to combat disease by providing safe drinking water and eliminating the health hazards of open sewer ditches, today the S&WB continues its mission using 21st century technology.

The Sewerage and Water Board of New Orleans consists of the Mayor, the two at-large council members of the City Council, one district councilman selected by the Council, two members of the Board of Liquidation, City Debt, and seven citizen members appointed by the Mayor, in accordance with the law, for overlapping terms of 9 years.

The S&WB is divided into 3 main operating areas: Water, Sewerage and Drainage serving 101,833 residential customers, 4,503 multi-residential customers, 12,350 commercial customers and 40 industrial customers for a customer base of 118,726[2].

[2] S&WB supplied data – Jan 2010

2.1. Water System

New Orleans was settled by the French in 1718 on the high ground adjacent to the Mississippi River--only 14 feet above sea level. However, many sections of the city are as much as six feet below sea level. As a result of its unusual topography, the city was subject to periodic flooding from the Mississippi River and Lake Pontchartrain, as well as frequent inundation from the high intensity rainfall.

Water for drinking or general use was either collected in large cypress cisterns that stored rainwater from the rooftops or taken from the river and allowed to settle in large earthenware jars. At that time, there were no purification or sterilization procedures.

In 1899, the Sewerage and Water Board was authorized by the Louisiana Legislature to furnish, construct, operate, and maintain a water treatment, distribution, and sanitary sewerage system for New Orleans. Today the agency supplies the city with water for drinking and fire protection.

Raw water from the Mississippi River is pumped to the Carrollton Water Purification Plant from both the Oak Street River Station and the Industrial Avenue River Station. The purification process begins at each river station with the addition of a coagulant chemical, commonly called polyelectrolyte. Polyelectrolyte consists of long chain molecules carrying electrical charges that cause fine suspended particles to coagulate, or gather together into larger particles. Water treated with polyelectrolyte travels through several large pipelines from the river pumping stations to the water plant.

As the raw water enters the Carrollton Plant, it is treated with ferric sulfate and lime. Ferric sulfate is also a coagulant chemical, and it is used to aid the polyelectrolyte in the raw water clarification process. Lime, also known as calcium oxide, is used for pH adjustment, softening, and corrosion control.

After the raw water has been treated with polyelectrolyte, ferric sulfate and lime, it is gently mixed by large mechanical paddles in two flocculation basins where the suspended particles gather together into larger particles. The flocculated water then travels into two (2) primary settling basins where the particles settle. The settled particles form a sludge layer on the bottom of each primary settling basin. This sludge is pushed into sumps by traveling mechanical rakes, and is then removed from the basins through a series of valves and pumps.

The clarified water then exits the settling basins, and is disinfected by the addition of free chlorine. Anhydrous ammonia is added shortly thereafter, producing chloramines. Chloramine is a compound produced by reacting free chlorine with ammonia, and is used for residual disinfection.

Chloraminated water then enters large secondary settling basins, allowing additional settling time for suspended particles and disinfection contact time. After the water exits the secondary settling basins, it is treated with sodium hexametaphosphate and fluorosilicic acid. The sodium hexametaphosphate is used as a sequestrant, which holds the lime in the solution keeping it from depositing on the filter or the media. The fluorosilicic acid is used to add fluoride to the drinking water to aid in the prevention of dental cavities.

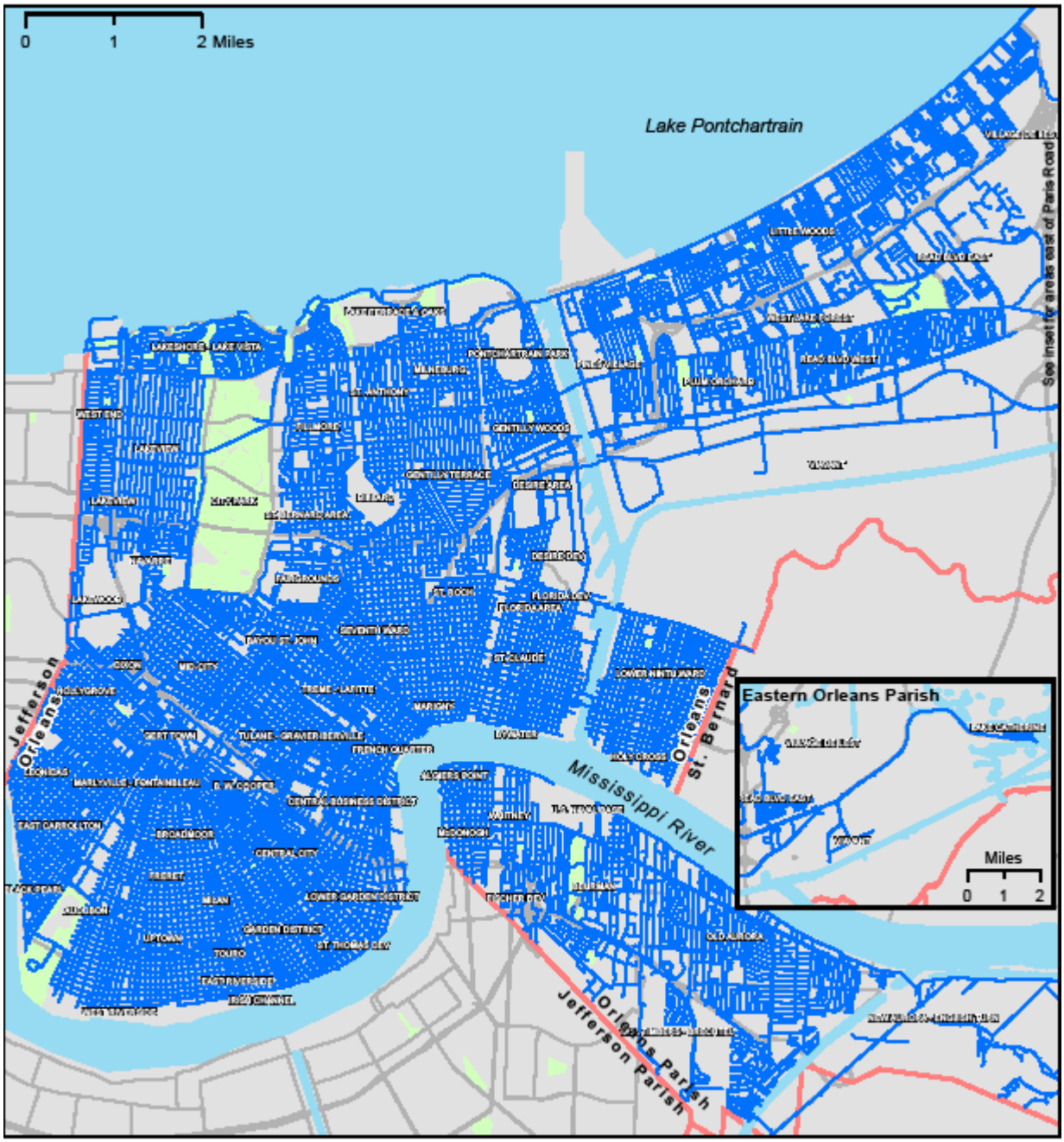
The final step in the purification process is filtration through 44 rapid sand filters. These filters consist of graded gravel topped first with a layer of sand and then with a layer of anthracite. After filtration, the purification process is complete, and drinking water is pumped out to customers.

The Sewerage and Water Board also operates a water treatment plant on the west bank of the Mississippi River in Algiers. The purification process at the Algiers Water Purification Plant is similar to that of the Carrollton Water Plant, utilizing the same water treatment chemicals with a slightly modified application scheme for their upflow clarifiers.

The Carrollton plant normally yields about 115 million gallons of finished water per day for the east bank of Orleans Parish. The Algiers Plant, which serves the predominantly residential west bank portion of the parish, purifies about 10 million gallons of water per day. Combined, the two plants treat approximately 47 billion gallons of water per year, removing 20,000 tons of solid material from the raw river water.

The treated water at the two plants is pumped through more than 1,610 miles of mains to more than 160,000 service connections. It is delivered to approximately 440,000 people on the east bank of Orleans Parish and approximately 57,000 people on the west bank.

Water



Water distribution lines in New Orleans

N.O. S&WB Water Lines
Water
Parks
Parish boundaries
Major streets
N

Data Source: New Orleans Sewerage and Water Board

Figure 5 S&WB Water System

2.2. Sewerage System

The unusual New Orleans topography, which makes area drainage so serious a problem, also makes a similar plan necessary for sewage disposal. The sanitary sewer system of the city is a gravity collection system, consisting of 1,450 miles of lateral and trunk sewers, ranging in size from 8 inches to 7 feet in diameter. Lifting and conveying the sewage by trunk sewers and sewer force mains requires 83 electrically operated pump and lift stations; 79 of these stations are automatically operated with no attendance other than periodic maintenance visits.

Sewer stations "A" and "D" on the East Bank and Station "C" on the West Bank are large, attended stations. These, as well as all automatic stations, transfer the total collected sewage from the entire city to the treatment plants.

Recognizing the need, as well as the national effort being made to reduce our country's waterway pollution, the Sewerage and Water Board has proceeded with a phased program for the treatment of all municipal sewage, both on the east and west banks of the Mississippi River.

In 1962, the Sewerage and Water Board reactivated and assumed the operation of a United States government-owned activated sludge plant to provide sewage treatment for the Michoud residential and industrial area east of the Industrial Canal. In 1965, the capacity of this plant was increased from one million gallons per day to 2.5 million gallons per day.

New ambient water quality standards led to a requirement for the conversion of the Michoud plant to tertiary treatment. Closure of the facility was deemed to be more cost effective and the flows to the Michoud plant were re-routed to the East Bank Sewage Treatment Plant in 1992.

Westbank Sewage Treatment Plant In 1973, the 20 million gallon-per-day West Bank Sewerage Treatment Plant came on-line.

East Bank Sewage Treatment Plant In 1970, the Board began the design to convert and expand its East Bank Plant increasing the capacity to treat the city's wastewater from 23 million gallons to 122 million gallons per day. State-of-the-art technology was selected for the treatment process, employing the high-purity oxygen modification of the activated sludge process.

Construction began in 1973 and was completed in 1980, giving the Sewerage and Water Board the capacity for secondary treatment of 100 percent of the city's sewage.

Sewerage Rates All residential and Public Housing Class quantity charges are applied to 85 percent of the metered consumption, allowing 15 percent of water use for lawn watering and other uses which contribute no flow to the sanitary sewer. Quantity charges for customers are based on 100% of metered private wells or non-Board sources that if discharged to the sanitary sewer system will be metered and the consumption included in computing sewerage quantity charges. Any customer who proves only a portion of the metered water usage discharged to the sanitary sewer system is charged for only that portion of the total water quantity.

2.2.1. Sewerage System Upgrades

The Sewerage and Water Board (S&WB) of New Orleans began a major rehabilitation and capacity upgrade of its aging sewage collection system in 1996, following a public hearing to obtain citizen input on the plan.

Like most of the nation's major metropolitan areas, New Orleans's underground water and sewer systems are at least 40 years old and, in many cases, up to 100 years old. Factors common to this area, such as unstable soil conditions and large numbers of tree roots, contribute to a higher-than-normal number of breaks and deterioration of the sewer pipes.

The SSERP, or Sewer System Evaluation and Rehabilitation Program, was eventually incorporated into the consent decree the S&WB signed with the EPA in 1998. At that time, timetables and deadlines were established for the work in each district.

The S&WB selected Montgomery Watson Harza (MWH), a global leader in large capital program management, to serve as SSERP program manager. MWH's program management experience includes planning and management of design and construction of extensive sewer rehabilitation-related projects in Houston, Baton Rouge, Miami and San Francisco.

In addition, the S&WB sought out EPA Federal grants to support the program totaling approximately $100 million over 10 years. The $100 million has been authorized by Congress. To date the Sewerage and Water Board has received $38.8 million in Federal Funds.

2.2.2. Sewerage System Facts

- The sanitary sewerage system in New Orleans is a gravity collection system, consisting of 1,600 miles of lateral and trunk sewers, ranging in size from eight inches to seven feet in diameter.
- Lifting and conveying the sewage (also called wastewater or effluent) by trunk sewers and force mains requires 83 electrically operated pump and lift stations. Seventy-nine of those stations are automatically operated.
- Sewer stations "A" and "D" on the East Bank and station "C" on the West Bank are large, attended stations. These, along with all automatic stations, transfer the total collected sewage from the entire city to two treatment plants.
- The S&WB system has two sewage treatment plants, one on the East Bank and one in Algiers. The combined treatment capacity of the two plants is 132 million gallons per day. The plants are currently operated by Veolia North America. Both plants were built in the 1970s and have been upgraded, modernized and expanded to increase capacity and to keep up with the growth of the city. The plants discharge treated wastewater into the Mississippi River.
- Sewer service rates in New Orleans are considered to be among the most reasonable in the nation. The Sewerage Department is funded only through the sewer fees charged on monthly bills for customers.
- Like other S&WB services, sewerage operations run 24-hour a day, seven days a week. In addition to regular staff on duty for three eight-hour shifts, emergency crews are on stand-by to be called in if needed.

- Design of the sewerage system began in 1898 and construction of the early phases was completed in the early 1900s. Through the years, the system has been expanded and modernized. As the city grew geographically and EPA requirements became more stringent, new construction added miles of underground mains, new pump and lift stations and larger and more efficient treatment plants.
- Continuous maintenance and repairs have been carried out by the S&WB over the years, but the age of the system, the soil, weather and other conditions unique to this area resulted in the need for an evaluation of the entire collection system. The first several phases of the evaluation have led to massive improvements and it's expected that future phases will reveal the need for millions of dollars in repair work in each area of the City.
- The Sewer System Evaluation and Rehabilitation Program (SSERP), underway since 1996, is part of the EPA Consent Decree the S&WB signed in 1998. It focuses on the sanitary sewer portion of the sewerage system that collects wastewater from homes and businesses and transports it to the wastewater treatment plants.
- SSERP is a ten-year effort to study and repair the system throughout the city. The approximate cost estimate for the improvements is greater than $600 million.
- To best carry out the plan to study and rehabilitate the area wide sewerage collection system, the S&WB divided the city into 10 basins.
- Testing is the first process in each basin. The results are analyzed and construction is carried out to repair damaged manholes, pipes, trunk lines and pumping stations. Testing in each district includes flow monitoring, videotaping of lines, smoke tests and dye tests to locate breaks, clogs and broken joints. Pumping stations are being tested for efficiency and output.
- Modern techniques for repairs are being used wherever possible to reduce the need for digging trenches in streets or sidewalks.
- The S&WB has completed testing in Lakeview, the CBD/French Quarter/Warehouse District, Gentilly, Uptown, Mid-City and the Lower Ninth Ward. Repairs were completed in Lakeview last year and are underway in the CBD/French Quarter/Warehouse District and Gentilly. Repairs will begin in Uptown and Mid-City next year.
- Work on the sewerage treatment plants includes major repairs to the headworks at the East Bank Treatment Plant, along with replacement of the inflow channel. In Algiers, a complete expansion of the plant is underway to greatly improve its efficiency, and work has already been completed to double its capacity.
- The S&WB is proud of its record with the EPA Consent Decree, as it has met every construction and reporting deadline outlined in the decree and had no fines relative to construction or reporting schedules.
- The S&WB is coordinating its efforts with the City's Department of Public Works street repair and replacement program to minimize inconveniences and to save money. Where possible, the S&WB is employing state-of-the-art trenchless methods of sewer repair that allows repairs without the need to dig up streets and yards.
- SSERP is managed for the S&WB by MWH Consulting Engineers.
- One modernization project online for ten years is SCADA (supervisory control and data acquisition), a sophisticated computer system that provides online monitoring of the 83 sewer pump and lift stations located throughout the city. Each facility is monitored for pressure, electrical power, mechanical functions, flow and security.
- Sewer Pumping Station A, located behind the Municipal Auditorium, houses the "heart and brain" of a state-of-the art $1.7 million monitoring system.

- Personnel on duty 24 hours a day at Station A monitor the functions at all stations. Crew can be dispatched quickly to a location at the first indication of a malfunction.
- Depending on the eventual total costs, funding for all the projects of SSERP will come from three sources: Federal funds, via EPA Grants, S&WB matching funds, and other S&WB operations and maintenance funds. The S&WB has already received $38 million in Federal grants.
- The S&WB will continue to work with the Mayor's Office, the City Council, the area's Congressional delegation and the White House to obtain additional funds for sewerage, but the S&WB must be able to provide local matching funds.

Figure 6 S&WB Sewer System

2.3. Drainage System

New Orleans is like a saucer, levees that have been built to protect us from the Mississippi River and Lake Pontchartrain waters also retain all the rainwater that falls within the city, making the city vulnerable to floods.

The Drainage System dates back to the turn of the century. In 1896, the New Orleans Drainage Commission was organized to carry out a master drainage plan that had been developed for the city. Three years later in 1899, the Sewerage and Water Board was authorized by the Louisiana Legislature to furnish, construct, operate, and maintain a water treatment, distribution, and sanitary sewerage system for New Orleans. In 1903, the Drainage Commission was merged with the Sewerage and Water Board to consolidate drainage, water, and sewerage programs under one agency for more efficient operations. This combined organization retained the title Sewerage and Water Board, and remains as such today.

Because the river levees are higher than the lake levees, most rainwater is pumped into Lake Pontchartrain. Exceptions are two (2) West Bank pumping stations and four (4) stations in Eastern New Orleans that pump rainwater into the Intracoastal Waterway or the Industrial Canal.

There are also 13 underpass stations, each with two or three pumps, which are automatically turned on by rising water. These pumps are checked daily and monitored by field personnel during rain events.

The system's pumping capacity is over 29 billion gallons a day, enough to empty a lake 10 square miles by 13.5 feet deep every 24 hours. That flow rate (over 45,000 cubic feet per second) is more than the flow rate of the Ohio River, the nation's fifth largest river.

The S&WB's drainage network includes approximately 90 miles of open canals and 90 miles of subsurface canals. Many of the subsurface canals are large enough to drive a bus through.

Generators that provide much of the power for pumps throughout the city are located at the S&WB power plant at the Carrollton Water Plant.

Operations Department crews watch the canal water level, monitor weather forecasts through a direct tie to the National Weather Service Radar System, communicate with other stations and senior management, and keep informed on weather activity around the city. They are accustomed to handling unexpected deluges.

During a flood, there are often rumors and reports to the S&WB and the media that pumps or entire pumping stations are out of service for any one of a variety of reasons. In fact, this is an extremely rare occurrence and the media is asked to confirm such reports with the S&WB before broadcasting them.

Figure 7 S&WB Drainage System

2.4. Purpose and Scope

The purpose of this project is to develop a Local Hazard Mitigation Plan (LHMP) that complies with the HMGP (Hazard Mitigation Grant Program) and 44.CFR.201.6 that classifies the Sewerage & Water Board of New Orleans as a single, local jurisdiction.

As a single, local jurisdiction with a LHMP, the S&WB can be a direct applicant to the State for various FEMA grant funding programs and reimbursements.

2.5. Participating Jurisdictions

The only jurisdiction directly covered by this Local Hazard Mitigation Plan is the Sewerage and Water Board of New Orleans. No outside agencies or jurisdictions participated in this planning effort due to specific technical and agency issues.

The S&WB serves the diverse population of the New Orleans area. The following map shows the geographic reach of the S&WB based on population density within NOLA zip codes.

Figure 8 S&WB Geographic Jurisdiction Map (zip code and pop density)

The spread of the S&WB service network mirrors the geographic spread of the City of New Orleans. For most planning purposes as described in this Plan the "City of New Orleans", "Orleans Parish" are geographically equivalent to the Sewerage and Water Board's as a special district.

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3. Planning Process

This section describes the planning process per 44.CFR.201.6.

Documentation of the Planning Process per 44 CFR 201.6, (c)(1) *The plan **shall** include the following: Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

3.1. Planning Process Narrative

This LHMP was developed utilizing the FEMA recommended guidance for Hazard Mitigation Planning (Local Multi-Hazard Mitigation Planning Guidance – July 1, 2008 – FEMA).

Development of this Hazard Mitigation Plan was led by the Lambert Engineers, LLC, an Engineering Planning Consulting firm for the Sewerage and Water Board of New Orleans, and an engineering consulting firm, Infinity Engineering.

At the S&WB staff level, the S&WB planning team was led by the Environmental Affairs Division and the Emergency Management Operations. The S&WB Planning Team had specific input from the Public Affairs divisions.

The USACE and NOOEP provided input into the planning process.

The first meeting of the Planning Team was October 1st, 2009. The Planning Team provided specific input on the mission statement and hazards identification. The Planning Team also reviewed early Plan drafts and provided input on recommended changes to the Plan.

Prior to the first Planning Team meeting, all relevant local and state agencies as well as the general public and business community were notified of the meeting and the planning process.

Hazards were identified at the November 17th, 2009 Planning Team meeting and finalized at the December 16th, 2009 meeting.

The risk assessment was prepared by the consultant with direction and input from the S&WB Planning Team members.

The consultant held a series of meetings with the Planning Team to identify the goals, objectives and mitigation actions for the Hazard Mitigation Plan.

A special public meeting was held prior to the Plan draft on November 9th, 2009 to obtain public comment and explain the planning process. All participants were encouraged to provide input on the Draft Plan.

On March 8th, 2010, the S&WB planning group and Lambert Engineers conducted a “red team” review for final edits of the draft plan prior to the final public meeting.

The core Planning Committee members are listed in Section 3.2. Public Meeting notices are listed in Appendix 6 – Public Meeting Notices .

The Draft Plan concept was reviewed and approved by S&WB Infrastructure Committee on 3/3/2010

The initial Draft Plan was reviewed and approved by Sewerage and Water Board Directors 3/17/2010

Informal submission of the draft plan to FEMA and GOSHEP followed on 3/18/2010.

Resulting Plan comments from FEMA, updates and public comments were reviewed and addressed.

The final Plan was formally adopted by the Board on.

The Plan was formally approved by FEMA on .

3.2. Planning Team Members

The Hazard Mitigation Lead Planner for Lambert Engineers was Paul G. Seldes, CHS-III, FPEM, CEM.

Team members included:

Lambert Engineers, LLC	**Sewerage & Water Board of New Orleans**	**GOSHEP**
*Paul G Seldes, FPEM – Hazard Mitigation Project Lead	Robert Miller, Deputy Director	Shenetia Magee-Henderson, Hazard Mitigation Planner (James Lee Witt Associates)
*Dennis Lambert, PE	*Gordon Austin, Environmental Affairs Division	
Richard Campanella, GIS Specialist	*Jason Higginbotham, Emergency Operations Division	
Infinity Engineering Consultants	Harvey Stern Environmental Affairs Division	
Michael Leitzinger, PE	Tom Miller, Emergency Operations Division	
	Robert Jackson, Community and Intergovernmental Relations Division	
	Ike Cameron, Risk Management	

Committee members participated in all reviews and planning meetings during the **current** planning process.

Members of the final "red team" review group are marked with an "*".

3.3. Description of the planning process

The FEMA process for HMP planning, from the FEMA How-To Guide 386-1 is illustrated in the following diagram.

Figure 9 FEMA Planning Process

3.4. Coordination with agencies

The consulting firm coordinated this planning process with input from other stakeholders including:

- New Orleans Office of Homeland Security and Emergency Preparedness
- US Army Corp of Engineers
- GOHSEP
- LEPC

On March 10th, 2010, the draft plan presentation was provided to the New Orleans LEPC for review and comment.

3.5. Planning meetings

To expedite the planning process, planning meetings were held via conference calls on a weekly/bi-weekly schedule throughout the planning process.

3.5.1. Meeting Schedule

- October 30, 2009
- November 5, 2009
- November 17, 2009
- December 2, 2009
- December 9, 2009
- December 16, 2009
- December 23, 2009
- January 6, 2010
- January 13, 2010
- January 20, 2010
- February 10, 2010
- February 17, 2010
- February 24, 2010

Meeting minutes are found in Appendix 5 – Planning Committee Meeting Agendas.

3.6. Public Outreach

Scheduled public meetings provide local citizen stakeholders an opportunity to provide input to the process and gain knowledge about their community and the role of hazard mitigation. The S&WB values participation from the public and community stakeholders served by the S&WB. The scheduled Public Meetings provide an opportunity for the public to comment during the planning process. The scheduled public meetings are also an opportunity for neighboring communities, agencies, businesses, academia, non-profits and other interested parties to be involved in the process.

44.CFR.201.6(b) defines the requirements for public involvement in the hazard mitigation planning process as follows:

Public Involvement per 44 CFR 201.6 (b): *An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:*
(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

3.6.1. Pre-Draft Phase Public Meeting

An initial Public Meeting, prior to the drafting phase, was held on November 9th, 2009 at the S&WB Carrolton Water Treatment Plant. In an effort to solicit comments from neighboring communities, businesses, academia, and other interested parties, public notices were advertised on the S&WB website and published in the Times-Picayune. The meeting utilized the following agenda:

1. Introductions
2. Overview of Mitigation Planning
3. Local Disaster History
4. Hazard and Risk Assessments
5. Mitigation Project Current and Planned
6. Review
7. Public Comment / Questions & Answers
8. Summary

The meeting was called to order at 7pm. The presentation that supported the above agenda was posted to the S&WB website for public review/comment. No members of the public attended and no comments were received. The meeting was adjourned at 7:30pm.

3.6.2. Pre-Adoption Public Meeting

The final public meeting was held on March 10th, 2010 prior to the Adoption of the Plan by the Sewerage and Water Board. The published Public Notice and meeting minutes are located in Appendix 6 – Public Meeting Notices .

3.7. Involving Key Stakeholders

Based on the specific requirements of the Sewerage and Water Board, and due to the complex nature of the S&WB network, no outside stakeholders were directly involved in this mitigation planning process. The City of New Orleans Office of Homeland Security and Emergency Preparedness provided some additional input and analysis for this Planning effort. The USACE provided project data and support to the planning committee.

3.8. Review and Incorporation of Existing Information

This LHMP incorporates elements from the following documents and existing Plans:

- S&WB Emergency Operations Plan – May 2008
- City of New Orleans Hazard Mitigation Plan – Dec 2005
- State of Louisiana Hazard Mitigation Plan – April 2008

Additional data from existing plans, studies, reports and technical analysis include the following documents:

USACE Project Information Report Damaged Flood Control Works - April 2006
USACE Performance Evaluation Plan and Interim Status (IPET) - Jan 2007
2010 S&WB Annual Operating Budget (adopted)
2010 S&WB Annual Capital Budget (adopted)
2008 S&WB Report on Operations (Black & Veatch)
USACE Operating Instruction Manual - June 2007

3.9. Adoption

This Plan was formerly adopted by the Sewerage and Water Board of New Orleans by resolution on _____. The resolution is attached in Appendix 1 - RESOLUTION TO ADOPT THE NEW ORLEANS SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN.

4. Hazard Vulnerability Assessment

The Hazard Vulnerability Assessment section identifies and profiles hazards based on a variety of factors. This section also documents the risk vulnerability for hazard events that pose a threat to the assets of the Sewerage and Water Board of New Orleans. These factors include regional history, topography, land development patterns and infrastructure design/demand.

The list of hazards to be profiled in this Plan was developed based on information from a variety of sources including: recent events, historical records, existing emergency management plans, and the knowledge of local residents and subject matter experts.

4.1. Hazard Identification

In compliance with regulatory requirements and specific grant guidance, the Sewerage and Water Board (S&WB) local hazard mitigation plan (LHMP) "shall" include all natural hazards that may impact the S&WB jurisdiction. This approach to specifically identify and address hazards is required under 44.CFR.201.6.

Hazard Identification per Requirement §201.6(c)(2)(i): *"[The risk assessment shall include a] description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events….."*
Identifying Structures §201.6(c) (2) (ii) A: " *The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas…"*
Hazard Loss Potential §201.6(c) (2) (ii) B: *"An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate…*

The following table compares the Louisiana State Hazard Mitigation Plan of 2008 (SHMP) hazards with the City of New Orleans Local Hazard Mitigation Plan (LHMP) of 2005. The hazard elements deemed as "significant" risk in the state plan are marked with an *. The City of New Orleans specifically excludes certain hazards as noted.

State of Louisiana Plan	City of New Orleans Plan
Coastal Erosion	Floods
Dust Storm	Hurricanes
Drought	Tornados
Earthquake	Hail
Expansive Soil	Thunderstorms/Lightning
Flood - Coastal*	Subsidence
Flood – Riverine	Chemical Spills/Accidents
Fog	Terrorism
Hailstorm	Levee Failure
High Wind - Hurricane*	Severe Winter Storms
High Wind - Tornado*	Drought
Hurricane / Tropical Cyclone	Avalanche (excluded)
Ice Storm*	Dam Failure (excluded)
Land Loss	Earthquake (excluded)
Sea Level Rise	Land-slide (excluded)
Severe Weather – Extreme Heat	Tsunami (excluded)
Severe Weather – Extreme Cold	Volcano (excluded)
Storm Surge	Wildfire (excluded)
Subsidence*	Erosion (excluded)
Tornado	
Wildfire*	
Dam Failure*	
Levee Failure*	
Hazardous Material Incident*	
Natural Biohazard Incident	
Nuclear Facility Incident	

Figure 10 Hazard Table

4.1.1. Identified Hazards

Based on regional history and agency data, 23 hazards are identified for the S&WB Plan divided between natural and manmade. Some hazards are combined in this Plan due to shared causative or effect patterns.

Natural Hazards	Manmade Hazards
Hurricane/Tropical Cyclone - Flood	Terrorism/Civil Unrest
Hurricane/Tropical Cyclone - Wind	Levee Failure
Flood (other)	Hazardous Materials
Earthquake	Cyber Attack
Tornado	Disaster Aftermath
Pandemic	
Severe Thunderstorms	
Subsidence (Erosion, Expansive Soils)	
Lightning	
Severe Heat/Severe Cold	
Storm Surge	
Hailstorm	
Drought	
Wildfire	
Winter Storm	
Avalanche	
Tsunami	
Volcano	

Figure 11 S&WB Identified Hazards

4.1.2. Hazards considered, but eliminated

Hazards not selected for this Plan include Avalanche, Cyber-Attack, Dam Failure, Drought, Earthquake, Landslide, Pandemic, Terrorism/Civil Unrest, Tsunami, Volcano, and Wildfire.

4.1.2.1. Avalanche and Volcano

The Avalanche and Volcano hazards were not selected due to the topography of the Orleans Parish region. These hazards do not pose a realistic threat to Orleans Parish and thus are of no threat to the Sewerage and Water Board service networks. An examination of USGS landslide hazard information indicates that Orleans Parish is at a low risk for landslides; therefore landslide hazards are not addressed in this Plan. The New Orleans region has no volcanic activity hence the Volcano hazard is excluded.

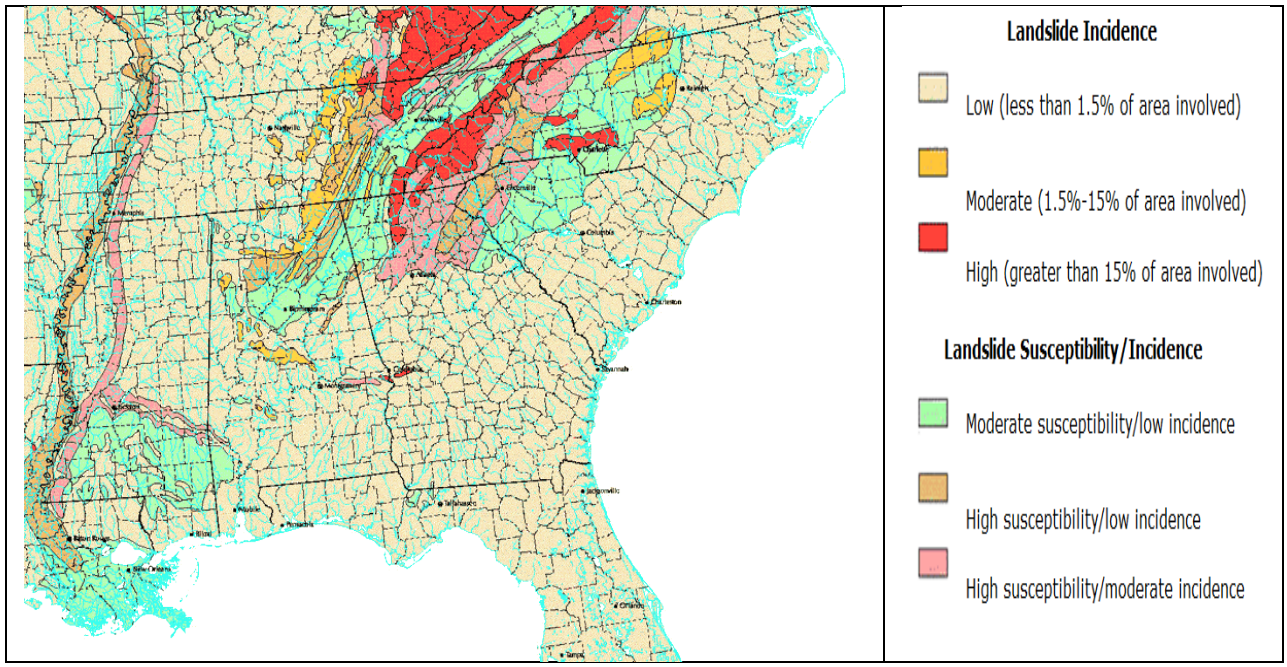


Figure 12 USGS Landslide Hazard Activity

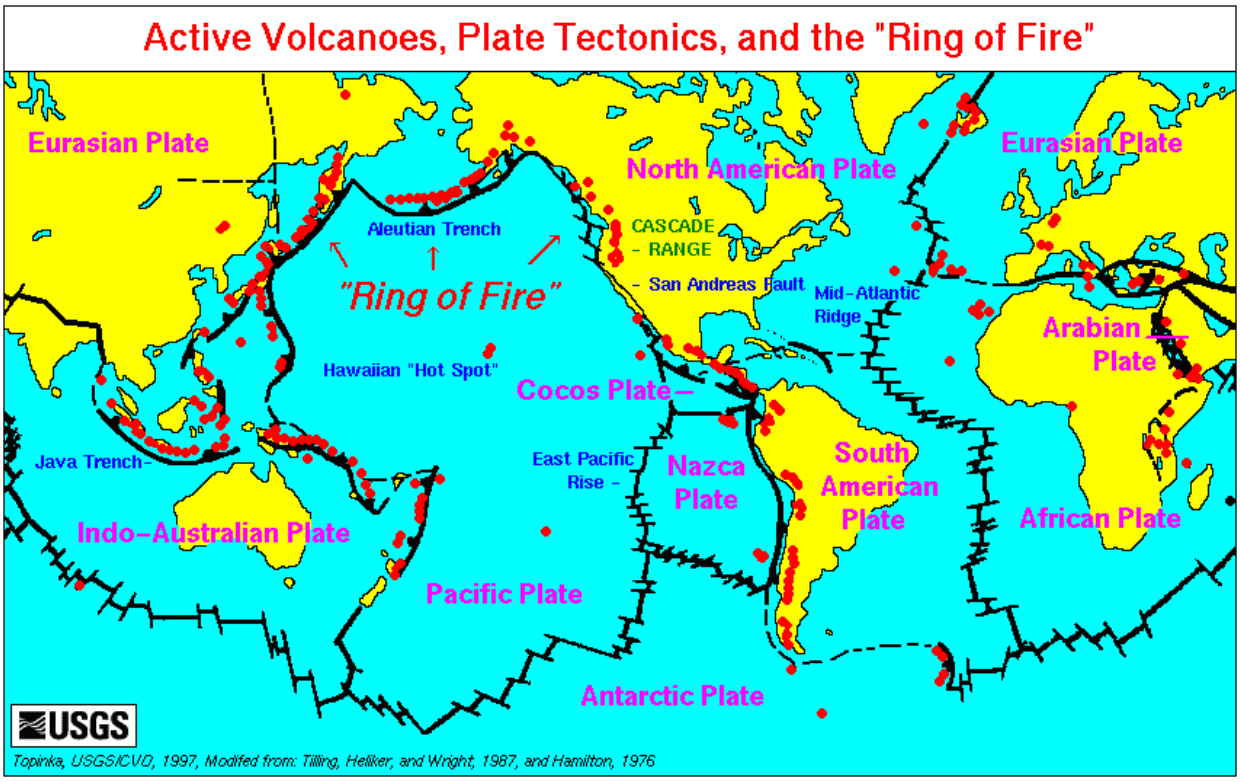


Figure 13 Global Volcanic Activity - USGS

4.1.2.2. Earthquakes

New Orleans is at a very low risk for earthquakes. Reviews of the U.S. Geological Survey National Seismic Hazard Data Mapping Project and the State of Louisiana Hazard Mitigation Plan (April 2008) indicate a 1 percent gravity (1%g) peak acceleration, which indicates a very low probability of occurrence. Therefore the assets of the S&WB are not subject to any risk from this hazard. The earthquake hazard is not profiled in the risk assessment due to this low probability combined with no historical earthquake occurrences.

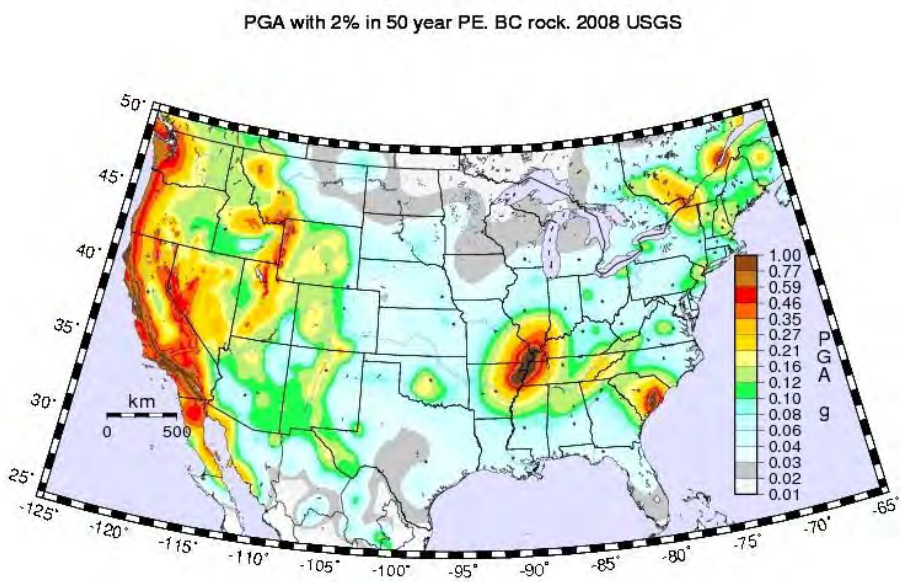


Figure 14 USGS Peak Acceleration Map

4.1.2.3. Dams

There are no dams located in Orleans Parish; therefore, Dam Failure is not relevant and not included in this Plan as it poses no risk to the S&WB.

4.1.2.4. Tsunami

New Orleans is not located on the West Coast of the United States, and is not a Pacific or Caribbean Island. The tsunami hazard is not profiled in the State of Louisiana or City of New Orleans Plan. Therefore, as the S&WB networks are not at risk for tsunami, the tsunami hazard is not profiled in this Plan.

4.1.2.5. Wildfire

Although the Louisiana State Hazard Mitigation Plan identifies wildfires as a viable hazard within the State of Louisiana, a review of the Observed Fire Danger Class Map and history indicates that New Orleans is at a low risk of wildfire danger. This observation, combined with the fact that New Orleans is not located near forests, grasslands, or densely wooded areas, and this hazard poses no threat to the S&WB, the wildfire hazard is not profiled in the risk assessment.

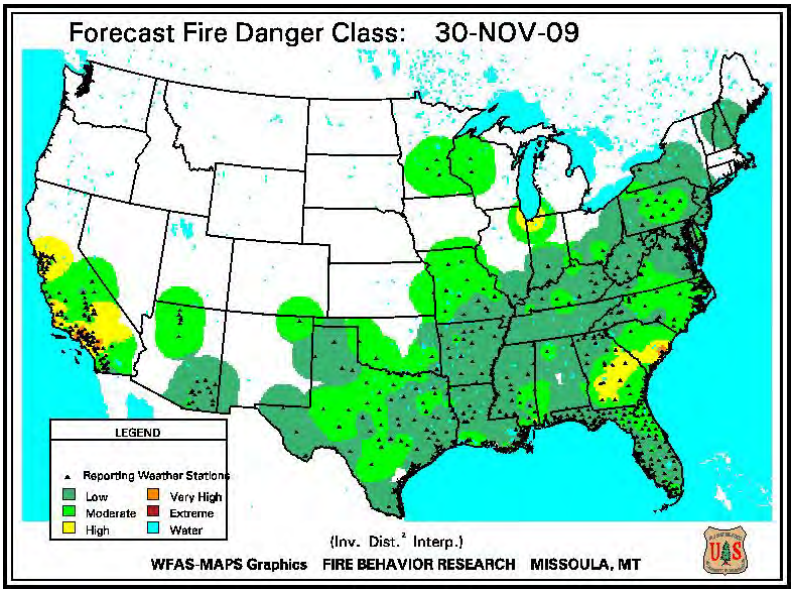


Figure 15 Observed Fire Danger Map

4.1.2.6. Pandemic

The Pandemic hazard is principally a staffing and human resource issue for the Sewerage and Water Board and is addressed within agency HR policies. Other Pandemic hazard issues are addressed within plans from the Department of Health and Hospitals and Dept of Health. Therefore, as Pandemic hazard issues are addressed elsewhere, the Pandemic hazard is not profiled in this Plan.

4.1.2.7. Drought

Drought as a hazard has been omitted from this Plan because droughts of such magnitude that require water restrictions are rare within the S&WB service area. Therefore, based on the results of the hazard profiling for this study, drought is not considered significant by the Planning Committee and is not addressed in this Plan.

4.1.2.8. Erosion

The original Hazard Mitigation Plan submitted by Orleans Parish included a hazard specifically relating to erosion. This hazard, which is a slow creeping event, is not specifically cited as a hazard in the Sewerage and Water Board Plan. The hazard identified as "Subsidence" in this Plan, which is a significant threat to Orleans Parish and all Southern Louisiana Parishes, is related to erosion. Subsidence should be considered the hazard and the effect is erosion. To have a section on both erosion and subsidence would be redundant. Therefore, Erosion is not included as a separate line item in this Plan.

4.1.2.9. Disaster Aftermath

Disaster Aftermath represents a manmade hazard that happens AFTER a hazard event. This hazard was newly identified by the Planning Committee. When large areas of a region are impacted by a large-scale hazard such as Hurricane Katrina, additional consequences may be created or damages increased or broadened post-hazard. Traffic flow, debris and construction activities all place a greater burden on local streets, roads and infrastructure. For example, during debris operations, heavy construction equipment may be routed through light traffic residential streets causing damage to road surfaces and buried infrastructure that may have escaped damage from the original hazard. The impact of this event is concentrated in areas with heavy construction, demolition and debris operations (See Appendix 8 – Building Permit Data) and may not become visibly apparent until years after the original hazard event. As the Aftermath hazard is primarily an effect of another event, discussion of this hazard is omitted from this Plan.

4.1.3. Special Note for Cyber Attack, Civil Unrest and Terrorism Hazards

Cyber Attack (Technological Hazards) and Civil Unrest/Terrorism hazards are primarily addressed by other local, state or federal entities or other plans and are therefore not included in this Plan. Some areas for concern include:

- The possibility of damage to Chlorine tank cars, which would generate a 9 mile plume of deadly gas. This would pose a significant risk with widespread evacuations.
- The injection of a dangerous substance into the water supply could also create extensive problems.

The main concern with these hazards as related to the S&WB is the impact on the water supply. If the water supply becomes unusable, the entire city is at risk and could require mass evacuations. At a minimum, large buildings would have to be evacuated if there is no water supply due to the possibility of a fire hazard.

The Civil Unrest hazard is typified by the kind of looting that took place after Hurricane Katrina. Wiring was stolen from some sewerage pumping stations (SPS) that were without electrical power. In addition the public went to a couple of stations and tried to enter while station employees were inside. The residents blamed the station employees for their flooded homes. The larger facilities have security guards to prevent any such action. This hazard and associated mitigation activities remain a security and law enforcement issue.

The S&WB adheres to the DHS threat level advisory protocols and has specific response plans for to each level. Specific mitigation, response and planning activities for these hazards are considered Security Sensitive Information (SSI) or Classified Information and are excluded from this Plan. They are best covered in a restricted access planning document.

4.1.1. Critical Infrastructure

Due to the design and nature of the S&WB networks (see Section2 – About the Sewerage and Water Board of New Orleans), the entire system represents critical infrastructure.

4.2. Included Hazards

After a review of historical disaster impacts and analysis of hazard and risk data, a total of 12 hazards were identified for inclusion in this Plan. Several hazard types with similar characteristics have been consolidated and are *italicized* in Figure 7. Hazards that may lack a historical S&WB impact but logically pose a threat to S&WB assets are included in this section of the Plan. Several of the key hazards are covered as part of the Hurricane Hazard event due to their related characteristics.

It is important to note that due to the "special district" nature of the Sewerage and Water Board, hazards impact this jurisdiction differently than Orleans Parish. The primary focus for S&WB is operational continuity as it results to the health and safety of the citizens of New Orleans. In many ways, the S&WB networks serve as a perimeter defense component for the City. Therefore, maintaining operational capability is a key goal. Geographically, the S&WB service network is synonymous with the geographic spread of Orleans Parish.

Note: There is incomplete data available from the S&WB for some of the included hazards. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

4.2.1. Hazards identified for this Plan

Hazard	Why Identified	Probability[3]	Impact[4]	Plan Section	History[5]
Flood	High risk of occurrence	High	High	4.3.1 / 4.3.4	Katrina 2005, Ivan 2005, TS Isidore 2002, Lilli 2002 TS Allison 2001, April 1999 flooding
Hailstorm	NOLA has recorded the 8th most costly hailstorm hazard for the US	Low	Low	4.3.2	2002 hailstorm with minimal damage to a crane (DPS 6)
Hazardous Materials	Potential for occurrence and impact to S&WB assets Presents systemic impact to S&WB	Medium	High	4.3.3	July 23, 2008 – oil spill in river Oct 28, 2008 – oil spill in river
Hurricane/Tropical Cyclone (Storm) – Flood Coastal Storm	Region is at significant risk for this hazard event per historical record	High	High	4.3.4	Katrina 2005, Ivan 2005, TS Isidore 2002, Lilli 2002 TS Allison 2001
Hurricane/Tropical Cyclone (Storm) – Wind Coastal Storm	Region is at significant risk for this hazard event per historical record	High	High	4.3.4	Katrina 2005, Ivan 2005, TS Isidore 2002, Lilli 2002 TS Allison 2001
Levee Failure	Catastrophic potential impact	Low	High	4.3.4	Katrina 2005
Lightning / Severe Storm / Thunderstorm	High probability of occurrence	High	Medium	4.3.6 / 4.3.4	Various
Severe Heat / Severe Cold / Winter Storm	Exacerbates general maintenance and repair	Low	Low	4.3.8	Various
Saltwater Intrusion	Presents systemic impact to S&WB	Medium	Medium	4.3.7	Occurrence in mid-1980's. no data currently available.
Storm Surge	Catastrophic potential impact	High	High	4.3.9 / 4.3.4	Katrina 2005
Subsidence (Erosion, Expansive Soils)	Long term damage Exacerbates damage by other hazards	Medium	Low	4.3.10	No data in historical record
Tornado	Significant damage results	Medium	Low	4.3.11	Two tornados in 2006. No damage to S&WB assets in historical record. Feb 2007

Figure 16 Hazards Included in Plan

[3] Probability is defined as the expected likelihood of a specific hazard occurrence within the next 5 years based on local planning efforts.
[4] Impact is defined as the severity or "degree of possible badness" of a hazard occurrence on S&WB assets based on local planning efforts.
[5] History includes a sampling of hazard occurrence where available

Hazards are grouped in a hazard matrix approach to prioritize active hazards.

	Probability		
Impact	Low	Medium	High
High	**Hazardous Materials** **Levee Failure**		**Flood** **Hurricane Flood –** **Hurricane Wind** **Storm Surge**
Medium		**Salt Water Intrusion**	**Lightning** **Severe Storm** **Thunderstorm**
Low	**Severe Heat/Cold** **Winter Storm**	**Subsidence** **Tornado**	**Hailstorm**

Figure 17 Hazard Matrix

Hazards with higher impact and probability ratings are grouped in the highest priority or "Red Zone", Hazards with moderate characteristics are Yellow and low rated hazards fall into the Green category.

This matrix key is used throughout this section of the Plan to identify overall hazard risk.

4.3. Hazard Profiles

Hazard profiles consist of five parts for each hazard addressed by the Plan: **Description**, **Previous (Past) Occurrences**, **Location**, **Severity** (extent), and **Probability of Future Events.**

> **Hazard Identification per Requirement §201.6(c)(2)(i)**: *"[The risk assessment shall include a] description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events....."*

The description of hazard events, location, and severity illustrate the typical occurrence of a given hazard. They depict the conditions that will likely be present when a hazard occurs and answer the question "How bad can things get?" for different hazards. The profiles describe past occurrences of hazards in Orleans Parish as well as the historical impact, the probability of future events and the impact on the assets of the Sewerage and Water Board.

These descriptions, location, and severity analysis of hazard events are important because they describe how the S&WB is likely to be affected by each hazard. The effects from each of the hazards covered by the Plan vary dramatically. Furthermore, any given hazard may affect Orleans Parish differently than it would affect another community. Because occurrences of a given hazard can vary in terms of magnitude, duration, and intensity, it is important to specify the conditions that each hazard is likely to create in Orleans Parish and on the S&WB service network. Additionally, a hazard can pose a significant risk to Orleans Parish but pose little risk to the assets of the S&WB; the focus of this Plan.

4.3.1. Flood

Probability	Impact	Reoccurrence
High	Low	1.2 years

4.3.1.1. Description of hazard

A "flood" in this Plan refers to riverine flooding; naturally occurring events involving rivers and their tributaries, floodplains, or localized low areas. In a typical flood event excess water from rainfall accumulates and either overflows onto banks (also referred to as "overbank" flooding) or backs up into adjacent floodplains (also referred to as "backwater" flooding). In Louisiana, and in particular Orleans Parish, flood events also include incidents that may be exacerbated, or even triggered by, manmade flood control interventions including levees, flood walls, and forced drainage systems. The failure of such systems can directly cause flooding, as Hurricane Katrina demonstrated, and levees and other barriers can impound water on their protected side, leading to extended inundation, as happened after both hurricanes Katrina and Rita.

Flood waters can be slow or fast rising, but generally develop over a period of days. Flooding tends to occur in the summer and early fall because of the heavy rains that are typified by increased humidity and high air temperature. Floods kill an average of 150 people a year nationwide. They can occur at any time of the year, in any part of the country, and at any time of day or night.

Over 9 million households are within the U.S. floodplains. . Most injuries and deaths occur when people are swept away by flood currents; most property damage results from inundation by sediment-filled water. Fortunately, most of the known floodplains in the United States have been mapped by FEMA, which administers the National Flood Insurance Program (NFIP). When a flood study is completed by the NFIP, the information and maps are assembled into a Flood Insurance Study (FIS). An FIS is a compilation and presentation of flood risk data for specific water courses, lakes, and coastal flood hazard areas within a community and includes causes of flooding. The FIS report and associated maps delineate Special Flood Hazard Areas (SFHAs), designate flood risk zones, and establish base flood elevations (BFEs), based on the flood that has a 1% chance of occurring annually, or the 100-year flood.

4.3.1.2. Past occurrences

Big rain events are fairly common in Orleans Parish and have caused much property damage in the general area. In the last 25 years, there have been 12 rain events that resulted in more than 6 inches of rain falling within 24 hours somewhere in the Parish. Since 1991, 4 of these events resulted in more than 11 inches of rain falling within 24 hours somewhere in the Parish. All 14 Federally Declared Disasters that have occurred in Orleans Parish since 1965 have involved a rain event. The NCDC (National Climatic Data Center) lists 25 flood-only occurrences (meaning not related to other hazard events such as tropical storms or hurricanes) between January 1970 and September 2009. The total property damage to the City of New Orleans, per the NCDC for these occurrences was $855,000. Real damages as measured by the City of New Orleans and local residents were much higher though an exact amount is unavailable.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 New Orleans	05/09/1994	1600	Flash Flood	N/A	0	0	500K	0
2 ORLEANS	05/08/1995	2030	Flash Flood	N/A	4	0	0	0
3 New Orleans	05/19/1997	04:00 PM	Urban/sml Stream Fld	N/A	0	0	0	0
4 New Orleans	01/05/1998	07:00 AM	Urban/sml Stream Fld	N/A	0	0	0	0
5 New Orleans	03/07/1998	08:30 AM	Urban/sml Stream Fld	N/A	0	0	0	0
6 Countywide	04/29/1998	05:00 AM	Urban/sml Stream Fld	N/A	0	0	0	0
7 New Orleans	08/21/1998	10:00 AM	Urban/sml Stream Fld	N/A	0	0	0	0
8 Countywide	09/11/1998	10:00 AM	Flash Flood	N/A	0	0	0	0
9 Countywide	08/09/1999	04:30 PM	Urban/sml Stream Fld	N/A	0	0	0K	0
10 New Orleans	06/05/2001	01:00 PM	Urban/sml Stream Fld	N/A	0	0	0	0
11 Algiers	06/07/2001	02:00 PM	Flash Flood	N/A	0	0	25K	0
12 New Orleans	06/11/2001	01:00 AM	Flash Flood	N/A	0	0	50K	0
13 New Orleans	06/21/2001	02:30 PM	Urban/sml Stream Fld	N/A	0	0	0	0
14 New Orleans	08/17/2002	12:25 PM	Urban/sml Stream Fld	N/A	0	0	0	0
15 New Orleans	08/22/2002	11:48 AM	Urban/sml Stream Fld	N/A	0	0	0	0
16 Countywide	09/25/2002	02:30 PM	Flash Flood	N/A	0	0	0	0
17 New Orleans	06/19/2003	11:30 AM	Flash Flood	N/A	0	0	150K	0
18 Countywide	06/30/2003	10:00 AM	Flash Flood	N/A	0	0	130K	0
19 New Orleans	12/21/2006	08:30 AM	Flash Flood	N/A	0	0	0K	0K
20 Vieux Carre	10/22/2007	11:15 AM	Flash Flood	N/A	0	0	0K	0K
21 Algiers	04/26/2008	03:00 AM	Flash Flood	N/A	0	0	0K	0K
22 Algiers	06/15/2008	08:30 AM	Flash Flood	N/A	0	0	0K	0K
23 Vieux Carre	06/29/2008	16:00 PM	Flood	N/A	0	0	0K	0K
24 Algiers	03/27/2009	04:45 AM	Flash Flood	N/A	0	0	0K	0K
25 Lee	09/13/2009	11:30 AM	Flash Flood	N/A	0	0	0K	0K
				TOTALS:	4	0	855K	0

Figure 18 National Climatic Data Center

One of the heaviest rain events in Orleans Parish in recent history occurred May 8-9, 1995. During this storm, as much as 17 inches of rain fell in parts of Orleans Parish over a 48-hour period. Four people drowned in this flood and one person died of a heart attack as a result of pushing his flooded car. Ultimately, $388 million in damages were documented in New Orleans by the City of New Orleans. Actual damages likely exceeded this amount.

The assets of the S&WB that may be potentially impacted by flood events are located throughout Orleans Parish. The maps on pages 20, 25, and 27 depict the scope of the Water, Sewer and Drainage systems of the S&WB. Any major flood event in the Parish has an immediate impact to S&WB systems. The current S&WB pumping system can handle 1 inch of rain the first hour and 1/2 inch per hour thereafter of rainfall.

A breakdown of damages shows how wide-spread the devastation from this flood was[6]:

- City buildings suffered an estimated $1 million in damages;
- Touro Hospital closed temporarily on May 8, 1995 as a result of the flooding;
- Charity Hospital, Mercy + Baptist Medical Center, and United Medical Center each suffered damages ranging from $50,000 to $250 million;
- Orleans Parish Prison had to move 750 inmates to the Louisiana State Penitentiary;
- Public schools suffered an estimated $9 million in damages;
- 46 of 124 schools incurred some damages;
- 11 public schools remained closed through at least May 12, 1995;
- Early estimates showed that between 10,000 and 30,000 housing units were damaged.

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

Several factors determine the severity of floods, including rainfall intensity (or other water source) and duration. A large amount of rainfall over a short time span can result in flash flood conditions. A small amount of rain can also result in floods in locations where the soil is saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs in a particular season each year, or in regions where annual flooding is derived principally from snowmelt, the floodplains may be inundated nearly every year. In areas of the

[6] All figures taken from articles that appeared in the *Times-Picayune* from May 10 to May 12, 1995.

country where flooding is caused by melting snow, and occasionally compounded by rainfall, the flood season is spring or early summer. Flooding as an effect of levee failure, as Orleans Parish suffered as a result of Hurricane Katrina, is also a hazard, but this is addressed thoroughly under the "Levee Failure" section.

Orleans Parish is more vulnerable to flooding than to any other disaster, natural or man-made. Several factors contribute to this vulnerability. First, Orleans Parish is flat. Across most of the Parish, elevations vary by a few feet at most. Thus when rain falls, it tends to pool in place. Second, most of Orleans Parish is below sea level and/or is surrounded by flood levees. Elevations below sea level combined with little slope in the topography and an extensive levee system indicates that rain water cannot flow out of the Parish but must be pumped out. This is the prime function of the S&WB's pumping network that is situated throughout Orleans Parish. New Orleans has 21 drainage pumping stations and 15 underpass pumping stations that pump water out of the city and into Lake Ponchartrain or canals. The pumps can move 1 inch of water in the first hour and ½ inch of water per hour after that. However, when heavy rain falls for an extended period, the pumps cannot keep up. A third factor that contributes to Orleans Parish's vulnerability to floods is the problem of clogged storm drains. As of March 2003, the City of New Orleans Public Works Department's list of clogged catch basins numbered 2,649. The catch basins become clogged with leaves, mud, trash and other debris, preventing the storm water from flowing into the large, underground collection boxes that are part of the storm water system. The problems mentioned above are compounded by the climate of Orleans Parish. Big rain events are fairly common in Orleans Parish and have caused much property damage in the area.

On August 29, 2005, Hurricane Katrina stuck the Gulf Coast near the Louisiana and Mississippi border. The storm, arguably the largest disaster in U. S. History, caused approximately 80% of the City of New Orleans to be flooded from rising water as a result of levee failures. Many structures had flood waters to the roof and hundreds of persons died. Considering that the flooding was the effect created by Hurricane Katrina and the levee failures, in order to avoid redundancy, this event is discussed more fully under the Previous Occurrence sections for both Levee Failure and Hurricanes.

4.3.1.3. Location

In Orleans Parish, heavy rains can occur at any time of the year, although the months with the most rain are May, June, July, and August, when tropical moisture is plentiful along the Gulf Coast. Most of Orleans Parish is subject to flood impact due to the area's topography.

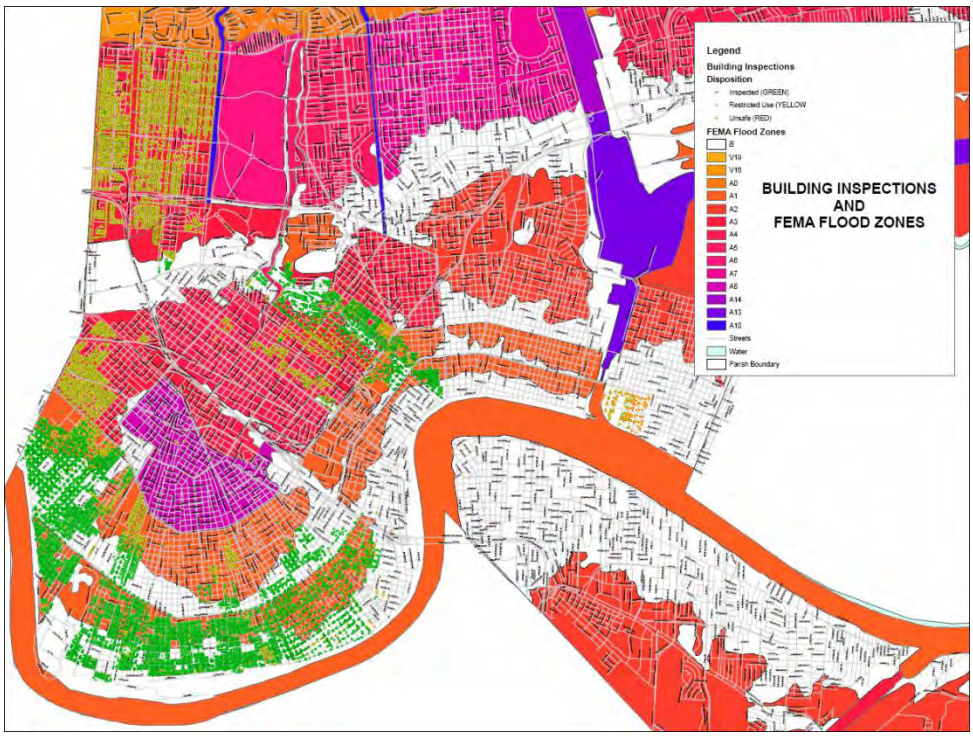


Figure 19 FEMA Flood Zones

A comparision of the maps on pages 20, 25, and 27 with the Flood Zone map in Figure 19 clearly depicts that nearly all S&WB assets are in flood risk areas.

4.3.1.4. Severity - S&WB Impact

Flood Hazard impacts to S&WB assets are generally S&WB vehicles or to building structures. After Hurricane Katrina in 2005, all S&WB pumps incurred damage either from floodwaters or wind-driven rain. The Katrina flood damages are directly related to the levee failure. The "worst case" extent of potential flooding is best illustrated by Figure 20 which shows the flood depths from Hurricane Katrina in 2005 where 80% of the City flooded. As the assets of the S&WB are distributed throughout Orleans Parish (see GIS maps on pages 20, 25, and 27) any flooding poses an impact.

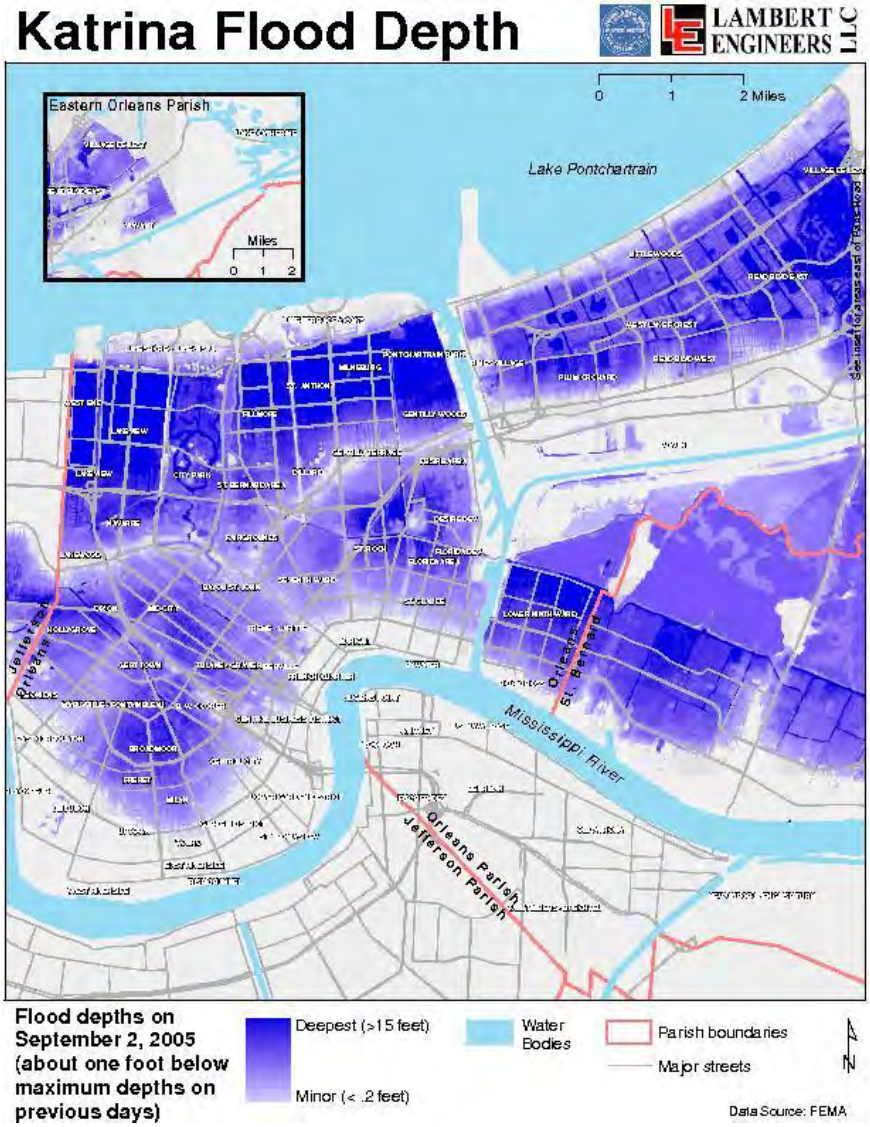


Figure 20 Katrina Flood Depth Map - FEMA

4.3.1.5. Probability

Areas that lie within the 100-year floodplain have a 1 percent chance of flooding in any given year. The areas that lie within the 500-year floodplain have a 0.2 percent chance of flooding in any given year or are protected by levees from 100-year flooding[7]. Flood probabilities are predictions and realistically there is no perfect certainty that the percentages will be exact. Floods can occur more or less frequently than the probabilities predict, especially in Orleans Parish when more than one hazard could result in flooding

The climate of the area and the topography of the Parish mean that flooding will continue to be the greatest threat to Orleans Parish for some time to come. Statistically, from the data in Figure 18, this Plan assigns a probability of a flood related event every 1.2 years. Due to the risk factors, this Plan determines that nearly all assets of the Sewerage and Water Board are at risk to the Flood Hazard.

[7] City of New Orleans Office of Emergency Preparedness

4.3.2. Hailstorm

Probability	Impact	Reoccurrence
High	Low	1.15 years

4.3.2.1. Description of hazard

Large hail results in nearly $1 billion in damage annually to property and crops in the United States. Hail is made up of spherical balls of ice. It is a product of thunderstorms or intense showers. It is generally white and translucent, consisting of liquid or snow particles encased with layers of ice. Hail is formed within the high tops of a well-organized thunderstorm. An updraft will sometimes throw rain droplets high up into the tops of a cloud. There, the temperature is well below freezing, and the droplets freeze. The droplet then falls and can become caught in another updraft. This time, a second coating of ice is added, making the hail stone larger. This cycle continues until the hailstone is too heavy to be lifted again, and it then falls as hail. The stronger the updraft, the longer the hail develops, and the bigger the hailstone is when it falls. Hail is not to be confused with sleet, which are frozen raindrops that fall during winter storms. Hail can be smaller than a pea or as large as a softball and can be very destructive to plants, cars, homes, buildings, crops, and animals. Large hailstones which fall at speeds faster than 100 mph can be very dangerous.

Rank	Date	Primary location	Loss Amount
1	5-15-98	Minn.-St. Paul, MN	$1.73 billion
2	5-5-95	Ft. Worth, TX	$929 million
3	4-19-96	Indianapolis, IN	$658 million
4	5-18-00	Chicago suburbs, IL	$572 million
5	4-25-94	Dallas-Ft. Worth, TX	$542 million
6	4-23-99	Northern Virginia	$394 million
7	7-7-00	Minn.-St. Paul, MN	$381 million
8	1-23-00	New Orleans, LA	$353 million
9	5-3-96	Louisville, KY	$339 million
10	4-16-98	Bowling Green, KY	$290 million

Figure 21 Top 10 National Hailstorm Events, 1994-2000[8]

As shown in Figure 21, on January 23, 2000, a hailstorm caused significant damage to property in the New Orleans metropolitan area. Ranging from dime to golf ball-size, the hail damaged roofs, windows, and vehicles, resulting in nearly 42,000 homeowner and 37,500 auto insurance claims at an estimated cost of $353 million. The Institute for Building and Home Safety (IBHS) identified this storm as the eighth most damaging storm in the nation in the period from 1994 to 2000.

[8]Source: IBHS 2002 Annual Conference, "Hailstorm Loss Database,"

4.3.2.2. Past occurrences

Between January 1970 and July 2004, the NCDC records that there have been 26 significant hailstorm events with hailstones greater than .75 of an inch. These include events with golf ball-sized hail in 1962, 1964, 1977, 1982, 2000 and 2002. The NCDC recorded no damage from these events within the City of New Orleans.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 ORLEANS	03/30/1972	1300	Hail	1.75 in.	0	0	0	0
2 ORLEANS	06/17/1973	1330	Hail	0.75 in.	0	0	0	0
3 ORLEANS	09/01/1974	1350	Hail	1.00 in.	0	0	0	0
4 ORLEANS	05/07/1975	2200	Hail	1.50 in.	0	0	0	0
5 ORLEANS	07/01/1977	1347	Hail	1.75 in.	0	0	0	0
6 ORLEANS	04/18/1980	1109	Hail	1.00 in.	0	0	0	0
7 ORLEANS	04/26/1982	1630	Hail	1.75 in.	0	0	0	0
8 ORLEANS	07/05/1984	1420	Hail	0.75 in.	0	0	0	0
9 ORLEANS	05/21/1985	1235	Hail	0.75 in.	0	0	0	0
10 ORLEANS	03/02/1991	1905	Hail	0.75 in.	0	0	0	0
11 ORLEANS	04/09/1991	1730	Hail	1.00 in.	0	0	0	0
12 ORLEANS	02/17/1992	0145	Hail	1.00 in.	0	0	0	0
13 ORLEANS	06/04/1992	1320	Hail	1.00 in.	0	0	0	0
14 New Orleans	04/10/1995	1951	Hail	0.75 in.	0	0	0	0
15 Newellton	10/27/1995	1645	Hail	1.75 in.	0	0	0	0
16 (new)lkfrnt Arpt New	04/14/1996	12:06 PM	Hail	0.75 in.	0	0	0	0
17 (new)lkfrnt Arpt New	07/28/1996	12:00 PM	Hail	0.75 in.	0	0	0K	0K
18 New Orleans	01/24/1997	12:45 PM	Hail	0.88 in.	0	0	0	0
19 New Orleans	03/29/1997	03:55 PM	Hail	1.50 in.	0	0	0	0
20 (new)lkfrnt Arpt New	06/21/1998	04:15 PM	Hail	0.75 in.	0	0	0	0
21 New Orleans	01/23/2000	11:03 PM	Hail	0.75 in.	0	0	0	0
22 Algiers	01/23/2000	11:12 PM	Hail	1.00 in.	0	0	0	0
23 New Orleans	06/21/2001	02:23 PM	Hail	0.88 in.	0	0	0	0
24 New Orleans	05/30/2002	11:35 AM	Hail	0.75 in.	0	0	0	0
25 New Orleans	02/04/2004	10:30 PM	Hail	1.75 in.	0	0	0	0
26 New Orleans	07/08/2004	01:36 PM	Hail	0.75 in.	0	0	0	0
				TOTALS:	0	0	0	0

Figure 22 New Orleans Hailstorms > .75 inch 1969-2009 - NCDC

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

Based on available LOCAL data, in January 2000, Orleans Parish experienced a storm that brought some of the largest hail ever recorded in the area. Hail 1.75 inches in diameter fell over a swath of New Orleans that was 5 miles long and 1 mile wide.

The hailstorms of 2002 caused damage to an outside overhead crane at DPS #6. The primary damage to the crane was fiberglass insulators that covered the electrical power track. Over 300 feet of fiberglass insulation damaged or destroyed by the large hail. The cost to replace the fiberglass insulation in labor and material was over $15,000. This damage is indicative of impact from the hailstorm hazard. The impact will be non-systemic and generally handled as ordinary repairs and maintenance.

4.3.2.3. Location

Due to the nature of hailstorms, all of the S&WB service area is subject to this hazard event. Hailstorms generally occur more frequently during the late spring and early summer, a period of extreme variation between ground surface temperatures and jet stream temperatures, producing the strong updraft winds needed for hail development.

4.3.2.4. Severity

Property damage is the primary result of a hail storm. Damage to roofs, windows, and vehicles would be the primary impact of a hail storm. Historical hail storm data indicates that the impact of a hailstorm results in an averages loss of 1% of the value of the structures in the hazard area, which is assumed to be 5% of all structures. Hail is not considered a major threat to the lives of the population in Orleans Parish.

4.3.2.5. Probability

The State of Louisiana's Hazard Profile indicates that Orleans Parish has had fewer than 50 hail events per year between 1950 and 2007. There is a 0.10% probability of hail of any size in any given year in Orleans Parish, according to the State of Louisiana Hazard Profile.

4.3.3. Hazardous Materials

Probability	Impact	Reoccurrence
Low	High	frequent

4.3.3.1. Description of hazard

Orleans Parish faces the threat of a hazardous material spill/accident from a variety of sources. The Parish has many facilities that use or store toxic chemicals. A leak at one of these facilities could cause health problems for residents, property damage, and economic losses due to downtime at businesses that are evacuated. New Orleans also faces threats from chemicals transported through the city on highways, railways, and waterways. Interstate 10, a major east-west corridor, runs through New Orleans. Because of its proximity to several major ports (including Jacksonville, New Orleans, Houston, Los Angeles), I-10 serves as a major transportation route for may freight trucks. Six major freight rail companies operate in the New Orleans area, including Illinois Central, CSX, Norfolk Southern, Kansas City Southern, BNSF, and Union Pacific. Many toxic chemicals are transported by rail through New Orleans routinely. New Orleans also has an extensive system of navigable waterways, including the Mississippi River and the Industrial Canal. A significant amount of industrial chemicals transported on the nation's inland waterway system pass through the New Orleans Industrial Canal. There is reason to believe that chemicals are also traveling on the City's streets as part of the intermodal transportation of these products and the many types of transportation available in the city. As the S&WB network is spread throughout the City, hazardous materials incidents pose a threat to that network.

The Carrollton Plant and the Algiers Plant of the Sewerage & Water Board of New Orleans are home to the potable water treatment facilities for the East and West banks of Orleans Parish. These plants employ personnel in the following areas: Facility Maintenance, Pumping and Power, Engineering, Training, Laboratory, and Water Purification. The Water Purification Department is responsible for the safe handling of the hazardous chemicals stored and unloaded at the plants. Both facilities are located in residential neighborhoods. The Carrollton plant property borders the Jefferson/Orleans parish line, while the Algiers Plant is near the Gretna/Orleans parish line. Therefore a chemical release could potentially affect residents of two parishes.

The Carrollton Water Plant, Algiers Water Plant, East Bank Sewer Treatment Plant and West Bank Sewer Treatment Plant have the following hazardous chemicals on site.

Sodium Hypochlorite	Currently switching Algiers and Carrollton facilities from Chlorine to Sodium Hypochlorite. The Algiers plant has two 6,000 gallon bulk storage tanks and three chemical metering pumps. The Carrollton Plant currently (as of Feb 2010) has a temporary storage facility consisting of three 10,000 gallon storage tanks and two centrifugal chemical pumps. The Carrollton Plant will have eight 15,000 gallon storage tanks and five metering pumps when the permanent hypochlorite facility is complete.
Chlorine	The West Bank Treatment Plant uses 1 ton cylinders of chlorine and is operated by a private firm. The Carrollton Plant receives chlorine in 55-ton rail cars. The rail cars are used as the storage vessel. Chlorine is taken directly out of the rail car, vaporized, and fed into the process. There are no bulk storage facilities for chlorine at Carrollton. There are typically 2-3 55-ton rail cars on site at the Carrollton Plant. The East Bank Sewage Treatment Plant also uses 55 ton rail cars of chlorine, with 1 rail car at the plant at a time.
Anhydrous Ammonia	Both facilities receive ammonia by tank truck. The Carrollton Plant has a 10,000-gallon bulk storage tank and the Algiers Plant has a 1,000-gallon bulk storage tank. The Carrollton bulk tank is located between the Engineering Building and the Head House. The Algiers bulk tank is located near the Head House. Ammonia is used in conjunction with the chlorine to provide residual disinfection for the potable water supply.

Small Hazardous Material spills that are internal to the S&WB are handled within the response protocols in S&WB's EOP and 29 CFR 1910.120(q). These are localized events with no systemic impact.

External hazardous materials events can take the form of an oil spill in the Mississippi River. Similar to the Salt Water Intrusion hazard in Section 4.3.7, oil (or other contaminants) that enter the water intakes can pose significant systemic impacts to the S&WB water system. Testing of water from the intakes is conducted regularly and existing plans cover water shutdown and contingency events.

The S&WB response may include the mobilization of activated carbon and oil absorbent booms at the water intakes and within the water plants themselves. Additional testing of the raw water may also be required. Where possible all costs are recovered from the offending party, such as the barge and/or shipping company found negligent and liable for the spill.

4.3.3.2. Past occurrences

During a six month period of 2003, the NOFD HazMat unit responded to 131 hazardous materials calls that could be classified as "localized" incidents. This level of activity is fairly "typical" for this hazard.

In 1987, a railcar filled with butadiene spilled, ignited, and exploded in a Gentilly neighborhood. A total of 19,000 residents were evacuated from their homes for three days as the fire burned. No one was killed in the incident, but many residents complained of respiratory ailments and other health problems.

There have been two recent occurrences of a hazardous materials event that have impacted S&WB assets. There have been oil spills in the Mississippi River on July 23rd, 2008 and October 28th, 2008. The total costs recovered by S&WB for these events were $93,400 and $6,294 respectively.

The July 23rd, 2008 New Orleans oil spill was an oil spill that occurred when No. 6 fuel oil was spilled into the Mississippi River after a tanker collided with Barge DM932 being pulled by a tugboat upriver

near the Crescent City Connection. Although early estimates stated approximately 400,000 gallons (1,514,164 liters) of the fuel oil was spilled into the river, subsequent estimates by the Office of Response and Restoration of the National Ocean Service placed the spill at approximately 280,000 gallons. The incident required shutting down the Algiers water intake for several hours. The S&WB monitored USCG operations and participated in the operations planning.

Figure 23 Barge DM932 bow section being removed from the Mississippi

On May 11th, 2008, a malfunction at the River One intake caused the overflow of an underground tank. Ferric Sulfate was released and the S&WB utilized a hazmat contractor for cleanup. No impact to life, property or operations was involved. This is typical of the several dozen events for this hazard between 1998 and 2008. Smaller hazardous material events such as the May 11th, 2008 event occur somewhat frequently. These events are either handled as ordinary maintenance (as exampled by sewage overflows) or involve cost recovery from a third party.

There are numerous fuel spills to city streets and occasional hazardous material spills to the streets that require a response from the S&WB to protect and clean storm drain lines. Any material spilled to the storm drainage system has potential to be pumped out to a receiving stream and demands that S&WB forces properly respond to any such incidents.

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

4.3.3.3. Location

Though hazardous materials events can occur anywhere, the most significant form of this threat is focused on the water intakes for the Algiers and Carrollton water purification plants which purify raw water from the Mississippi River and supply potable water to the City's residents.

Figure 24 Carrollton Water Purification Plant

Figure 25 Algiers Water Purification Plant

4.3.3.4. Severity

The water quality laboratory conducts daily analyses of the river water quality and purified water. Water samples from the distribution network are also analyzed regularly. The lab continues to meet the mandated analytical requirements of the water plants and is certified by the Louisiana Department of Health and Hospitals for analysis of coliform bacteria.

The severity of this hazard is depended on the specific location, type of material and amount of material involved. Hazardous Materials events pose the risk of contaminants entering into the potable water systems of the S&WB. Though little risk to public health exists due to regular and extensive testing, the potential impact to residents and businesses remains as a result of a disruption of the water supply.

New Orleans' vulnerability to chemical accidents along transportation routes is more difficult to gauge because hazardous chemicals are not located at a fixed site and because many different chemicals are transported through New Orleans.

The potential to shutdown the potable water system and use alternate sources of potable water remain the most significant potential impact and cost. The lack of usable water in the City could necessitate large scale evacuations. Large buildings would require evacuation due to the potential of increased fire hazard. The impact of this hazard is dependent on the length of time of an outage to the water supply. A complete disruption to water intakes or treatment plants represents a cost beyond measure. No capability exists for alternate water supplies. It is important to note that there are currently no viable alternative water sources, nor a viable plan to transport water into the region. In the event of a systemic failure, alternatives are technically. logistically or financially outside of the realm of possibility.

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or sensitive infrastructure components.

4.3.3.5. Probability

Given the traffic on the Mississippi River dedicated to chemical and/or oil transport, the potential probability of external incidents is significant. On average, the State of Louisiana receives about 5,000 reports of accidental hazardous materials spills annually. Most accidental releases have occurred while chemicals were being transported along major highways. Orleans Parish will continue to experience accidental hazardous materials spills on a regular basis.

4.3.4. Hurricane / Tropical Cyclone / Coastal Storms

Probability	Impact	Reoccurrence
High	High	3.73 years

4.3.4.1. Description of hazard

Hurricanes are tropical cyclones that have maximum sustained winds of at least 74 miles per hour. In addition to strong winds, they are capable of producing heavy rains, high waves, and storm surges. Orleans Parish is threatened by hurricanes that develop in the Atlantic Ocean and the Gulf of Mexico. The greatest threat to Orleans Parish comes during the Atlantic Ocean/Gulf Hurricane season, which runs from June 1 to November 30. Hurricanes generate several hazards that can cause extensive damage. High winds, large amounts of rainfall, tornados and storm surge are all associated hazards. Storm surge, a dome of water pushed ashore by a hurricane, is commonly the greatest threat to property and human life. The area's low elevations and network of levees make it especially vulnerable to the surge of a hurricane. The effects of a strong hurricane can be catastrophic to any location, however, New Orleans is especially vulnerable because of the threat to a system of levees that channel and hold the waters of canals, Lake Pontchartrain and the Mississippi River. This specific hazard is discussed thoroughly under the "Levee Failure" section.

The impact of tropical storms and tropical depressions can be as devastating as hurricanes due to the heavy rains and resultant flooding.

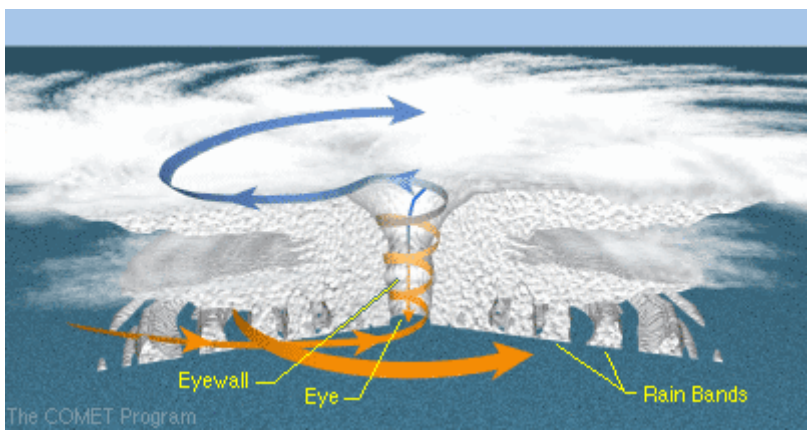


Figure 26 Hurricane Structure

Hurricanes, Tropical Cyclones and Coastal Storms also serve as causative factors for other hazards, notably Floods, Storm Surge, and Levee Failure.

4.3.4.2. Past occurrences

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

New Orleans has been affected by numerous hurricanes throughout its history. Since 1965, five hurricanes have caused enough damages that the Parish was declared a disaster area: Hurricane Betsy in 1965 (category 3), Hurricane Camille in 1969 (one of only two category 5 hurricanes to ever make landfall in the U.S.), Hurricane Juan in 1985 (category 1), Hurricane Andrew in 1992 (category 3 when it made landfall in Louisiana), Hurricane Georges in 1998 (category 3), Hurricane Katrina in August 2005 (category 3 at landfall, and Hurricane Rita in September 2005 (category 3). Many other hurricanes and tropical storms have caused damages in Orleans Parish due to heavy rains or high winds.

The following graphic displays hurricanes that passed within 65 nautical miles of New Orleans between 1879 and 2008.

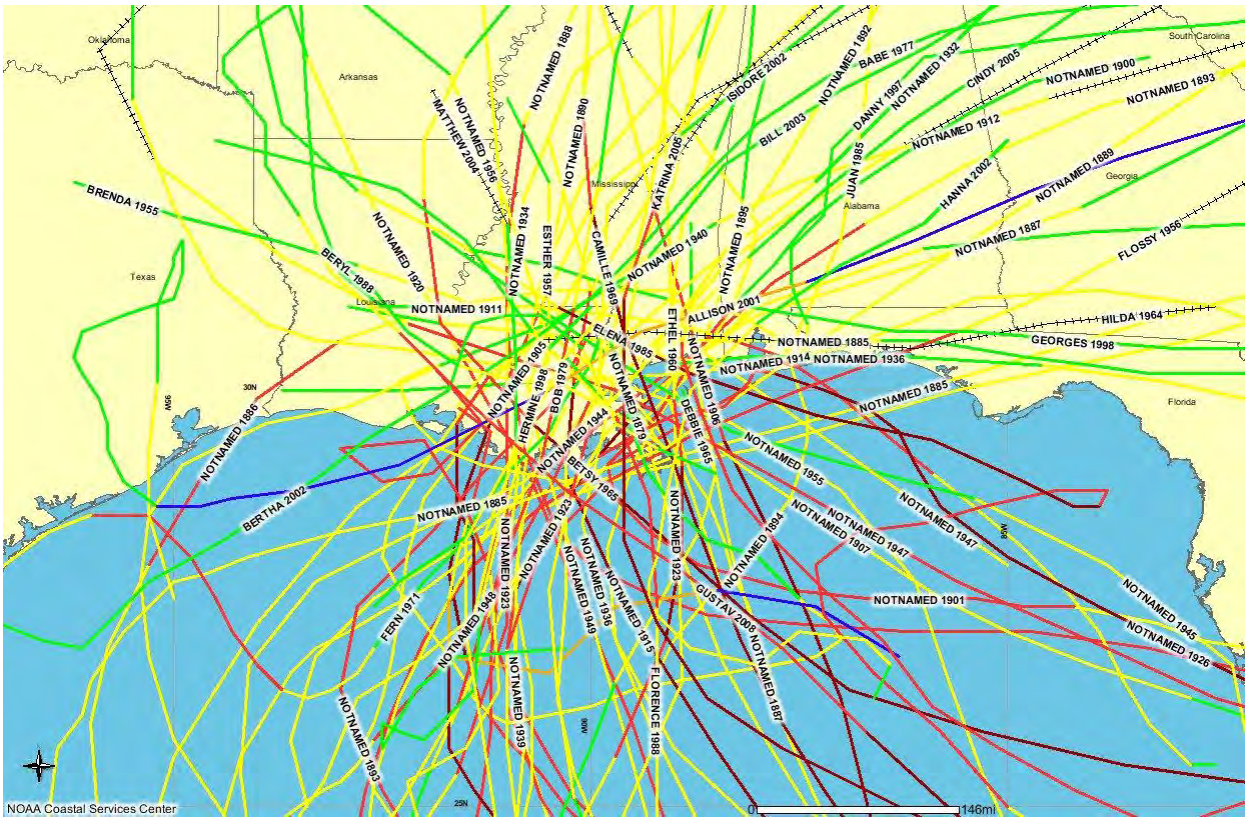


Figure 27 Hurricanes within 65 nautical miles of New Orleans 1879-2008 - NOAA

Statistically, the City gets brushed or hit directly an average of every 3.73 years and averages a direct hit every 12.55 years.[9]

Figure 28 Hurricanes within 65 nautical miles of New Orleans 1990-2008 – NOAA

The following table identifies the 9 NOLA Presidential Declarations related to tropical events in the last 8 years and the costs incurred to the S&WB for associated damages.

Year	Date	Name/Desc	Cost[10]	Active[11]	Disaster Number
2005	24-Sep	Hurricane Rita		X	1607
2005	29-Aug	Hurricane Katrina	$629,873,665	X	1603
2005	23-Aug	TS Cindy			1601
2004	15-Sep	Hurricane Ivan	$1,516,118		1548
2002	3-Oct	Hurricane Lili	$1,472,072		1437
2001	27-Sep	TS Isidore	$941,469		1435
2001	11-Jun	TS Allison	$189,100		1380
1999	9-Apr	Severe Storms, Tornadoes and Flooding			1269
1998	23-Sep	TS Frances Hurricane George			1246

Figure 29 NOLA Presidential Declarations 1998-2005 – Sewerage & Water Board

[9] Hurricane City - http://www.hurricanecity.com/city/neworleans.htm
[10] Cost represents total damage expenses for S&WB assets
[11] This event is still in active mode at the time this Plan was written

The NCDC lists 16 Hurricanes or Tropical Storms that impacted New Orleans between 1969 and 2009.

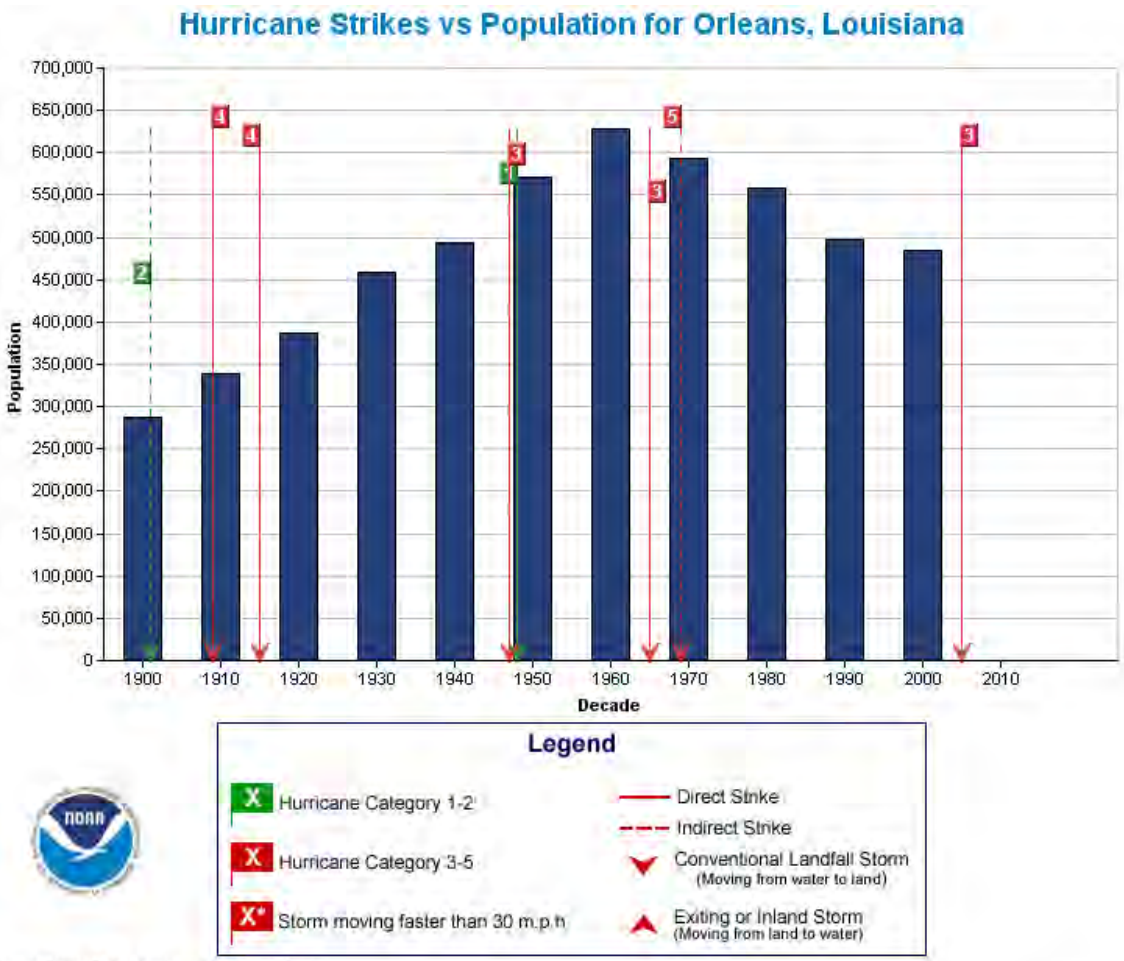
Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Southeast Louisiana	10/04/1995	2400	Hurricane Opal	N/A	0	0	200K	0
2 LAZ061>064 - 066>070	07/17/1997	09:00 AM	Hurricane	N/A	0	0	5.0M	0
3 LAZ038 - 040 - 058>070	09/10/1998	03:00 PM	Tropical Storm	N/A	0	0	31.5M	0
4 LAZ040 - 058 - 060 - 062 - 066>070	09/19/1998	12:00 PM	Tropical Storm	N/A	0	0	0K	0
5 LAZ038>040 - 058>070	09/27/1998	12:00 PM	Hurricane	N/A	0	0	30.1M	0
6 LAZ038 - 040 - 058 - 060>064 - 069>070	08/04/2002	06:00 PM	Tropical Storm	N/A	0	0	50K	0
7 LAZ040 - 058 - 060>064 - 068>070	09/14/2002	12:00 AM	Tropical Storm	N/A	0	0	0	0
8 LAZ038 - 040 - 049>050 - 057>060 - 062>070	09/25/2002	10:00 AM	Tropical Storm	N/A	0	0	108.6M	0
9 LAZ034>040 - 046>050 - 056>070	10/02/2002	06:00 PM	Hurricane	N/A	0	0	149.6M	0
10 LAZ038>040 - 050 - 058>070	06/30/2003	06:00 AM	Tropical Storm	N/A	0	0	34.0M	0
11 LAZ040 - 058>070	09/15/2004	10:00 AM	Hurricane/typhoon	N/A	0	0	11.8M	0
12 LAZ038 - 040 - 050 - 058>070	10/09/2004	03:00 PM	Tropical Storm	N/A	0	0	50K	0
13 LAZ038>040 - 050 - 058>070	07/05/2005	03:00 PM	Hurricane/typhoon	N/A	0	0	47.5M	0
14 LAZ040 - 061>064 - 068>070	07/10/2005	04:00 AM	Tropical Storm	N/A	0	0	0	0
15 LAZ034>040 - 046>050 - 056>070	08/28/2005	11:00 AM	Hurricane/typhoon	N/A	0	0	16.9B	0
16 LAZ034>038 - 040 - 046>050 - 056>070	09/23/2005	07:00 AM	Tropical Storm	N/A	0	0	48.0M	0
				TOTALS:	0	0	17.396B	0

Figure 30 Hurricanes and Tropical Storms 1969-2009 (NCDC)

4.3.4.3. Location

All of Orleans Parish is vulnerable to the effects of tropical storms and so all the assets of the S&WB are subject to this hazard.

The population of the Greater New Orleans (GNO) area is highly vulnerable to the impact of tropical storms and hurricanes. Economic and population issues exacerbate the impact of the hazard. Large segments of the population are impacted as shown in Figure 31.



Hurricane Strike Data: National Hurricane Center
Population Data: U.S. Census Bureau
NOTE:Population values may be missing in some counties, particularly for earlier periods. This is most often attributable to the fact that the county had not yet been established.
NOTE:There may be discrepancies between the strike data shown in this chart and the HURDAT strike data used in the Historical Hurricanes Tracks Tool. The National Hurricane Center is currently updating the strike data used for these charts. For more information visit http://www.aoml.noaa.gov/hrd/data_sub/re_anal.html
NOTE:Population data is current as of 2000 U.S. Census. X-axis on graphs depict years through 2010 to illustrate storms that have occurred from 2000-2006.

Figure 31 Hurricane Strikes vs. Population for New Orleans - NOAA

4.3.4.4. Severity

The strength of hurricanes is measured using the Saffir-Simpson scale (Figure 32). This scale classifies a hurricane based on its maximum sustained winds and describes typical damage for each category.

Category	Winds (mph)	Typical Damage	Examples
Tropical Depression	<39	Minimal	
Tropical Storm	39-73	Minimal though heavy rains and/or slow moving storms can cause significant flooding to low lying areas and flood zones.	Fay 2008
1	74-95	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.	Hanna 2008, Gaston 2004
2	96-110	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.	Juan 2003, Erin 1995
3	111-130	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain may be flooded well inland.	Jeanne 2004, Katrina 2005, Bertha 2008
4	131-155	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.	Charley 2004, Ike 2008
5	156+	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline.	Camille 1969, Andrew 1992, , Felix 2007

Figure 32 Saffir-Simpson Hurricane Scale

The winds associated with a hurricane cause many devastating effects. In addition to causing wind-blown related structural damage, winds increase the storm surge as they grow stronger. A category 1 hurricane with winds 74-95 mph may have storm surge of 4-5 feet above normal. A category 3 hurricane (winds 111-130) generally has a storm surge of 9-12 feet. A category 5 storm (winds greater than 155) could have storm surge 18 feet or more above normal. Generally, the higher the storm surge, the further inland flooding will spread and the greater the destruction. Other factors impact the severity of the storm surge. Topography of both the affected land mass and the floor of the body of water can greatly increase the extent of the surge. Generally, the flatter the land masses and the floor of the body of water are, the greater the surge and devastation. The topography of the land masses and bodies of water (Gulf of Mexico, Lake Borgne and Lake Pontchartrain) that surround Orleans Parish are generally flat.

Additionally, wind direction impacts the storm surge. The winds on the right side of the eye of a hurricane are the strongest, therefore land masses and urban areas on that side of the storm will experience greater storm surge. Orleans Parish is extremely vulnerable simply because it is not only near the Gulf of Mexico; it also has two massive, relatively flat, and shallow lakes adjacent to it, Lake Pontchartrain and Lake Borgne. These bodies of water can all have a significant surge impact (see Storm Surge, Section 4.3.9) on New Orleans.

Property damage associated with hurricane force winds increases greatly with the wind strength of the hurricane. A category 1 storm may cause little or no damage to permanent buildings. Most damage will be to mobile homes, trees, shrubs and signs. A category 3 storm will cause some structural damage to homes, down trees, and destroy signs. Winds from a category 5 storm will be devastating to buildings. There will be complete roof failure on many residences and commercial buildings.

The severity of these storms related to S&WB assets are dependent on the strength, duration and rainfall of the storm. There are approximately 22 pump stations in Orleans Parish with a total capacity exceeding 45.000 cfs. All stations were damaged by Hurricane Katrina (2005) either by floodwater and/or wind driven rain water. Katrina made landfall in Louisiana on August 29, 2005, as an upper level Category 3 hurricane on the Saffir-Simpson Hurricane Scale with sustained winds of 125 mph (201 km/h) and higher gusts, at 6:10 a.m. CDT near Buras-Triumph in Plaquemines Parish, Louisiana.

When Hurricane Katrina flooded the pump stations and the Wood screw pump motors[12], the brackish and polluted water remained in some stations for many. This water damaged wire, bearings and insulation. Corrosion quickly developed at contact points and connections and electrical insulation became saturated with the water. Some of the damaged equipment was washed and dried out only to fail later due to damage caused by the polluted water. Some equipment was able to be replaced from off the shelf components. Crews were brought in on an emergency basis to rewind the large motors in place as they could not be moved. Other equipment, including the pump drivers, was cleaned, dried and field tested to ensure that most moisture was essentially baked out of the insulation.

If a Katrina level of flooding occurs from future events, the S&WB can expect similar but lesser damages as the large motors were rewound using different materials that will withstand polluted water. Where it was economically feasible some equipment was raised to prevent damage from future flooding.

The following table identifies repair efforts required by the drainage pumping stations immediately after Hurricane Katrina.

[12] See Appendix 3 for a description of the Pump Stations

Meto Orleans East Bank	Cost ($)	Average Annual Cost ($)	Average Annual Benefits ($)	Net Benefits ($)	B/C Ratio	Federal Cost ($)	Non-Federal Cost ($)
Drainage Pump Station #3	2,410,000						2,410,000
Drainage Pump Station #4-London Avenue	473,000						473,000
Drainage Pump Station #19-W. of Indust. Canal	702,000						702,000
Drainage Pump Station #2	2,759,000						2,759,000
Drainage Pump Station #7-Orleans Avenue	1,074,000						1,074,000
Drainage Pump Station #12	128,000						128,000
I-10 Underpass Drainage Pump Station.	298,000						298,000
Drainage Pump Station #6-17th Street	2,494,000						2,494,000
Drainage Pump Station #1-Broad Street	2,080,000					2,080,000	
Monticello Drainage Pump Station	6,000						6,000
Pritchard Place Drainage Pump Station.	16,000					16,000	
Drainage Pump Station #17-Station D	7,492,000						7,492,000
Carrolton Frequency Changer	2,585,000						2,585,000
Subtotal	22,517,000	1,258,000	16,320,000	15,062,000	13	2,096,000	20,421,000
Lower Ninth Ward							
Drainage Pump Station #5-E. of Indust. Canal	1,670,000	93,000	193,000	100,000	2.1	0	1,670,000
Lower Algiers/English Turn							
Drainage Pump Station #11	2,780,000	155,000	8,781,000	8,626,000	56.7	0	2,780,000
Algiers							
Drainage Pump Station #13	2,990,000	167,000	4,821,000	4,654,000	28.9	0	2,990,000
New Orleans East							
Drainage Pump Station #10-Citrus	3,770,000						3,770,000
Drainage Pump Station #14-Jahncke	1,220,000						1,220,000
Drainage Pump Station #16-St. Charles	1,020,000						1,020,000
Drainage Pump Station #20-Amid	2,062,000						2,062,000
Grant Drainage Pump Station	274,000						274,000
Elaine Drainage Pump Station	573,000						573,000
Drainage Pump Station #18-Maxent	1,000						1,000
Drainage Pump Station #15-Michoud	756,000						756,000
Subtotal	9,676,000	540,000	4,046,000	3,506,000	7.5	0	9,676,000
Total	39,633,000	2,213,000	34,161,000	31,948,000	15.4	2,096,000	37,537,000

Figure 33 Estimated Katrina Repair Costs for Pumping Stations – New Orleans PIR – USACE – April 2006

Due to the critical nature of drainage systems for the City and the added importance of water and sewer systems, the impact of a major hurricane event on S&WB assets can be catastrophically high. Much of the impact is the same for flood, levee failure and storm surge hazard events.

Hurricane wind damages account for damaged roofs to facilities, power poles down and facility windows blown in. Generator #3 at the Carrollton Water Plant was damaged in Katrina due to rain water getting in thru blown out windows.

Nearly $2,000,000 was required to repair/replace downed power poles for the S&WB power system. Power interruptions are a common occurrence during any tropical weather event.

Hurricane Katrina was indicative of potential damages from a "major" hurricane. Similar but lesser levels of impact can be expected from less intense tropical systems.

4.3.4.5. Probability

Based on historical data, statistically the City gets brushed or hit directly an average of every 3.73 years and averages a direct hit every 12.55 years.

A key probability indicator for hurricane activity is that of "Return Periods". Hurricane return periods are the frequency at which a certain intensity or category of hurricane can be expected within 75 nm (86 statute miles) of a given location. In simpler terms, a return period of 20 years for a Category 3 or greater hurricane means that on average during the previous 100 years, a Category 3 or greater hurricane passed within 75 nm (86 miles) of that location about five times. We would then expect, on average, an additional five Category 3 or greater hurricanes within that radius over the next 100 years.

The Return Period data is produced by the National Hurricane Center Risk Analysis Program (HURISK) by Charles Neumann. The basic idea is that a population of tropical cyclones falling within the 65 nm (75 miles) circle is obtained from the best-track file. For that set of storms, the maximum wind within the circle is found. Then, a count is conducted to find how many systems had winds of 30-34 kt, 35-39 kt etc. Once the count is known, a function is used to "fit" the distribution. Since there are only a few intense tropical cyclones typically in the 100-year record for a particular site, the mathematical function helps to smooth this out and "fill in the holes". The smooth function is then used to estimate the number of systems that would occur over a longer time period. We would expect that if we actually had a much longer historical record (several centuries) that the number of extreme events (i.e., category 5 hurricanes) observed would roughly match our estimates based on the shorter period of record.

The following images in Figure 34, graphically presents the HURISK datasets.

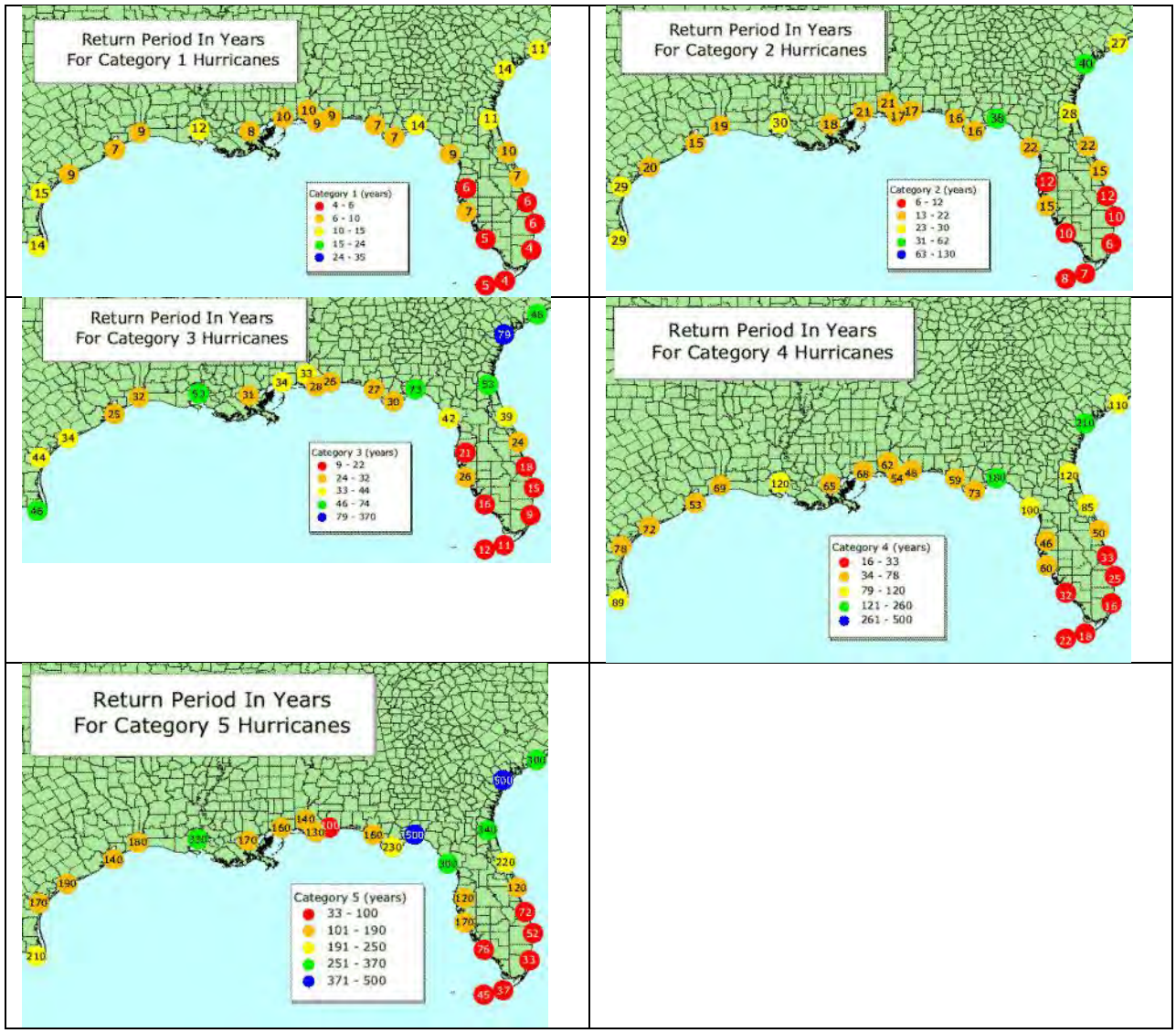


Figure 34 HURISK - NHC

Though Hurricane forecasting is still an inexact science, the historical trends and current research clearly demonstrate that the New Orleans region and the S&WB service network is at extremely high risk for tropical events.

4.3.5. Levee Failure

Probability	Impact	Reoccurrence
Low	High	Rare

4.3.5.1. Description of hazard

Levees play a vital role in protecting Orleans Parish. A failure of any of these levees will dump water into Orleans Parish and endanger not only property, but human and animal life. New Orleans sits in a shallow "saucer" with much of the City below sea level. This further increases the risks and potential for catastrophic losses because incoming water would rise as the "saucer" fills.

Man-made levees can fail in a number of ways. The most frequent (and dangerous) form of levee failure is a breach. A levee breach is when part of the levee actually breaks away, leaving a large opening for water to flood the land protected by the levee. A breach can be a sudden or gradual failure that is caused either by surface erosion or by a subsurface failure of the levee. Levee breaches are often accompanied by levee boils, or sand boils. A sand boil occurs when the upward pressure of water flowing through soil pores under the levee (under seepage) exceeds the downward pressure from the weight of the soil above it. The under seepage resurfaces on the landside, in the form of a volcano-like cone of sand. Boils signal a condition of incipient instability which may lead to erosion of the levee toe or foundation or result in sinking of the levee into the liquefied foundation below. Complete breach of the levee may quickly follow.

Sometimes levees are said to fail when water overtops the crest of the levee. Levee overtopping can be caused when flood waters simply exceed the lowest crest of the levee system or if high winds begin to generate significant swells in the ocean or river water to bring waves crashing over the levee.

The Lake Pontchartrain and Vicinity project employed generations of USACE (US Army Corp of Engineers) employees and contractors at an estimated total cost of more than $500 million, while consuming nearly $200 million in state and locally generated funds. Prior to Katrina, it was estimated to be about 85 percent constructed, but was not expected to reach completion until 2015. A similar West Bank and Vicinity project had been initiated on the other side of the river in 1986 after serious flooding associated with Hurricane Juan.

The West Bank HPS (Hurricane Protection System) was expected to cost $330 million, again with a 35 percent local cost share, and was only 38 percent built prior to Katrina. Though it started much later, it was scheduled to be completed only a year after the east bank HPS. This much less capable system was not tested in 2005 to the same degree as the east bank HPS.

The pre-Katrina combined cost estimate to complete the east and west bank GNO hurricane protection systems, a total of about $1 billion, can be compared with costs recently compiled by the USACE for emergency repairs to the two projects since Katrina, and with estimates of additional expenditures necessary to achieve a more realistic 100-year level of protection. Emergency repairs carried out by USACE contractors in the year since Katrina to return the GNO levees and floodwalls to the pre-storm condition have cost between $400 and $600 million, if the interim lakeshore drainage canal closures are

included. The repaired HPS still provides a substantially lower level of protection than that originally authorized in 1965.

Figure 35 illustrates the protective Levee System around New Orleans.

Figure 35 New Orleans Levee System

It is important to note in this Plan that a Levee Failure does not generally have any occurrence outside of another hazard event (i.e. Tropical Storm/Hurricane). It is due to the devastating nature of this failure that it is included as a separately addressed hazard.

4.3.5.2. Past occurrences

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

Prior to Hurricane Katrina there is no record of a systemic Levee failure with impact to the S&WB.

On August 29, 2005, Hurricane Katrina, a powerful category 3 storm at landfall, hit the Gulf Coast near the border of Louisiana and Mississippi. It initiated what has been called the greatest disaster in U.S. history due to a series of catastrophic effects. One effect was that the City of New Orleans flooded as a result of several levee breaks that occurred during or soon after the storm hit. Even though the causes of the breaks are under investigation by several entities, most certainly the powerful storm surge, strong winds and excess water contributed to the levee failures. Additionally, once the water dumped into Orleans Parish, there was no expeditious way for it to be removed other than by pumping it out. As a result, the flood waters remained in Orleans Parish, as well as neighboring parishes, for several weeks causing catastrophic damage to businesses, residences, vehicles and infrastructure. Over one thousand persons died in Louisiana as a result of the effects created by Katrina and a large number of them perished in Orleans Parish as a direct result of rising water from the levee breaks.

As the storm passed through the New Orleans area, the first levee break was reported on the Industrial Canal near the Orleans and St. Bernard Parish Line. This break permitted the waters from the canal to pour into the 9th Ward. Following the report of a break on the Industrial Canal, it was reported that the 17th Street Canal had been compromised and that a levee wall had failed. The 17th Street Canal connects to Lake Ponchartrain and is on the border between Orleans and Jefferson Parishes. The break on this canal was on the Orleans Parish side. Then in addition to the 9th Ward, water was dumping into Orleans Parish from the west and flooding homes, businesses, vehicles, infrastructure and endangering lives of humans and animals. Water from the 17th Street Canal moved into portions of Lakeview, Mid-City, Carrollton, Uptown, the Central Business District and the French Quarter. There were more than 50 breaches of the levee system including the London Avenue Canal and water moved into most parts of the City. Generally, only the areas nearest the Mississippi River where there were some elevated areas near or above sea level were spared.

The levee breaches stranded survivors on roof tops and in attics who had to be rescued by helicopters and boats. Many citizens, who were trapped in attics and unable to escape, died from drowning or other disaster related causes. The Orleans Parish infrastructure was devastated. Roads and bridges were damaged, electricity and gas lines destroyed and water mains disrupted. It was estimated that 75-80% of Orleans Parish properties, over 100,000, received some flood damage from the compromised levees. The monetary cost to taxpayers, insurance companies and Orleans Parish citizens has been estimated to

be between 50-100 billion dollars. Hundreds of thousands of Orleans Parish residents had to abandon their flooded homes and relocate to other areas of the country that were then in turn impacted by the homeless New Orleans residents. Some citizens will never return to Orleans Parish. The economic and social climate of Orleans Parish was severely altered. The Parish's revenue sources, largely dependent on the tourism industry, were devastated and will take a long time to recover. Following the levee breaks and subsequent flooding, civil unrest broke out and looting became rampant. The New Orleans Police Department and other public service departments were devastated with the loss of vehicles and other equipment items needed to perform their duties.

Shortly after Hurricane Katrina, Orleans Parish again suffered the effects of water pouring through a levee break. On September 23, 2005, as powerful Hurricane Rita prepared to make landfall at the border of Texas and Louisiana, surging water began pouring through the previously damaged Industrial Canal wall. Once again the 9th Ward flooded with some areas under as much as 8 feet of water.

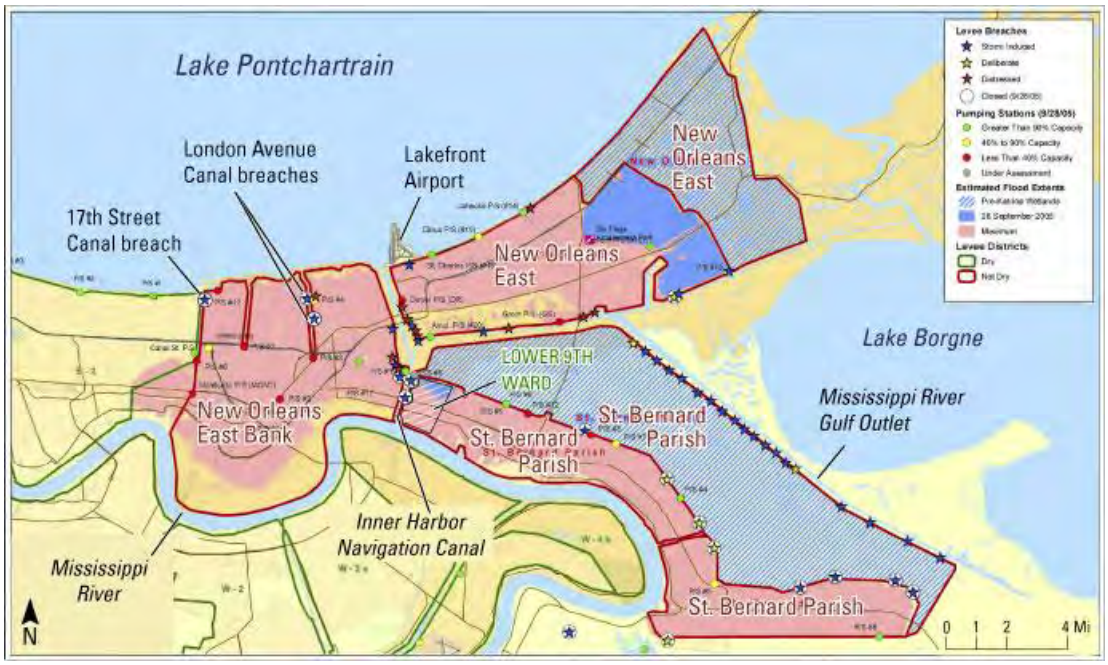


Figure 36 Locations of places and levee breaches - NOAA

Figure 37 Industrial Canal breach area August 31, 2005 (NOAA)

4.3.5.3. Location

A complex system of levees hold back waters that are designed to keep Orleans Parish safe from Lake Ponchartrain, the Mississippi River and a network of canals that are used for drainage and industrial purposes. A breach of one or more levees would cause massive flooding in Orleans Parish. Due to the scale and scope of possible flooding from a Levee Failure the entire S&WB service area is subject to the impact of this hazard. Additionally, much of New Orleans is below sea level and once a breach of a levee occurs, it becomes very difficult, time consuming and costly to remove the water from the affected area. Effected structures and infrastructure may remain submerged in flood waters for lengthy periods of time until the breach can be repaired and the water pumped from flooded areas. A breach in any levee is possible at any time from either natural or manmade causes and the resulting flooding would be catastrophic to the Parish. Figure 38 shows the extent and depth of flooding after Katrina in 2005. Note that comparing the S&WB network diagrams in Section 2 to this map shows the widespread systemic impact of this hazard to S&WB assets.

4.3.5.1. Severity

Levee Failure has the potential to be a catastrophic hazard event for Orleans Parish and the S&WB networks. A re-occurrence of this hazard would likely create many of the same consequences as seen after Katrina. Thousands of homes and businesses would be severely damaged, or destroyed, and much of the Parish's infrastructure would be devastated. The monetary loss to the Federal, State and Local government would be staggering. Lives would be disrupted and some citizens would more than likely die. The economic and tax structure of the Parish would be severely negatively impacted and cause

significant damage to Orleans Parish's ability to meet its payroll and other governmental financial obligations. Furthermore, the Parish's vital role as an import and export port for the nation would be affected as seen with the levee breaks related to Hurricane Katrina.

After Hurricane Katrina in 2005, all S&WB pumps incurred damage either from floodwaters or wind-driven rain. The Katrina flood damages are directly related to the levee failure. Specific information about the impact of floodwaters on S&WB assets can be found in Section 4.3.4.4. The "worst case" extent of potential flooding is best illustrated by Figure 20 which shows the flood depths from Hurricane Katrina in 2005 where 80% of the City flooded.

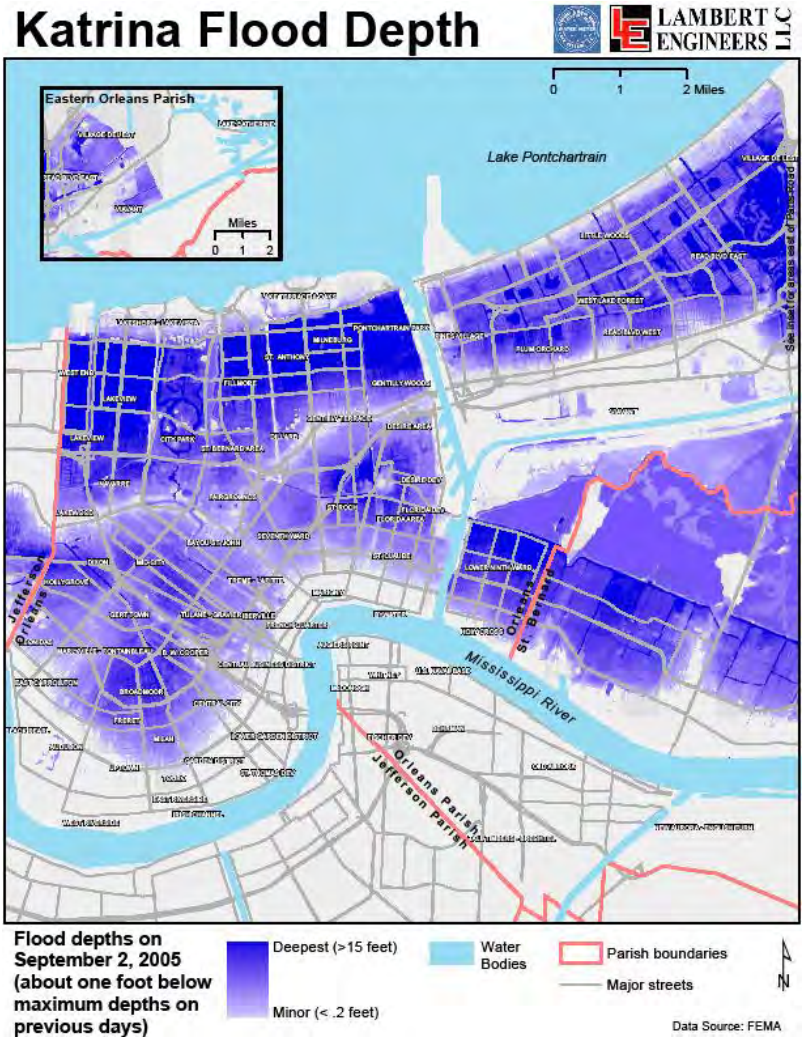


Figure 38 Katrina Flood Depth - Data Source: FEMA

Figure 39 Levee Failure Locations - Hurricane Katrina 2005 (FEMA)

The Sewerage and Water Board Drainage, Water, Power and Sewer systems suffered heavy damages as a result of the levee failures from Hurricane Katrina. The heavy flooding was over 12 feet throughout the system.

The impact of a Levee Failure to the S&WB is demonstrated by the levee failures after Hurricane Katrina. With much of the City flooded, S&WB assets were heavily damaged. As shown in Figure 39, a breach in the levee system quickly overwhelms the pumping stations capacity. This exacerbates the impact of rising water and additional rainfall. In addition, based on Katrina patterns, residency patterns change impacting the S&WB client base. The S&WB provides services to under-populated areas at a financial loss.

Future impacts from such failures will be significantly mitigated by USACE ongoing mitigation projects.

4.3.5.2. Probability

The probability of a Levee Failure unrelated to other hazard events (hurricane, tropical cyclone, terrorism, ship/barge incident) is minimal. By far the most likely cause remains that of hurricanes and coastal storms. See Section 4.3.4 for hurricane probability data. The New Orleans region has a hurricane/tropical storm recurrence interval of being hit or brushed every 3.73 years. Though Levee Failures are most likely to be caused by a hurricane, not every hurricane causes a levee failure. Therefore while the probability for hurricanes is determined as “High”, the probability factor for the

Levee Failure hazard as determined by this Plan is “Low”. As there is nothing in the historic record regarding systemic levee failures, this hazard has a reoccurrence factor of “Rare”.

4.3.6. Lightning/Thunderstorms/Severe Storms

Probability	Impact	Reoccurrence
High	Medium	.24 years

4.3.6.1. Description of hazard

The key issues for the Sewerage and Water Board for this hazard are similar to hurricane and coastal storm events and are included in Section 4.3.4.

Many thunderstorms occur in Orleans Parish each year. This is largely due to its proximity to the Gulf of Mexico, a rich source of the low-level moisture needed for the development of thunderstorms. Thunderstorms can be accompanied by high winds, heavy rains, lightning, hail, and occasionally tornados.

Thunderstorms typically occur when dense cold air overlies warm moist air and uplift is initiated by one of several possible factors such as solar heating, orographic (topographic) effects or fronts and troughs. Strong localized upward currents of air can develop as the heat energy stored in moist warm air is converted to kinetic energy high in the clouds. During this process, condensation of the moist air occurs at altitude, together with separation of positive and negative electrical charges, leading to the generation of lightning. Hail is formed by the freezing of raindrops at very high levels. These are then thought to grow steadily in size while being re-circulated throughout the storm by powerful updrafts and downdrafts. When the weight of the circulating water and ice can no longer be supported by the updrafts, they fall to earth in concentrated shafts, dragging the surrounding air downwards and causing strong “downburst” winds at the surface. When conditions are favorable, mature thunderstorms can form in very short periods of time and have highly organized motion comprising complementary up and down drafts. Sometimes, practical warnings for such events are not possible.

Wind is defined as the motion of air relative to the earth’s surface. In the mainland United States, the mean annual wind speed is reported to be 8 to 12 mph. High winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems, or gradient winds from high or low pressure systems moving across the state. High winds are speeds reaching 50 mph or greater, either sustaining or gusting. A downburst wind is defined as a strong downdraft resulting in an outward burst of damaging winds on or near the ground. Downburst winds can produce damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.

Lightning, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperature higher than 50,000 degrees F. The rapid heating and cooling of the air near the channel causes a shock wave, which produces thunder. Lightning can kill or injure humans and animals. It can also destroy property, including buildings and equipment.

High winds associated with hurricanes and tornados are discussed is separate sections of this Plan relating to those specific hazards.

4.3.6.2. Past occurrences

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

Orleans Parish usually has between 60 and 75 thunderstorms per year. Although such storms occur year round, they are more common in the summer months, averaging 10-15 per month, than in the winter months, averaging 2 per month. Thunderstorms in Orleans Parish frequently result in one to four inches of rain. According to the NCDC, between 1969 and 2009, there have been 121 recorded severe storms that impacted New Orleans accounting for $1.4 million dollars of NCDC tracked property damage. Actual local damage estimates are considerably higher but undocumented.

Figure 40 shows thunderstorms since 1995 that caused property damage and the location of the damage.

Location	Date	Property Damage
New Orleans	May 8, 1995	$750,000
New Orleans	February 13, 1997	$1,000
Lakefront Airport	April 26, 1997	$50,000
New Orleans	June 21, 1998	$1,000
Lake Catherine	January 2, 1999	$1,000
New Orleans	July 14, 2000	$1,000
New Orleans	July 22, 2000	$10,000
Algiers	August 20, 2000	$5,000
Lakefront Airport	September 1, 2000	$1,000
New Orleans	November 6, 2000	$50,000
New Orleans	June 5, 2001	$15,000
Parish-wide	April 8, 2002	$25,000
New Orleans	July 7, 2002	$4,000
New Orleans	July 17, 2003	$3,000

Figure 40 Thunderstorms since 1995 with Reported Property Damage Source: National Climatic Data Center

Orleans Parish has also experienced property damage due to lightning in recent years.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Algiers	06/17/1994	0200	Lightning	N/A	0	0	50K	0
2 Algiers	05/30/1995	1455	Lightning	N/A	0	2	0	0
3 New Orleans Lakefron	04/14/1996	02:00 PM	Lightning	N/A	0	0	0	0
4 New Orleans Lakefron	04/17/1996	03:45 PM	Lightning	N/A	1	0	0	0
5 New Orleans	06/21/1998	05:20 PM	Lightning	N/A	0	0	120K	0
6 Algiers	09/06/1999	07:15 PM	Lightning	N/A	0	0	50K	0
7 New Orleans	06/04/2000	11:00 AM	Lightning	N/A	2	0	0	0
8 New Orleans	05/30/2005	06:30 AM	Lightning	N/A	0	0	0	0
9 New Orleans	06/06/2005	12:00 PM	Lightning	N/A	0	0	0	0
10 New Orleans	06/04/2007	10:30 AM	Lightning	N/A	0	0	50K	0K
				TOTALS:	3	2	270K	0

Figure 41 Orleans Parish Lightning Events Source: National Climatic Data Center

4.3.6.3. Location

All of Orleans Parish is at risk of strong thunderstorms with associated winds and lightning.

4.3.6.4. Severity

The extent (severity) of thunderstorms may be measured by the cell intensity: ordinary cell, multicellular, and supercell. The most common type of thunderstorm is termed the *ordinary* cell, which is limited in size and lifespan, but can produce short bursts of severe weather. *Multi-cellular* storms are more persistent and larger in impact, formed by successive cell generation on the forward left flank, allowing them to move transverse to the prevailing wind and to present a broader impact front. High winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems, or gradient winds from high or low pressure systems moving across the state. High winds are speeds reaching 50 mph or greater, either sustaining or gusting. A downburst wind is defined as a strong downdraft resulting in an outward burst of damaging winds on or near the ground. Downburst winds can produce damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder. A downdraft wind is defined as a small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation as in a shower or thunderstorm. A downburst is the result of a strong downdraft.

Several other variants also exist, but the most dangerous form is termed the *super cell* thunderstorm. The *super cell* is typically an isolated form and always has the potential to be severe because of its strong and persistent rotating updraft, which dissipates at the upper levels forming the characteristic

anvil and overshoot of clouds. Vertical wind shear (i.e. wind speed increasing with height) is important in the development of severe storms such as *super cells.* The shearing effect serves to separate the updrafts from the downdrafts, thus creating a circulation. In a normal thunderstorm, the downdraft tends to fall back into the updraft, effectively dissipating the storm's energy. Hail and heavy rain are associated with the downdraft zones and under some specific conditions may also form a tornado towards the left rear flank of the storm cell. This small but rapidly rotating column of air descends below the cloud base, reaching the surface with devastating consequences. As the storms translate at speeds typically in the range of 40 to 50 km/h, these relatively narrow impact widths become long swaths of potentially very high damage. *Super cells* may have a lifespan of several hours and present an impact front as wide as 40 km. Records of damage generally indicate "pulsing" whereby the ground level impacts tend to fluctuate, probably depending on the supply of material held aloft by the updrafts. Very severe *super cells* can exhibit almost continuous damage fronts for several hours as combinations of wind, rain, and hail.

The severity and impact of Severe Storms are similar to that of Hurricanes and Coastal Storms (Section 4.3.4). Flooding, levee failure and storm surge are potential coinciding impacts though to a lesser degree and likelihood than from a hurricane. Flooding from severe storms tends to be more "spot" oriented and less systemic. Exact location are dependent of the storm track, local elevation and local topography. The impact to S&WB assets are dependent on the specific equipment located in the "spot" flood area.

Much of the impact for this hazard is covered in sections on Tornados (4.3.11), Hurricanes (4.3.4) and Hailstorms (4.3.2). Lightning does present a unique hazard in that it can damage some HV switching equipment. HV motors have built in surge protection and are protected from all but the largest over-voltage events. Damage to structures, roofs and power utility poles remain the more likely impact.

4.3.6.5. <u>Probability</u>

Nationally, South Florida has the greatest number of thunderstorms, with an annual average of 100 to 130, and an average duration of 80 to 100 minutes. Louisiana has an annual average of 100 – 110 thunderstorms lasting from 90 to 100 minutes.

Analysis of the historical record supports a reoccurrence factor of every .24 years for these hazards. As previously stated, historically Orleans Parish has between 60 and 75 thunderstorms per year all of which have some impact to the S&WB network, with an average of 10-15 a month during the summer months and 2 per month in the winter. These averages will likely remain constant in the future. This Plan rates this hazard as a "High" probability.

4.3.7. Saltwater Intrusion

Probability	Impact	Reoccurrence
Medium	Medium	Rare

4.3.7.1. Description of hazard

The volume of the Mississippi River's water flow is presently high enough to prevent salt water from intruding upstream into the Mississippi River above Head of Passes. The intrusion of salt water upstream into the Mississippi River is a naturally occurring periodic condition.

The river's bottom profile is deeper than the Gulf of Mexico water surface level up to about 15 miles downstream of Natchez, Mississippi. Denser salt water flows upstream along the bottom of the River underneath the less dense fresh river water. Salt water's upriver travel can ultimately affect municipal drinking water and industrial water supplies.

Salt water intrusion into the Mississippi occurs when there are prolonged periods of low river flow. This typically occurs in the late summer/early fall. A salt water wedge begins to work its way up the river from the Gulf of Mexico. The salt water is denser than the fresh water, so it tends to hug the bottom. The S&WB monitors the river daily for chloride content, which is an indicator of the amount of salt in the river, and drinking water facilities downriver from GNO will be affected before S&WB facilities, so there is some advance warning of the approach of this salt water wedge. Though not usable for drinking, the affected water supply is still suitable for sanitation and fire protection.

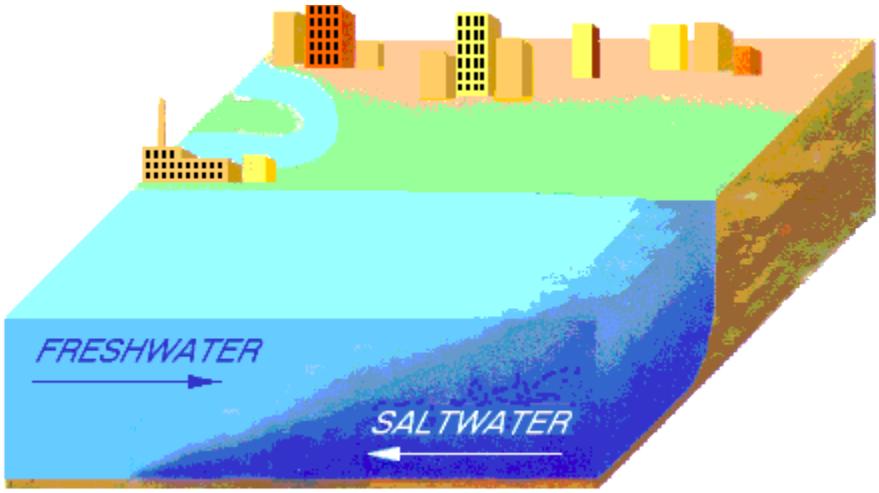


Figure 42 Saltwater wedge in Mississippi River

4.3.7.2. Past occurrences

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

The last known occurrence of a significant salt water intrusion hazard was sometime in the 1980's however, the historical record of the event is not available.

4.3.7.3. Location

This hazard results from the location of the salt water wedge relative to the water intake location. The entire S&WB service area can be subject to this hazard.

4.3.7.4. Severity

The severity of a Salt Water Intrusion event is dependent upon the chloride concentration and duration of the event. When the chloride concentration approaches 250 mg/L, the water will begin to taste salty, and no one will want to drink it. Though the affected river water can be used for fire protection, it would not be usable as drinking water. It will still be useable for fire protection, and sanitary use, but not for drinking. The USACE has response measures in place (a sill built in the river) to control a salt water wedge. The S&WB currently has no provisions or capability to remove or reduce chloride during the treatment process. The USACE has the ability to deter/delay the movement of this salt water wedge up the river by building a sill on the bottom of the river. Thus this hazard has the potential to shut down the availability of potable water in the New Orleans service area.

4.3.7.5. Probability

Though there is no record in the historical data of a salt wedge that interrupted water service, there was a "near" occurrence in 1983. This is an ongoing hazard that is continuously monitored by both the USACE and the S&WB. This Plan rates the future probability of this hazard as a "Medium".

4.3.8. Severe Cold / Severe Heat / Winter Storms

Probability	Impact	Reoccurrence
Low	Low	8 years

4.3.8.1. Description of hazard

Winter months in Louisiana (December, January, and February) have average seasonal temperatures ranging from the mid-40s over northern Louisiana to the low 50s across southern parishes. While average seasonal temperatures remain above the freezing mark statewide, cold fronts extending from Canada through the state occur at least once during most winters. Severe winter weather in Louisiana consists of freezing temperatures and heavy precipitation, usually in the form of rain, freezing rain, or sleet, but sometimes in the form of snow. Severe winter weather affects all but the extreme coastal margins of the state.

Because severe winter storm events are relatively rare in Louisiana, compared to more northern states where winter events are expected and states tend to be better equipped to handle them, occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; collapsed roofs from fallen trees and limbs and heavy ice and snow loads; and felled trees, telephone poles and lines, electrical wires, and communication towers. As a result of severe ice storms, telecommunications and power can be disrupted for days.

Severe winter weather in New Orleans (as indicated by activation of the City of New Orleans Freeze Plan) can be defined as when the outside temperature or wind chill reaches 38 degrees or below. Severe winter weather in New Orleans may also consist of freezing temperatures and heavy precipitation in the form of rain, freezing rain, or sleet, but rarely in the form of snow. Severe winter storm events are relatively rare in Louisiana and New Orleans.

As a state situated in the southern United States and near the Gulf of Mexico, winter weather is not typically thought of as a frequent weather hazard in Louisiana. But, winter weather, ranging from extreme cold to freezing rain, snow and dense fog, can move across Louisiana.

The wind chill temperature is how cold people and animals feel when outside. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually lowering the internal body temperature. The updated Wind Chill Formula was implemented in 2001. The new formula uses advances in science, technology, and computer modeling to provide a more accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures.

Other hazards created by winter cold include the improper use of space heaters and poorly maintained heating systems. These can create a fire and/or carbon monoxide hazard potentially resulting in injuries and fatalities.

Because of its temperate climate, Orleans Parish is rarely affected by winter storms. The average low temperature during the month of January is 43° F.

During summer months, the average temperatures are around 81° F. Extended periods of extreme heat are not typical for the area.

	Temp. (°F)	Relative	Humidity	Extreme (Days Per	Temperature Month)	Rain Inches	(Days	Cloudiness Per	Month)
	Average	A.M.	P.M.	Below 32°	Above 90°	Average	Clear	Partly Cloudy	Cloudy
January	51.3	85%	68%	5	0	5.1	7	7	17
February	54.3	84%	65%	3	0	6.0	8	6	14
March	61.6	85%	63%	0	0	4.9	8	8	15
April	68.5	87%	61%	n/a	n/a	4.5	8	10	12
May	74.8	89%	62%	0	4	4.6	9	11	11
June	80.0	90%	64%	0	16	5.8	8	13	9
July	81.9	91%	67%	0	21	6.1	5	15	12
August	81.5	91%	67%	0	21	6.2	7	14	10
September	78.1	89%	66%	0	9	5.5	10	11	10
October	69.1	87%	61%	0	1	3.1	14	8	9
November	61.1	86%	63%	1	0	4.4	10	8	12
December	54.5	85%	67%	3	0	5.8	8	7	16
Annual	68.1	87%	65%	13	72	61.9	101	118	146

Figure 43 Average New Orleans Temperatures (City of New Orleans)

4.3.8.2. Past occurrences

The last major freeze was in 1989 during one of the most significant cold spells in the South in a century. Temperatures in New Orleans dropped below freezing for 64 consecutive hours; the lowest temperature recorded in New Orleans during this cold spell was 11°F. While icy roads were a problem, the biggest impact of this cold spell was the breakage of water pipes throughout the city.

The last severe winter storm to occur in Orleans Parish was on December 25, 2004 when approximately half an inch of sleet and snow accumulated in New Orleans. Since severe winter storms are rare in New Orleans the storm caused several transportation issues. As a result of icy bridges, overpasses, and elevated roadways there were transportation accidents and many road closures. The New Orleans International Airport was also shut down for several hours due to ice on the runways.

There is no record of extreme heat occurrences that have had any impact on S&WB assets.

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as

well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

Between 1969 and 2009, the NCDC has recorded 5 events involving excessive heat, Freeze, or excessive Cold or Winter Storms in the New Orleans region.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 LAZ001>070	03/14/1993	0000	Freeze	N/A	1	0	0	50.0M
2 LAZ062	08/14/1999	10:00 AM	Excessive Heat	N/A	0	2	0K	0
3 LAZ062	07/16/2000	03:32 PM	Excessive Heat	N/A	1	0	0	0
4 LAZ062	07/16/2000	03:49 PM	Excessive Heat	N/A	1	0	0	0
5 LAZ062	01/03/2008	00:00 AM	Cold/wind Chill	N/A	2	0	0K	0K
6 LAZ038 - 040 - 056>070	12/25/2004	07:00 AM	Winter Storm	N/A	0	0	0	0
				TOTALS:	5	2	0	50.000M

Figure 44 Severe Heat/Cold/Winter Storm (NCDC)

4.3.8.3. Location

Because there is no defined geographic boundary, all people and property in New Orleans are exposed to the risk of damage from these severe weather hazards. The assets of the S&WB are equally impacted given the geographic scope of the service networks. Winters in Orleans Parish are mild and the risk of winter storms is low.

4.3.8.4. Severity

An extended period of below freezing weather (time vs. temperature below freezing) could cause critical valves and equipment to become inoperable and cause exposed smaller mains to freeze reducing water flow to some areas of the city. Many pumps use water to cool and lubricate bearings. If frozen, these bearings/pumps can fail. Some smaller pumps might freeze and break. Many homes with exposed piping would freeze and burst causing greater demand for water services.

Severe Heat is not normally a problem unless temperatures exceed the ability for equipment to operate. The Sewerage and Water Board's system was designed to operate in severe operating temperatures in order to insure the delivery of Water, Sewer and Drainage services.

Past impacts from this hazard has been non-systemic and handled as ordinary operating repairs and maintenance.

4.3.8.5. Probability

While Louisiana is far less likely to have heavy snow and ice accumulation than most other states in the U.S., winter weather is expected to occur at least once each winter. According to data from the National Climatic Data Center, Louisiana is in the lowest category of probable snow depth, 0 – 25 cm snow depth with a 5% chance of being equaled or exceeded in any given year. Louisiana winter storms that have had severe consequences for the state, have generally delivered between one and three inches of ice accumulations. Due to its geographic location in the southeastern part of the state, Orleans Parish is at minimal risk to have a severe winter storm.

4.3.9. Storm Surge

Probability	Impact	Reoccurrence
High	High	4.44 years

4.3.9.1. Description of hazard

Storm Surge is an offshore rise of water associated with a low pressure weather system, typically a tropical cyclone. Storm surge is caused primarily by high winds pushing on the ocean's surface. The wind causes the water to pile up higher than the ordinary sea level. Low pressure at the center of a weather system also has a small secondary effect, as can the bathymetry of the body of water. It is this combined effect of low pressure and persistent wind over a shallow water body which is the most common cause of storm surge flooding problems. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides. Because much of the United States' densely populated Atlantic and Gulf Coast coastlines lie less than 10 feet above mean sea level, the danger from storm tides is tremendous.

Figure 45 Storm Surge - NOAA

The level of surge in a particular area is also determined by the slope of the continental shelf. A shallow slope off the coast (Figure 45) will allow a greater surge to inundate coastal communities. Communities with a steeper continental shelf will not see as much surge inundation, although large breaking waves can still present major problems. Storm tides, waves, and currents in confined harbors severely damage ships, marinas, and pleasure boats.

The Storm Surge hazard does not occur outside of other hazard events. Therefore, the resulting characteristics of this hazard are covered in the Hurricane section (4.3.4) of this Plan. The impact of storm surge will be the same as for flooding.

The National Hurricane Center forecasts storm surge using the SLOSH model, which stands for Sea, Lake and Overland Surges from Hurricanes. The model is accurate to within 20 percent. SLOSH inputs include the central pressure of a tropical cyclone, storm size, the cyclone's forward motion, its track, and maximum sustained winds. Local topography, bay and river orientation, depth of the sea bottom, astronomical tides, as well as other physical features are taken into account, in a predefined grid referred to as a SLOSH basin.

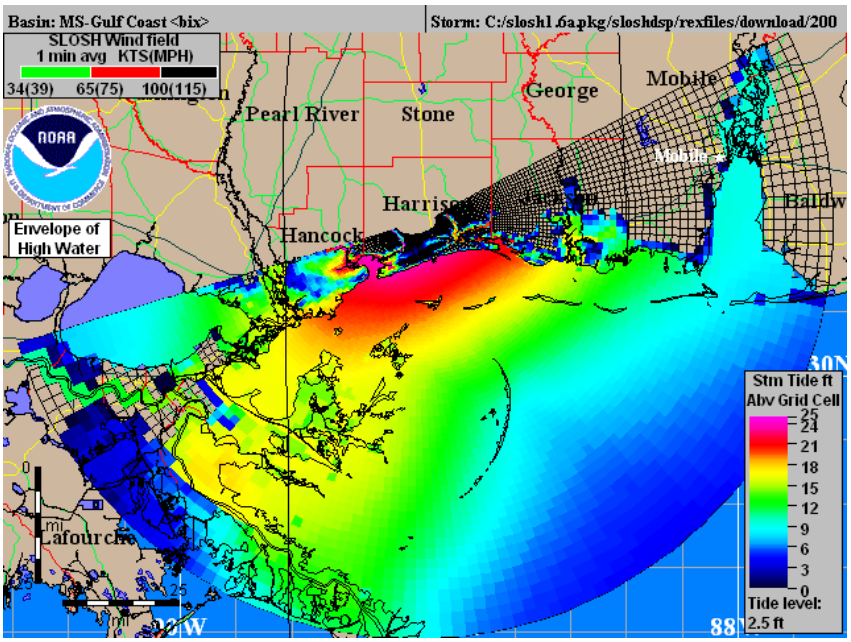


Figure 46 Maximum height of the storm surge above each grid cell in NOAA's SLOSH model for Hurricane Katrina of 2005

Overlapping SLOSH basins are defined for the southern and eastern coastline of the continental U.S. Some storm simulations use more than one SLOSH basin; for instance, Katrina SLOSH model runs used both the Lake Ponchartrain / New Orleans basin, and the Mississippi Sound basin, for the northern Gulf of Mexico landfall. The final output from the model run will display the maximum envelope of water, or MEOW, that occurred at each location. To allow for track or forecast uncertainties, usually several model runs with varying input parameters are generated to create a map of MOMs, or Maximum of Maximums. And for hurricane evacuation studies, a family of storms with representative tracks for the region, and varying intensity, eye diameter, and speed, are modeled to produce worst-case water heights for any tropical cyclone occurrence. The results of these studies are typically generated from several thousand SLOSH runs. These studies have been completed by USACE, under contract to the Federal Emergency Management Agency, for several states and are available on their Hurricane Evacuation Studies (HES) website. They include coastal county maps, shaded to identify the minimum SSHS category of hurricane that will result in flooding, in each area of the county.

4.3.9.2. <u>Past Occurrences</u>

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Chef Menteur	02/15/1998	02:00 PM	Storm Surge	N/A	0	0	0	0
2 Countywide	09/12/1998	11:00 AM	Storm Surge	N/A	0	0	0	0
3 LAZ038 - 040 - 058 - 060>063 - 066>070	06/30/2003	02:00 PM	Storm Surge	N/A	0	0	4.1M	0
4 LAZ040 - 058 - 060>062 - 066>070	09/15/2004	10:00 AM	Storm Surge	N/A	0	0	4.0M	0
5 LAZ038 - 040 - 050 - 058 - 060>062 - 066>070	10/09/2004	03:00 PM	Storm Surge	N/A	0	0	100K	0
6 LAZ061>062 - 064 - 067>070	07/05/2005	03:00 PM	Storm Surge	N/A	0	0	2.5M	0
7 LAZ040 - 059 - 061>064 - 067>070	08/29/2005	02:00 AM	Storm Surge	N/A	0	0	31.3B	0
8 LAZ038 - 040 - 050 - 058>070	09/23/2005	07:00 AM	Storm Surge	N/A	0	0	432.0M	0
9 LAZ038 - 040 - 049 - 057>058 - 060 - 062 - 066	09/11/2008	12:00 PM	Storm Surge/tide	N/A	0	0	0K	0K
				TOTALS:	0	0	31.743B	0

Figure 47 Storm Surge Events 1969-2009 (NCDC)

Hurricane Katrina in 2005 produced one of the highest storm surges ever recorded of 25 feet in Bay St Louis Mississippi.

In the FEMA flood inundation map below, showing the path of Katrina with respect to this area, the entire area was swept by the surge. Along almost the entire length of Highway 90, on either side, were homes facing the water.

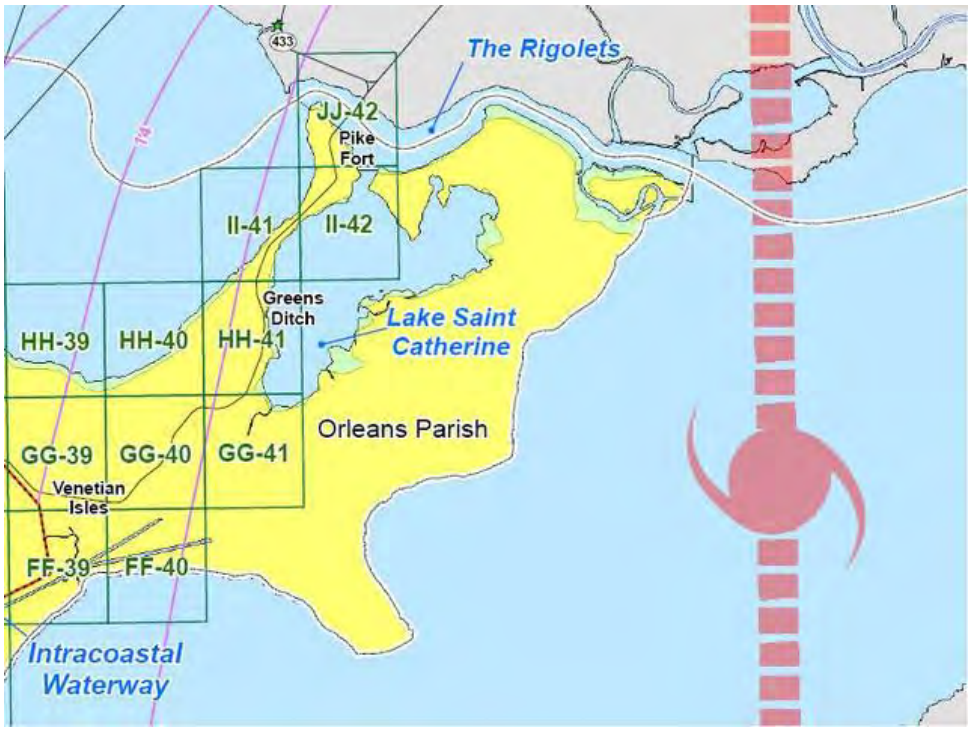


Figure 48 FEMA Katrina Inundation Map

4.3.9.3. Location

Based on the topography of the region and the related hazard data for Levee Failures and Hurricanes/Tropical Storms, the entire region is under threat from this hazard as shown in Figure 49.

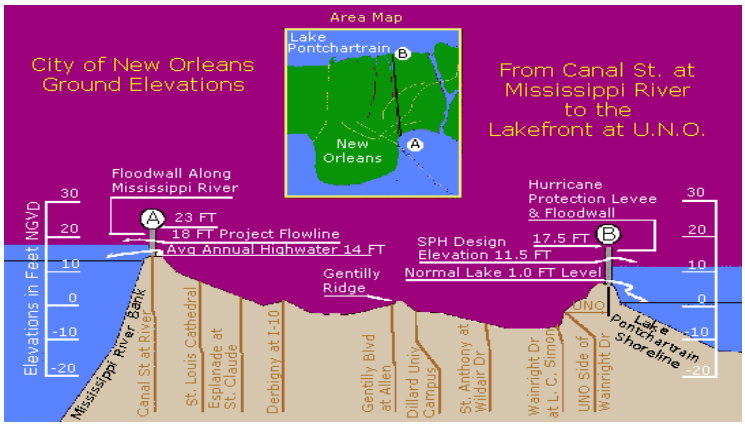


Figure 49 slide from S&WB

4.3.9.4. Severity

The impact of a Storm Surge Hazard to the S&WB will be very similar to that of a Flood Hazard or Levee Failure Hazard. Figure 50 shows the SLOSH Model data for Hurricane Katrina. If Katrina or a similar storm followed a more westerly track, New Orleans could expect 20-25 foot storm surges. This, in turn, could breach or overtop the levees. Large areas of the City would be flooded and S&WB pumping stations would again be impacted. The extent of this hazard is dependent on the depth and duration of resultant flood water.

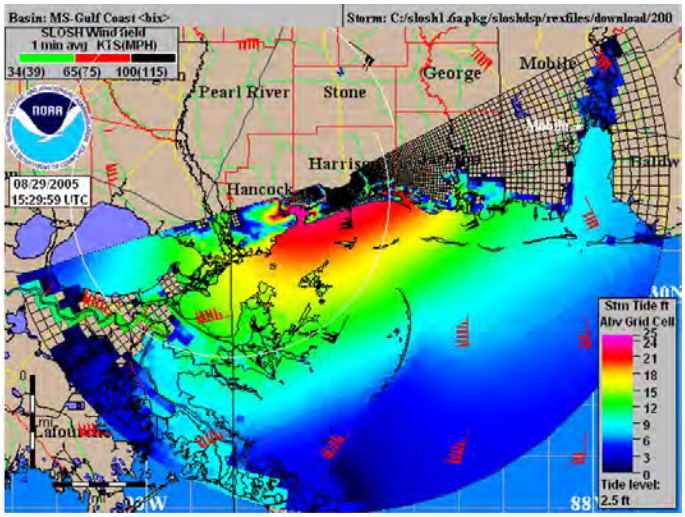


Figure 50 SLOSH Model - Aug 29, 2005 - NOAA

4.3.9.5. Probability

Based on the data from the NCDC, between 1969 and 2009, New Orleans has been subject to Storm Surges approximately every 4.4 years. Given the likelihood of the hurricane/tropical storm hazard of every 3.73 years, this Plan rates this hazard as a "High" probability of reoccurrence.

4.3.10. Subsidence (Expansive Soils)

Probability	Impact	Reoccurrence
Medium	Low	Ongoing (100%)

4.3.10.1. Description of hazard

Subsidence is the sinking of large portions of the Earth's crust. The New Orleans region has been experiencing high rates of subsidence for the past several decades. Subsidence in the region is caused by natural processes, such as the natural compaction of soils, as well as to the activities of humans, such as oil and gas extraction. Human activities exacerbate the effects of subsidence in the region. Erosion of land mass is the effect of subsidence.

The single most important factor that has contributed to subsidence in the region is the change to the hydrology of Southeast Louisiana, including Orleans Parish. River deltas naturally undergo accretion and subsidence. Accretion is the process by which sediments accumulate through flooding of the banks and natural levees. Subsidence occurs as these sediments compact over time. Prior to the 20th Century, the accretion process equaled or exceeded the subsidence process in the Mississippi River Delta. However, the creation of flood-protection levees along the Mississippi River has stopped the accretion process in recent decades. Thus, there is nothing to counteract the natural subsidence that occurs in this area.

This map of New Orleans shows the average rates of subsidence that RADARSAT detected over a three-year study period. Red indicates the areas that sunk the most, up to 28.6 millimeters each year (just over an inch). Blue indicates the areas that sank the least. An inch a year may seem like a small change, but the researchers point out that the rate observed between 2002 and 2005 is probably at or near the slowest subsidence rate the area has experienced since the levees were first built in the 1960s: sinking probably occurred even faster just after the levees were first built. Indeed, many parts of the City were already meters below sea level in 2002. Historically, eastern New Orleans has seen the greatest subsidence in southern Louisiana. This part of the City was 3 to 5 meters below sea level when Katrina struck and consequently saw some of the worst flooding. For example, the line of red dots along the Mississippi River-Gulf Outlet Canal (which failed during Hurricane Katrina) indicates that the area experienced some of the highest subsidence rates during the study period.

4.3.10.2. Past occurrences

Subsidence is a slow, ongoing process. Subsidence in the NOLA area has been tracked for several decades. See Section 4.3.10.1.

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

4.3.10.3. Location

The sinking problem in Louisiana, as a result of subsidence, has run anywhere from 6 to 20 inches over the past 20 years. This results in recurring maintenance to address infrastructure problems. Subsidence continues to be a problem for the Greater New Orleans Area, including all of Orleans Parish. Most of these areas are built on Mississippi River silt, and the silt is slowly settling and compacting. Houses not built on deep pilings are tipping and cracking. Subsidence is also responsible for infrastructure problems, including ruptured water and sewer lines. However, it is coastal subsidence that poses the greatest threat to New Orleans. Loss of land masses makes the City more vulnerable to the effects of hurricanes, including high winds and storm surge. As the entire region is subject to impact from this hazard, the assets of the S&WB are at significant risk. Shifting soils impact the integrity of sub-surface infrastructure that makes up key components of the S&WB service networks. Figure 51 shows the impact of this hazard within the City of New Orleans.

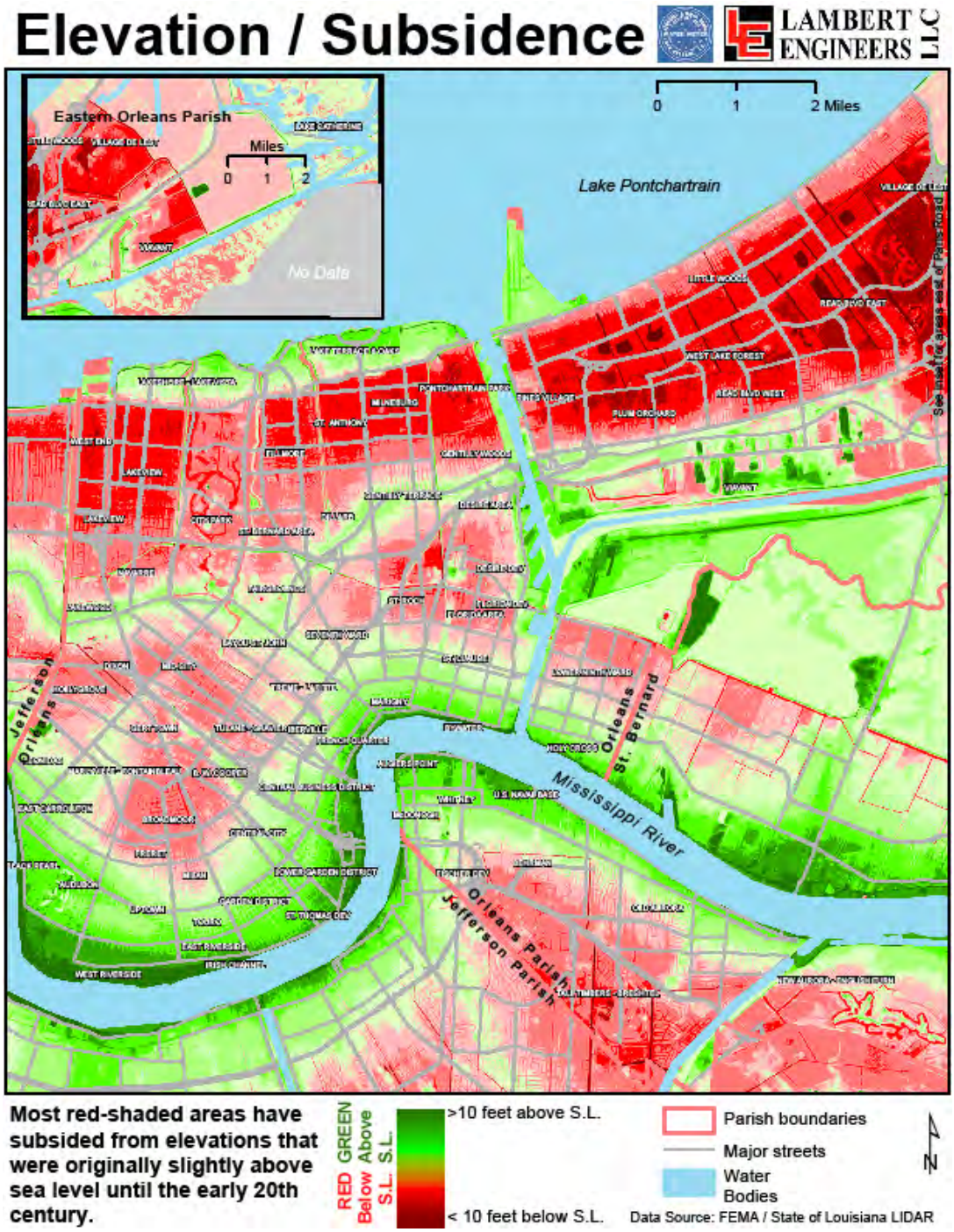


Figure 51 NOLA Area Impacted by Subsidence

4.3.10.4. Severity

While the effects on property in the New Orleans metropolitan area can be significant, subsidence is a creeping hazard event, one with chronic, not acute impacts. Subsidence is a constant process that cannot be easily mitigated through comprehensive mitigation actions. Subsidence problems are addressed on an individual basis as problems are discovered. Therefore, no personal loss estimation can be made for this hazard. However, in the long term, the loss of coastal land masses that provide some protection for the City of New Orleans from hurricanes is vitally important. The loss of this important natural barrier will have a tremendous impact on all of New Orleans and surrounding parishes by making them more vulnerable, especially to powerful hurricanes.

The loss of coastal land masses from Subsidence exacerbates the impact from Hurricanes and Coastal storms. This directly impacts the S&WB assets with increased threats from flooding and storm surge.

The extent of subsidence on S&WB assets is a long-term, ongoing issue. Damages to pipes, structures and infrastructure are repaired as needed on an ongoing basis. This hazard requires ongoing monitoring and analysis.

Figure 52 illustrates the extent of the Subsidence Hazard in the New Orleans area.

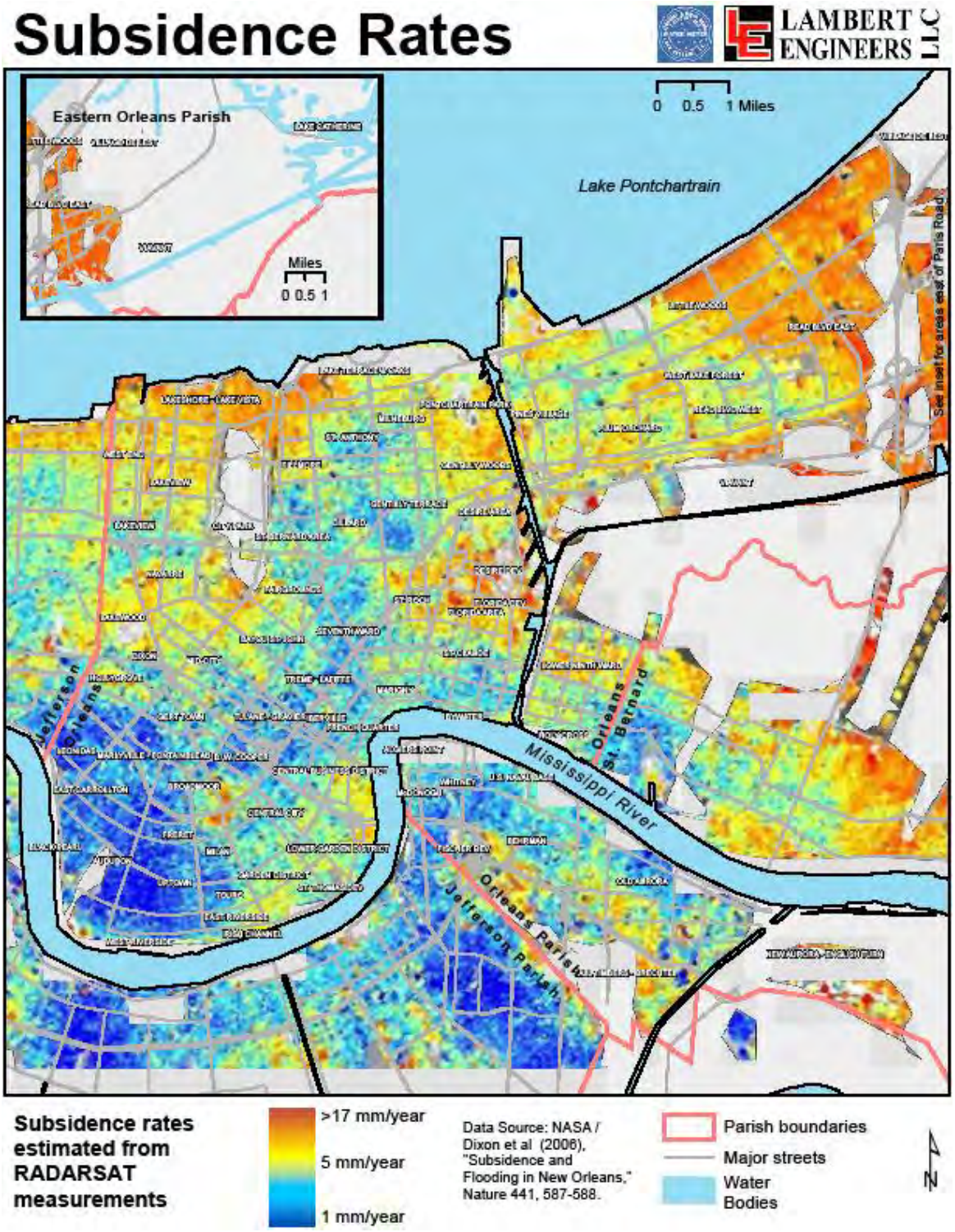


Figure 52 New Orleans Land Subsidence rates - NASA EO 2006

4.3.10.5. Probability

Subsidence occurs slowly and continuously over time or on abrupt occasions, as in the case of sudden formation of sinkholes. Coastal Louisiana wetlands erosion is continuing due to subsidence largely related to the Mississippi River's drainage. The exact place and time of a disaster related to subsidence cannot usually be predicted with any degree of certainty. This is true of both slow subsidence related to fluid withdrawal and sudden subsidence related to sinkhole formation or mine collapse. Due to the nature of the Subsidence Hazard, it is not possible to develop a statistical probability that has any real degree of certainty. Therefore the Reoccurrence probability factor determined within this Plan is "Ongoing". The probability of continued subsidence in the New Orleans region is 100%.

4.3.11. Tornados

Probability	Impact	Reoccurrence
Medium	Low	4 years

4.3.11.1. Description of hazard

One of the most spectacular and destructive forces in nature is the tornado. Each year approximately 1,500 tornadoes touch down across the United States causing an estimated $1.1 billion in damages and over 80 deaths. NOAA's tornado climatology data reveals that the United States' central plain region - stretching from Texas to South Dakota - experiences the greatest number of tornadoes on earth. This area is often referred to as "tornado alley." Tornados are areas of strong, rotating winds caused by the convergence of a warm air mass and a cold air mass. They can be spawned by thunderstorms or hurricanes. Although certain conditions are more likely to produce tornados, it is impossible to predict when a tornado will occur and where it will travel once it has formed.

A tornado is a violently rotating column of air extending between, and in contact with, a cloud and the surface of the earth. The most violent tornados are capable of tremendous destruction with wind speeds of 250 miles per hour or more. In extreme cases, winds may approach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.

Tornados are the most hazardous when they occur in populated areas. Tornados can topple mobile homes, lift cars, snap trees, and turn objects into destructive missiles. Among the most unpredictable of weather phenomena, tornados can occur at any time of day, in any state in the union, and in any season. In Louisiana, tornados have a higher frequency in the spring months of March, April, and May. While the majority of tornados cause little or no damage, some are capable of tremendous destruction. Additionally, tornados are often generated from hurricanes so the entire hurricane season has to be viewed as risk period for this hazard.

New Orleans lies outside of the so-called “Tornado Alley”. Tornado Alley is a nickname given to an area in the southern plains of the central U.S. that consistently experiences a high frequency of tornadoes each year. Tornadoes in this region typically happen in late spring and occasionally the early fall. The Gulf Coast area has a separate tornado maximum nicknamed "Dixie Alley" with a relatively high frequency of tornadoes occurring in the late fall (October through December). Although the boundaries of Tornado Alley are debatable (depending on which criteria you use - frequency, intensity, or events per unit area), the region from central Texas, northward to northern Iowa, and from central Kansas and Nebraska east to western Ohio is often collectively known as Tornado Alley. Meteorologically, the region known as Tornado Alley is ideally situated for the formation of super-cell thunderstorms, often the producers of violent (EF2 or greater) tornadoes.

As shown in the following figure, the State of Louisiana in general experiences only a moderate frequency of this hazard in comparison to other regions of the US.

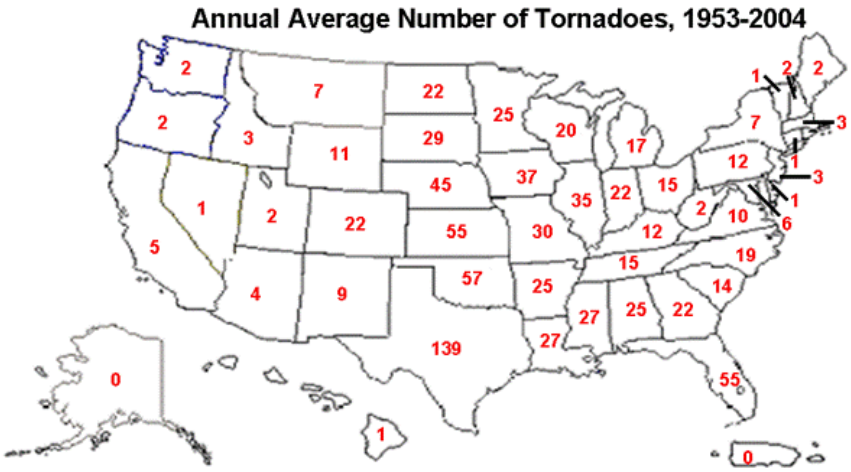


Figure 53 US Tornado Frequency - NOAA

4.3.11.2. Past occurrences

NOTE: There is incomplete data available from the S&WB for this hazard. Many of the historical records of the Sewerage and Water Board were lost or destroyed due to Katrina related flooding in the basement of the St Joseph Building Headquarters in 2005. This includes property appraisal and construction data as well as data related to specific events and damages. This incident is documented per a FEMA PW (project worksheet) #4116, dated March 16th, 2006.

New Orleans-area historical tornado activity is slightly below the Louisiana state average.

On 12/6/1983, a category 4 (max. wind speeds 207-260 mph) tornado 22.9 miles away from the New Orleans city center injured 25 people and caused between $5,000,000 and $50,000,000 in damages.

On 10/3/1964, a category 4 tornado 31.8 miles away from the city center killed 22 people, injured 165 people, and caused between $500,000 and $5,000,000 in damages.

The following table identifies NCDC tracked tornado events impacting the GNO between 1969 and 2009.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 ORLEANS	03/10/1971	0200	Tornado	F2	0	0	2.5M	0
2 ORLEANS	12/06/1971	1330	Tornado	F1	0	0	25K	0
3 ORLEANS	07/29/1977	1150	Tornado	F1	0	3	25K	0
4 ORLEANS	06/22/1981	1345	Tornado	F2	0	0	25K	0
5 ORLEANS	04/19/1991	1330	Tornado	F1	0	0	25K	0
6 New Orleans	08/10/2000	04:12 PM	Tornado	F0	0	0	0	0
7 Lake Catherine	06/30/2003	11:45 AM	Tornado	F0	0	0	5K	0
8 New Orleans	02/02/2006	02:42 AM	Tornado	F2	0	0	500K	0
9 New Orleans	02/13/2007	03:03 AM	Tornado	F2	0	15	2.0M	0K
10 Gentilly	02/13/2007	03:10 AM	Tornado	F2	1	10	1.0M	0K
				TOTALS:	1	28	6.105M	0

Figure 54 Sample Tornado Events Greater New Orleans - NCDC

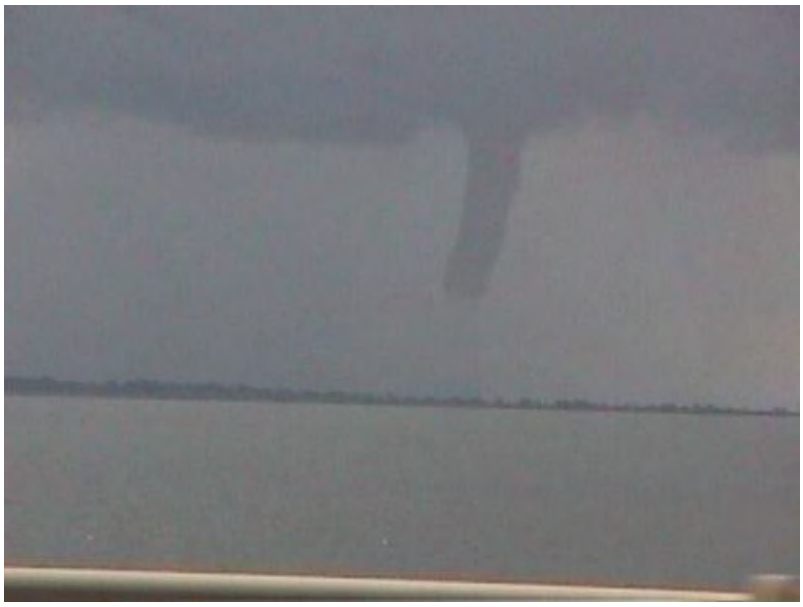


Figure 55 2008 Funnel Cloud over Lake Pontchartrain

4.3.11.3. Location

Because there is no defined geographic boundary, all people and property in New Orleans are exposed to the risk of damage from tornados. The sub-surface assets of the S&WB are at minimal risk from this hazard. However, all buildings, facilities and above ground infrastructure of the S&WB are at risk.

4.3.11.4. Severity

Tornado intensity is measured by the Fujita Scale, which links wind speed to damage done by the tornado. Figure 56 shows the Fujita Scale ratings for tornados from F0 to F5[13].

Fujita Rating	Wind Speed (mph)	Type of Damage Done
FO	40-72	Light damage. Some damage to chimneys. Breaks branches off trees. Pushes over shallow-rooted trees. Damages sign boards.
F1	73-112	Moderate damage. The lower limit is the beginning of hurricane wind speed. Peels surface off roofs. Mobile homes pushed off foundations or overturned. Moving autos pushed off roads. Attached garages may be destroyed.
F2	113-157	Considerable damage. Roofs torn off frame houses. Mobile homes demolished. Boxcars pushed over. Large trees snapped or uprooted. Light object missiles generated.
F3	158-206	Severe damage. Roof and some walls torn off well-constructed houses. Trains overturned. Most trees in forest uprooted.
F4	207-260	Devastating damage. Well-constructed houses leveled. Structures with weak foundations blown off some distance. Cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate. Automobile size missiles fly through the air in excess of 100 meters. Trees debarked. Steel reinforced concrete structures badly damaged.

Figure 56 Fujita Scale

[13] Additional background on the Fujita and Enhanced Fujita Scale can be found at http://www.spc.noaa.gov/efscale/

If a tornado hit a DPS (Drainage Pumping Station), it could prevent it from operating. A tornado could impact S&WB overhead High Voltage Power (HVP) lines that run throughout the City. The anticipated impacts from this hazard would, most likely, be non-systemic and result in "typical" repair jobs. An F3 or higher Tornado, if directly striking a pumping station, could destroy or severely damage the facility with potential damages of $1,000,000 to $3,000,000.

S&WB Building and other above ground structures would suffer damages proportional to the Fujita Rating of a specific occurrence.

4.3.11.5. Probability

Given the regional and historical trends for tornado activity, the New Orleans region has a Medium probability for the occurrence of this hazard. Based on NCDC data, New Orleans experiences a Tornado every 4 years. There is a low probability of a tornado directly striking an S&WB facility.

The probability of tornados increases dramatically during a hurricane event. However, any resulting damages would be covered as hurricane damage.

5. Assessing Vulnerability

This section of the Plan provides an overall summary of the jurisdiction's vulnerability per 44.CFR.201.6.

Vulnerability per 44.CFR.201.6(C)(2)(ii): A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
Vulnerability per 44.CFR.201.6(C)(2)(ii)(A): The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas
Vulnerability per 44.CFR.201.6(C)(2)(ii)(B): An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;
Vulnerability per 44.CFR.201.6(C)(2)(ii)(C): Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

The S&WB networks are basically a network of critical facilities that constitute part of the City's perimeter defense against hazard impacts. The critical facility list can be found in Appendix 2 – Critical Facility List. The impact and loss potential from potentially catastrophic hazard events would easily be beyond value with the total or near total loss for any of the S&WB's major network components. The "estimated project cost" to the S&WB just from Hurricane Katrina in 2005 is calculated at $385,844,865.89.

5.1. Critical Facility Analysis

The S&WB networks (Sewerage, Water and Drainage) represent integrated systems serving the GNO area. Damage to one component in one of these systems places greater burdens on other components. Systemic failures to one of the networks can rapidly develop into an impact that is beyond measure. A complete list of critical S&WB assets is shown in Appendix 2 – Critical Facility List. Additionally, the Carrollton Water Facility has a power plant on site.

5.2. Vulnerability Summary

This section of the Plan provides a brief description of S&WB vulnerability for each hazard.

Vulnerability per 44.CFR.201.6(C)(2)(ii)(A): The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas
Vulnerability per 44.CFR.201.6(C)(2)(ii)(B): An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;

The following chart identifies vulnerabilities and estimated damages by structure type and is color coded by low (green), moderate (yellow) or severe (red) damage potential.

Structure Type Key:

SPS=Sewer Pumping Station DPS=Drainage Pumping Station UPS=Underpass Pumping Station
STP=Sewage Treatment Plant WTP=Water Treatment Plant

Hazard	Vulnerability	Impacted Structures and Estimated Losses
Flood Damage Potential **HIGH**	Due to the potential for significant flooding (see Figure 38), S&WB assets located throughout the services area are at risk. The damage or loss of a single critical asset (pump station, treatment plant, intake), places greater burden on other system components thereby increasing the risk to the entire system. Flooding poses a systemic risk with potential losses dependent on the extent of flooding. Major flooding as seen after Hurricane Katrina poses potential losses in the hundreds of millions of dollars. Key factors for losses remain the depth and duration of flood water.	**Based on worst case scenario** **SPS** - 40 stations between $1.6m and 1.8m per station. **DPS** – 23 stations at $15 million per 1000 CFS. **UPS** – 10 stations at $1.3million dollars per station. **STP** – 2 plants. East bank $500,000,000 West bank $170,000,000 **WTP** – 2 plants. Carrolton $500,000,000 Algiers $170,000,000 **St Joseph Headquarters** - $5,400,000 **Central Yard** - $14,000,000 >$300,000,000 Note: The SPS, DPS, UPS assets of S&WB are spread throughout Orleans Parish and would be impacted by ANY flood related event. The WTP, STP , Yard and St Joseph office would be impacted by localized flooding in their immediate vicinity.
Hailstorm Damage Potential **LOW**	Hailstorms can occur anywhere in the region and structures and vehicles are vulnerable to damage. Damage from this hazard tends to be non-systemic and be repair and maintenance oriented.	**Based on historical data** **SPS, DPS, UPS, STP, WTP, St Joseph Headquarters, Central Yard** < $1,000,000
Hazardous Materials Damage Potential **MODERATE**	Hazardous spills in close proximity to water intakes remain possible given the traffic on the Mississippi River. The closure of water intakes would pose a significant risk to the potable water supply for the S&WB service area. Costs for typical spills are recovered from the third party. Internal spills are covered by EOP procedures.	**Based on historical data** **SPS, DPS, UPS, STP WTP, St Joseph Headquarters, Central Yard** >$1,000,000 **Note**: the loss of a water intake would be a loss beyond value.

Hazard	Vulnerability	Impacted Structures and Estimated Losses
Hurricane/Tropical Cyclone (Storm) – Flood Coastal Storm Damage Potential **HIGH**	Historically, the New Orleans region is extremely vulnerable to this hazard. The combined impacts (wind, rain, flood, levee, storm surge) place the entire S&WB network in the risk area. See the "Flood" hazard description above.	**Replacement Costs for the facilities are likely related to worst-case scenarios. Expected damages from minor events will be far less tham the worst-case amounts for replacement.** **SPS** - 40 stations between $1.6m and 1.8m per station. **DPS** – 23 stations at $15 million per 1000 CFS. **UPS** – 10 stations at $1.3million dollars per station. **STP** – 2 plants. East bank $500,000,000 West bank $170,000,000 **WTP** – 2 plants. Carrolton $500,000,000 Algiers $170,000,000 **St Joseph Headquarters** - $5,400,000 **Central Yard** - $14,000,000
Hurricane/Tropical Cyclone (Storm) – Wind Coastal Storm Damage Potential **MODERATE**	Historically, the New Orleans region is extremely vulnerable to this hazard. The combined impacts (wind, rain, flood, levee, storm surge) place the entire S&WB network in the risk area. The standing HV power lines are at risk from wind damage. Based on Katrina (2005), $2,000,000 was spent to repair/replace these poles. S&WB buildings are subject to "typical" structural building damage from storm winds (roof, windows, wall, etc).	**Wind Events impact above-ground infrastructure. Damage to roofs, HV power lines and other structures can be expected from any moderate wind event.** **SPS, DPS, UPS, STP, WTP, St Joseph Headquarters, Central Yard** > $1,000,000
Levee Failure Damage Potential **HIGH**	Though unlikely by itself, the resultant flooding from a levee failure would knock out sections of the S&WB network. The vulnerability of S&WB assets is consistent with the flood hazard (above).	**The following numbers are based on worst case scenario. Levee Failure events can rapidly escalate to catastrophic.** **SPS** - 40 stations between $1.6m and 1.8m per station. **DPS** – 23 stations at $15 million per 1000 CFS. **UPS** – 10 stations at $1.3million dollars per station. **STP** – 2 plants. East bank $500,000,000 West bank $170,000,000 WTP – 2 plants. Carrolton $500,000,000 Algiers $170,000,000 **St Joseph Headquarters** - $5,400,000 **Central Yard** - $14,000,000
Lightning / Severe Storm / Thunderstorm Damage Potential **LOW**	Flooding from severe storms and thunderstorms can pose a significant risk. Heavy rainfall events are not uncommon in the region and assets vulnerable to flooding are at risk from this hazard. Lightning strikes in the region are also fairly common. HV equipment and system are vulnerable to over voltage and voltage spikes. Aside from flood potential, most vulnerability remains similar to the flood hazard (above)	**Most of the S&WB network is not impacted by these events. Lightning strikes can cause overvoltage and significant rain events can lead to spot flooding.** **SPS, DPS, UPS, STP, WTP, St Joseph Headquarters, Central Yard** < $1,000,000

Hazard	Vulnerability	Impacted Structures and Estimated Losses
Severe Heat / Severe Cold / Winter Storm Damage Potential **LOW**	The infrastructure (pipes, valves, etc) are subject to damage from extended freeze events. Some equipment is subject to overheating during extended heat event. This hazard tends to be non-systemic and repair/maintenance oriented.	**Due to the spot nature of heat/cold impacts to infrastructure, damages from these events would be expected to be minimal.** **SPS, DPS, UPS, STP, WTP, St Joseph Headquarters, Central Yard** < $1,000,000
Saltwater Intrusion Damage Potential **HIGH**	Depending on the proximity of a salt water ridge to water intakes and the concentration levels of sodium chloride, the entire potable water system is vulnerable. Loss of the potable water system is a financial impact beyond value.	**Saltwater Intrusion represents a significant hazard potential. Though no physical damage to infrastructure occurs, the lack of potable water in GNO makes this a potential catastrophic event.** **WTP** – shutdown would result in no water service to the City of New Orleans. This impact is beyond value.
Storm Surge Damage Potential **HIGH**	Given the high risk of tropical storms, storm surge poses the same issues as flood and levee failure for S&WB assets.	**Based on worst case scenario** **SPS** - 40 stations between $1.6m and 1.8m per station. **DPS** – 23 stations at $15 million per 1000 CFS. **UPS** – 10 stations at $1.3million dollars per station. **STP** – 2 plants. East bank $500,000,000 West bank $170,000,000 **WTP** – 2 plants. Carrolton $500,000,000 Algiers $170,000,000 **St Joseph Headquarters** - $5,400,000 **Central Yard** - $14,000,000
Subsidence (Erosion) Damage Potential **LOW**	This hazard poses a risk to all underground infrastructures (pipes, mains, valves). As this is a slow process, the issue is non-systemic and repair/maintenance oriented.	**Subsidence is a slow creeping event. Damage typically impacts under-ground infrastructure. This is typified by ongoing maintenance related to breaks and repairs.** **SPS, DPS, UPS, STP, WTP, St Joseph Headquarters, Central Yard** < $1,000,000
Tornado Damage Potential **MODERATE**	The region has a moderate risk for tornados given the national averages (see Figure 53). Structures and assets can be struck but a) the damage tends to be non-systemic, and b) the region tends to experience minor F0-F2 events. A direct strike by a major Tornado (F3 or f=greater) could result in catastrophic damage to an impacted facility.	**tornado events tend to impact above-ground infrastructure. Most structures would be damaged by a direct hit. Damage from a moderate tornado would potentially be significant depending on the specific facility and scale of the event.** **SPS, DPS, UPS, STP, WTP, St Joseph Headquarters, Central Yard** > $1,000,000

Figure 57 Estimated Impact and Losses by Structure Type

5.2.1. Systemic Notes – Valuation Data

This section contains specific system information about potential losses.

Valuations for the S&WB service network have been broken out in the following categories:

- Drainage stations
- Underpass stations
- Sewer Stations
- Sewer plants
- Water Plants
- Central yard complex
- St Joseph Headquarters building

This valuation data has been reviewed by the S&WB Engineering Department for accuracy as it relates to each system.

5.2.1.1. Water Plants

The S&WB provides potable water to the New Orleans service area. It is difficult to measure potential impact to the water system itself. At the extreme end, the loss of a WTP (water treatment plant) or a water intake would constitute an impact beyond measure.

Using available historical cost data and current construction data the total replacement cost for the CWP (Carrolton Water Plant) is estimated at $500-$600 million or more depending on the land costs.

The Algiers water plant would be 1/3 of the CWP.

5.2.1.2. Sewerage Stations

Loss of sewerage in the City could result in widespread health hazards, negatively impact quality of life and lead to potential long-term problems. The Sewage Treatment Plants discharge treated wastewater into the Mississippi River. Any systemic damage to this system would pose an environmental impact that is beyond measure[14].

Using historical contracts and current market costs, a complete rebuild of a sewer pumping station would be between $1.6m and 1.8m. Note that SPS A, C and D would likely be higher.

[14] After Hurricane Katrina, the S&WB had to discharge untreated waste into the Mississippi River with no discernable health or environmental impact.

5.2.1.3. Drainage Stations

Any incapacitation of the drainage system would result in water accumulation in streets shortly after the first significant rainfall. Loss of pumping activity (which continuously removes groundwater filtrating from the Mississippi River and Lake Pontchartrain) would result in ground saturation and filling of the reservoir capacity of the drainage canals even without precipitation, thus exacerbating accumulation when it does rain. Flooding from storm surge or levee failure would be magnified by loss of the pumping system. Potentially, flooding on a Katrina scale would be possible with a financial impact beyond measure.

Using historical contracts and current market data a complete rebuild of a drainage pumping station is estimated at $20 million per 1000 CFS.

5.2.1.4. Underpass Pumping Stations

Using historical contracts and current market data, rebuilding an underpass pumping station is estimated at $1.3 million dollars.

5.2.1.5. Sewer Treatment Plant

Using historical contracts and current market data, a rebuild of the East Bank Sewer treatment is estimated at $500 million dollars. The West Bank treatment plant would be 1/3 of the East Bank treatment plant.

5.2.1.6. St Joseph Headquarters

Based on current construction and market data, rebuilding the St. Joseph Headquarters is estimated at $1.8 million dollars per floor (3 floors for a total estimate of $5.4 million).

5.2.1.7. Central Yard

Using historical contracts and current market the central yard complex if completely rebuild would come in approximately $ 12 to 14 million dollars.

5.3. NFIP Compliance

This section describes local NFIP compliance per 44.CFR.201.6.

NFIP Compliance per 44.CFR.201.6(c)(2)(ii): A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods

Orleans Parish is a participant in the National Flood Insurance Program (NFIP). S&WB structures insured under NFIP are listed in Appendix 7 – NFIP Coverage. The Sewerage and Water Board complies with the NFIP policies as directed by Orleans Parish. There are no repetitive loss structures within the S&WB service network.

5.4. Land Use Trends

This section of the plan describes local land use trends per 44.CFR.201.6.

Description of Land use per 44.CFR.201.6(c)(2)(ii)(c): Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

5.4.1. Population [15]

The population of Orleans Parish has steadily declined over several decades, falling from 625,000 in 1960 to 485,000 in 2000. The largest factor of the decline is the out migration from Orleans Parish to surrounding parishes, St. Tammany, Jefferson and Plaquemines.

Despite the city-wide populations decrease before Hurricanes Katrina and Rita certain neighborhoods within New Orleans did experience slight increases in population. They include the French Quarter, Mid City, Lakeview and Gentilly. However, the highest concentration of residents is found in New Orleans East comprising of Planning Districts 9, 10 & 11 with approximately 89,537 residents. The population of Orleans Parish directly impact the service delivery of the S&WB network and the billing revenue associated with such delivery.

5.4.2. Land Use[16]

Understanding the physical character of New Orleans is of critical importance when developing a mitigation strategy. At the heart of New Orleans are its 74 neighborhoods all of which are grouped into 13 Planning Districts in the New Century New Orleans Land Use Master Plan. Land use in most of these districts is mixed comprising of residential, neighborhood commercial, regional commercial, institutional and industrial type uses. The density of land uses in New Orleans is fairly consistent and is characterized as low-rise, low-density single and two-family homes. Planning districts east of the City are less dense and contain more green space, while planning districts that encompass the downtown area are the most

[15] Information provided by City of NO
[16] Information provided by City of NO

heavily developed with the least amount of open space. Approximately one fourth to one-third (figure varies) of the City's 116,176 acres of land is classified as wetlands. This high percentage of wetlands statistically describes the unusual topographic facts of this City, which largely lies below sea-level and is built among swamps.

Prior to Hurricane Katrina few major changes to the land use patterns in New Orleans were expected. This projection was based on several factors. First, much of Orleans Parish is already developed, and most of the undeveloped land lies outside of the hurricane levee protection system. The parts of the Parish within the levee system that are undeveloped lie in far eastern New Orleans. Thus, there is little land that is suitable for development that has a desirable location. Second, in 1999 the New Orleans City Planning Commission adopted a new Land Use Plan. For almost all planning districts and almost all land uses, the Land Use Plan calls for minor changes. The only major change from existing land uses in the plan is the centralization of industrial land uses near the Industrial Canal, the Desire/Agriculture Street Landfill area, and the Intracoastal Waterway. Land that previously had been used for heavy industry in Central City and along former rail corridors has been downgraded to light industry and regional commercial.

5.4.3. S&WB and Land Use Trends

As the provider of sewer, water and drainage services to the City of New Orleans, the S&WB monitors land use trends to identify, define and plan service requirements. The City's recently adopted Master Plan takes into consideration land use and development. The S&WB regularly participates in the City's Master Plan process.

The Sewerage and Water Board as part of its design practices always considers land purchases for future use to address development trends. For example the Sewerage and Water Board has purchased vacant lots around each of its Water treatment plant for expansion. The Board has also purchased property outside of Orleans Parish in St.Rose to be used for a future river intake station for expansion of services.

6. Mitigation Strategy

This section of the Plan details specific mitigation goals and specific mitigation actions as required by 44.CFR.201.6.

Local hazard Mitigation Goals per 44.CFR.201.6(c)(3)(i): The hazard mitigation strategy **shall** include: A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

6.1. Goals and Objectives

The primary goal of local governments is to promote the public health, safety, and welfare of the citizens of the community. In keeping with this standard, the Sewerage and Water Board of New Orleans has developed the following goal statements for local hazard mitigation planning. The goals are intentionally broad in nature as they serve to establish parameters that were used in developing more specific objectives and mitigation actions.

6.1.1. Goals

Goals represent general guidelines and are generally broad policy type statements.

1. Identify and pursue preventive measures to reduce losses to existing and future S&WB assets due to hazards.
2. Enhance S&WB agency awareness and understanding of disaster preparedness and mitigation planning in order to protect the health and well-being of people in Orleans Parish before, during and after hazard events.
3. Ensure the ability of S&WB services and facilities to continue operating during and after hazard events.
4. Ensure sufficient controls, systems and procedures are in place to identify, respond to and recover from hazard events.
5. Maintain an efficient and professional organization structure to support hazard mitigation planning goals.
6. Promote cooperation between local agencies with regard to hazard mitigation activities.

6.1.2. Objectives

Objectives define strategies and/or implementation steps to attain the goals defined in section 6.1.

Objectives	Supported Goals
1. Develop a comprehensive risk management policy for the S&WB	2, 3, 5
2. Conduct regularly scheduled risk and risk management approach reviews with Board of Directors.	2, 3, 5,6
3. Develop a comprehensive business continuity plan.	2, 3, 4, 5
4. Review and revise the organization structure for risk management.	2, 3, 4, 5
5. Assign responsibility for specific risks to specific functions.	2, 3, 4, 5
6. Implement and train S&WB on enhanced command and control software (hazard/incident management software).	2, 4
7. Increase/improve drainage capability within the S&WB service area – protect the City of New Orleans from storm induced flooding.	1
8. Bring damaged sewer pumping stations back to operational mode.	1
9. Enhance property protection measures at critical facilities.	1
10. Protect critical facility and ensure continuing operations	1
11. Develop an enhanced S&WB tracking and analysis capability.	2, 3, 4, 5

6.2. MITIGATION ACTIONS

Mitigation Actions are the specific actions that work to achieve the goals (section 6.1.1) and objectives (section 6.1.2).

Local hazard Mitigation Goals per 44.CFR.201.6(c)(3)(ii): A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

6.3. Analysis of Mitigation Actions

The Sewerage and Water Board of New Orleans has developed the following mitigation actions that will have a positive effect on mitigating potential damages from most, if not all, natural hazards. When evaluating projects the S&WB will consider the following criteria:

- Public Health and Safety Requirements
- Regulatory Compliance Requirements
- Engineering and Technical Requirement
- Past Hazards effect on site locations.
- Base Flood Elevation of site location.

In developing actions, the S&WB relied on the following six mitigation policy categories provided by FEMA. The Planning Team evaluated current and pending S&WB projects and identified those that meet the mitigation goals and objectives.

1. **Prevention (P) Measures**

Preventative measures are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or where capital improvements have not been substantial.

2. **Property Protection (PP) Measures**

Property protection measures protect existing structures by modifying the building to withstand hazardous events, or removing structures from hazardous locations.

3. **Natural Resource (NR) Protection**

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their mitigative functions. Such areas include floodplains, wetlands, and dunes. Parks, recreation or conservation agencies and organizations often implement these measures.

4. **Emergency Services (ES) Measures**

Although not typically considered a mitigation technique, emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event.

5. **Structural (S) Projects**

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event. The projects are usually designed by engineers and managed or maintained by public works staff.

6. **Public Information (PI) Measures**

Public information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques that the public can use to protect themselves and their property.

Figure 58 FEMA Mitigation Policy Categories

6.3.1. Prioritization

Local hazard Mitigation Goals per 44.CFR.201.6(c)(3)(iii): An action plan describing how the actions identified in paragraph (c)(2)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

All Projects in Appendix 3 – Mitigation Projects List are of equal priority due to the above criteria. The S&WB uses BCA (benefit/cost analysis) to guide project feasibility based on the first 3 primary criteria.

The S&WB utilizes FEMA's recommended STAPLE/E decision-making criteria, in addition to the S&WB baseline criteria of:

1) Public Health and Safety Requirements
2) Regulatory Compliance Requirements
3) Technical and Engineering Requirements
4) Benefit/Cost Analysis

STAPLE/E Criteria Set

Social: Does the measure treat people fairly? (different groups, different generations)
Technical: Will it work? (Does it solve the problem? Is it feasible?)
Administrative: Do you have the capacity to implement & manage project?
Political: Is there public support? Did they participate? Is political leadership willing to support?
Legal: Does your organization have the authority to implement? Is it legal? Are there liability implications?
Economic: Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
Environmental: Does it comply with Environmental regulations?

6.4. Identification of Mitigation Actions

Based on the identified Mitigation Goals and Objectives, the Sewerage and Water Board has developed the following Mitigation Actions. Representative projects for these actions are summarized in Appendix 3 – Mitigation Projects List.

Mitigation Action	Risks Addresses	Goals	Priority	Responsible Dept	Funding Resources	Timeframe
Mitigate Pumping Stations thru storm-proofing that eliminates below-ground pumping stations, elevating pumping components, and elevation of electrical components. Additionally build new pumping stations to provide permanent storm surge risk reduction.	Flooding, Storm Surge, Hurricane (All), Levee Failure	1,3,4	1	S&WB Operations	FEMA, USACE	ongoing
Develop formalized Risk Management and Business Continuity policies that ensure consistent operations, response and recovery to all hazards. Implement management systems to support policies and track hazard related activities.	ALL	2,3,4,5,6	2	S&WB Risk Mgmt, S&WB Emergency Mgmt	S&WB	ongoing
Ensure continued sewer, water and drainage operations by installation of new generators to operate Water Plants in the event of a power failure and mitigate against hazard caused outages.	ALL	1,3,4	2	S&WB Operations	USACE	Nov 2010
Mitigate flood and other hazards by implementing protective measures for critical networks that include emergency dams and/or berm construction.	ALL	1	1	S&WB Operations	S&WB, USACE, FEMA	ongoing

6.5. Identified Mitigation Projects

The map in Figure 59 identifies the Katrina PW's (Project Worksheets) underway as of Jan 1, 2010. Other mitigation projects that are underway or planned are listed in the remainder of this section.

6.5.1. Benefit Cost Analysis and Alternative Mitigation Strategies

In defining a benefit/cost analysis, the S&WB identifies specific objectives, defines appropriate engineering practices, conducts feasibility and scoping studies and then determines the most effective project scope to achieve the objectives. As many mitigation projects are determined by public health and safety requirements, regulatory compliance requirements or technical engineering requirements, there are generally no "alternative" mitigation solutions to be weighed and even cost/benefit is superseded by public safety and regulatory requirements..

6.5.2. Representative Mitigation Projects

This section serves to show examples of specific Mitigation Projects as related to Mitigation Actions. Mitigation Projects are listed in Appendix 3. The following projects represent significant projects for the S&WB. The projects have been organized by S&WB system component. Figure 59 identifies S&WB locations currently involved in FEMA PW funded projects.

Figure 59 Katrina Related PW funded Mitigation Projects - data from S&WB

6.5.2.1. General Mitigation Projects

1. The Sewerage and Water Board Drainage, Water, Power and Sewer systems suffered heavy damages as a result of the levee failures from Hurricane Katrina. The heavy flooding was over 12 feet throughout the system. The Board mitigation strategy is to repair and replace facilities above the flood of record for each facility or to the base flood elevation. For example the Board had in place at the time of the storm a Berm at its East Bank Sewer Treatment Plant with a height of 12'. A 12' storm surge impacted the plant and caused 41M dollars worth of damages. The Board plans mitigation measures to construct a t-wall on top of the existing Berm, bring the height to 18' thus protect the East Bank Treatment Plant from futures storm surges.

2. The Sewerage and Water Board's system was designed to operate in severe operating temperatures in order to insure the delivery of Water, Sewer and Drainage services. To mitigate against the failure of high and cold temperatures the Board has its own independent Power Production Plant that services it network of facilities in the event that the local utility goes down. These high power distribution lines are incased in concrete and run undergrounds throughout the city. In addition to its Powerhouse the Board has generators at various stations to insure that the climate control system remains operational to mitigate against high and low temperatures. The Board has continuing mitigation projects underway to enhance and protect power generation and distribution.

2.1.1.1. Water Projects

1) The USACE are installing a 15MW Generation to operate the Carrollton water plant in the event of a power failure. This project has two primary purposes related to storm proofing pump stations. First it provides power through a 60Hz underground feeder (to be constructed by USACE) to run two pumps at DPS 1. Secondly, if for any reason the 25 Hz system is completely down and does not have Entergy power available, this generator also has "black start" capability which will enable the generator to start without any outside power source and then both through the Central Control Building and the existing on-site 25 Hz/ 60 Hz frequency changer to run the water plant and river intake pumps to provide water for the 25 Hz generator boilers which will in turn run the 25 Hz drainage pumps throughout the New Orleans area via the existing underground 25 Hz feeder system.
2) Tiger Dams have been brought to reduce the impact of flooding for the Main Water Plant Power House for a cost of $58,000. (completed)
3) Tiger Dams have been purchased to reduce the impact of flooding for the Central Control Operations for a cost of $58,000. (completed)

Figure 60 Tiger Dam demo - photo S&WB

2.1.1.2. Drainage Projects

1) The USACE is working on a new pumping station for the 17th street canal to reduce flooding from levee failure. The new closure structures, as authorized, will provide permanent storm surge risk reduction by preventing hurricane storm surge from Lake Pontchartrain from entering the canals. The pumps will take storm water from the canals around the closure structures so that the interior drainage system can continue to function when the closure structures prevent direct discharge to Lake Pontchartrain. The project is being designed to serve as an integral part of a systems approach to providing 100-year level of risk reduction for the Greater New Orleans Area. As a part of the LPV and because the project is not hydraulically independent, it will not provide the 100-year level of risk reduction alone. It is dependent upon a commensurate upgrade of the LPV in east Jefferson Parish and Orleans Parish west of the Industrial Canal.

The purpose of the project is to protect the City of New Orleans and Jefferson Parish from storm surge-induced flooding through the 17th Street, Orleans Avenue, and London Avenue Outfall Canals, while not impeding the ability of the area's internal drainage system to function. The overall need of the project is to provide a comprehensive, integrated storm damage reduction system that would prevent storm surge-induced flooding via the outfall canals and reduce the imminent and continuing threat to life, health, and property posed by flooding from hurricanes and other tropical storm events. The purpose and need is to achieve a 100-year level of risk reduction over the period of evaluation from hurricane and storm damage".

2.1.1.3. Sewer Projects

1) As part of the Sewerage and Water Board's efforts to bring the damaged sewer pumping stations back to operational mode, the S&WB is implementing measures to prevent and/ or mitigate future damage from similar conditions that occurred during Hurricane Katrina. The basic measures include eliminating below-ground pumping stations and moving all pumps, motors, and electrical equipment above grade, effectively raising pumps approximately 20 to 30 feet from where they previously existed. Additionally, many of the stations will have associated electrical and controls equipment mounted on elevated platforms to reduce the possibility of submergence during flooding. These stations consist of all concrete shell construction. The stations are generally configured with a narrow access tube from ground surface, which opens to a larger room below

grade, underground that houses pumps and motors. These stations are generally square or rectangular in nature with sides 10 to 12 feet in length and the dry well floor being approximately 20 to 25 feet below grade.

There are 65 related projects of this type and a complete list of related projects can be found in Appendix 3 – Mitigation Projects List.

The general scope below, of work for each pump station is a combination of the activities for the different locations of these stations.

- Plug existing pump suction and discharge lines, to prevent flow into the dry well.
- Remove all existing equipment inside dry well, including valves, piping, pumps, and controls.
- Retrofit new pump station and discharge lines that connect to the existing suction and discharge lines within the dry well.
- Retrofit new concrete slab above abandoned dry well structure.
- Retrofit new structure, connect piping as required.
- Retrofit new pile-supported concrete platform for electrical, control and SCADA equipment. Top of slab to be approximately 4'-0'' above finish grade.
- Retrofit a galvanized rack of 4-inch channel, and install new electrical, control and SCADA panels on platform.
- Install an aluminum canopy above electrical/controls platform.
- Supply and install SCADA antenna tower on concrete pad adjacent to electrical platform. Install SCADA antenna on tower and connect all necessary wiring.
- Pave pump station sites that are not currently paved.
- Retrofit fencing around pump station sites.
- Start up pump station and operate and maintain pump station for a minimum of 30 days following substantial completion and repair any problems at no cost to S&WB

2) The S&WB is installing a 4MW Generator to operate the East bank Waste Water Treatment Plant to reduce the risk of power failure that would result in the loss of sewer treatment for the East bank of New Orleans. Expected completion is mid-2011.

3)

3. Mitigation Implementation

Appendix 3 – Mitigation Projects List contains a list of representative active and proposed mitigation projects on behalf of the S&WB. Implementation of certain mitigation actions are ongoing projects, several years in duration. Other actions can be accomplished in a very short to immediate timeframe.

Of the 74 projects summarized in this Plan, the breakdown is as follows:

- 4 projects completed
- 63 projects related to Sewer Pumping Stations
- 3 projects related to policy or procedure issues
- 5 projects with undefined timelines
- 35 projects scheduled for completion in 2010
- Total of Estimated Amounts for projects is $98,184,480[17]

Each of the construction related mitigation projects follow the S&WB's standards for project implementation. Each system has a contracted S&WB Project Manager. The contracted firms oversee the implementation of all PW and mitigation tasks via standardized tasks, as follows:

- Project Management
- Construction Management
- Design, Implementation and Evaluation management
- Resource Management

All the contracted firms adhere to requirements of 44.CFR and provide the required quarterly reports.

Each Mitigation Action, will be monitored and progress updated by the S&WB Office of Emergency Management. The S&WB LHMP will be evaluated annually to determine the effectiveness of its projects, programs, and policies. The Office of Emergency Management (OEM) will be responsible for convening annual Planning Team meetings to report on Mitigation Actions Implementation progress. The OEM will be responsible for scheduling and organizing the Planning Team and/or Steering Committee meetings, collecting, analyzing and incorporating annual reports, and providing revised drafts to the stakeholders.

The Sewerage and Water Board has incorporated their Department of Emergency Management as part of the overall contract review process to insure that any construction, new building or land purchases consider any hazard that may impact their function. Due to the complexity of the system some facilities have to be located in high vulnerability areas to insure that water, sewer, and draining services reach each area of the city. When this is the case Emergency Management insures that mitigation approaches are implemented.

[17] This figure includes only projects with estimated amounts. Projects without completed scoping are not included in this total.

4. Plan Maintenance

This section of the Plan describes the formal process that will ensure the Plan remains an effective and relevant document. This section establishes the method and schedule for monitoring, evaluating, and updating the LHMP during a five-year plan-update cycle. It also establishes how the S&WB will maintain community involvement in the Plan.

The Plan will be monitored by the Emergency Management Office of the Sewerage and Water Board of New Orleans. The Plan will be updated[18]:

1) Every 5 years per 44.CFR.201.6(d)(3) and submitted for approval to GOSHEP and FEMA.
2) After an actual hazard event occurrence.
3) Annually during the hurricane off-season.
4) Other times as deemed necessary by the S&WB.

Plan Monitoring per 44.CFR.201.6(c)(4)(i): A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
Incorporating the Plan into Existing Planning Mechanisms per 44.CFR.201.6(c)(4)(ii): A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
Continued Public Involvement per 44.CFR.201.6(c)(4)(iii): Discussion on how the community will continue public participation in the plan maintenance process.

4.1. Plan Maintenance Approach

- Incorporate hazard mitigation actions into existing planning mechanisms.
- Determine how mitigation projects and actions will be monitored.
- Establish indicators of effectiveness or success.
- Develop an evaluation and revision schedule to ensure the Plan is up-to-date at the end of the five-year cycle.
- Establish a process for public input and community involvement during the planning cycle.

[18] Note- 44.CFR.201 only REQUIRES 5 year updates. Other updates are best practices at the discretion of the S&WB.

4.2. Monitoring

This Plan must be updated on a regular basis to remain an effective tool. The S&WB Office of Emergency Management (OEM) will monitor the implementation of mitigation actions identified in the Plan.

During the five-year planning cycle, the Office of Emergency management will undertake the following initiatives:

- Collect annual reports from the agencies and departments involved in implementing mitigation projects or activities identified in the Mitigation Strategy section of this Plan.
- Maintain and update the mitigation action table and project summary lists.
- Conduct site visits and obtain reports of completed or initiated mitigation actions to incorporate in the plan revision as needed.
- Research and document new hazard information pertaining to the Sewerage and Water Board of New Orleans during the planning cycle and incorporate into a revised Risk Assessment section as needed.
- Organize annual meetings with the Mitigation Planning Team (Planning Committee) to discuss relevant hazard mitigation issues, provide status updates, and discuss available grant opportunities.
- Coordinate, compile, and disseminate hazard mitigation funding information and applications.
- Convene a meeting of the Steering Committee following a natural disaster or when funding is announced to prioritize and submit potential mitigation actions for funding.

The above activities outline plan maintenance during the four years leading up to the fifth year of the planning cycle. In March of Year 4 of the planning cycle, the OEM will lead a more intensive planning effort and reconvene the Planning Team to ensure S&WB has an updated LHMP by the end of Year 5. The Planning Team will be responsible for compiling, documenting, and incorporating all changes derived from the activities listed above into a revised plan document.

During these updates, the Plan will be evaluated to ensure that the Risk Assessment portion of the Plan is current. Any changes to the hazards that threaten New Orleans or to the vulnerability of S&WB assets will be noted. The Plan update will consider issues such as changes to the S&WB assets, changes within Orleans Parish, changes in vulnerability due to the completion of mitigation projects, and new information about hazards. The Plan's Goals and Objectives will be reviewed to determine their relevance to current conditions in the Parish and S&WB assets.

The plan will be reviewed, revised and updated every five years from the date of FEMA's approval. If a disaster occurs or as action items are met, the plan will be reviewed, revised, and updated

sooner than the required five years, via the process outlined above. The Planning Team will be (re)convened to conduct the comprehensive evaluation and update.

4.3. Evaluation

The S&WB LHMP will be evaluated annually to determine the effectiveness of its projects, programs, and policies. The OEM will be responsible for scheduling and organizing the Planning Team and/or Steering Committee meetings, collecting, analyzing and incorporating annual reports, and providing revised drafts to the stakeholders. Each year, the OEM will assess the current version of the Plan and determine the improvements necessary for the plan update. The OEM will evaluate the Planning Team to determine if other agencies should be added.

A thorough examination of the Plan will take place during the fifth year of the process to ensure the S&WB has an updated LHMP at the end of the planning cycle. The Planning Team will review the goals and action items to determine their relevance to changing situations in the region, as well as changes in local, state or federal policy, and to ensure they are addressing current and expected conditions. The Planning Team will look at any changes in resources that may influence the plan implementation (such as funding) and program changes to determine need for reassignment. The Planning Team will review the all portions of the Plan to determine if this information should be updated or modified, given any new available data. The Planning Team will evaluate the content of the Plan using the following criteria:

- Are the mitigation actions effective?
- Are there any changes in land development that affect mitigation priorities?
- Do the goals, objectives, and action items meet social, technical, administrative, political, legal, economic, and environmental criteria as defined in FEMA's STAPLEE analysis?
- Are the goals, objectives, and mitigation actions relevant given any changes to the S&WB or within New Orleans?
- Are the goals, objectives, and mitigation actions relevant given any changes to local, state or federal regulations or policy?
- Is there any new data that affects the Risk Assessment portion of the Plan?

4.4. Update

The Planning Team will update the LHMP every five years to reflect the results of the annual reports and on-going plan evaluation by OEM. Throughout the planning cycle, OEM will compile new information and incorporate it into the Plan. The process for updating the Plan will begin at four (4) years. The OEM will also assess and incorporate recommended comments expressed by FEMA in

the initial review into the plan revision. During the update process for this Plan, additional agencies will be invited to participate in the Plan update process. These agencies include:

- New Orleans Office of Emergency Preparedness
- New Orleans Office of Homeland Security
- US Army Corp of Engineers
- New Orleans Fire Dept
- New Orleans Dept of Public Works
- New Orleans Levee District
- LEPC (Local Emergency Planning Commission)
- GOHSEP (Governor's Office of Homeland Security and Emergency Preparedness)

The general timeline for the Plan Update Process is shown in Figure 61.

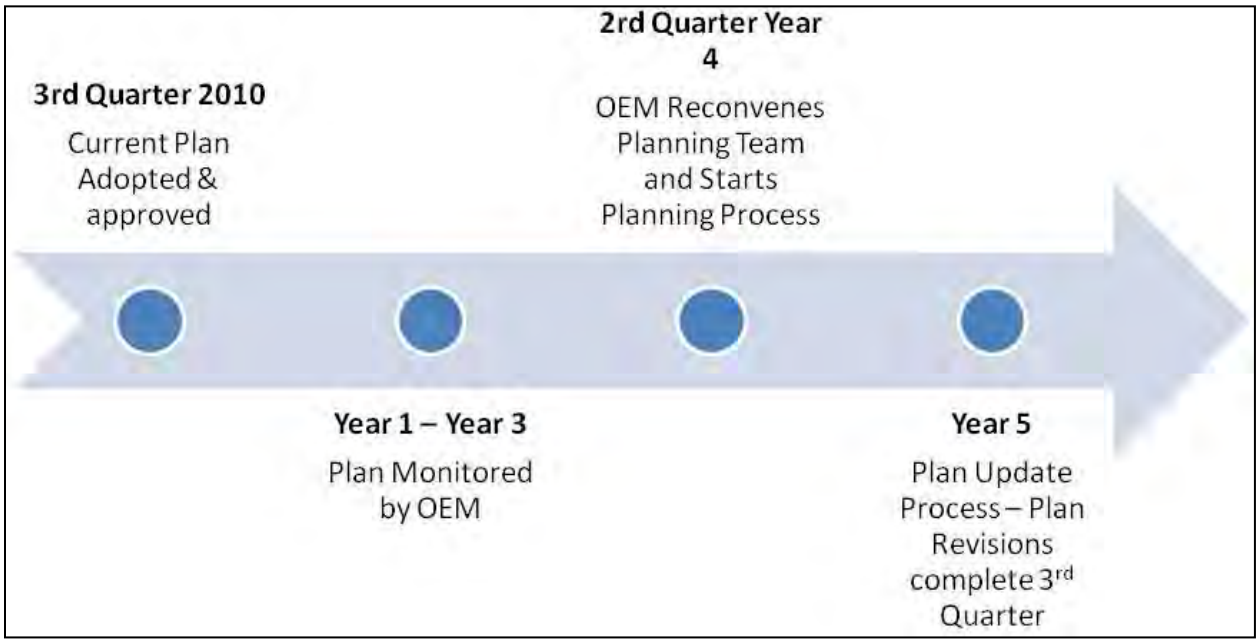


Figure 61 Plan Update Process Timeline

The Sewerage and Water begins its revision to its Emergency Plan's at the beginning of each year. Representatives for the each of the Boards department are part of the Planning Team. They are broken down into the following groups;

- Command
- Operations
- Logistics
- Finance
- Communications

Each section above is to consider their respective area for compliance in the emergency and mitigation plans. As part of their evaluation checklist of the plans they are required to submit mitigation ides to reduce the impact from a disasters.

4.5. Incorporation into Existing Planning Mechanisms

While this hazard mitigation Plan was written to stand on its own, the people of New Orleans are best served by a comprehensive, integrated planning process. This Plan or elements of this Plan will be provided to other New Orleans City agencies for integrated planning efforts and incorporated into other S&WB planning mechanisms such as the CEMP and EOP.

The Board holds two exercises each year a tabletop and full scale exercise to test it's preparedness and response to disasters. As part of the Board's overall Emergency Response Exercise program it will incorporate the mitigation plan into the planning stages, exercise injects and after action reports. Mitigation and hazard avoidance are also now considered in new building and infrastructure design.

4.6. Continued Public Involvement

The S&WB will involve the public in the plan maintenance process and during the 5 year update review to the Plan in the same ways used during the original plan development. The public will be notified when the revision process is started and will be provided with the opportunity to review and comment on the changes to the Plan. Appropriate public meetings will be held with opportunities for public review and comment. The S&WB Office of Emergency Management will be responsible for coordinating and organizing all public participation in the Planning Process.

Copies of the approved final Plan will be available to the public via the S&WB website.

5. Plan adoption

This section of the Plan documents the formal adoption of this Plan by _____ on _____.

> **Plan Adoption Requirement per 44.CFR.201.6(c)(5):** [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council)…

The executed adoption resolution is attached in Appendix 1 - RESOLUTION TO ADOPT THE NEW ORLEANS SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN.

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Appendix 1 - RESOLUTION TO ADOPT THE NEW ORLEANS SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN

WHEREAS, The New Orleans Sewerage and Water Board has engaged in extensive studies of the natural hazards facing its properties; and

WHEREAS, The New Orleans Sewerage and Water Board has prepared the New Orleans Sewerage and Water Board Hazard Mitigation Plan; and

WHEREAS, the goals of this plan are to reduce the loss of life, decrease repetitive property losses due to natural disaster, and provide leadership and coordination to encourage all departments and sections under the auspices of The New Orleans Sewerage and Water Board to undertake hazard mitigation planning activities, which will minimize potential losses resulting from natural disasters; and

WHEREAS, the strategies of this plan are to identify and characterize hazards, asses risks, prioritize and implement mitigation measures; and

WHEREAS, the adoption of the New Orleans Sewerage and Water Board Hazard Mitigation Plan would be in the best interest and protection of the population located on all the New Orleans Sewerage and Water Board properties.

NOW, THEREFORE, BE IT, RESOLVED BY THE NEW ORLEANS SEWERAGE AND WATER BOARD THAT THE DOCUMENT ENTITLED THE NEW ORLEANS SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN AND ALL OFFICIAL MAPS PERTAINING THERETO, ARE HEREBY ADOPTED THIS, THE _____ DAY OF _____.

_____

, New Orleans Sewerage and Water Board President

Appendix 2 – Critical Facility List

Hazards identified as follows: H(hurricane), T(tornado), F(flood), S(storm surge), Su(subsidence),W(severe weather/heat/cold), Ha(hail), SI(salt water intrusion).

	Name	Full Address	City	State	Zip	Hazards Impacted
	Sewer Operation					
1	West Bank STP	3501 E.Canal St.	New Orleans	La	70119	ALL
2	East Bank STP	6501 Florida Ave.	New Orleans	La	70117	ALL
3	Sta A SPS	1321 Orleans Ave.	New Orleans	La	70116	H,T, F,S,W
4	Sta B SPS	4725 St.Claude At Jourdan	New Orleans	La	70117	H,T, F,S,W
5	Sta C SPS	1107 Pacific St.	New Orleans	La	70114	H,T, F,S,W
6	01 SPS	7336 Cohn At Lowerline	New Orleans	La	70118	H,T, F,S,W
7	03 SPS	8720 Olive Near Eagle	New Orleans	La	70118	H,T, F,S,W
8	04 SPS	5899 Fleur DE LIS	New Orleans	La	70124	H,T, F,S,W
9	05 SPS	3912 Erato St	New Orleans	La	70125	H,T, F,S,W
10	06 SPS	242 S. Solomon At Palmura	New Orleans	La	70119	H,T, F,S,W
11	08 SPS	Corner of N. Broad & Toulose	New Orleans	La	70119	H,T, F,S,W
12	9 SPS	2540 Annette At Law	New Orleans	La	70119	H,T, F,S,W
13	14 SPS	4000 Clara Dr	New Orleans	La	70115	H,T, F,S,W
14	15 SPS	2431 Palmyra Near Rochblave	New Orleans	La	70119	H,T, F,S,W
15	16 SPS	3751 N. Miro at Paulmyra	New Orleans	La	70117	H,T, F,S,W
16	17 SPS	4975 Spain AT Selma	New Orleans	La	70122	H,T, F,S,W
17	18 SPS	Vicksburg at Florida	New Orleans	La	70124	H,T, F,S,W
18	19 SPS	3730 Jumonville At Milton	New Orleans	La	70122	H,T, F,S,W
19	20 SPS	328 37th St.	New Orleans	La	70124	H,T, F,S,W
20	21 SPS	6670 Memphis at Filmore	New Orleans	La	70124	H,T, F,S,W
21	22 SPS	5705 Perlita Near Reynes	New Orleans	La	70122	H,T, F,S,W
22	23 SPS	4500 Mithra	New Orleans	La	70126	H,T, F,S,W
23	25 SPS	2245 Charbonnet At Tonti	New Orleans	La	70117	H,T, F,S,W
24	26 SPS	2244 St. Maurice at Tonti	New Orleans	La	70117	H,T, F,S,W
25	Alcee Fortier	Alcee Fortier Blvd At Levee	New Orleans	La	70129	H,T, F,S,W
26	America	6789 Dwyer at Westlake	New Orleans	La	70126	H,T, F,S,W
27	America Marine	4045 Jourdan Rd.	New Orleans	La	70126	H,T, F,S,W
28	Amid	6800 Almonster Blvd	New Orleans	La	70126	H,T, F,S,W
29	Aurora	6000 Carlise Ct.	New Orleans	La	70131	H,T, F,S,W
30	Berge	11501 Morrison Rd	New Orleans	La	70128	H,T, F,S,W
31	Blvd X	4433 Chef Menteur Hwy	New Orleans	La	70127	H,T, F,S,W
32	Bariarwood	13701 Morrison Rd	New Orleans	La	70128	H,T, F,S,W
33	Bridge Plaza	2914 Vespasian St	New Orleans	La	70114	H,T, F,S,W
34	Bullard	5501 Bullard Ave	New Orleans	La	70128	H,T, F,S,W
35	Burke	9001 Morrison Rd	New Orleans	La	70127	H,T, F,S,W
36	Castle Manor	4950 Gwain St	New Orleans	La	70127	H,T, F,S,W
37	Cerise	5001 Cerise St	New Orleans	La	70127	H,T, F,S,W
38	Chicksaw	Chicsaw & Metropolitan	New Orleans	La	70126	H,T, F,S,W
39	City Park	5701 Marconia ct	New Orleans	La	70124	H,T, F,S,W

	Name	Full Address	City	State	Zip	Hazards Impacted
40	Crowder	5500 Crowder blvd	New Orleans	La	70127	H,T, F,S,W
41	Dodt	8118 Chef Menteur Hwy	New Orleans	La	70126	H,T, F,S,W
42	Eastover	6051 Eastover	New Orleans	La	70128	H,T, F,S,W
43	English turn I	2201 Stanton Rd	New Orleans	La	70131	H,T, F,S,W
44	English Turn II	123 1/2 Oak Alley	New Orleans	La	70131	H,T, F,S,W
45	English Turn III	400 English Turn Parkway	New Orleans	La	70131	H,T, F,S,W
46	Eton	3440 Eton st.	New Orleans	La	70131	H,T, F,S,W
47	Folgers	14601 Gentilly rd	New Orleans	La	70127	H,T, F,S,W
48	Forest Isle	5631 W. Forest Park Ln	New Orleans	La	70131	H,T, F,S,W
49	France And Fla	2701 France Rd	New Orleans	La	70126	H,T, F,S,W
50	Garden Oaks	3201 Memorial park Dr.	New Orleans	La	70114	H,T, F,S,W
51	Gentilly Oaks	5000 Papnia Dr at Vienna	New Orleans	La	70127	H,T, F,S,W
52	Holiday	2799 Holiday Dr	New Orleans	La	70131	H,T, F,S,W
53	Horace	3301 Lawrence St.	New Orleans	La	70114	H,T, F,S,W
54	Huntlee	3201 Huntlee Dr.	New Orleans	La	70131	H,T, F,S,W
55	Industrial Park	4200 Industrial Parkway	New Orleans	La	70129	H,T, F,S,W
56	Kmart	Desire Pkwy at Gentilly Dr	New Orleans	La	70126	H,T, F,S,W
57	Lake Forest	10451 Lk Forest Blvd	New Orleans	La	70127	H,T, F,S,W
58	Lake Land Terrace	5057 Warren Dr	New Orleans	La	70127	H,T, F,S,W
59	Lakewood South	Country Club Dr And Marcia	New Orleans	La	70124	H,T, F,S,W
60	Lamb	6450 Morrison Rd	New Orleans	La	70126	H,T, F,S,W
61	Lawrence	7900 Morrison Rd	New Orleans	La	70126	H,T, F,S,W
62	Liggett	12501 Morrison Rd	New Orleans	La	70128	H,T, F,S,W
63	Lower Coast	3700 Old Woodland Hwy	New Orleans	La	70131	H,T, F,S,W
64	Mccoy	Mccoy St. and Gentilly Rd	New Orleans	La	70127	H,T, F,S,W
65	Mech Equip (Meco)	3855 France Rd	New Orleans	La	70126	H,T, F,S,W
66	Memorial	2501 Memorial Pk	New Orleans	La	70114	H,T, F,S,W
67	Michoud	4400 Michoud Blvd	New Orleans	La	70129	H,T, F,S,W
68	Oak Island	14201 Michoud Blvd	New Orleans	La	70129	H,T, F,S,W
69	Park Timbers	4100 Lennox Blvd	New Orleans	La	70131	H,T, F,S,W
70	Pines Village	6155 Dwyer Rd	New Orleans	La	70126	H,T, F,S,W
71	Plum Orchard	7300 Chef Menteur Hwy	New Orleans	La	70126	H,T, F,S,W
72	Shorewood	14441 Morrison Rd	New Orleans	La	70128	H,T, F,S,W
73	Southern Scrap	Harbor Rd	New Orleans	La	70126	H,T, F,S,W
74	Tall Timbers	3800 Tall Pines Dr	New Orleans	La	70131	H,T, F,S,W
75	Vent Isles no.2	20711 Old Spanish Trail	New Orleans	La	70129	H,T, F,S,W
76	Victoria	Victoria St. at Old Gentilly Rd	New Orleans	La	70126	H,T, F,S,W
77	Village De Lest	11324 Dwyer off Michoud	New Orleans	La	70129	H,T, F,S,W
78	Webber	10141 Morrison Rd	New Orleans	La	70127	H,T, F,S,W
79	Willowbrook	Willowbrook off Michoud	New Orleans	La	70129	H,T, F,S,W
80	Wilson	7709 Wilson St	New Orleans	La	70123	H,T, F,S,W
81	Woodland	4150 Woodland Dr.	New Orleans	La	70131	H,T, F,S,W
82	Wright rd	Wright Rd at Lake Forest Blvd	New Orleans	La	70128	H,T, F,S,W

	Name	Full Address	City	State	Zip	Hazards Impacted
	Drainage Station					
1	01 DPS	2501 S. Broad St.	New Orleans	La	70119	H,T, F,S,W
2	02 DPS	444 N. Broad St.	New Orleans	La	70119	H,T, F,S,W
3	03 DPS	2251 N. Broad St.	New Orleans	La	70119	H,T, F,S,W
4	04 DPS	5700 Warrington Dr	New Orleans	La	70122	H,T, F,S,W
5	05 DPS	4841 Florida Ave	New Orleans	La	70117	H,T, F,S,W
6	06 DPS	345 Orphum	New Orleans	La	70005	H,T, F,S,W
7	07 DPS	5741 Orleans Ave.	New Orleans	La	70124	H,T, F,S,W
8	10 (Citrus)	9600 Haynes Blvd	New Orleans	La	70127	H,T, F,S,W
9	11 DPS	5301 East Sixth Street	New Orleans	La	70131	H,T, F,S,W
10	12 DPS	7223 Pontchartrain Blvd	New Orleans	La	70124	H,T, F,S,W
11	13 DPS	4201 Tall Spruce	New Orleans	La	70131	H,T, F,S,W
12	14 (Jancke)	12200 Haynes Blvd	New Orleans	La	70128	H,T, F,S,W
13	15 DPS	Iwwy and Intercoastal Dr	New Orleans	La	70129	H,T, F,S,W
14	16 (St. Charles)	7200 Wales St	New Orleans	La	70126	H,T, F,S,W
15	17 (Station D)	2800 Florida Ave	New Orleans	La	70117	H,T, F,S,W
16	18 (Maxent)	Michoud Bayou and Levee	New Orleans	La	70129	H,T, F,S,W
17	19 DPS	4500 Florida Ave	New Orleans	La	70117	H,T, F,S,W
18	20 (Amid)	6300 Intercoastal Water Way	New Orleans	La	70129	H,T, F,S,W
19	Dwyer	4500 Dwyer Rd	New Orleans	La	70126	H,T, F,S,W
20	Elaine	3100 Elaine St	New Orleans	La	70126	H,T, F,S,W
21	Grant	3100 Grant St.	New Orleans	La	70127	H,T, F,S,W
22	Oleander	9400 Oleander St.	New Orleans	La	70814	H,T, F,S,W
23	Carrolton Freq Changer	8400 Earhart Blvd	New Orleans	La	70118	H,T, F,S,W
	Name	**Full Address**	**City**	**State**	**Zip**	
	Underpass DPS					
1	Bay Street	Bay Street and R/R Track	New Orleans	La	70122	H,T, F,S,W
2	Canal Blvd	5500 Canal Blvd	New Orleans	La	70124	H,T, F,S,W
3	Franklin Ave	3100 Franklin Ave.	New Orleans	La	70122	H,T, F,S,W
4	Hospital	Gulf Dr and I-610	New Orleans	La	70124	H,T, F,S,W
5	New Carrollton	Carrollton Ave and I-10 Exit	New Orleans	La	70118	H,T, F,S,W
6	Old Carrollton	Carrollton Ave and Tulane Ave.	New Orleans	La	70119	H,T, F,S,W
7	Paris Ave.	3200 Peoples Ave.	New Orleans	La	70122	H,T, F,S,W
8	Ponchartrain	Pontchartrain and I-10	New Orleans	La	70113	H,T, F,S,W
9	Press Dr.	Press Dr and Leon C Simon	New Orleans	La	70126	H,T, F,S,W
10	St. Bernard Ave	3300 St. Bernard ave.	New Orleans	La	70119	H,T, F,S,W

	Name	Full Address	City	State	Zip	Hazards Impacted
	Water Facilities					
1	Carrollton Water Plant	8801 Spruce St	New Orleans	La	70118	All
2	Algiers Water Plant	900 Lamarque St.	New Orleans	La	70114	All
3	Michoud Water Tank	15301 Chef Menteur Hwy	New Orleans	La	70129	All
4	Algiers Water Tank	Casmiere St.	New Orleans	La	70131	All
5	Carrollton Intake 1	General Ogdon	New Orleans	La	70118	All
6	Carrollton Intake 2	Industrial Ct.	New Orleans	La	70121	All
7	Algiers Intake 1	200 Dearmas St.	New Orleans	La	70114	All
8	Algiers Intake 2	1401 Brooklyn St.	New Orleans	La	70114	All

	Name	Full Address	City	State	Zip	
	Support Facilities					
1	St. Joseph HQ	625 St. Joseph St.	New Orleans	La	70130	All
2	Central, Yard Complex	2900 Peoples Ave.	New Orleans	La	70122	All

Appendix 3 – Mitigation Projects List

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/Completion Dates		Estimated Amount
*	1	1385	Chickasaw	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/10/10	$	526,000.00
*	1	914	City Park	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	665,000.00
*	1	825	Lakeview South	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	595,000.00
*	1	884	SPS #20	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	1321	SPS#4	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	1339	SPS #24	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	1635	SPS #25	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	1395	SPS #26	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	807	Alcee Fortier	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	665,000.00
*	1	1171	America	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	3355	Amid	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	2221	Castle Manor	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	2244	Cerise	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	1184	Eastover	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	665,000.00
*	1	1191	Gentilly Oaks	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	178,000.00
*	1	2002	Industrial Parkway	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$	665,000.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/Completion Dates	Estimated Amount
*	1	1172	Lakeland Terrace	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 178,000.00
*	1	1027	McCoy	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 12,267.00
*	1	910	Oak Island	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 665,000.00
*	1	1176	Paris Road	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 45,223.84
*	1	858	Willowbrook	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 130,246.13
*	1	1396	Wilson	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 178,000.00
*	1	1036	Wright	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 178,000.00
*	1	934	Pines Village	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	9/30/10	$ 210,000.00
*	1	936	SPS # 18	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 765,000.00
*	1	892	SPS#19	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 765,000.00
*	1	862	SPS #21	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 765,000.00
*	1	921	SPS #22	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 765,000.00
*	1	875	SPS #17	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/2010	$ 765,000.00
*	1	1035	SPS #23	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/2010	$ 765,000.00
*	1	1375	SPS #9	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 765,000.00
*	1	805	SPS #16	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 765,000.00
*	1	1668	SPS B	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 999,000.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/Completion Dates	Estimated Amount
*	1	4199	SPS #5	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/10	$ 990,000.00
*	1	803	Michoud	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	3/31/11	$ 1,600,000.00
*	1	87	Boulevard X	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 665,000.00
*	1	870	Bullard	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 635,250.00
*	1	907	Crowder	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 574,750.00
*	1	824	DODT	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 3,700,000.00
*	1	883	Lake Forest	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 1,280,621.00
*	1	873	Plum Orchard	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 1,280,621.00
*	1	1158	Victoria	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 1,280,621.00
*	1	821	Berg	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 713,900.00
*	1	872	Briarwood	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 592,900.00
*	1	814	Lawrence	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 1,280,621.00
*	1	878	Liggett	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 605,000.00
*	1	869	Shorewood	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 713,900.00
*	1	818	Weber	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/11	$ 595,750.00
*	1	277	SPS A	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/11/11	$ 350,000.00
*	1	1179	France and Florida	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/11/2011	$ 481,792.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/Completion Dates	Estimated Amount
*	1	811	K-Mart	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/11/2011	$ 580,800.00
*	1	800	Meco	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/11/2011	$ 441,650.00
*	1	935	America Marine	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/31/11	$ 435,600.00
*	1	806	Folgers	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/31/11	$ 665,000.00
*	1	1186	Southern Scrap	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/31/11	$ 1,045,128.00
*	1	804	Venetian Isles	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/31/11	$ 532,400.00
*	1	801	Village D'Lest	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/31/11	$ 1,521,400.00
*	1	889	Burke	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	7/31/11	$ 586,850.00
*	1	625	SPS #8	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	10/31/12	$ 1,280,621.00
*	1	627	SPS #1	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	10/31/12	$ 765,000.00
*	1	621	SPS #3	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	10/31/12	$ 765,000.00
*	1	4199	SPS #6	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	12/31/12	$ 1,280,621.00
*	1	1834	SPS #15	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	4/30/13	$ 990,000.00
*	1	11317	SPS D	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 860,488.31
*	1	863	Lamb	see 6.4.1	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,500,459.00
-	4		Tiger Dams - Main Water Plant	See 6.5.2	S&WB Operations	Hurricane, Flood, Levee Failure	ES	S&WB	3	10	COMPLETED	$ 58,000.00
-	4		Tiger Dams - Central Control Operations	See 6.5.2	S&WB Operations	Hurricane, Flood, Levee Failure	ES	S&WB	3	10	COMPLETED	$ 58,000.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/Completion Dates	Estimated Amount
2	2		Purchase and Implement WebEOC	See 6.5.2	S&WB Emergency Mgmt	All	ES, PI	NA	4,5, 6	1,6,11	TBD	NA
1	3		15 MW generator - Carrollton Water Plant	See 6.5.2	S&WB Operations, USACE	All	ES, PP	NA	1,3	9,10	11/18/10	$ 31,200,000.00
1	4		East Bank STP Berm	See 6.5.2	S&WB Operations	Hurricane, Flood, Levee Failure	ES, PP	FEMA	1,3	9,10	TBD	$ 14,000,000.00
1	4		17th street canal Pumping Station	See 6.5.2	S&WB Operations, USACE	Hurricane, Flood, Levee Failure	ES,PP	USACE	1,3	9,10	TBD	NA
1	3		4MW generator East Bank STP (EBSTP)	See 6.5.2	S&WB Risk Mgmt	All	ES, PP	S&WB	1,3	9,10	6/30/11	$ 6,000,000.00
2	2		Development of comprehensive risk policy	See 6.5.2	S&WB Operations	All	NA	S&WB	2,4, 5	1,2,3,4 ,5	TBD	$ -
2	2		Development of agency specific COOP plan	See 6.5.2	S&WB Emergency Mgmt	All	ES, PP	S&WB	2,4, 5	5	TBD	$ -
											Total	$ 96,184,480.28

Appendix 4 – Pump Station Background

In 1913, A.B. Wood provided the solution to the problem of providing greater pumping capacity for New Orleans and the prevention of severe flooding in the city. The solution was large diameter screw pumps. Wood's electric screw pump consisted of a large discharge pipe within which an impeller was housed. The 12 foot diameter pumps were installed and in use by 1915 and the 14 foot diameter pumps were installed in 1928 (Figure 3). The pump driver is a synchronous motor. A synchronous motor uses the application of three-phase ac power to the motor stator causing a rotating magnetic field to be set up around the rotor. The rotor is energized with dc power from a motor generator set (the rotor consists of winding which act like poles of a bar magnet). The strong rotating magnetic field attracts the strong rotor field activated by the dc current. This attraction results in a strong turning force (torque) on the rotor shaft. The rotor is therefore able to turn a load (in this case a pump impeller) as it rotates in step with the rotating magnetic field. Wood's pump driver is an open winding synchronous motor used for pump application circa 1913. The rotors resemble a Ferris Wheel of diameters ranging from 6 feet for constant duty pumps and up to 14 feet for the large pumps. These original motors, which are still in use, run on 25Hz power supplied by a central power plant operated by the Sewerage and Water Board of New Orleans. There are no replacement motors available and all repairs to motor components are made on an as needed basis. Because of the uniqueness of these machines, repairs can only be performed by a few specialized companies. One of the most difficult repairs to accomplish is the rewinding of the poles (rotor coils).

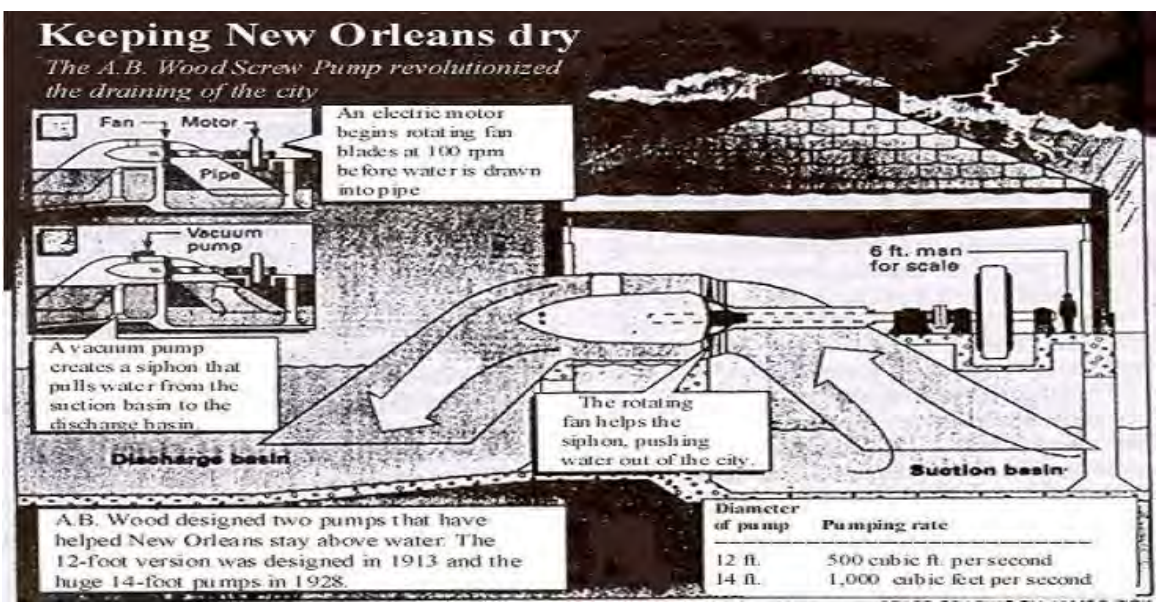


Figure 62 Baldwin Wood Screw Pump

Appendix 5 – Planning Committee Meeting Agendas

This appendix contains the agendas of the S&WB Hazard Mitigation Planning Committee from Oct 30th, 2009 thru February 23rd, 2010.

Hazard Mitigation Planning

Agenda
Friday Oct 30 2009 – 2:30pm

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues from 10/21
    a. GIS data
    b. other items, if any
3) Public Meeting
    a. Date & time
    b. Location
    c. PPT Template
        i. comments and input
    d. Public Meeting Organization
        i. SWB Overview and welcome
        ii. SWB Network
            1. GIS presentation
        iii. Hazard Mitigation planning intro
        iv. Hazard Mitigation projects
        v. Summary and Questions
4) Next Steps
5) Next Meeting (Nov 4 - 2:30 PM)
6) Adjourn

Hazard Mitigation Planning

Agenda

Thursday November 5th 2009 – 2:30pm

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues from 10/30
   a. additional info for public meeting per notes in PPT draft
3) Public Meeting
   a. PPT Template
      i. comments and input ?
   b. Public Meeting Organization
      i. Intro
      ii. About SWB
      iii. Hazard Mitigation
      iv. Project Overview
      v. Wrap-up and comments
4) Next Steps
   a. Review meeting Monday (11/9)?
   b. After action meeting?
5) Next Meeting TBD
6) Adjourn

Hazard Mitigation Planning

Agenda

Thursday November 17th 2009 – 2:30pm

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Review of Public Meeting - 11/9
   a. Issues and Questions
3) Hazard Profiles and Data
   a. Identify hazards
      i. historical data - impact of Katrina on S&WB network & services
      ii. other hazard historical data ?
   b. Identify risk
      i. hazard probability
      ii. expected impact and losses
4) Mitigation Project Data
5) Project Timeline
6) Next Conference Call - Dec 1st
7) Happy Thanksgiving!
8) Adjourn

Hazard Mitigation Planning

Agenda

Wednesday December 9th 2009 – 3:00pm (CST)

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues
3) Data Requests Status
    a. Hazard Matrix 11/19
    b. Hazard Identification 11/17
    c. Facility Worksheet 11/13
    d. Project Worksheet 11/13
4) Schedule
    a. Data for #3 MUST be received before 12/31
5) Plan Review
    a. Draft plan elements for review
        i. Requires 1 week turnaround from S&WB
6) Next Meeting 12/16/09 at 3pm ?
7) Adjourn

Hazard Mitigation Planning

Agenda

Wednesday December 16th 2009 – 3:00pm (CST)

Conf Line: 1-866-390-5250
Pin: 857-1555 #

1) Roll Call
2) Open Issues
3) Hazard Identification Status
   a. Identify Hazards
   b. Hazard History & Info
   c. S&WB damage data
4) Status of Plan Draft Sections 1&2
5) Next Meeting ?
6) Adjourn

Hazard Mitigation Planning

Agenda

Wednesday December 23rd 2009 – 3:00pm (CST)

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues
   a. Identify Hazards (complete!)
   b. Hazard History & Info
   c. S&WB damage data
   d. Facility data
   e. Lack of response from S&WB Risk Management
3) Status of Plan Draft Sections 1&2 (Introduction & About)
4) Upcoming draft for section 3 (planning process)
5) Schedule working session early January (tele-conference or in person)
6) Next Meeting Jan 6th, 2009
7) Adjourn

Hazard Mitigation Planning

Agenda (REVISED)
Wednesday January 6th 2010 – 3:00pm (CST)

Conf Line: 1-866-390-5250
Pin: 857-1555 #

1) Roll Call
2) Open Issues
3) Draft Sections 1&2 (Intro & About)
4) Draft Sections 3 (Planning Process) – for S&WB internal comment
5) Draft Section 4 (Hazard Profiles – Overview)
6) Schedule working session early January (week of Jan 18.)
7) Next Meeting Jan 14th, 2009
8) Adjourn

Hazard Mitigation Planning

Agenda

Wednesday January 13th 2010 – 3:00pm (CST)

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues
3) Draft Sections
    a. Turnaround time
    b. Approved Drafts
        i. Section 1&3
        ii. Hazard Identification
4) Schedule working session (participation is mandatory)
    a. Agenda – Review and finalize hazard assessments
    b. Define mitigation goals and objectives
    c. Jan 25th afternoon 1pm-5pm
    d. Jan 26th morning 9am-noon
5) Schedule 2nd public meeting
6) Period of Performance end date – April 11, 2010
    a. Finalize Plan Feb.
    b. Unofficial review by state in mid-March
    c. Public meeting and adoption in late-March
    d. Submit for approval end of March.
7) Next Meeting Jan 20th, 2009
8) Adjourn

Hazard Mitigation Planning

Agenda
Wednesday January 20th 2010 – 3:00pm (CST)

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues
3) Hazard Matrix walkthrough
4) Working Sessions
    a. Jan 25th 1pm – 5pm
        i. Review and finalize hazard assessment
        ii. Complete impact assessments for S&WB assets
    b. Jan 26th 9am – noon
        i. Identify and document mitigation goals and objectives
        ii. Identify and document mitigation related projects
5) Period of Performance end date – April 11, 2010
    a. Finalize Plan Feb.
    b. Unofficial review by state in mid-March
    c. Public meeting and adoption in late-March
    d. Submit for approval end of March.
6) Next Meeting Jan 27 - ??
7) Adjourn

Hazard Mitigation Planning

Agenda
Wednesday Feb 10th 2010 – 3:00pm (CST)

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues
3) Plan Status
   a. Sections 1 & 2 – drafted and approved by S&WB
   b. Section 3 (Planning Process) – pending final draft of other sections
   c. Section 4 – Risk Assessment – first draft almost complete. Pending clarification of Salt Water Intrusion hazard and tech writer review
   d. Section 5 – Loss Estimation – in process but requires worksheet data (PW, asset list, damage history).
   e. Section 6/7 – Mitigation Strategy – in process but requires project data
   f. Section 8/9 – Plan Maintenance & Adoption – in process
4) Timeline
   a. Documents for review will require 48-72 hour turnaround
   b. Final review meeting March 8th
   c. Public Meeting March 10th
   d. Finalize and edit plan – week of march 15th.
   e. Submit for unofficial review (Approval Pending Adoption) between March 22 and 29
   f. Required edits after comments
   g. Adoption April 9th
5) Questions/Comments
6) Next Meeting Feb 18th, 2009 (note: THURSDAY)
7) Adjourn

Hazard Mitigation Planning
Agenda

Thursday Feb 18th 2010 – 3:00pm (CST)

Conf Line: 1-866-390-5250
Pin: 857-1555 #

1) Roll Call
2) Open Issues
3) Plan Status
    a. Sections 1 & 2 – drafted and approved by S&WB
    b. Section 3 (Planning Process) – pending final draft of other sections
    c. Section 4 – Risk Assessment – out for comment
    d. Section 5 – Loss Estimation – out for comment
    e. Section 6/7 – Mitigation Strategy – in process but requires project data
    f. Section 8/9 – Plan Maintenance & Adoption – in process
4) Mitigation Strategy
a. Review Project lists
5) Timeline
    a. Documents for review will require 48-72 hour turnaround
    b. Public Meeting March 10th
    c. Finalize and edit plan – week of march 15th.
    i. No material changes. Cleanup and linking
    d. Submit for unofficial review (Approval Pending Adoption) between March 22 and 29
    e. Required edits after comments
    f. Adoption April 9th
6) Questions/Comments
7) Next Meeting Feb 23rd 2010
8) Adjourn

Hazard Mitigation Planning

Agenda
Wednesday Feb 23rd 2010 – 3:00pm (CST)

```
Conf Line:   1-866-390-5250
Pin:    857-1555 #
```

1) Roll Call
2) Open Issues
3) Plan Status
   - Section 1 & 2 (Intro and About S&WB) are done and approved by S&WB.
   - Section 3 (Planning Process) is pending (waiting on planning process details after the public meeting on 3/10)
   - Section 4 -Risk Assessment went out for comment on 2/12. Comments received from Emergency Management. Waiting for final comments from S&WB.
   - Section 5 - Impact and Losses, i think is done. It went out for comment on 2/16 and we got Gordon's comments on 2/19 and these have now been incorporated.
   - Section 6 & 7 - The mitigation strategy and implementation section is almost done. This should go out for comment in time for Wednesday's call.
   - Section 8 & 9 for Plan Maintenance and Adoption is done. Ready for review.
4) Schedule
   a. March 3rd – Infrastructure Committee
   b. March 8th – Red Team (S&WB Internal) meeting – S&WB EOC 1pm
   c. March 9th – prep for public meeting
   d. March 10th – Public Meeting
   e. March 17th – S&WB Board Meeting
   f. March 25th - Submission
5) Questions/Comments
6) Next Meeting March 3rd, 2010 (Infrastructure Committee, will send out status e-mail)
7) Adjourn

Appendix 6 – Public Meeting Notices

Public Meeting #1

The initial public meeting was held in the Auditorium at the Carrollton Water Plant on November 9th, 2009. The meeting was called to order at 7pm. The scheduled agenda was:

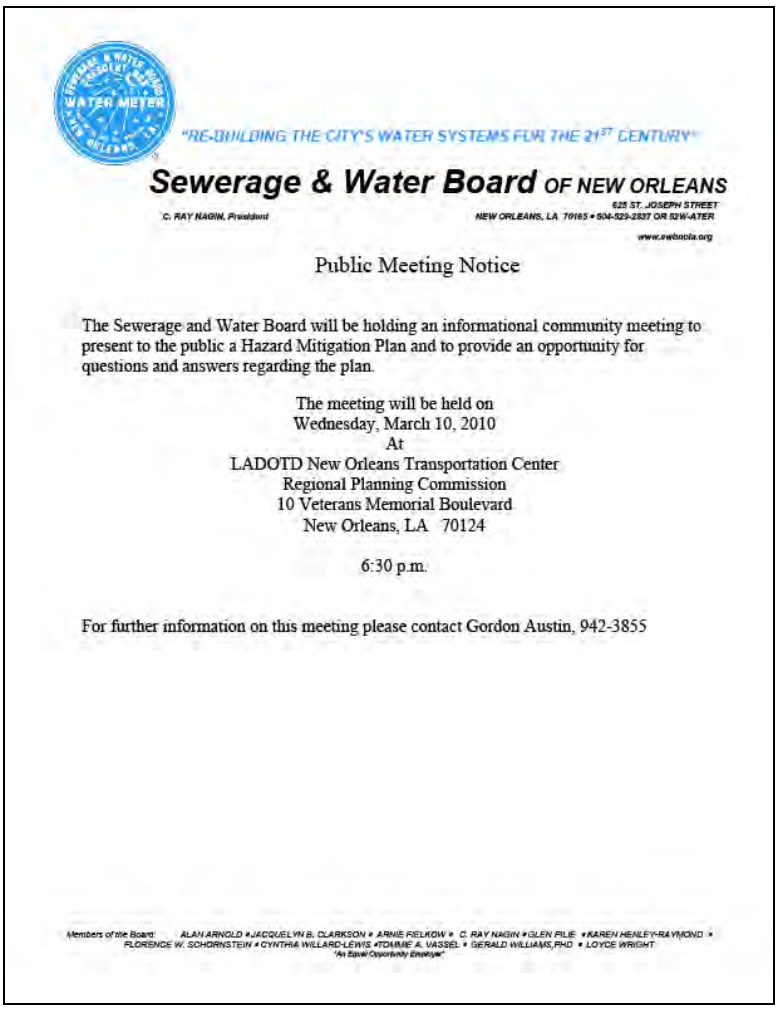
1. Introductions
2. Overview of Mitigation Planning
3. Local Disaster History
4. Hazard and Risk Assessments
5. Mitigation Project Current and Planned
6. Review
7. Public Comment / Questions & Answers
8. Summary

The meeting was not attended by any members of the public and no public comments were received. The presentation that supported the above agenda was posted to the S&WB website for public review/comment. The meeting was adjourned at 7:30PM.

Public Meeting #2

The final public meeting was held on March 10th, 2010 at 6:30 pm at the LADOTD Regional Planning Commission building at 10 Veterans Memorial Blvd.

The following public notice ran in the Times Picayune on Friday, Feb 26th; Thursday March 4 (legal notices); Monday , March 8; Tuesday March 9 (legal Notices--Display ads). Notices were also posted publicly at S&WB facilities and on the S&WB website.



"RE-BUILDING THE CITY'S WATER SYSTEMS FOR THE 21ST CENTURY"

Sewerage & Water Board OF NEW ORLEANS

C. RAY NAGIN, President

625 ST. JOSEPH STREET
NEW ORLEANS, LA 70165 • 504-529-2837 OR 52W-ATER
www.swbnola.org

Public Meeting Notice

The Sewerage and Water Board will be holding an informational community meeting to present to the public a Hazard Mitigation Plan and to provide an opportunity for questions and answers regarding the plan.

The meeting will be held on
Wednesday, March 10, 2010
At
LADOTD New Orleans Transportation Center
Regional Planning Commission
10 Veterans Memorial Boulevard
New Orleans, LA 70124

6:30 p.m.

For further information on this meeting please contact Gordon Austin, 942-3855

Members of the Board: ALAN ARNOLD • JACQUELYN B. CLARKSON • ARNIE FIELKOW • C. RAY NAGIN • GLEN FILIE • KAREN HENLEY-RAYMOND • FLORENCE W. SCHORNSTEIN • CYNTHIA WILLARD-LEWIS • TOMMIE A. VASSEL • GERALD WILLIAMS, PhD • LOYCE WRIGHT
"An Equal Opportunity Employer"

Figure 63 S&WB Public Meeting Notice

Appendix 7 – NFIP Coverage

	Insured Location	Building	Building Coverage	Contents Coverage
1	8800 S Claiborne Ave	Claiborne Pumping Station	$ 500,000.00	$ 500,000.00
2	8800 S Claiborne Ave	Panola St Pumping Station	$ 400,000.00	$ 400,000.00
3	8800 S Claiborne Ave	Meter Shop	$ 500,000.00	$ 500,000.00
4	8800 S Claiborne Ave	Machine Shop	$ 500,000.00	$ 500,000.00
5	8800 S Claiborne Ave	Welding Shop	$ 500,000.00	$ 300,000.00
6	8800 S Claiborne Ave	Electrical Storage Shed	$ 400,000.00	$ 300,000.00
7	8800 S Claiborne Ave	New Garage	$ 75,000.00	$ 75,000.00
8	8800 S Claiborne Ave	Dry Boat Storage	$ 75,000.00	$ 75,000.00
9	8800 S Claiborne Ave	Metal Storage	$ 75,000.00	$ 75,000.00
10	8800 S Claiborne Ave	Chlorine Building	$ 200,000.00	$ 75,000.00
11	8800 S Claiborne Ave	New Chemical Building	$ 400,000.00	$ 300,000.00
12	8800 S Claiborne Ave	Old Chemical Building	$ 350,000.00	$ 250,000.00
13	8800 S Claiborne Ave	Switch Gear Building	$ 150,000.00	$ 150,000.00
14	8800 S Claiborne Ave	Electrical Storage-parts only	$ 40,000.00	$ 40,000.00
15	8800 S Claiborne Ave	Claiborne substation	$ 150,000.00	$ 50,000.00
16	8800 S Claiborne Ave	Sycamore Substation	$ 150,000.00	$ 50,000.00
17	8800 S Claiborne Ave	Hamilton St Substation	$ 150,000.00	$ 50,000.00
18	8800 S Claiborne Ave	Frequency Change Building	$ 411,800.00	$ 125,000.00
19	8800 S Claiborne Ave	Hamilton St Warehouse	$ 500,000.00	$ 500,000.00
20	8800 S Claiborne Ave	Gas Compressor Building	$ 125,000.00	$ 40,000.00
21	8800 S Claiborne Ave	Electrical Shop	$ 300,000.00	$ 275,000.00
22	8800 S Claiborne Ave	Central Control Building	$ 400,000.00	$ 300,000.00
23	8800 S Claiborne Ave	Spruce St Warehouse	$ 500,000.00	$ 152,500.00
24	8800 S Claiborne Ave	Lab/Engineering Building	$ 500,000.00	$ 500,000.00
25	2900 Peoples Ave	Main Warehouse	$ 500,000.00	$ 500,000.00
26	2900 Peoples Ave	Administration Building	$ 500,000.00	$ 500,000.00
27	2900 Peoples Ave	Garage 1	$ 500,000.00	$ 500,000.00

	Insured Location	Building	Building Coverage	Contents Coverage
28	2900 Peoples Ave	Garage 2	$ 500,000.00	$500,000.00
29	2900 Peoples Ave	Switch Gear	$ 150,000.00	$ 150,000.00
30	2900 Peoples Ave	Mechanic/Body Shop	$ 350,000.00	$ 350,000.00
31	2900 Peoples Ave	Labor Building	$ 500,000.00	$ 500,000.00
32	2900 Peoples Ave	Pumping/Power Station	$ 500,000.00	$ 500,000.00
33	900 Lamarque St	Chemical House	$ 400,000.00	$ 250,000.00
34	900 Lamarque St	Head House/Filter Gallery	$ 500,000.00	$ 500,000.00
35	900 Lamarque St	High Lift Pumping Station	$ 400,000.00	$ 250,000.00
36	900 Lamarque St	Power Control	$ 400,000.00	$ 300,000.00
37	900 Lamarque St	Recycle Basin Pump Room	$ 50,000.00	$ 50,000.00
38	900 Lamarque St	Station C Building	$ 500,000.00	$ 500,000.00
39	900 Lamarque St	Storage Building	$ 300,000.00	$ 300,000.00
40	6501 Florida Ave.	General Receiving	$ 300,000.00	$ 300,000.00
41	6501 Florida Ave.	Solids Handling Building	$ 500,000.00	$ 500,000.00
42	3501 E. Canal St.	Emergency Diesel Generator	$ 400,000.00	$ 200,000.00
43	3501 E. Canal St.	Office/Operations Center	$ 500,000.00	$ 500,000.00
44	3501 E. Canal St.	Effluent Pump Building	$ 500,000.00	$ 500,000.00
45	625 St. Joseph St.	625 St. Joseph	$ 500,000.00	$ 500,000.00

Note: None of the S&WB facilities are classified as repetitive loss.

Appendix 8 – Building Permit Data

Figure 64 New Orleans Building Permit Data - Aug 2007

Appendix 9 - Hurricane direct hits on the mainland U.S. coastline

Hurricane direct hits on the mainland U.S. coastline and for individual states by Saffir/Simpson category
1851-2006

AREA	CATEGORY						Major Hurricanes
	1	2	3	4	5	ALL	
U.S. Coastline (Texas to Maine)	113	74	76	18	3	284	97
Texas	23	18	12	7	0	60	19
Louisiana	18	14	15	4	1	52	20
Mississippi	2	5	8	0	1	16	9
Alabama	12	5	6	0	0	23	6
Florida	44	33	29	6	2	114	37
Georgia	12	5	2	1	0	20	3
South Carolina	19	6	4	2	0	31	6
North Carolina	22	13	11	1	0	46	13
Virginia	9	2	1	0	0	12	1
Maryland	1	1	0	0	0	2	0
Delaware	2	0	0	0	0	2	0
New Jersey	2	0	0	0	0	2	0
Pennsylvania	1	0	0	0	0	1	0
New York	6	1	5	0	0	12	5
Connecticut	4	3	3	0	0	10	3
Rhode Island	3	2	4	0	0	9	4
Massachusetts	5	2	3	0	0	10	3
New Hampshire	1	1	0	0	0	2	0
Maine	5	1	0	0	0	6	0

Glossary

A

ABFE Advisory Base Flood Elevation

ADA Americans with Disability Act

ADCIRC ADvanced CIRCulation model

AEL Annual Estimated Loss

AICP American Institute of Certified Planners

APA American Planning Association

ARC American Red Cross

ASCE American Society of Civil Engineers

B

BCA Benefit-cost analysis

BOCA Building Officials and Code Administrators

BFE Base Flood Elevation

BLM Bureau of Land Management

BRV Building Replacement Value

C

CBR chemical/biological/radiological

CDBG Community Development Block Grants

CDC U.S. Centers for Disease Control and Prevention

CED Coastal Engineering Division of Louisiana OCRM

CEM Comprehensive Emergency Management

CEO Community Education and Outreach

CERT Citizens Emergency Response Team

CF Criticality Factor

CFR Code of Federal Regulations

CI/KR Critical Infrastructure and Key Resources Program of DHS

CIAP Coastal Impact Assistance Program

CMD Coastal Management Division of Louisiana DNR

COOP Continuity of Operations Planning

CPI Consumer Price Index

CPGP Calcasieu Parish Groundwater Project

CPRA Louisiana Coastal Protection and Restoration Authority

CRD Coastal Restoration Division of Louisiana OCRM

CRMS Coastwide Reference Monitoring Systems

CRS Community Rating System

CRT Louisiana Department of Culture, Recreation, and Tourism

CUSEC Central United States Earthquake Consortium

CVI Coastal Vulnerability Index

CWPP Community Wildfire Protection Plan

CWPPRA Coastal Wetlands Planning, Protection and Restoration Act

CWRP Coastal Wetland Reserve Program of Louisiana DNR

CZM Coastal Zone Management

CZMP Coastal Zone Management Plan

D

D&B Dun and Bradstreet

DAF Louisiana Department of Agriculture and Forestry

DDF Depth-Damage Function

DED Louisiana Department of Economic Development

DEQ Louisiana Department of Environmental Quality

DFIRM Digital Flood Insurance Rate Map

DHH Louisiana Department of Health and Hospitals

DHS U.S. Department of Homeland Security

DMA 2000 Disaster Mitigation Act of 2000

DNR Louisiana Department of Natural Resources

DOA Louisiana Division of Administration

DOC Louisiana Department of Corrections

DOQQ Digital Orthophoto Quarter Quadrangle

DOS Department of State

DOTD Louisiana Department of Transportation and Development

DPS Drainage Pumping Station

DR Disaster Recovery (Division at GOHSEP)

DSS Louisiana Department of Social Services

DWF Louisiana Department of Wildlife and Fisheries

E

EDA U.S. Economic Development Agency

EMA Emergency Management Agency

EMAP Emergency Management Accreditation Program

EMI Emergency Management Institute

EOC Emergency Operations Center

EOP Emergency Operations Plan

EPA U.S. Environmental Protection Agency

EPM Emergency Program Manager

ESRI Environmental Systems Research Institute

ETL Engineer Technical Letter

F

F Degrees Fahrenheit

FBI U.S. Federal Bureau of Investigation

FEMA U.S. Federal Emergency Management Agency

FFE First Floor Elevation

FHBM Flood Hazard Boundary Map

FIA Flood Insurance Administration

FIMA Flood Insurance Management Agency

FIRM Flood Insurance Rate Map

FMA Flood Mitigation Assistance grant program

FPC Facility Planning and Control

FPI Fire Potential Index

FPMS Floodplain Management Services

fps feet per second

FY Fiscal Year

G

GAO Government Accounting Office

GIS Geographic Information System

GNO Greater New Orleans

GOCA Louisiana Governor's Office of Coastal Activities

GOHSEP Louisiana Governor's Office of Homeland Security and Emergency Preparedness

GORD Louisiana Governor's Office of Rural Development

GPS Global positioning system

GSA U.S. General Services Administration

H

HAZMAT Hazardous material

HAZUS Hazards U.S.

HAZUS-MH Hazards U.S. – Multi-Hazard

HIDF Hazardous Materials Incident Damage Function

HIRA Hazard Identification and Risk Assessment

HMP Hazard mitigation plan

HMGP Hazard Mitigation Grant Program

HMTAP Hazard Mitigation Technical Assistance Program

HPS Hurricane Protection System

HUD U.S. Department of Housing and Urban Development

I

IA Individual Assistance grant program

IBC International Building Code

IBHS Institute for Building and Home Safety

ICC International Code Council

ICS Incident Command System

IDDF Inundation Depth-Damage Function

IEB Interim Emergency Board

IEMS Integrated Emergency Management System

IFG Individual and Family Grants

IFLOWS Integrated Flood Observing and Warning System

IFR Interim Final Rule of DMA 2000

IRC International Residential Code

ISDF Ice Storm Damage Function

L

LaGIC Louisiana Geographic Information Center

LAMAP Louisiana Mosquito Abatement Program

LaNG Louisiana National Guard

LCA Louisiana Coastal Area

LCCC Local Citizen Corps Committees

LCDBG Louisiana Community Development Block Grant

LCRP Louisiana Coastal Resources Program

LDI Louisiana Department of Insurance

LEADA Louisiana Emergency Assistance and Disaster Act
LEM Local Emergency Management

LEPC Local Emergency Planning Committee

LFMA Louisiana Floodplain Management Association

LF Linear Feet/ Foot

LGISC Louisiana Geographic Information System Council

LHMP Local Hazard Mitigation Plan

LLDF Land Loss Damage Function

LMCA Louisiana Mosquito Control Association

LOF Loss of Function

LOMA Letter of Map Amendment

LOMR Letter of Map Revision

LRA Louisiana Recovery Authority

LRCP Louisiana Coastal Resources Program

LSU AgCenter Louisiana State University -Agricultural Center

LSU Louisiana State University

LSUCCC Louisiana State Uniform Construction Code Council

M

MOA Memorandum of Agreement

MOM maximum of the maximum

MOU Memorandum of Understanding

MMI Modified Mercalli Index

MMP Map Modernization Program

mph miles per hour

mps meters per second

MSL Mean sea level

N

NBC Nuclear, Biological, Chemical

NCDC National Climatic Data Center

NED National Elevation Dataset

NEPA National Environmental Policy Act

NFIP National Flood Insurance Program

NFIRA National Flood Insurance Reform Act

NHC National Hurricane Center

NIBS National Institute of Building Sciences

NID National Inventory of Dams

NIMS National Incident Management System

NIST National Institute of Standards and Technology

NITF National Insurance Task Force

NMFS National Marine Fisheries Service

NOAA National Oceanic and Atmospheric Administration

NPS National Park Service

NRCS Natural Resources Conservation Service

NTSB National Transportation Safety Board

NWS National Weather Service

O

OCD Office of Community Development of Louisiana DOA

OCRM Office of Coastal Restoration and Management of Louisiana DNR

OCS Outer Continental Shelf

OFPC Office of Facility Planning and Control of Louisiana DOA

OHS/EP Office of Homeland Security / Emergency Preparedness

OMB Office of Management and Budgets of Louisiana DOA

OPB Office of Planning and Budget of Louisiana DOA

OPH Office of Public Health of Louisiana DHH

P

PA Public Assistance grant program

PCWRP Parish Coastal Wetlands Restoration Program

PDM Pre-Disaster Mitigation grant program

PDM-C Pre-Disaster Mitigation Competitive Grant Program

PGA Peak Ground Acceleration

PL Public Law

PNP Private Non-Profit

PPE Personal Protective Equipment

PPGP Planning Pilot Grant Program

PSA Public Service Announcement

PUD planned urban (or unit) development

PW Project Worksheet

Q

Q3 Digital Quality Level 3 Flood Data

R

RACES Radio Amateur Civil Emergency Service

RFC Repetitive Flood Claim program

RL Repetitive flood loss properties

RMP Risk Management Programs

S

SARS severe acute respiratory syndrome

SBA U.S. Small Business Administration

SBC Standard Building Code

SFHA Special Flood Hazard Area

SHMO State Hazard Mitigation Officer

SHMPC State Hazard Mitigation Planning Committee

SHMT State Hazard Mitigation Team

SHPO State Historic Preservation Officer

SLOSH Sea, Land, and Overland Surges from Hurricanes Model

sq mi square miles

SPS Sewer Pumping Station

SSDF Storm Surge Damage Function

SWCC Soil and Water Conservation Committee

SWCD Soil and Water Conservation District

T

TND traditional neighborhood development

TRI Toxic Release Inventory

U

UASI Urban Area Security Initiative

UCC Louisiana State Uniform Construction Code

UGB Urban Growth Boundary

UNO University of New Orleans

USB Urban Service Boundary

USACE U.S. Army Corps of Engineers

USBC Uniform Statewide Building Code

USC United States Code

USDA U.S. Department of Agriculture

USFS U.S. Forestry Service

USFWS U.S. Fish and Wildlife Service

USGS U.S. Geologic Survey

V

VOAD Volunteer Organizations Active in Disaster

W

WDF Wind Damage Function

WMD Weapons of Mass Destruction

WRDA Water Resources Development Act

WSCF Wildfire Suppression Cost Functions

WUI Wildland Urban Interface