Sewerage & Water Board of New Orleans

Local Hazard Mitigation Plan 2018

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1. Introduction

The Sewerage and Water Board of New Orleans (S&WB) provides potable water, sanitary sewer and drainage 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 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 S&WB Planning Area - NASA LandSat 7

Also, refer to Figure 1, the Detailed Map of the S&WB Facility Properties within the planning area.

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 defined as a sustained action taken to reduce or eliminate long-term risk to people and/or property to people and their property from hazards.

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 Hurricane Katrina in 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 1998-2017. 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.

Year	Date	Name	Cost	Disaster Number
2017	7-Feb	Severe Storms, Tornadoes	$2,996,597	4300
2017	28-Aug	Tropical Storm Harvey	$563,762	4345
2012	29-Aug	Hurricane Isaac	$333,657,856	4080
2008	13-Sep	Hurricane Ike	$224,867,930	1792
2008	2-Sep	Hurricane Gustav	$711,873,853	1786
2005	24-Sep	Hurricane Rita	$683,710,739	1607
2005	29-Aug	Hurricane Katrina	$13,464,259,210	1603
2005	23-Aug	TS Cindy	$2,825,868	1601
2004	15-Sep	Hurricane Ivan	$9,018,988	1548
2002	3-Oct	Hurricane Lili	$71,734,094	1437
2001	27-Sep	TS Isidore	$6,506,667	1435
2001	11-Jun	TS Allison	$9,038,563	1380
1999	9-Apr	Severe Storms, Tornadoes	$898,066	1269
1998	23-Sep	TS Frances/Hurricane George	$28,957,783	1246
			$15,550,909,976	

Figure 3 Presidential Disaster Declarations in Louisiana 1997 - 2017

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 S&WB 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 S&WB 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 S&WB 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 projects as an integral part of an overall and 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, welfare, economic vitality, and the operational capability of critical infrastructure.

1.3. Regulatory Requirements

This Hazard Mitigation Plan is created subject to the FEMA Mitigation Planning regulations under the Code of Federal Regulations (CFR), Title 44, and 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. 4001et 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. The Stafford Act (officially the Robert T. Stafford Disaster Relief and Emergency Assistance Act, *as Amended April 2013*) provides the statutory authority for most federal disaster response activities. The Act requires states to prepare mitigation plans as a condition of disaster assistance

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 of New Orleans' eleven member Board of Directors consists of the Mayor, two representatives of the Board of Liquidation, and eight citizen members, of which five represent council districts, one at-large representative, and two consumer advocates.

Citizen members are appointed by the mayor with the advice and consent of the city council from a list of nominees submitted by a Selection Committee comprised of representatives from the following organizations: Dillard University, Loyola University, Tulane University, Xavier University, Delgado Community College, University of New Orleans, Southern University at New Orleans, New Orleans Chamber of Commerce, New Orleans Regional Black Chamber of Commerce, and the Urban League of Greater New Orleans.

Citizen members are required to be registered voters in Orleans Parish, shall have been a domiciliary of Orleans Parish for two years previous to their appointment, shall have experience in either architecture, environmental quality, finance, accounting, business administration, engineering, law, public health, urban planning, facilities management, public administration, science, construction, business management, community or consumer advocacy, or other pertinent disciplines, and their appointment shall reflect the gender and racial diversity of our city. Two citizen members shall be consumer advocates with community advocacy or consumer protection experience or experience in a related field.

The term of office for members appointed to the Sewerage and Water Board of New Orleans is four years and a member shall serve no more than two consecutive terms of office.

All S&WB properties are shown on Figure 1. Further, detailed maps of facilities & sewer, water and drainage networks by Council District are provided in Appendix 10[1].

[1] S&WB supplied data – May 2017

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. In order to mitigate against the inundation, pump stations were constructed. Dewatering of the subsurface soils often includes consolidation of soil particles. The S&WB Planning Area which includes its water distribution network often experiences significant damage due to subsidence.

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. Treated water is pumped through approximately 1,600 miles of water mains from two purification plants with a combined capacity of 270 MGD. Raw water from the Mississippi River is pumped to the Carrollton Plant from both the Oak Street River Station and the Industrial Avenue River Station. There are three high lift stations in operation and approximately 125,000 service connections

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.

Chlorinated 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 S&WB 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 up-flow 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.

The S&WB does provide some limited services to adjoining St. Bernard, Jefferson and Plaquemine's Parishes. Mostly areas that is physically remote to the Parishes and also as emergency supply of potable water thru interconnections of water mains.

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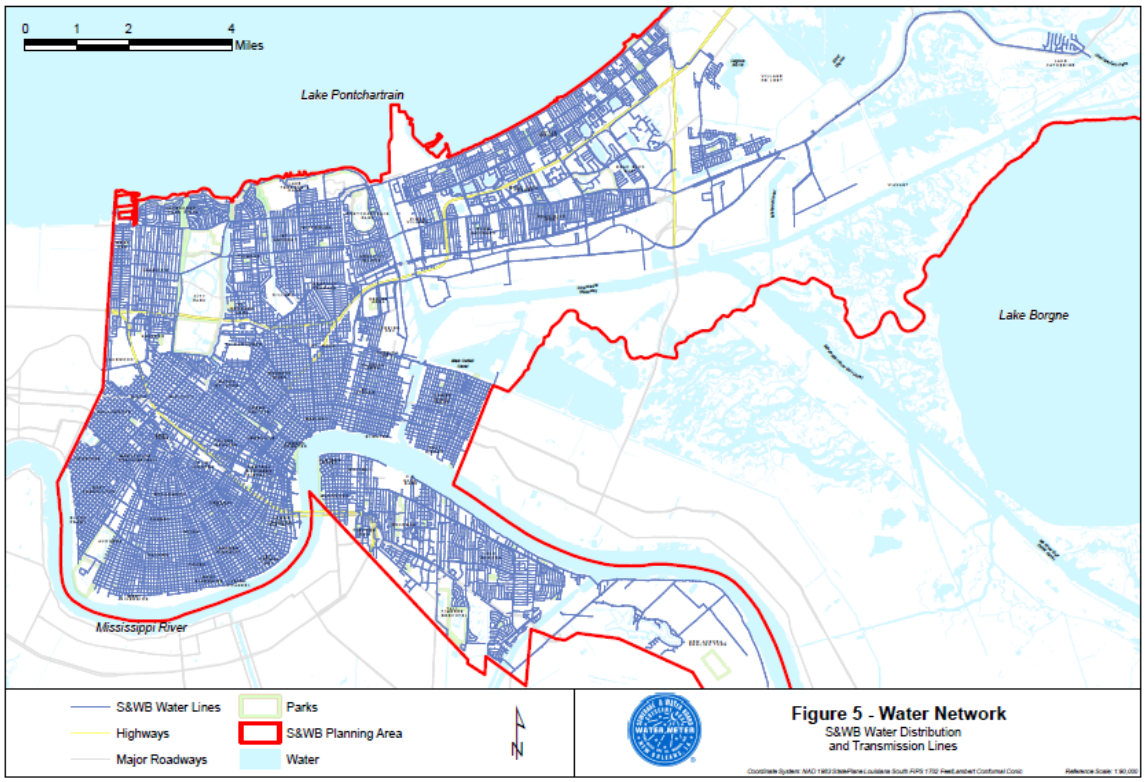

Figure 5 S&WB Water Network

2.2. Sewerage System

The unusual New Orleans topography, which makes area drainage a serious problem, also makes a similar plan necessary for sewage disposal. The sanitary sewer system of the city is a gravity collection system, consisting of approximately 1,450 miles of lateral and trunk sewers, ranging in size from 8 inches to 7 feet in diameter. Approximately 100 miles of lines are force mains. Lifting and conveying the sewage by trunk sewers and sewer force mains requires 84 electrically operated pump and lift stations to two treatment plants with a combined capacity of 244 MGD.

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 S&WB 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 S&WB 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 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 1,450 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 84 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 244 MGD. 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-hours a day, seven days a week. In addition to regular staff on duty for three eight-hour shifts, emergency crews are on standby 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 were scheduled to begin in Uptown and Mid-City for 2011.
- 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 84 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 $1.7M 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.

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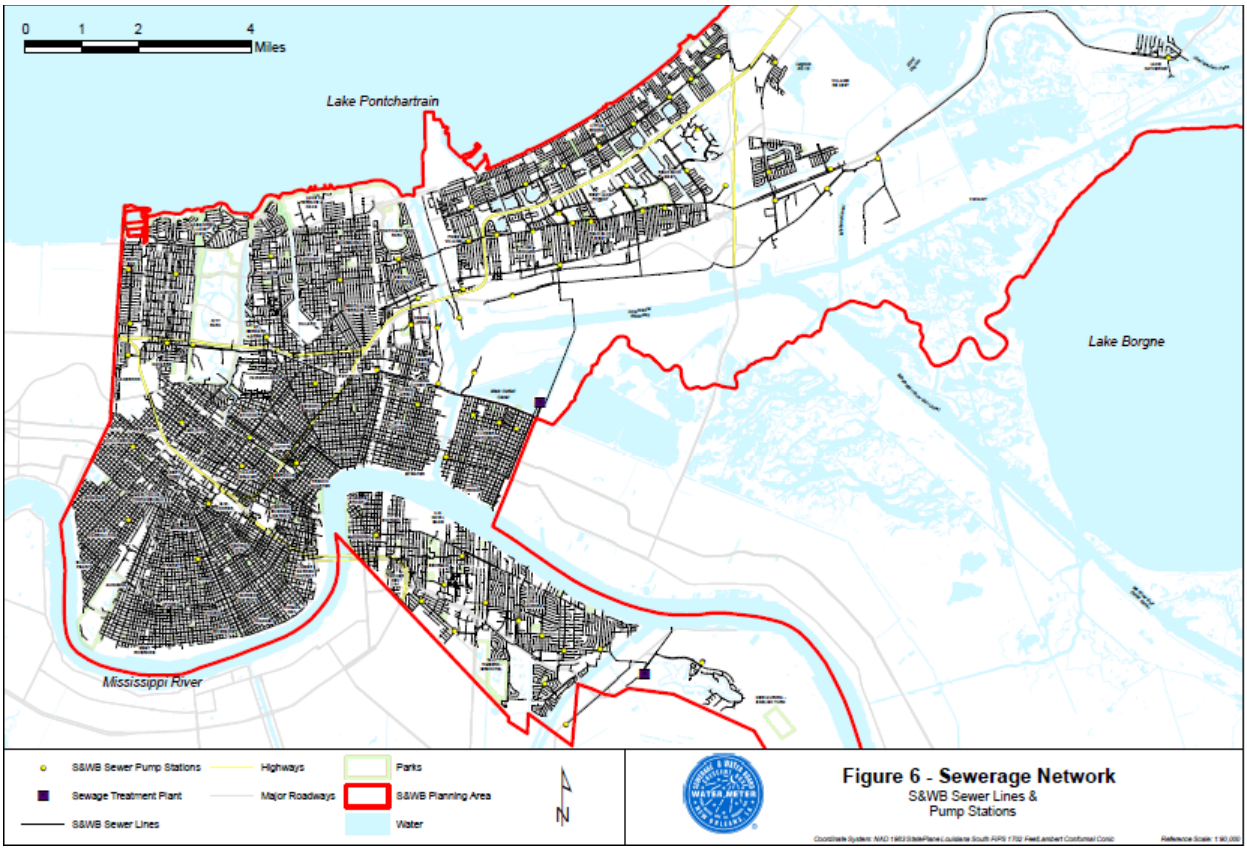

Figure 6 S&WB Sewerage Network

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.

Completed in 2013, the Greater New Orleans Urban Water Plan evaluated the potential to augment traditional drainage systems with green infrastructure systems designed to slow and absorb stormwater runoff, thereby relieving pressure on the conventional drainage system. The plan found that the principle of “living with water,” could be applied on residential and commercial properties to reduce nuisance flooding and produce aggregate benefits, including subsidence mitigation. It also posited the use of larger-scale green infrastrucgture on municipal parks and neutral grounds where feasible. These concepts were further endorsed by the city in its Resilient New Orleans strategy, unveiled in 2015.ecause 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 a total of 37 drainage pump stations consisting of 24 major drainage pump station and 13 underpass stations. The underpass station each has 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.

Completed in 2013, the Greater New Orleans Urban Water Plan evaluated the potential to augment
Traditional drainage systems with green infrastructure systems designed to slow and absorb stormwater

Runoff, thereby relieving pressure on the conventional drainage system. The plan found that the principle of “living with water”, could be applied on residential and commercial properties to reduce nuisance flooding and produce aggregate benfits, including subsidence mitigation. It also posited the use of large scale green infrastructure on municipal parks and neutral grounds where feasible. These concepts were further endorsed by the city in its Resilent New Orleans strategy, inveiled in 2015.

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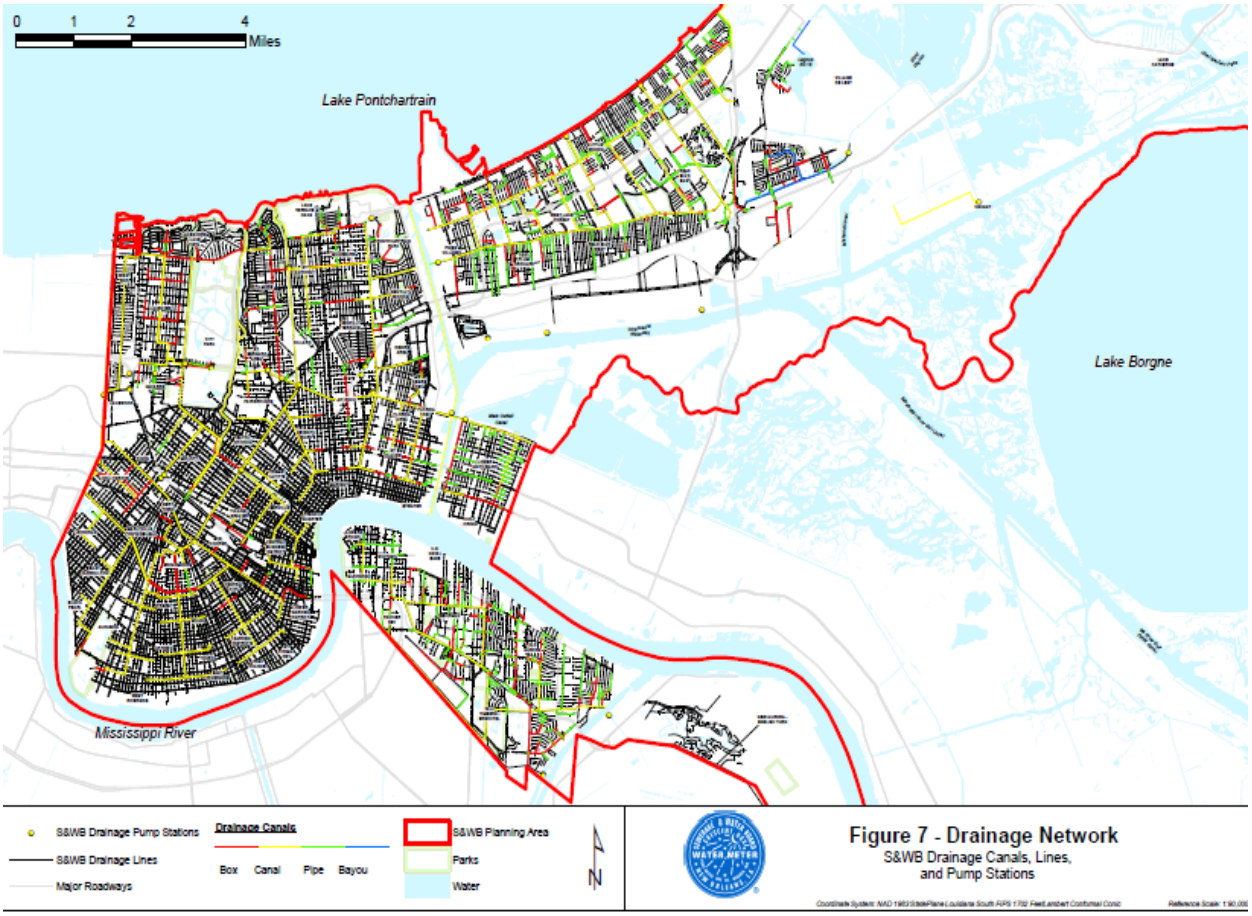

Figure 7 S&WB Drainage Network

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. A portion of Jefferson Parish is serviced by SWBNO drainage infrastructure along the parish line.

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. Refer to Figure 8.

The S&WB Planning Area is the geographic boundaries of the City of New Orleans. For most planning purposes as described in this Plan the “City of New Orleans”, “Orleans Parish” & “the S&WB Planning Area” are geographically equivalent to the Sewerage and Water Board, as a special district. See Figure 1 – S&WB Facilities with planning area boundary. All networks and applicable figures denote the planning area.

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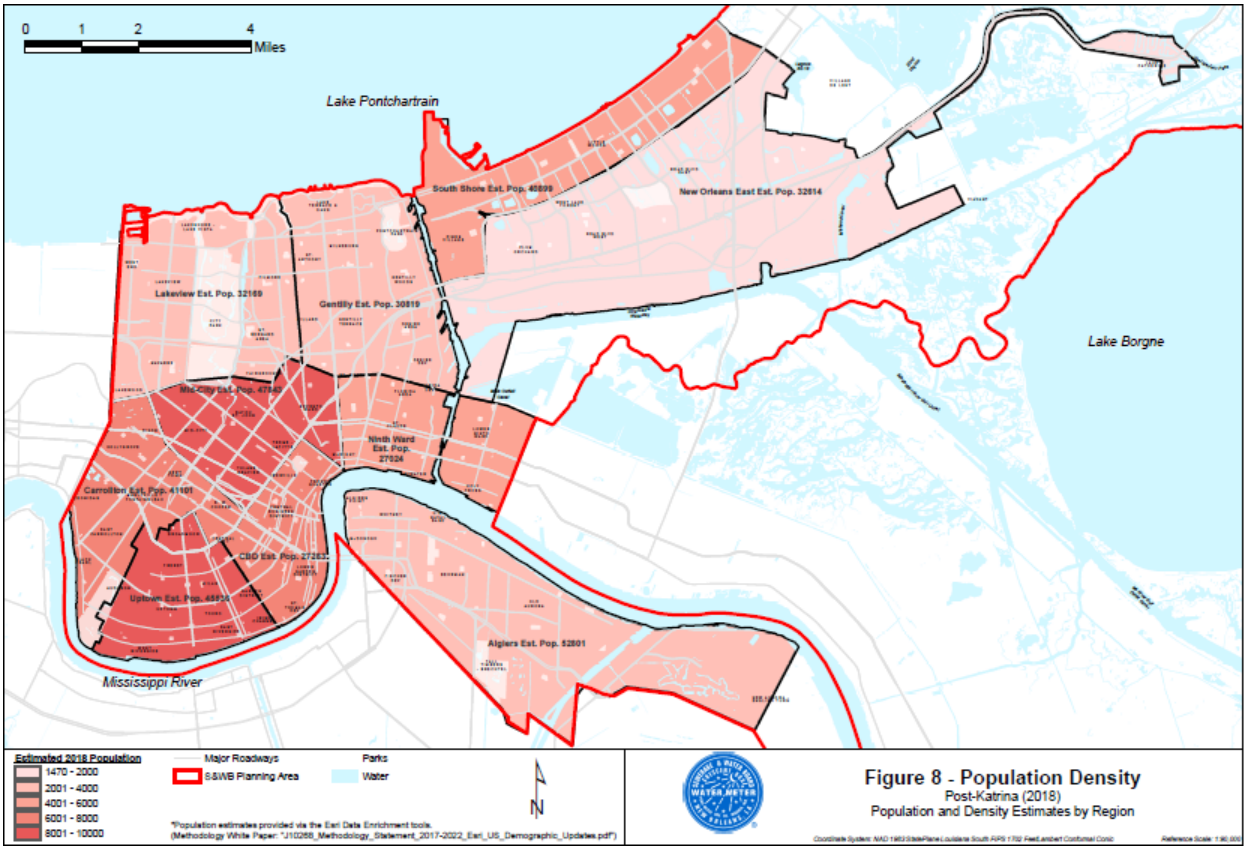


Figure 8 S&WB Population Density

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 Local Hazard Mitigation Plan (LHMP) was developed utilizing the FEMA recommended guidance for Hazard Mitigation Planning Below is a summary:

- ✓ Update of this Hazard Mitigation Plan was led by the S&WB Emergency Management Director.
- ✓ At the S&WB staff level, the S&WB planning team was led by the Emergency Management Operations.
- ✓ The NOHSEP/GOHSEP provided input into the planning process.
- ✓ The first meeting of the S&WB HMP Team to update the S&WB HMP Plan was January 26, 2017. 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.
- ✓ Hazards were identified at the July 27, 2017 Planning Team meeting and finalized at the July 27, 2017 meeting.
- ✓ On March 22, 2018 the S&WB planning group and conducted a review for final edits of the draft plan prior to the submission to the S&WB Emergency Planning Committee.
- ✓ 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 was posted to SW&B website for review and comment by the Public on September 10, 2018 and remained on the S&WB External Website untill October 17, 2018
- ✓ The 1st Public meeting was held to review the plan update on September 27,2018 at New Orleans Lakefront Airport.
- ✓ The Draft Plan concept was reviewed and approved by S&WB Audit Committee (2nd Public Meeting) on October 10,2018.
- ✓ The Final Draft Plan was reviewed and approved by Sewerage and Water Board Directors October 17,2018.

3.2. Planning Team Members

Team members included:

Name	Agency/Community Member
Jason Higginbotham	S&WB OEM Director
Leon Contreras	S&WB OEM Planning Section Chief
Ron Spooner	S&WB Chief of Engineering
Eric Labat	S&WB Chief of Operations
John Wilson	S&WB Support Service Director
Randi Jones	S&WB Environmental/Program Delivery Unit
Ryan Mast	NOHSEP Director, HazardMitigation Administrator
Jeffrey Giering	GOHSEP Hazard Mitigation
Nathan Lott*	Water Collaborative of Greater New Orleans
Allison DeJong*	Propeller's Water Program
Robert Turner	Orleans Levee District

Should be: Director, Hazard Mitigation Administrator

(*) Community Members

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

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 S&WB OEM Office coordinated this planning process with input from other stakeholders including:

- Federal Emergency Management Agency (FEMA)
- S&WB Engineering and Operations
- New Orleans Office of Homeland Security and Emergency Preparedness
- US Army Corp of Engineers (USACE)
- Governor's Office of Homeland Security and Emergency Protection (GOHSEP)
- Local Emergency Planning Committee Utilities Sub Committee

On June 27,2018 the draft plan presentation was provided to the State of Louisiana Hazard Mitigation Office for review and comment.

3.5. Planning meetings

To expedite the planning process, planning meetings were held throughout the planning process.

3.5.1. Meeting Schedule

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, to gain knowledge about their community, and the role of hazard mitigation. The S&WB values participation from the public and community stakeholders it serves. Scheduled Public Meetings provide an opportunity for the public to comment during the planning process. 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 –Adoption Public Meeting

A Public Meeting, prior to finalizing the HMP update was held on Septemebr 27, 2018 at the New Orleans Lakefront Airport 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 posted in the Main Office Building Customer Service lobby. The meeting utilized the following agenda:

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

The meeting was called to order at 6pm. The presentation that supported the above agenda was posted to the S&WB website for public review/comment. Six Memebrs of the public attended and no comments were received. The meeting was adjourned at 7 pm.

3.7. Adoption Public Meeting

The final public meeting was held on October 10,2018 prior to the adoption of the HMP by the Sewerage and Water Board. The published Public Notice and meeting minutes are located in

Appendix 6 – Public Meeting Notices .

3.8. Involving Key Stakeholders

Based on the specific requirements of the S&WB, 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 United States Army Corps of Engineers (USACE) provided project data and support to the planning committee.

3.9. Review and Incorporation of Existing Information

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

- S&WB Emergency Operations Plan – December 2017
- City of New Orleans Hazard Mitigation Plan – 2015
- State of Louisiana Hazard Mitigation Plan – 2014

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

- ✓ USACE Project Information Report Damaged Flood Control Works - 2017
- ✓ USACE Performance Evaluation Plan and Interim Status (IPET) – 2017
- ✓ USACE Operating Instruction Manual - 2017
- ✓ S&WB Report on Operations (Black & Veatch) - 2017
- ✓ S&WB Annual Operating Budget (adopted) - 2017
- ✓ S&WB Annual Capital Budget (adopted) - 2017

3.10. Adoption

This Plan will be formally adopted by the S&WB of New Orleans Board of Directors on October 17,2018 by resolution #R-163-2018. The resolution is attached inAppendix 1 - RESOLUTION #163-2018 TO ADOPT THE UPDATE TO 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 S&WB 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, the knowledge of local residents, and subject matter experts.

4.1. Hazard Identification

In compliance with regulatory requirements and specific grant guidance, the 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 2014 (SHMP) hazards with the City of New Orleans Local Hazard Mitigation Plan (LHMP) of 2015. 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, the S&WB identified 24 hazards in two categories: natural and man-made. 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	Infrastructure Failure
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 the affected the S&WB since 2012 Hazard Mitigation Plan Adoption

Probability	Impact	Hazard	Date	Incidents	Impact to S&WB	Mitigation Measures	Mitigation Status
Medium	High	Hazardous Materials/River Allision	2/2/2016	River Allision	Damage to Old and New River Stations Wharf	Barges placed at River Stations Install Marine Beacons	Completed In Design
Low	High	System Failure	12/11/2016	A/C outage at St. Joseph	IT Server Failure	Construct Alt Server at Main Water Plant	In Design
Medium	Low	Tornado	2/7/2017	Tornado	Loss of Power at 17 Sewer Stations	Purchase Generators/Pumps for 67 Sewer Stations	In Design
High	High	Hurricane	6/21/2017	Ts-Cindy	Staffing and Response Cost	Construction of Resilience Center and Safe House	In Design
High	High	Flood	7/24/2017	Flood (5" of Rain One Hour)	Pumping Station Capacity and Power interruptions	Purchase and Install 5 Electric Motor Devices at Main Water Plant	Testing
High	High	Flood	8/5/2017	Flood (9" of Rain One Hour)	Pumping Station Capacity and Power interruptions	Purchase and Install 5 Electric Motor Devices at Main Water Plant	Testing
Low	High	System Failure	8/9/2017	System Failure	S&WB Power Plant Failure	Purchase and Install 5 Electric Motor Devices at Main Water Plant	Testing
High	High	Hurricane	10/11/2017	TS Nate	Staffing and Response Cost	Construction of Resilience Center and Safe House	In Design
Low	Low	Severe Heat / Severe Cold / Winter Storm	12/16/2017	Winter Storm INGA	Infrastructure Piping Breaks, East and West Bank Boil Water	Construction of Backup Filter at Main Water Plant	Construction

4.1.3. 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.

4.1.3.1. 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 the S&WB Planning Area and thus are of no threat to the S&WB service networks. An examination of United States Geological Survey (USGS) landslide hazard information indicates that the S&WB Planning Area 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.

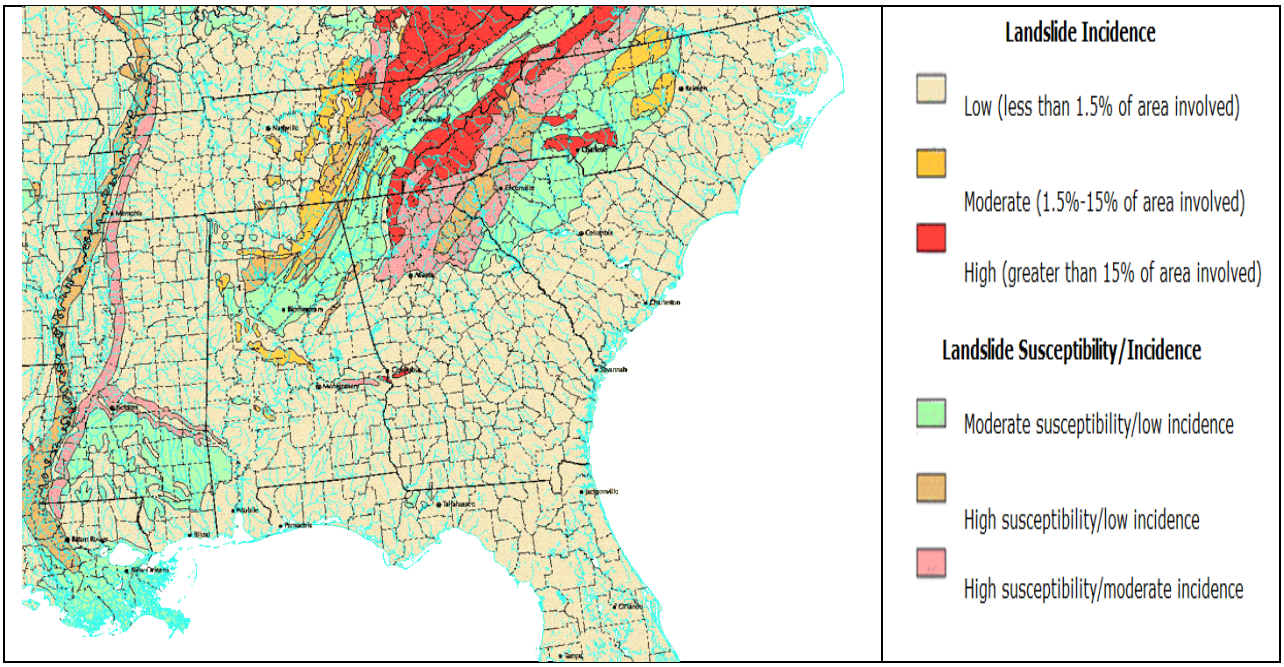


Figure 12 USGS Landside Activity

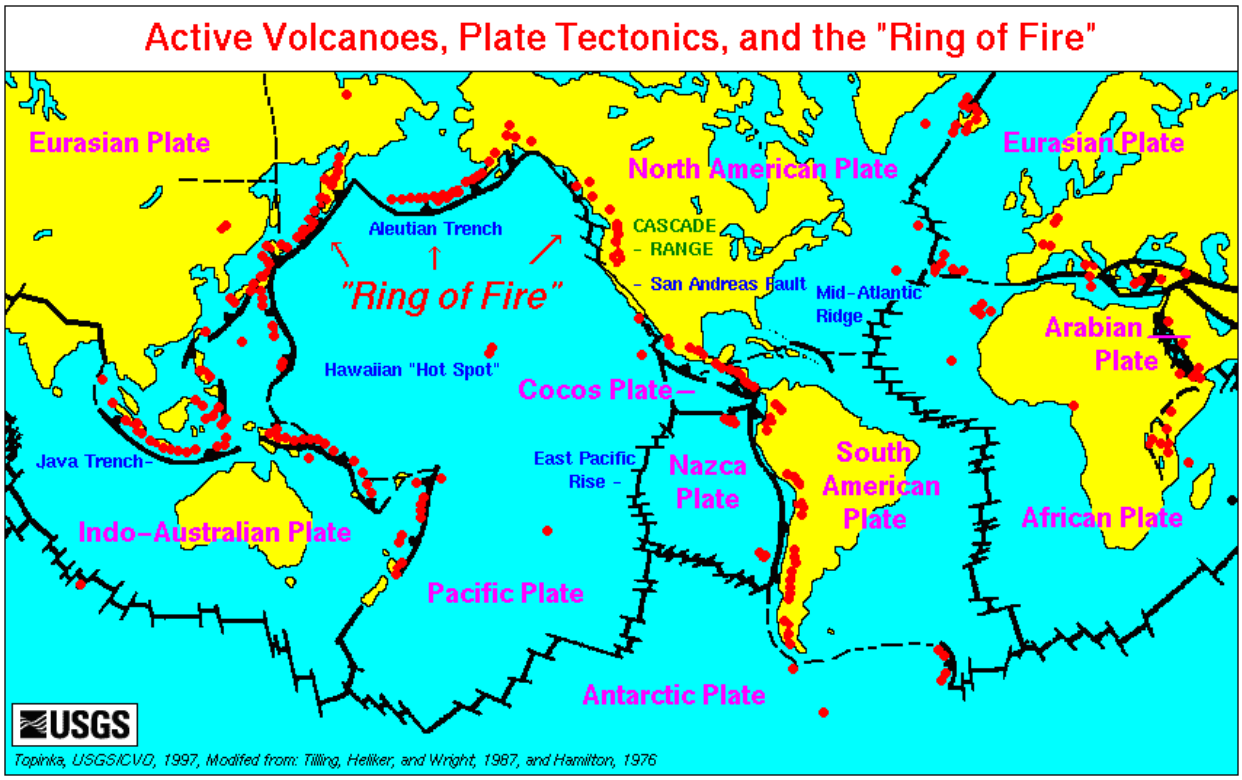
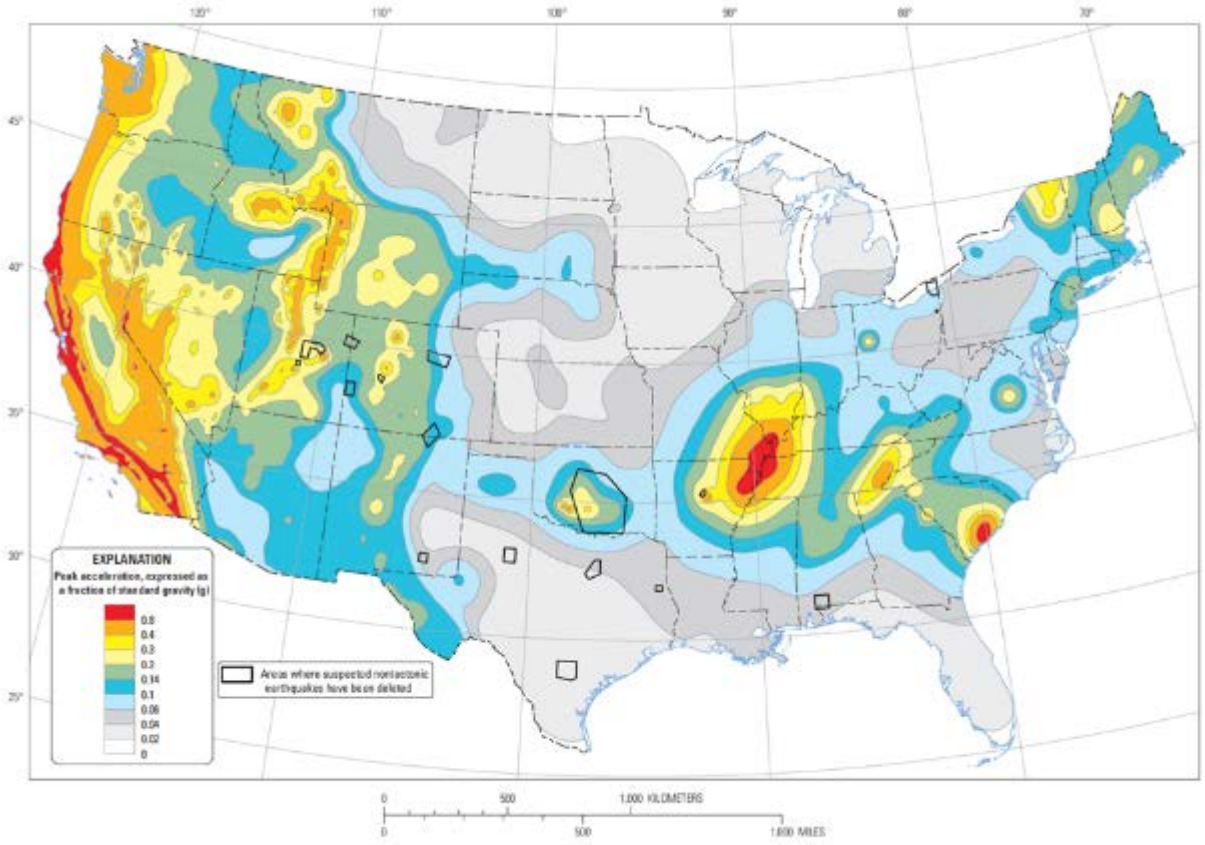


Figure 13 Global Volcanic Activity (USGS)

4.1.3.2. Earthquakes

New Orleans is at a very low risk for earthquakes. Reviews of the 2017 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.



Two-percent probability of exceedance in 50 years map of peak ground acceleration

Figure 14 **Two-percent probability 50-year map**

4.1.3.3. Dams

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

4.1.3.4. Tsunami

Tsunami hazards apply to locations on the United States West Coast and islands in the Pacific Ocean and Caribbean Sea. As New Orleans is not in these locations, the State of Louisiana and City of New Orleans Plans do not include profiles on tsunami hazards.

4.1.3.5. 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.

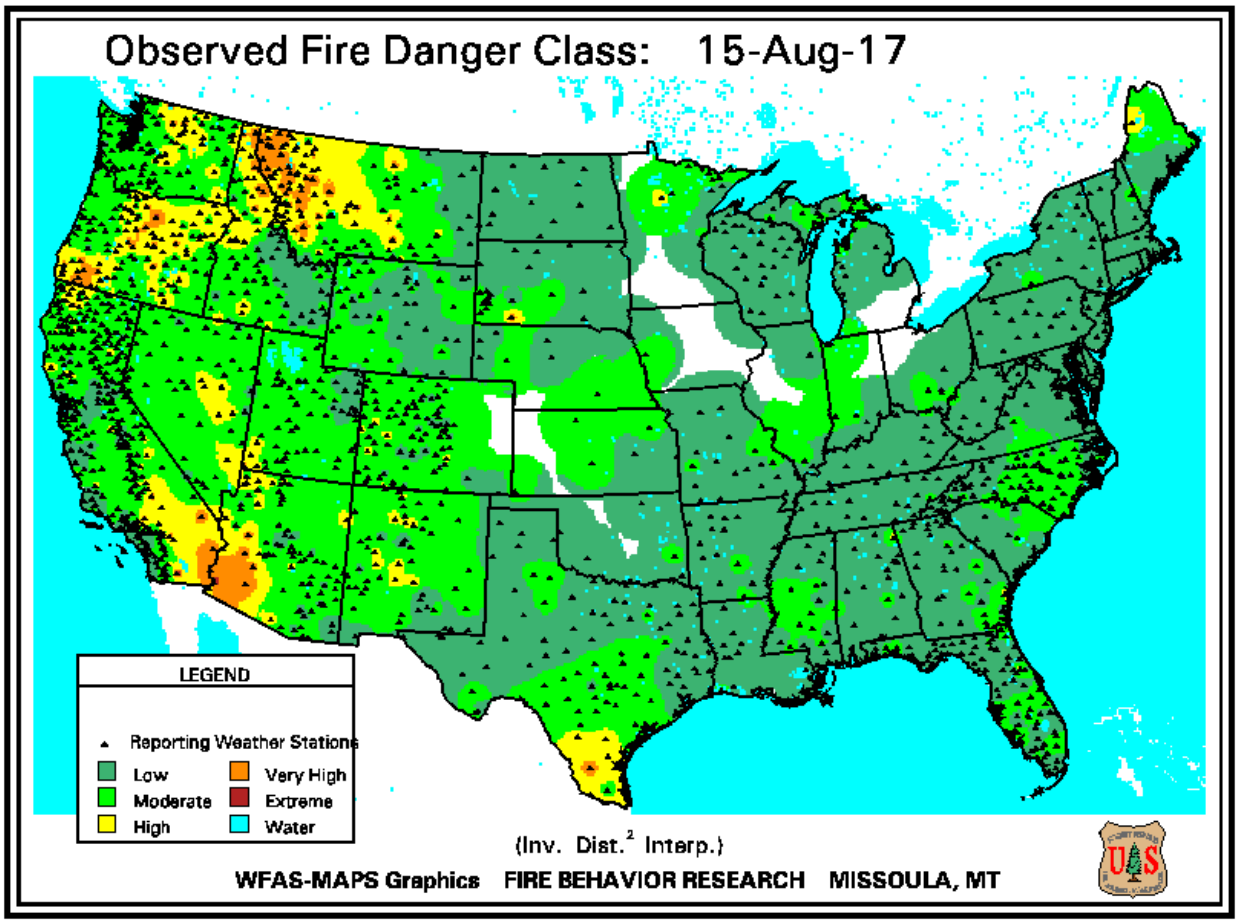


Figure 15 Observed Fire Danger Map

4.1.3.6. Pandemic

The Pandemic hazard is principally a staffing and Human Resource (HR) issue for the S&WB and is addressed within agency HR policies. Other Pandemic hazard issues are addressed within plans from the Department of Health and Hospitals and Department of Health. Therefore, as Pandemic hazard issues are addressed elsewhere, the Pandemic hazard is not profiled in this Plan.

4.1.3.7. 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.

4.1.3.8. 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 S&WB Plan. The hazard identified as "Subsidence" in this Plan, which is a significant threat to the S&WB Planning Area 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.

4.1.3.9. Disaster Aftermath

Disaster Aftermath represents a man-made 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 or damages may be created, 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 **Error! Reference source not found.**) 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.

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

Cyber Attach (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:

- SCADA system likely has some vulnerabilities and should be given more attention.
- 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 failure of SCADA due to attack or equipment malfunction during a major storm event could hamper response and requires at least redundant communication between all pump stations.

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 includes looting, trespassing, and breaking & entering. These events occurred throughout Orleans Parish the aftermath of Hurricane Katrina. Examples of these hazards include wiring being stolen from Sewerage Pump Stations (SPS) and civilians trespassing stations. Larger S&WB facilities have security resources to mitigate these hazards, but these remain pressing security and law enforcement issues.

The S&WB adheres to the Department of Homeland Security (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.

4.1.5. 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 13 hazards were identified to be included in this Plan. Several hazard types with similar characteristics have been consolidated and are *italicized* in Figure 16. Hazards that may lack a historical S&WB impact but logically pose a threat to S&WB assets are also 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.

Geographically, the S&WB service network and responsible area is the same as Orleans Parish, however, due to the "special district" designation the S&WB hazards are treated differently than the Parish. The consequences of losing even a small number of SPS would be very swift and directly impact the health and safety of citizens; as such, sustained operability of S&WB pump stations is a focus at all times.

Note: There is incomplete data available from the S&WB for some of the included hazards. Many of the historical records of the S&WB 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) No. 4116, dated March 16th, 2006.

4.2.1. Hazards identified for this Plan

Hazard	Why Identified	Probability[2]	Impact[3]	Plan Section	History[4]
Flood	High risk of occurrence	High	High	4.3.1 / 4.3.4	July 2017, August 2017, 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 of the U.S.	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	Hurricane Isaac 2012, Tropical Storm Harvey 2017, Gustav 2008, 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 and one in 2017. No damage to S&WB assets in historical record.
Infrastructure Failure	August 9, 2017 S&WB Power Plant Outage	Low	High	4.3.12	December 11,2016 IT Server Failure On August 9, 2017 the S&WB experienced a failure of all 25 cycle Turbines at the Board's main powerhouse.

Figure 16 Hazards Included in Plan

[2] Probability is defined as the expected likelihood of a specific hazard occurrence within the next 5 years based on local planning efforts.

[3] Impact is defined as the severity or "degree of possible badness" of a hazard occurrence on S&WB assets based on local planning efforts.

[4] History includes a sampling of hazard occurrence where available

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

Impact	Probability: Low (49% - 0%)	Probability: Medium (74% - 50%)	Probability: High (100% - 75%)
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 the S&WB Planning Area as well as the historical impact, the probability of future events and the impact on the assets of the S&WB. 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 / the S&WB Planning Area 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 the S&WB Planning Area 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; which is 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 the S&WB Planning Area, flood events also include incidents that may be exacerbated, or even triggered by, man-made 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 seasons, 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 the S&WB Planning Area and have caused much property damage in the general area. In the last 25 years, there have been 18 rain events that resulted in more than 10 inches of rain falling within 24 hours somewhere in the Parish. Since 1991, 6 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 the S&WB Planning Area since 1965 have involved a rain event. The NCDC lists 25 flood-only occurrences (meaning not related to other hazard events such as tropical storms or hurricanes) between July 1997 and October 2017. Per the NCDC, the total property damage within the S&WB Planning Area of these occurrences was $3.64B.

LOCATION	DATE	EVENT_TYPE	SCALE	DEATHS	INJURIES
ORLEANS (ZONE)	7/17/1997	Hurricane (Typhoon)		0	0
ORLEANS (ZONE)	9/10/1998	Tropical Storm		0	0
ORLEANS PAR.	9/11/1998	Flash Flood		0	0
ORLEANS (ZONE)	9/19/1998	Tropical Storm		0	0
ORLEANS (ZONE)	9/27/1998	Hurricane (Typhoon)		0	0
ORLEANS PAR.	8/10/2000	Tornado	F0	0	0
ORLEANS PAR.	6/7/2001	Flash Flood		0	0
ORLEANS PAR.	6/11/2001	Flash Flood		0	0
ORLEANS (ZONE)	8/4/2002	Tropical Storm		0	0
ORLEANS (ZONE)	9/14/2002	Tropical Storm		0	0
ORLEANS (ZONE)	9/25/2002	Tropical Storm		0	0
ORLEANS PAR.	9/25/2002	Flash Flood		0	0
ORLEANS (ZONE)	10/2/2002	Hurricane (Typhoon)		0	0
ORLEANS PAR.	6/19/2003	Flash Flood		0	0
ORLEANS (ZONE)	6/30/2003	Tropical Storm		0	0
ORLEANS PAR.	6/30/2003	Flash Flood		0	0
ORLEANS PAR.	6/30/2003	Tornado	F0	0	0

ORLEANS (ZONE)	9/15/2004	Hurricane (Typhoon)		0	0
ORLEANS (ZONE)	10/9/2004	Tropical Storm		0	0
ORLEANS (ZONE)	7/5/2005	Hurricane (Typhoon)		0	0
ORLEANS (ZONE)	7/10/2005	Tropical Storm		0	0
ORLEANS (ZONE)	8/28/2005	Hurricane (Typhoon)		638	0
ORLEANS (ZONE)	9/23/2005	Tropical Storm		0	0
ORLEANS PAR.	2/2/2006	Tornado	F2	0	0
ORLEANS PAR.	12/21/2006	Flash Flood		0	0
ORLEANS PAR.	2/13/2007	Tornado	EF2	0	15
ORLEANS PAR.	2/13/2007	Tornado	EF2	1	10
ORLEANS PAR.	10/22/2007	Flash Flood		0	0
ORLEANS PAR.	4/26/2008	Flash Flood		0	0
ORLEANS PAR.	6/15/2008	Flash Flood		0	0
ORLEANS (ZONE)	9/1/2008	Hurricane (Typhoon)		0	0
ORLEANS (ZONE)	9/11/2008	Tropical Storm		0	0
ORLEANS PAR.	3/27/2009	Flash Flood		0	0
ORLEANS PAR.	9/13/2009	Flash Flood		0	0
ORLEANS (ZONE)	11/9/2009	Tropical Storm		0	0
ORLEANS PAR.	12/12/2009	Flash Flood		1	0
ORLEANS PAR.	4/23/2010	Flash Flood		0	0
ORLEANS PAR.	5/16/2010	Flash Flood		0	0
ORLEANS PAR.	7/6/2010	Tornado	EF0	0	0
ORLEANS (ZONE)	9/2/2011	Tropical Storm		0	0
ORLEANS (ZONE)	9/2/2011	Tropical Storm		0	0
ORLEANS PAR.	4/3/2012	Flash Flood		0	0
ORLEANS PAR.	4/4/2012	Flash Flood		0	0
ORLEANS PAR.	7/20/2012	Flash Flood		0	0

ORLEANS PAR.	7/20/2012	Flash Flood		0	0
ORLEANS PAR.	8/9/2012	Flash Flood		0	0
ORLEANS (ZONE)	8/28/2012	Hurricane (Typhoon)		0	0
ORLEANS PAR.	8/29/2012	Flash Flood		0	0
ORLEANS PAR.	5/2/2013	Flash Flood		0	0
ORLEANS (ZONE)	1/24/2014	Winter Weather		0	0
ORLEANS PAR.	5/9/2014	Flash Flood		0	0
ORLEANS PAR.	5/9/2014	Flash Flood		0	0
ORLEANS PAR.	4/14/2015	Flash Flood		0	0
ORLEANS PAR.	5/31/2015	Flash Flood		0	0
ORLEANS PAR.	4/1/2016	Flash Flood		0	0
ORLEANS PAR.	8/4/2016	Tornado	EF0	0	2
ORLEANS PAR.	2/7/2017	Tornado	EF3	0	33
ORLEANS (ZONE)	6/20/2017	Tropical Storm		0	0
ORLEANS PAR.	8/5/2017	Flash Flood		0	0
ORLEANS PAR.	8/8/2017	Flash Flood		0	0
ORLEANS PAR.	10/2/2017	Flash Flood		0	0
ORLEANS PAR.	10/2/2017	Flash Flood		0	0
		61 Incidents			

Figure 18 National Climate Data Center

One of the heaviest rain events in the S&WB Planning Area in recent history occurred May 8th-9th, 1995. During this storm, as much as 17 inches of rain fell in parts of the S&WB Planning Area 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.

The assets of the S&WB that may be potentially impacted by flood events are located throughout the S&WB Planning Area. Figures 5, 6 & 7 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[5]:

- 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.

Rainfall duration, rainfall intensity, topography, and ground cover all directly impact the severity of flooding. Even over a short period of time, if rainfall is intense enough flash flooding will occur. Also, even with a relatively small amount of rain, certain areas can be risk areas for flooding: including large paved areas, concrete areas, or soil that is already saturated from prior rainfall. Water runoff is greater in areas with steep slopes and / or little vegetation, and therefore flood risk is greater in these areas. Flooding risk from natural sources (seasonal rainfall, snowmelt, floodplains, etc.) is treated separately from flood risks associated with levee failure.

The S&WB Planning Area is more vulnerable to flooding than to any other disaster, natural or man-made. Several factors contribute to this vulnerability. First, the S&WB Planning Area is flat. Across most of the Parish, elevations vary by a few feet at most. Hence when rain falls, it tends to pool in place. Second, most of the S&WB Planning Area 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 rainwater 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 the S&WB Planning Area. New Orleans has 24 drainage pumping stations and 13 underpasses pumping stations that pump water out of the city and into Lake Pontchartrain 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 the S&WB Planning Area'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 stormwater from flowing into the large, underground collection boxes that are part of the stormwater system. The problems mentioned above are compounded by the climate of Orleans Parish. Big rain events are fairly common in the S&WB Planning Area and have caused much property damage in the area.

On August 29, 2005, Hurricane Katrina struck the Gulf Coast near the Louisiana and Mississippi border. The storm, perhaps 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

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

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.

July 22, 2017 a slow-moving storm dumped more than four inches of rain on parts of the New Orleans area and left low-lying streets flooded Saturday afternoon.

August 5, 2017 between 8 to 10 inches of rain made landfall in New Orleans, flooding entire neighborhoods. According to the Mayor's Office, several neighborhoods experienced rainfall amounts in 100-year events, which have a one percent chance of occurring every year. The recorded rainfall topped the highest recording in recent history in many neighborhoods.

City officials released the following information on rainfall during Saturday's flood:

- Broadmoor- 5.49 inches
- Mid-City- 9.43 inches
- St. Bernard- 5.74 inches
- Gentilly- 3.94 inches
- Lower Nine- 3.64 inches
- Lakeview- 4.71 inches
- City Park- 4.96 inches
- Lower Coast Algiers- 1.54 inches
- New Orleans East- 0.74 inches
- St. Roch- 5.62 inches
- Hollygrove area- 2.07 inches

4.3.1.3. Location

In the S&WB Planning Area, 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 the S&WB Planning Area is subject to flood impact due to the area's topography.

All of the S&WB facility properties and assets are shown in Figure 1 and are vulnerable to flooding.

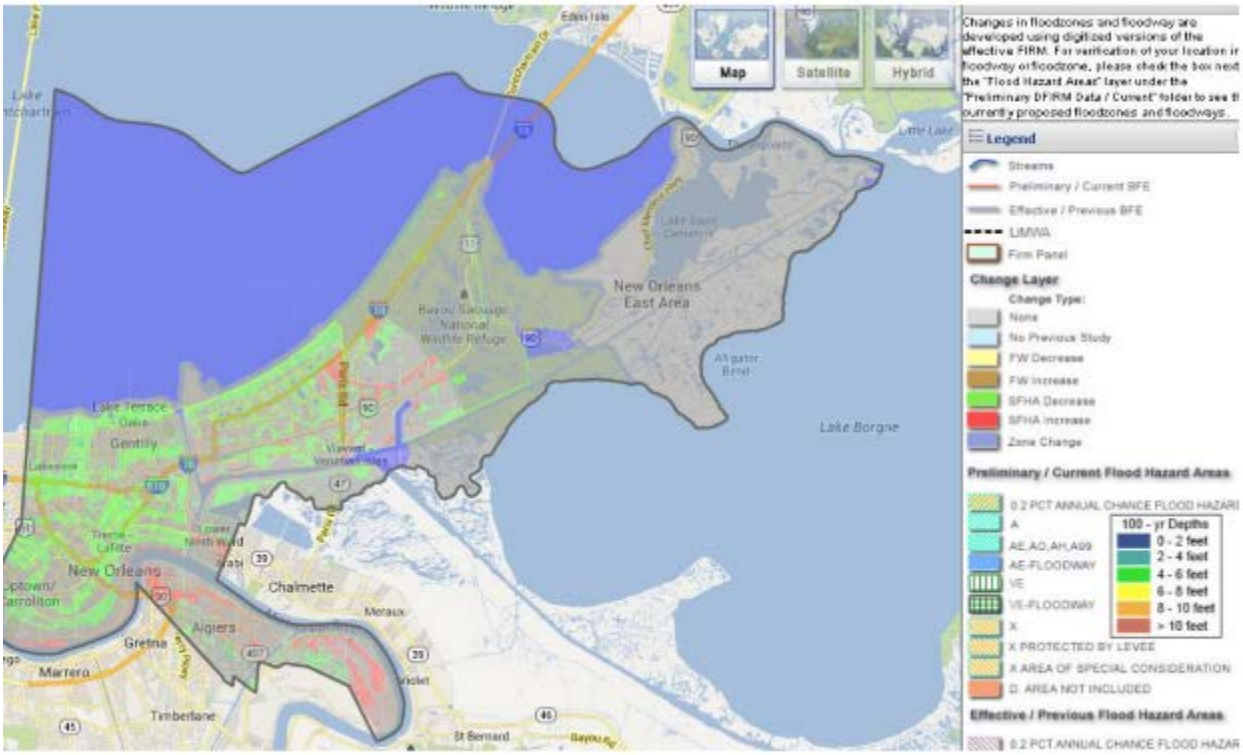


Figure 19 **FEMA Flood Zones as published in 2017**

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4.3.1.4. Severity - S&WB Impact

Flood Hazard impacts to S&WB assets are generally to 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 S&WB Planning Area flooded. As the assets of the S&WB are distributed throughout Orleans Parish (see Figures 20, 25 and 27) any flooding poses an impact.

As shown in Figure 20, the S&WB Planning Area including all S&WB facility properties & assets is susceptible to flooding between 2ft and 15ft during a severe event such as Katrina. Detailed figures for sewer, water and drainage of Katrina flood waters are provided in Appendix 11.

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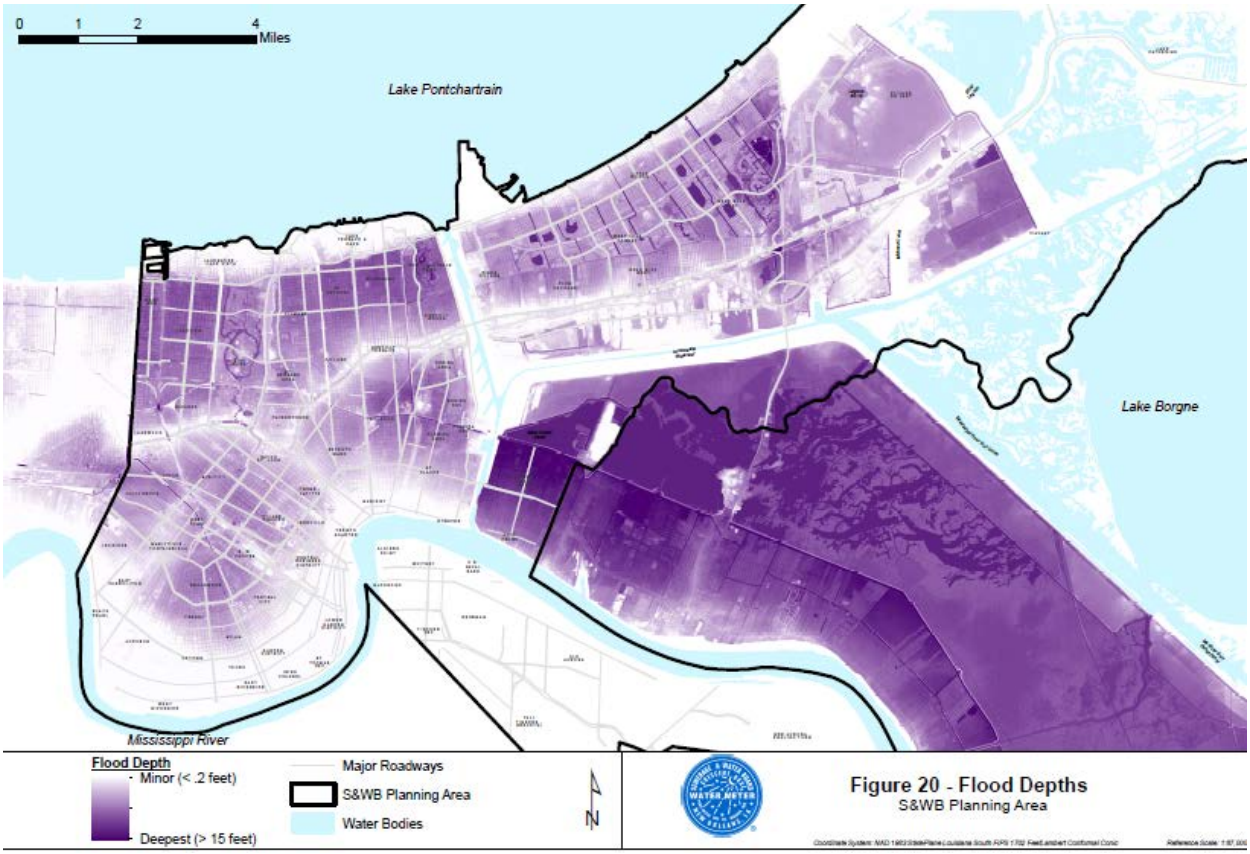


Figure 20 Flood Depths

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[6]. 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 the S&WB Planning Area 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 the S&WB Planning Area 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 S&WB are at risk to the Flood Hazard.

[6] 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

Hail is a special kind of precipitation, typically a result of thunderstorms or intense rainstorms. These spherical chunks of ice are generally white and translucent, consisting of liquid or snow particles encased within layers of ice and are not to be confused with sleet (frozen raindrops typical of winter rainstorms). Hail is formed within the high tops of a well-organized thunderstorm: an updraft will carry rain droplets high into the top layers of the storm cloud, where the droplets freeze due to lower temperatures. The frozen droplets will fall, only to be carried up again by another updraft. The freezing process occurs again and a second layer of ice is formed. This up-and-down cycle continues until the ball of ice is too heavy to be carried by an updraft, at which point the hail falls to the ground. The stronger the updraft and the longer the up-and-down cycle progress, the heavier and bigger the hail. Hail can be as small as a pea or as large as a softball and can fall at speeds up to 100mph. Hail can be extremely dangerous and damaging to property, cars, people, animals, and vegetation; hail causes nearly $1 billion in damages every year in the United States.

Hail Loss Claims 2013 - 2015: Top 10 Hail Loss States					
State	2013	2014	2015	Total	State % of US Hail Claim Total
Texas	122,005	134,028	138,539	394,572	19%
Colorado	32,741	99,565	50,285	182,591	9%
Nebraska	45,860	80,293	22,193	148,346	7%
Kansas	52,404	39,222	36,337	127,963	6%
Illinois	24,002	63,723	32,788	120,513	6%
Oklahoma	60,131	11,760	26,302	98,193	5%
Missouri	14,703	45,264	34,953	94,920	4%
Minnesota	45,860	16,688	30,641	93,189	4%
South Dakota	27,819	30,634	16,428	74,881	4%
Indiana	30,733	21,996	12,552	65,281	3%
Yearly Top 10 State Totals	**456,258**	**543,173**	**401,018**	**1,400,449**	
Top 10: % of Yearly Total	**63%**	**66%**	**70%**	**66%**	

Note: Percentages have been rounded to the nearest whole number.

Figure 21 Top 10 National Hailstorm Events, 2013-2015

On January 23, 2000, New Orleans experienced a hailstorm with hail ranging from dime to golf ball sized chunks. The hail damaged roofs, windows, vehicles, and other property resulting in nearly 42,000 homeowner insurance claims and 37,500 auto insurance claims, at an estimated cost of $353 million. The Institute for Building and Home Safety (IBHS) ranked the storm as the eighth most damaging storm in the nation, between 1994 and 2000.

4.3.2.2. Past occurrences

Between November 1970 and November 2017, the NCDC recorded 26 significant hailstorm events with hailstones greater than .75 of an inch.

LOCATION	AREA	BEGIN_DATE	MAGNITUDE
ORLEANS PAR.	NEW ORLEANS	3/30/1972	1.75
ORLEANS PAR.	NEW ORLEANS	6/17/1973	0.75
ORLEANS PAR.	NEW ORLEANS	9/1/1974	1
ORLEANS PAR.	NEW ORLEANS	5/7/1975	1.5
ORLEANS PAR.	NEW ORLEANS	7/1/1977	1.75
ORLEANS PAR.	NEW ORLEANS	4/18/1980	1
ORLEANS PAR.	NEW ORLEANS	4/26/1982	1.75
ORLEANS PAR.	NEW ORLEANS	7/5/1984	0.75
ORLEANS PAR.	NEW ORLEANS	5/21/1985	0.75
ORLEANS PAR.	NEW ORLEANS	3/2/1991	0.75
ORLEANS PAR.	NEW ORLEANS	4/9/1991	1
ORLEANS PAR.	NEW ORLEANS	2/17/1992	1
ORLEANS PAR.	NEW ORLEANS	6/4/1992	1
ORLEANS PAR.	New Orleans	4/10/1995	0.75
ORLEANS PAR.	(NEW)LKFRNT ARPT NEW	4/14/1996	0.75
ORLEANS PAR.	(NEW)LKFRNT ARPT NEW	7/28/1996	0.75
ORLEANS PAR.	NEW ORLEANS	1/24/1997	0.88
ORLEANS PAR.	NEW ORLEANS	3/29/1997	1.5
ORLEANS PAR.	(NEW)LKFRNT ARPT NEW	6/21/1998	0.75
ORLEANS PAR.	NEW ORLEANS	1/23/2000	0.75
ORLEANS PAR.	ALGIERS	1/23/2000	1
ORLEANS PAR.	NEW ORLEANS	6/21/2001	0.88
ORLEANS PAR.	NEW ORLEANS	5/30/2002	0.75
ORLEANS PAR.	NEW ORLEANS	2/4/2004	1.75
ORLEANS PAR.	NEW ORLEANS	7/8/2004	0.75
ORLEANS PAR.	SOUTH PT	5/26/2011	1
ORLEANS PAR.	GENTILLY	6/7/2011	1
ORLEANS PAR.	NEW ORLEANS	2/24/2013	1
ORLEANS PAR.	NEW ORLEANS	4/8/2014	0.75
ORLEANS PAR.	VIEUX CARRE	4/15/2015	1.75
ORLEANS PAR.	MICHAUD	4/15/2015	1.5
ORLEANS PAR.	CHEF MENTEUR	1/21/2017	1
ORLEANS PAR.	LEE	2/7/2017	1.5

Figure 22 S&WB Planning Area Hailstorms > .75" 1970-2017

Based on available data, in March 2015, Orleans Parish & the S&WB Planning Area experienced a storm that brought some of the largest hail ever recorded in the area. Hail 1.75 inches in diameter fell over the "old square "(Vieux Carre) in the City of New Orleans.

In 2002, hailstorms caused damage to an overhead crane at DPS #6. The components most directly impacted were fiberglass insulation on the electrical power track. Over 300 feet of fiberglass insulation was damaged or destroyed. The cost to replace the insulation was around $15,000 in material and labor. This impact is indicative of typical hail damage, which is considered non-systemic and performed as ordinary repairs and maintenance.

4.3.2.3. Location

Due to the nature of hailstorms, all of the S&WB Planning 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 hailstorm. 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 the S&WB Planning Area.

4.3.2.5. Probability

The State of Louisiana's Hazard Profile indicates that the S&WB Planning Area has had fewer than 33 hail events per year between 1950 and 2017. There is a 0.10% probability of hail of any size in any given year in the S&WB Planning Area, 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

The S&WB Planning Area 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 (I-10), a major east-west corridor, runs through New Orleans and the S&WB Planning Area. 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 regularly. New Orleans also has an extensive system of navigable waterways, including the Mississippi River and the Industrial Canal. A significant amount of industrial chemicals are 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 S&WB Planning Area'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 S&WB Planning Area, hazardous materials incidents pose a threat to that network.

The Carrollton Plant and the Algiers Plant of the S&WB of New Orleans are home to the potable water treatment facilities for the East and West banks of the S&WB Planning Area. 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 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 regularly conducted 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 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.

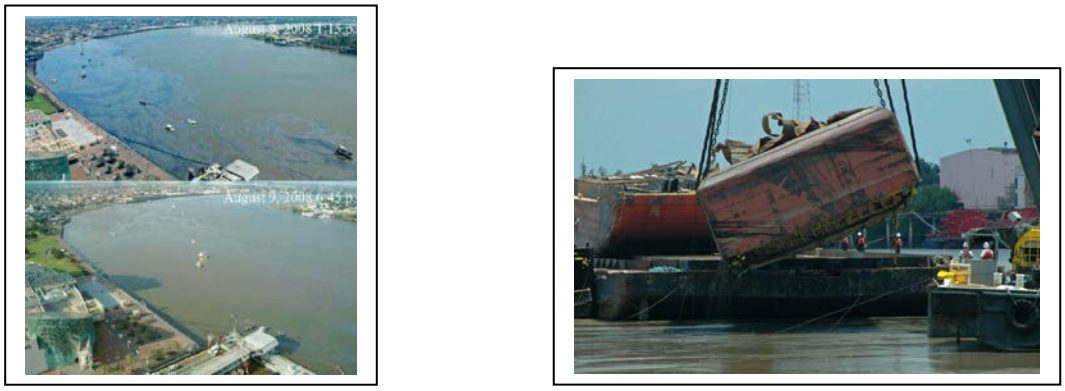


Figure 23 Barge DM932 Oil Spill with bow section being removed from the Mississippi River

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.

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 (LDHH).

The severity of this hazard is dependent 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. The S&WB Planning Area's 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 the City of New Orleans. The potential to shut down 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 S&WB Planning Area could require 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. The S&WB Planning Area will continue to experience accidental hazardous materials spills on a regular basis.

2015 Vessel Calls for New Orleans, LA

(Research and Innovative Technology Administration, Bureau of Transportation Statistics, USDOT)

Measure	Value
Vessel Calls (all types), 2015	7,192
Tanker	2,661
Container	487
Dry Bulk	3.479
Other (e.g., Combination, Ro-Ro)	565
Cruise Departures, 2012	59
Cruise Passengers (in thousands), 2012	161

NOTES: For an explanation of Ship Types, please refer to the Maritime Administration's *Glossary of Shipping Terms*, which is available at http://www.marad.dot.gov/documents/Glossary_final.pdf.
SOURCES: Vessel Calls: U.S. Department of Transportation, Maritime Administration, *and U.S. Port Calls by Vessel Type,* available at http://www.marad.dot.gov/ as of May 2015. **Cruise:** U.S. Department of Transportation, Maritime Administration, *North America Cruise Summary Data*, available at http://www.marad.dot.gov/ as of May 2012.

Based on the above metrics, the S&WB Planning Area has a 35% probability of a tanker calling on the Port of New Orleans whereas the potential for a spill is less than 1%.

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. The S&WB Planning Area is threatened by hurricanes that develop in the Atlantic Ocean and the Gulf of Mexico. The greatest threat to the S&WB Planning Area comes during the Atlantic Ocean/Gulf Hurricane season, which runs from June 1st to November 30th. Hurricanes generate several hazards that can cause extensive damage. High winds, large amounts of rainfall, tornadoes 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, the City of New Orleans is especially vulnerable because of the threat to the levees system. Levees network 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.

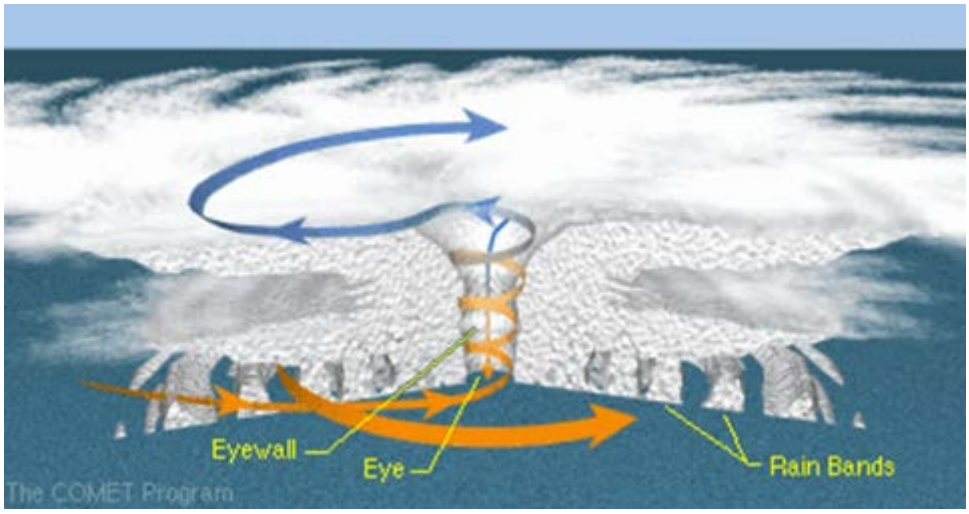


Figure 26 Hurricane Structure

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

New Orleans and the S&WB Planning Area have 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 the S&WB Planning Area due to heavy rains or high winds.

The following graphic displays major hurricanes in the Gulf of Mexico between 2001 and 2010. Figure 27 illustrates the Northern Gulf of Mexico Hurricanes.

The S&WB implemented mitigation against flooding as a result of Hurricane Katrina. Under the S&WB sewer pump station elevation program, a total project cost of $20,145,706.37 has been estimated. The following sewer pumping stations were not elevated during the time of Hurricane Katrina and as a result suffered major flooding: SPS8, Corner of N. Broad & Toulouse; DOTD at 8118 Chef Menteur Hwy; Lake Forest, 10451 Lk Forest Blvd; Plum Orchard, 7300 Chef Menteur Hwy; Victoria, Victoria St. at Old Gentilly Rd; SPS 6, 242 S. Solomon At Palmyra; Lawrence, 7900 Morrison Rd; and Burke, 9001 Morrison Rd. The sewer pump stations have been elevated through the Hazardous Mitigation Grant Program as a result of Hurricane Katrina.

Statistically, the S&WB Planning Area gets brushed or hit an average of every 3.73 years directly and averages a direct hit every 12.55 years.[7]

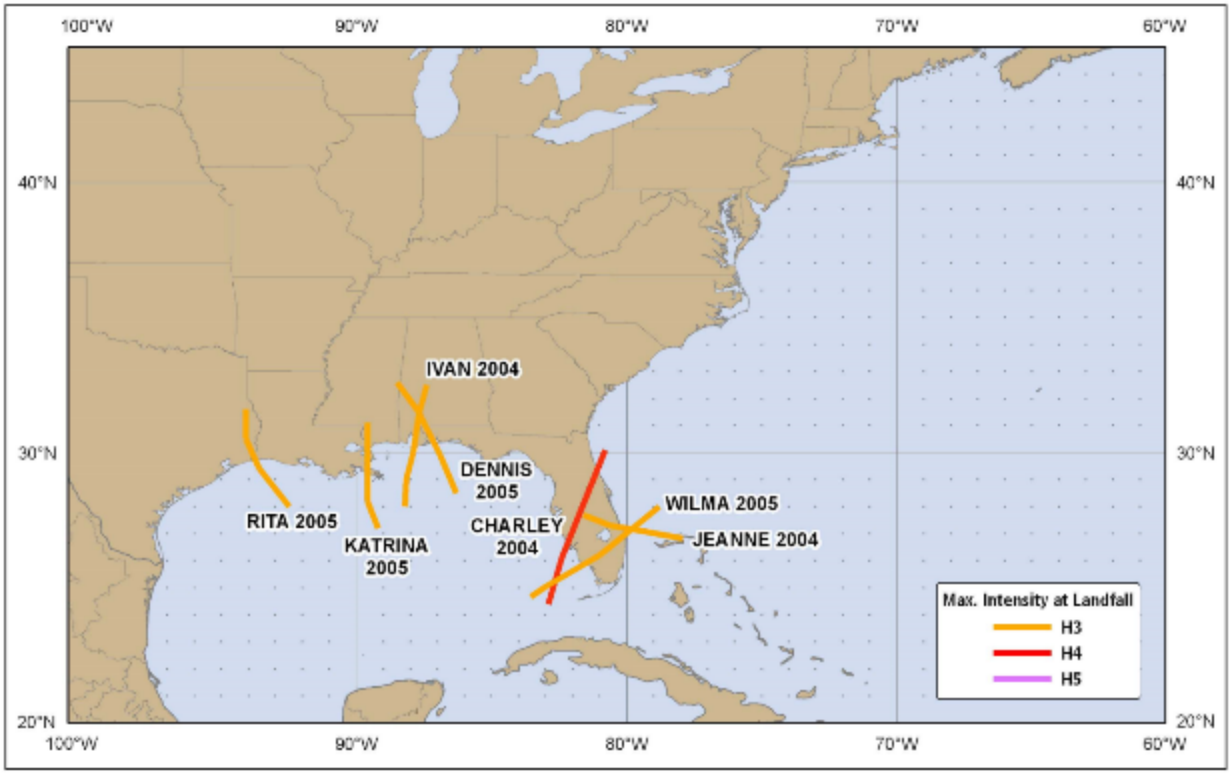


Figure 27 Northern Gulf of Mexico Hurricanes Past Track Maps of Major Hurricanes 2001 – 2010 NOAA

Figure 28 identifies the 14 NOLA Presidential Declarations in the last 19 years and the costs incurred to the S&WB for associated damages.

Year	Date	Name/Desc	Cost[8]	Active[9]	Disaster Number
2017	7-Nov	Tornado	$0		4300
2012	26-Aug	Hurricane Isaac	$3.4 million	X	3347
2008	11-Sept	Hurricane Ike	$0		1792
2008	1-Sept	Hurricane Gustav	$755,000	X	1786
2007	12-Feb	Tornado	$0		1685
2005	24-Sep	Hurricane Rita	$0		1607
2005	29-Aug	Hurricane Katrina	$803 million	X	1603
2005	23-Aug	TS Cindy	$0		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	$0		1269
1998	23-Sep	TS Frances Hurricane George	$0		1246

Figure 28 S&WB Planning Area Presidential Declarations 1998-2017

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

The NCDC lists 21 Hurricanes and Tropical Storms that impacted New Orleans and S&WB Planning Area between 1997 and 2017.

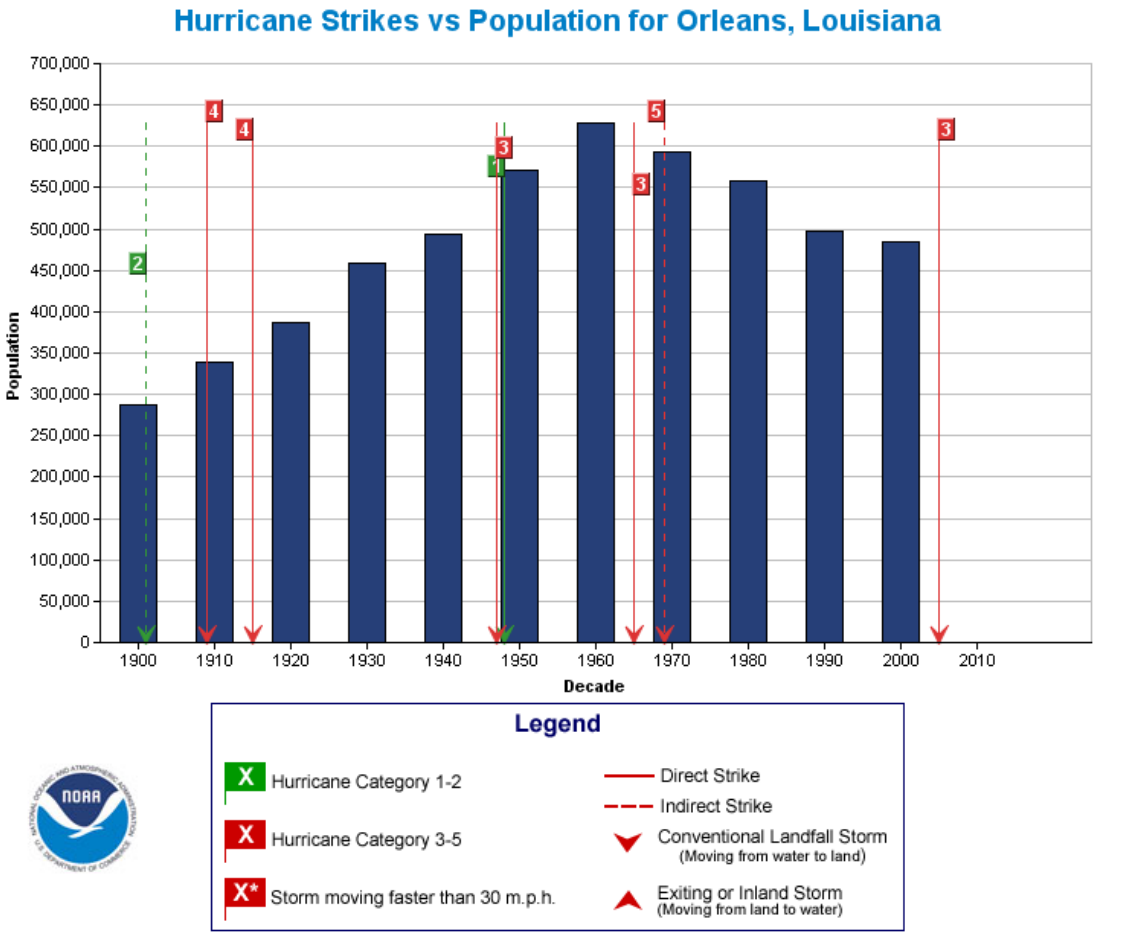
DATE	EVENT_TYPE	DEATHS
7/17/1997	Hurricane (Typhoon)	0
9/10/1998	Tropical Storm	0
9/19/1998	Tropical Storm	0
9/27/1998	Hurricane (Typhoon)	0
8/4/2002	Tropical Storm	0
9/14/2002	Tropical Storm	0
9/25/2002	Tropical Storm	0
10/2/2002	Hurricane (Typhoon)	0
6/30/2003	Tropical Storm	0
9/15/2004	Hurricane (Typhoon)	0
10/9/2004	Tropical Storm	0
7/5/2005	Hurricane (Typhoon)	0
7/10/2005	Tropical Storm	0
8/28/2005	Hurricane (Typhoon)	638
9/23/2005	Tropical Storm	0
9/1/2008	Hurricane (Typhoon)	0
9/11/2008	Tropical Storm	0
11/9/2009	Tropical Storm	0
9/2/2011	Tropical Storm	0
9/2/2011	Tropical Storm	0
8/28/2012	Hurricane (Typhoon)	0

Figure 29 NWS Hurricanes and Tropical Storms 1997-2017

4.3.4.3. Location

All of the S&WB Planning Area 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 S&WB Planning 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 30.



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 30 Hurricanes Strikes vs. Population for the S&WB Planning Area

4.3.4.4. Severity

The strength of hurricanes is measured using the Saffir-Simpson scale in Figure 31. 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 31 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 the S&WB Planning Area 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. The S&WB Planning Area 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 the City of 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 23 pump stations and 14 underpasses drainage pump stations in the S&WB Planning Area with a total capacity exceeding 45,000cfs. All stations were damaged by Hurricane Katrina (2005) either by floodwater and/or wind driven rainwater. 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[10], the brackish and polluted water remained in some stations for many weeks. 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 were cleaned, dried and field tested to ensure that most moisture was essentially baked out of the insulation.

If a Katrina-level event were to occur, the S&WB can expect similar but lesser damages as the large motors will withstand damage from polluted water due to more resistant material used in the rewinding process. 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.

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

Summary of Cost and Benefits

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	$2,410,000.00						$2,410,000.00
Drainage Pump Station #4-London Avenue	$473,000.00						$473,000.00
Drainage Pump Station #19-W. of Indust. Canal	$702,000.00						$702,000.00
Drainage Pump Station #2	$2,759,000.00						$2,759,000.00
Drainage Pump Station #7-Orleans Avenue	$1,074,000.00						$1,074,000.00
Drainage Pump Station #12	$128,000.00						$128,000.00
I-10 Underpass Drainage Pump Station.	$298,000.00						$298,000.00
Drainage Pump Station #6-17th Street	$2,494,000.00						$2,494,000.00
Drainage Pump Station #1-Broad Street	$2,080,000.00					$2,080,000.00	
Monticello Drainage Pump Station	$6,000.00						$6,000.00
Pritchard Place Drainage Pump Station.	$16,000.00					$16,000.00	
Drainage Pump Station #17-Station D	$7,492,000.00						$7,492,000.00
Carrolton Frequency Changer	$2,585,000.00						$2,585,000.00
Subtotal	$22,517,000.00	$1,258,000.00	$16,320,000.00	$15,062,000.00	13.0	$2,096,000.00	$20,421,000.00
Lower Ninth Ward							
Drainage Pump Station #5-East of Industrial Canal	$1,670,000.00	$93,000.00	$193,000.00	$100,000.00	2.1	$0.00	$1,670,000.00
Lower Algiers/English Turn							
Drainage Pump Station #11	$2,780,000.00	$155,000.00	$8,781,000.00	$8,626,000.00	56.7	$0.00	$2,780,000.00
Algiers							
Drainage Pump Station #13	$2,990,000.00	$167,000.00	$4,821,000.00	$4,654,000.00	28.9	$0.00	$2,990,000.00
New Orleans East							
Drainage Pump Station #10-Citrus	$3,770,000.00						$3,770,000.00
Drainage Pump Station #14-Jahncke	$1,220,000.00						$1,220,000.00
Drainage Pump Station #16-St. Charles	$1,020,000.00						$1,020,000.00
Drainage Pump Station #20-Amid	$2,062,000.00						$2,062,000.00
Grant Drainage Pump Station	$274,000.00						$274,000.00
Elaine Drainage Pump Station	$573,000.00						$573,000.00
Drainage Pump Station #18-Maxent	$1,000.00						$1,000.00
Drainage Pump Station #15-Michoud	$756,000.00						$756,000.00
Subtotal	$9,676,000.00	$540,000.00	$4,046,000.00	$3,506,000.00	7.5	$0.00	$9,676,000.00
Total	**$39,633,000.00**	**$2,213,000.00**	**$34,161,000.00**	**$31,948,000.00**	**15.4**	**$2,096,000.00**	**$37,537,000.00**

Figure 32 Katrina Repair Costs for Pumping Stations

Congress has funded the USACE through its Hurricane and Storm Damage Risk Reduction System (HSDRRS), a total of $14.45B through the 7th Supplement with a Federal Share of $12.8B as of June, 2012.

This funding included $204M in Orleans Parish Storm Proofing Projects with 5 in construction and 5 completed. Furthermore, the Orleans Parish pump station repair has included 14 repair projects at 23 stations and the Carrollton Frequency Changer Building for $66.2M. All of these projects protect the S&WB Planning Area.

Due to the critical nature of drainage systems for the S&WB Planning Area 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 No.3 at the Carrollton Water Plant was damaged in Katrina due to rainwater 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 S&WB Planning Area gets brushed or hit an average of every 3.73 years directly 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 30-34kt, 35-39kt 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 period of time. 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 33, graphically presents the HURISK datasets.

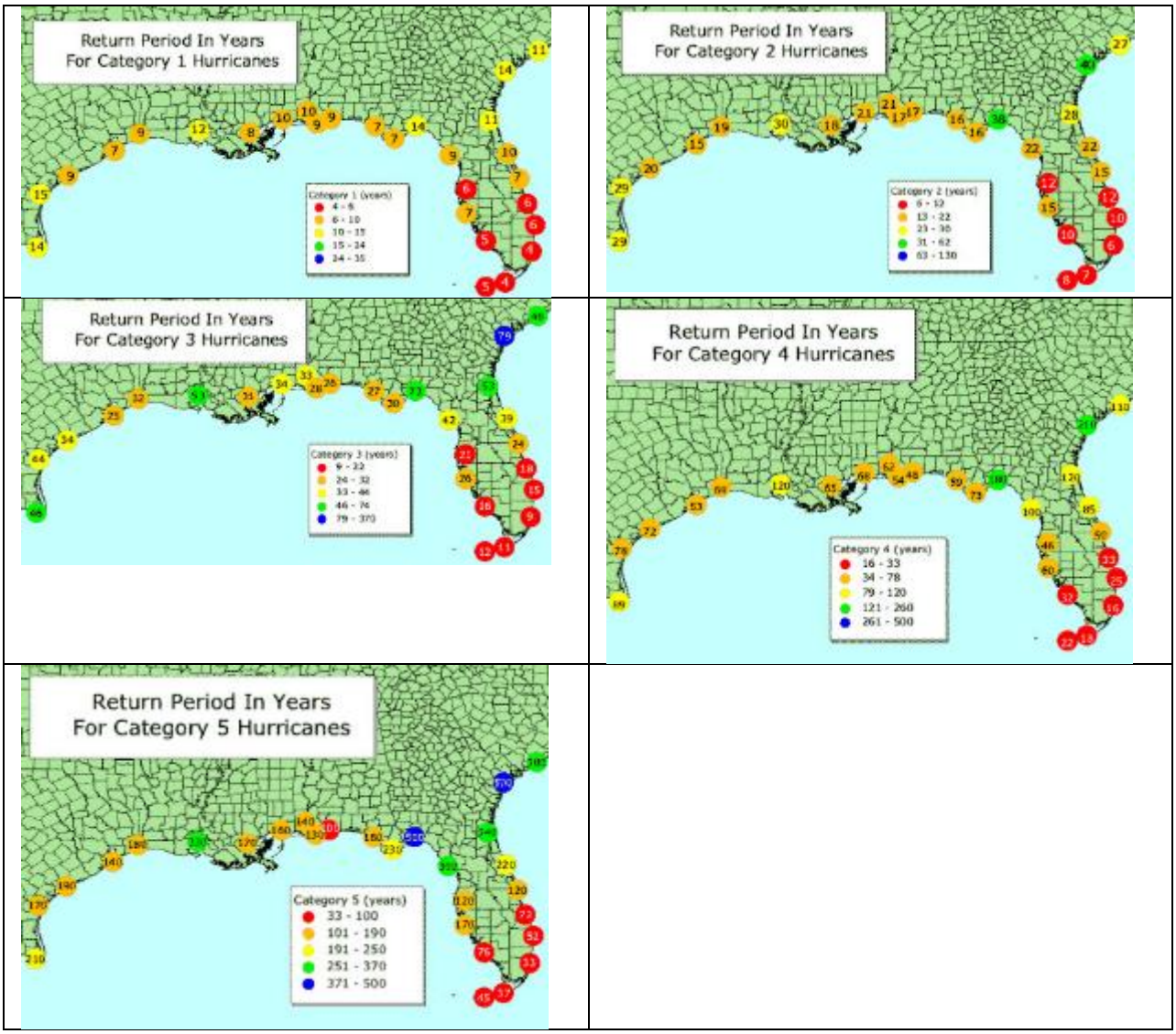


Figure 33 HURISK - NHC

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 Planning Area are 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 the S&WB Planning Area. A failure of any of these levees will dump water into the S&WB Planning Area and endanger not only property, but human and animal life. The City of New Orleans sits in a shallow "saucer" with much of the S&WB Planning Area 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.

Historically, the Lake Pontchartrain and Vicinity Project (authorized following Hurricane Betsy in 1965) is a USACE Congressional authorization USACE with an estimated total cost of more than $500M (Federal Share) and $200M (Local Share). 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 Hurricane Protection System (HPS) 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 (HPS), 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 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.

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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

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 including all of the S&WB Planning Area and 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 the S&WB Planning Area, there was no expeditious way for it to be removed other than by pumping it out. As a result, the flood waters remained in the S&WB Planning Area, 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 Pontchartrain 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 S&WB Planning Area. 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 rooftops 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 the S&WB Planning Area properties, over 100,000, received some flood damage from the compromised levees. The monetary cost to taxpayers, insurance companies and citizens has been estimated to be $50-$100billion. Hundreds of thousands residents had to abandon their flooded homes and relocate to other areas of the country that were then in turn impacted by the homeless population. Some citizens will never return to Orleans Parish. The economic and social climate of the S&WB Planning

Area was severely altered. The S&WB Planning Area's revenue sources 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, the S&WB Planning Area 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.

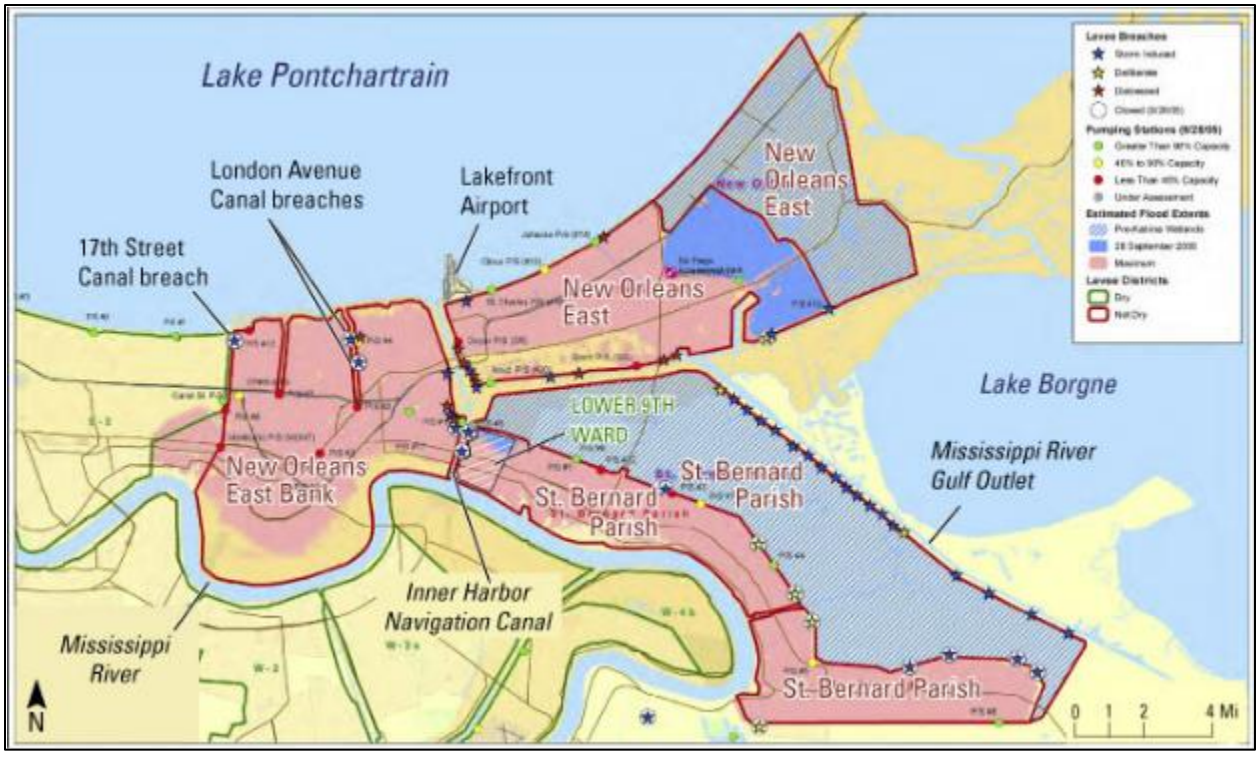

Figure 34 Locations of place and levee breaches (NOAA)

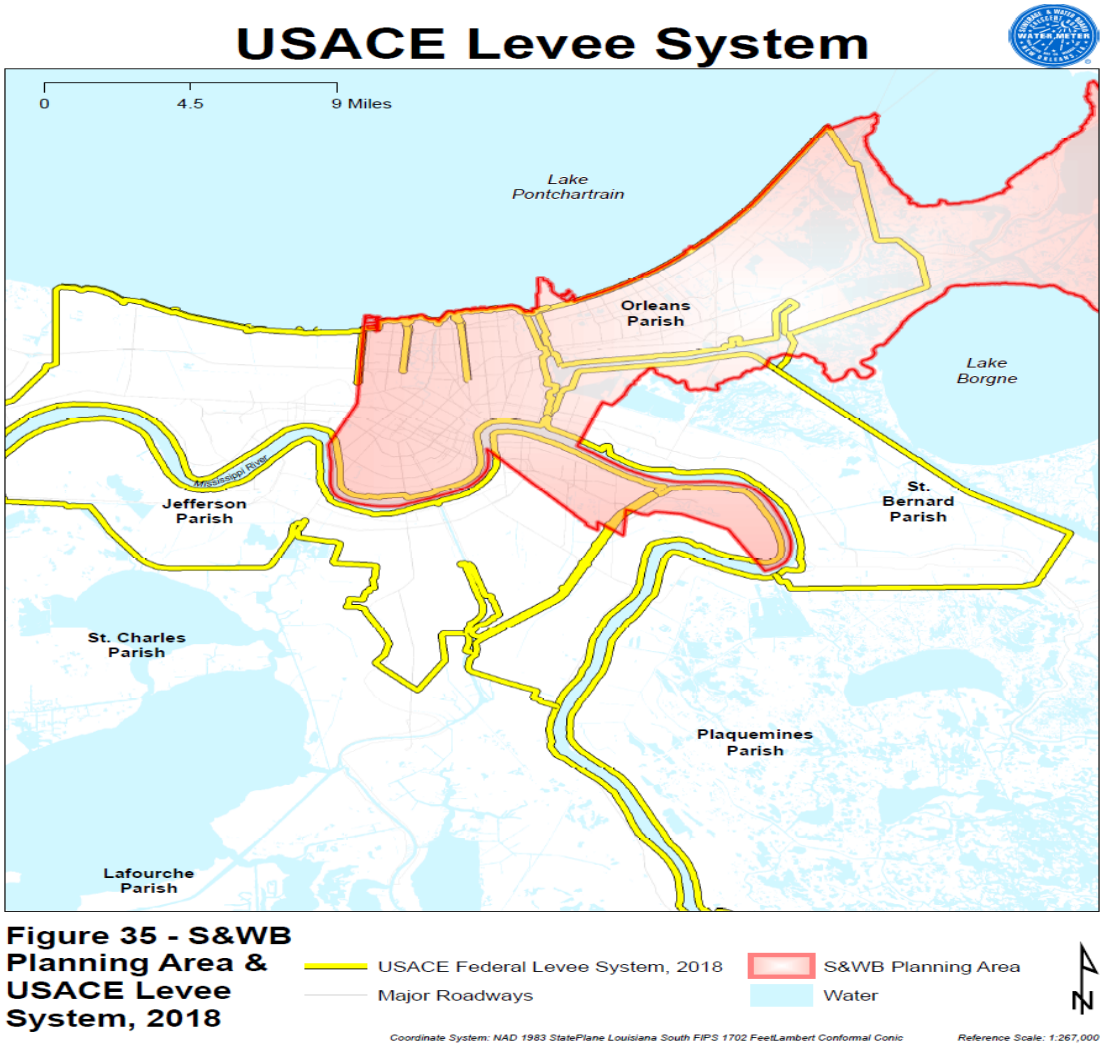

Figure 35 USACE Levee System

4.3.5.3. Location

A complex system of levees hold back waters that are designed to keep the S&WB Planning Area safe from Lake Pontchartrain, 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 the S&WB Planning Area. 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 the City 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. Affected 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.

4.3.5.1. Severity

Levee failure has the potential to be a catastrophic hazard event for the S&WB Planning Area and all the S&WB facility properties / assets / 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 S&WB Planning Area flooded.

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(Refer to following page)

Figure 36 Levee Failure Locations – Hurricane Katrina 2005

The S&WB 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 S&WB Planning Area flooded, S&WB assets were heavily damaged. As shown in Figure 38, 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 including the S&WB Planning Area has a hurricane/tropical storm recurrence interval of being hit or brushed every 3.73 years. 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". Levee failure or overtopping along the Mississippi River in either East or West Bank would likely be associated with substantial storm events elsewhere in the watershed coupled with a structural failure or ship/barge incident As there is nothing in the historic record regarding systemic levee failures, this hazard has a reoccurrence factor of "Rare.

Hurricane Katrina brought intense rainfall, storm surges and severe wind. Within the S&WB Planning Area, estimates of precipitation based on radar rainfall data indicate that up to 13.6 inches fell in some areas over the 24-hour period. According to the American Society of Civil Engineers (ASCE) report, The New Orleans Hurricane Protection System: What Went Wrong and Why, the 100-year rainfall (24-hour duration) for the City of New Orleans is 12.58 inches which was based on U.S. Weather Bureau Technical Paper 40 (1961). This meant that there was a 1 in 100 probability in any given year that there will be 24-hour period where the accumulated rainfall will be greater than 12.58 inches. Hurricane Katrina had a probability-based recurrence interval in the range of 50 to 500 years, meaning that, in the future, a storm such as Hurricane Katrina has 1 in 50 to 1 in 500 chance of occurring in any one year or less than 2%. As discussed earlier in the section, Congress has funded, through the 7th Supplement, the USACE through its Hurricane and Storm Damage Risk Reduction System (HSDRRS), a total of $14.45billion. The HSDRRS is a one hundred year level of protection which actually means reducing risk from a storm surge that has a 1% chance of being equaled or exceeded in any given year. The 1% chance is based on the combined chances of a storm of a certain size and intensity (pressure) following a certain track. Different combinations of size, intensity and track can result in a 100-year surge event. The chance of levee failure is even lower.

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 S&WB for this hazard are similar to hurricane and coastal storm events and are included in Section 4.3.4.

Many thunderstorms occur in the S&WB Planning Area 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 tornadoes are discussed in separate sections of this Plan relating to those specific hazards.

4.3.6.2. Past occurrences

A lightning event on June 6, 2005 caused four water pumps to lose power at the S&WB East Bank Water Treatment Plant. Service was interrupted for 1hr until alternative power was routed to bring the water pressure back to normal. The S&WB Planning Area 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 the S&WB Planning Area frequently result in 1 to 4 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 of NCDC tracked property damage. Actual local damage estimates are considerably higher but undocumented. Figure 37 shows thunderstorms since 1995 that caused property damage and the location of the damage. Below is how these events are reported.

Details of Lightning Event "10" (see Figure 40)

8 events were reported between 11/01/1995 and 11/30/2017 (8066 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	8
Number of Days with Event and Death:	2
Number of Days with Event and Death or Injury:	2
Number of Days with Event and Property Damage:	3
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Begin Location	Begin Date	Event Type	Magnitude	Deaths	Damage Property
New Orleans	11/11/1995	Thunderstorm Wind	52	0	$ -
Lakefront ARPT New Orleans	1/24/1996	Thunderstorm Wind	53	0	$ -
New Orleans	2/13/1997	Thunderstorm Wind		0	$ 500.00
Lakefront ARPT New Orleans	4/26/1997	Thunderstorm Wind	57	0	$ 50,000.00
FT Pike	4/26/1997	Thunderstorm Wind	54	0	$ -
New Orleans	2/10/1998	Thunderstorm Wind	50	0	$ -
New Orleans	6/21/1998	Thunderstorm Wind		0	$ 1,000.00
Lake Catherine	1/2/1999	Thunderstorm Wind		0	$ 1,000.00
New Orleans	7/14/2000	Thunderstorm Wind		0	$ 500.00
New Orleans	7/22/2000	Thunderstorm Wind		0	$ 10,000.00
New Orleans Lakefront	8/20/2000	Thunderstorm Wind	59	0	$ -
Algiers	8/20/2000	Thunderstorm Wind		0	$ 5,000.00
New Orleans Lakefront	8/31/2000	Thunderstorm Wind	53	0	$ -
New Orleans Lakefront	9/1/2000	Thunderstorm Wind		0	$ 1,000.00
New Orleans	9/1/2000	Thunderstorm Wind		0	$ 5,000.00
New Orleans	11/6/2000	Thunderstorm Wind		0	$ 50,000.00
New Orleans	6/5/2001	Thunderstorm Wind		0	$ 15,000.00
Lakefront ARPT New Orleans	6/19/2001	Thunderstorm Wind	51	0	$ -
Countywide	4/8/2002	Thunderstorm Wind		0	$ 15,000.00
Lakefront ARPT New Orleans	4/8/2002	Thunderstorm Wind	57	0	$ -
Lake Catherine	4/8/2002	Thunderstorm Wind		0	$ 10,000.00
New Orleans	7/7/2002	Thunderstorm Wind		0	$ 4,000.00
Lakefront ARPT New Orleans	7/13/2002	Thunderstorm Wind	56	0	$ -
New Orleans	7/13/2002	Thunderstorm Wind		0	$ 250.00
New Orleans	7/17/2003	Thunderstorm Wind	50	0	$ 3,000.00
New Orleans	11/18/2003	Thunderstorm Wind	50	0	$ 8,000.00
Lakefront ARPT New Orleans	4/11/2004	Thunderstorm Wind	52	0	$ -
Lakefront ARPT New Orleans	6/3/2004	Thunderstorm Wind	53	0	$ -
New Orleans	7/6/2004	Thunderstorm Wind	50	0	$ 15,000.00
Algiers	11/24/2004	Thunderstorm Wind	50	0	$ 1,500.00
New Orleans	1/13/2005	Thunderstorm Wind	50	0	$ 1,500.00
Algiers	7/3/2005	Thunderstorm Wind	50	0	$ 1,500.00
Little Woods	8/15/2006	Thunderstorm Wind	50	0	$ 300.00
Lakefront ARPT New Orleans	11/6/2006	Thunderstorm Wind	50	0	$ 1,000.00
New Orleans	5/4/2007	Thunderstorm Wind	50	0	$ 1,000.00
Lakefront ARPT New Orleans	2/6/2008	Thunderstorm Wind	63	0	$ -
Lakefront ARPT New Orleans	2/12/2008	Thunderstorm Wind	59	0	$ -
New Orleans Lakefront	2/12/2008	Thunderstorm Wind	50	0	$ 2,000.00
New Orleans	5/15/2008	Thunderstorm Wind	50	0	$ 1,500.00
Lakefront ARPT New Orleans	3/27/2009	Thunderstorm Wind	50	0	$ 1,000.00
South PT	4/2/2009	Thunderstorm Wind	50	0	$ 4,000.00
Gentilly	5/16/2009	Thunderstorm Wind	50	0	$ 3,000.00
Lakefront ARPT New Orleans	7/2/2009	Thunderstorm Wind	52	0	
New Orleans	6/4/2010	Thunderstorm Wind	52	0	$ 2,000.00
Gentilly	11/30/2010	Thunderstorm Wind	61	0	$ 50,000.00
Lakefront ARPT New Orleans	4/4/2011	Thunderstorm Wind	51	0	$ -

Figure 37 Thunderstorms since 1995 with Reported Property Damage Source: National Climatic Data Center

The S&WB Planning Area has also experienced property damage due to lightning in recent years.

Location	Area	Begin Date	Event Type	Deaths	Damage Property
Orleans PAR.	New Orleans Lakefront	4/14/1996	Lightning	0	$ -
Orleans PAR.	New Orleans Lakefront	4/17/1996	Lightning	1	$ -
Orleans PAR.	New Orleans	6/21/1998	Lightning	0	$ 120,000.00
Orleans PAR.	Algiers	9/6/1999	Lightning	0	$ 50,000.00
Orleans PAR.	New Orleans	6/4/2000	Lightning	2	$ -
Orleans PAR.	New Orleans	5/30/2005	Lightning	0	$ -
Orleans PAR.	New Orleans	6/6/2005	Lightning	0	$ -
Orleans PAR.	New Orleans	6/4/2007	Lightning	0	$ 50,000.00

Figure 38 S&WB Planning Area Lightning Events: NCDC Locations

All of the S&WB Planning Area is at risk of strong thunderstorms with associated winds and lightning.

4.3.6.3. 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 *supercell* thunderstorm. The *supercell* 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 *supercells.* 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 50km/h, these relatively narrow impact bands become long swaths of potentially very high damage. *Supercells* 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 *supercells* 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 locations 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 Tornadoes (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.

4.3.6.4. Probability

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 the S&WB Planning Area 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 intrusion of salt water upstream into the Mississippi River is a naturally occurring condition. 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.

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

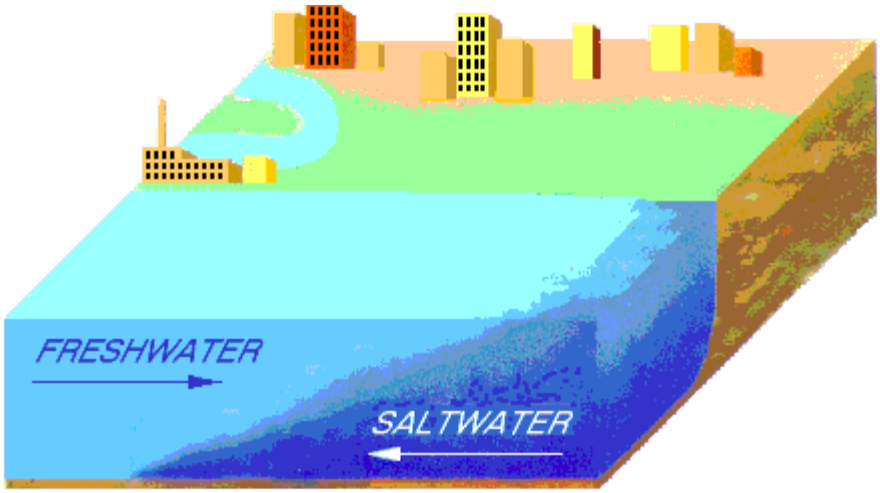

Figure 39 Saltwater wedge in Mississippi River (USACE)

4.3.7.2. Past occurrences

The last known occurrences of a significant saltwater intrusion hazard was in 1988 and 1999, however, the historical record of the event is not available. In early August of 2012, a saltwater wedge had reached River Mile 89 at Chalmette and continues to move northward. The Algiers water intake is more likely to be impacted.

4.3.7.3. Location

This hazard results from the location of the saltwater 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. The affected river water is not potable however; it can still be used for fire protection and sanitary application. The USACE has response measures in place (a sill built in the river) to control a saltwater 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 saltwater 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.

In August of 2012, the USACE began to construct the needed periodic underwater dam or sill for $5.8M to block the denser salt water from moving farther upriver toward the S&WB Intake Facilities and other lower Mississippi River parishes. The 2012 sill is 1,700 feet long and will be constructed at Alliance, Louisiana in Plaquemines Parish. During the August 2012, saltwater intrusion an eight-inch water main of 750' was installed to provide potable water for Plaquemines Parish from the Algiers Water Plant.

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 / Winter Storms

Probability	Impact	Reoccurrence
Low	Low	8 years

4.3.8.1. Description of hazard

Winter months in Louisiana (December- 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 within the S&WB Planning Area (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 the City of 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 the City of 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, the S&WB Planning Area is rarely affected by winter storms. The average low temperature during the month of January 2018 was 29° F.

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

Figure 40 Average S&WB Planning Area Temperatures

4.3.8.2. Past occurrences

The last major freeze was in 2018 during one of the most significant cold spells in the South in a century. Winter Storm INGA impacted the New Orleans area on the evening of Tuesday, January 16th and into Wednesday, January 17th. The system brought freezing temperatures (29 to 33 degrees), ice, and some snow to the city forcing closures of most major roadways, government offices, and schools. Freezing temperatures caused hundreds of pipes to break across the city which ultimately resulted in the pressure in the water distribution system dropping below 15psi, triggering precautionary boil water advisory.

Freezes generally cause impacts to transportation systems and linkages; hence, all resident workers are impacted. S&WB operations mitigate these impacts by various written procedures in documents for emergency preparedness & coordination to ensure all critical facilities remain operable (i.e., pumps, etc.)

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

LOCATION	BEGIN_DATE	EVENT_TYPE	DEATHS_DIRECT
ORLEANS (ZONE)	2/2/1996	Cold/Wind Chill	0
ORLEANS (ZONE)	12/18/1996	Cold/Wind Chill	0
ORLEANS (ZONE)	12/25/2004	Winter Storm	0
ORLEANS (ZONE)	1/3/2008	Cold/Wind Chill	2
ORLEANS (ZONE)	1/17/2018	Cold/Wind Chill	0

Figure 41 1995-2018 Cold/Winter Storms (NCDC) Locations

Because there is no defined geographic boundary, all persons 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 the S&WB Planning Area are mild and the risk of winter storms is low.

4.3.8.3. 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.

The S&WB's system was designed to operate in severe operating temperatures in order to ensure 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.

4.3.8.4. 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 1 and 3 inches of ice accumulations. Due to its geographic location in the southeastern part of the state, the S&WB Planning Area 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.

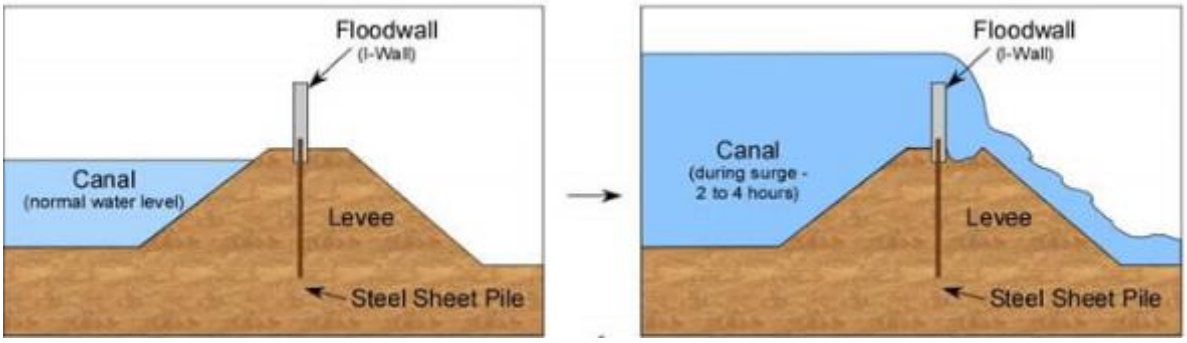

Figure 42 Storm Surge & Overtopping of Floodwalls

The level of surge in a particular area is also determined by the slope of the continental shelf. A shallow slope off the coast 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 Sea, Lake and Overland Surges from Hurricanes model (SLOSH). 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.

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 Pontchartrain/ 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 (MEOW), which 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 Maximum of Maximums (MOMs). 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. Past Occurrences

LOCATION	BEGIN DATE	BEGIN TIME	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	DAMAGE PROPERTY
ORLEANS PAR.	2/15/1998	1400	Storm Surge/Tide	0	0	$ -
ORLEANS PAR.	9/12/1998	1100	Storm Surge/Tide	0	0	$ -
ORLEANS (ZONE)	6/30/2003	1400	Storm Surge/Tide	0	0	$ 100,000.00
ORLEANS (ZONE)	9/15/2004	1000	Storm Surge/Tide	0	0	$ 400,000.00
ORLEANS (ZONE)	10/9/2004	1500	Storm Surge/Tide	0	0	$ 10,000.00
ORLEANS (ZONE)	7/5/2005	1500	Storm Surge/Tide	0	0	$ 250,000.00
ORLEANS (ZONE)	8/29/2005	200	Storm Surge/Tide	0	0	$ 17,900,000,000.00
ORLEANS (ZONE)	9/23/2005	700	Storm Surge/Tide	0	0	$ 4,320,000.00
ORLEANS (ZONE)	9/1/2008	0	Storm Surge/Tide	0	0	$ 750,000.00
ORLEANS (ZONE)	9/11/2008	1200	Storm Surge/Tide	0	0	$ -
ORLEANS (ZONE)	9/2/2011	1600	Storm Surge/Tide	0	0	$ 15,000.00
ORLEANS (ZONE)	8/28/2012	600	Storm Surge/Tide	0	0	$ 62,500,000.00
ORLEANS (ZONE)	6/21/2017	0	Storm Surge/Tide	0	0	$ -
ORLEANS (ZONE)	10/7/2017	1800	Storm Surge/Tide	0	0	$ -

Figure 43 Storm Surge Events 1969-2017 (NCDC)

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

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 44.

http://en.wikipedia.org/wiki/File:New_Orleans_Levee_System.svg#filehistory

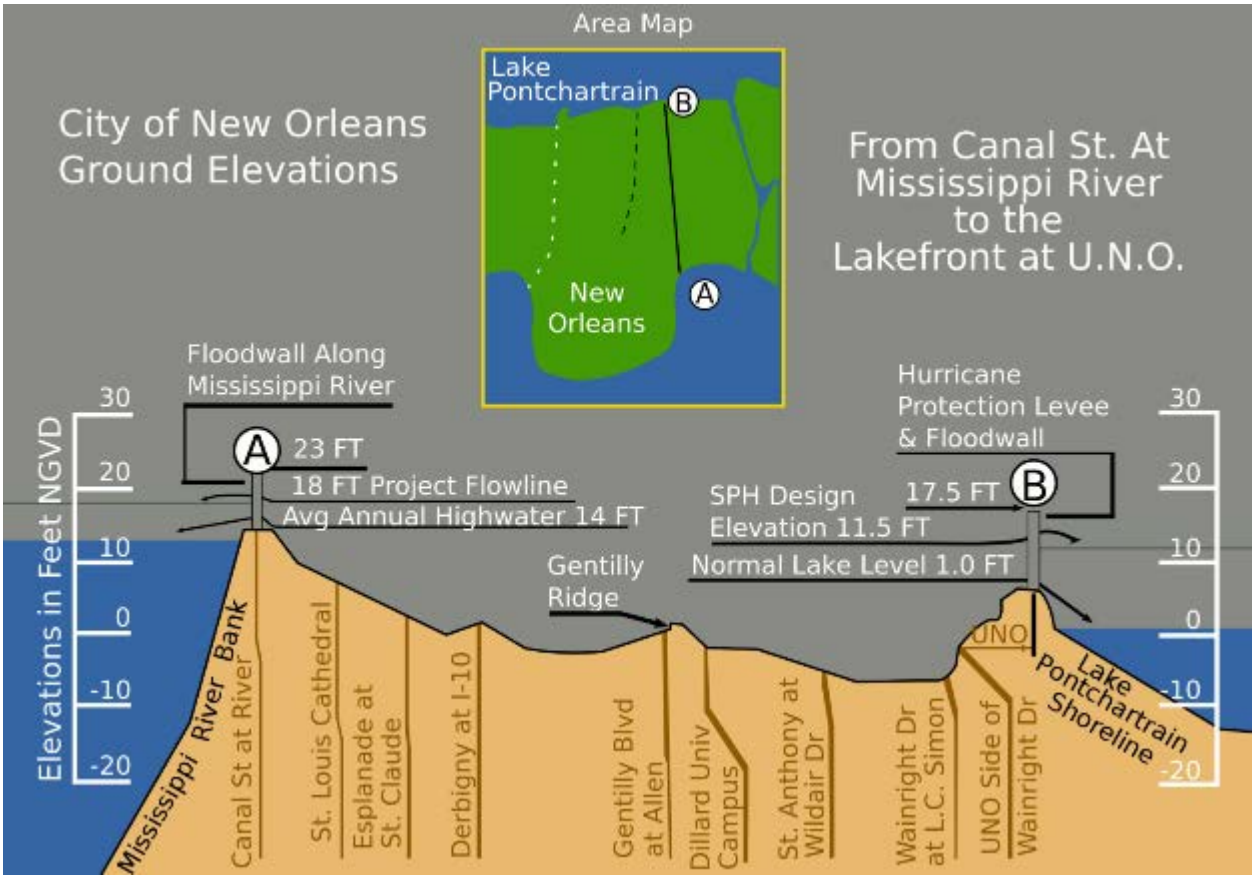

Figure 44 S&WB Planning Area Bowel Effect

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 45 shows the SLOSH Model data for Hurricane Katrina. If a storm of similar size to Hurricane Katrina were to follow a more westerly track, the City of New Orleans could expect 20-25 foot storm surges. This, in turn, could breach or overtop the levees. Large areas of the S&WB Planning Area 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.

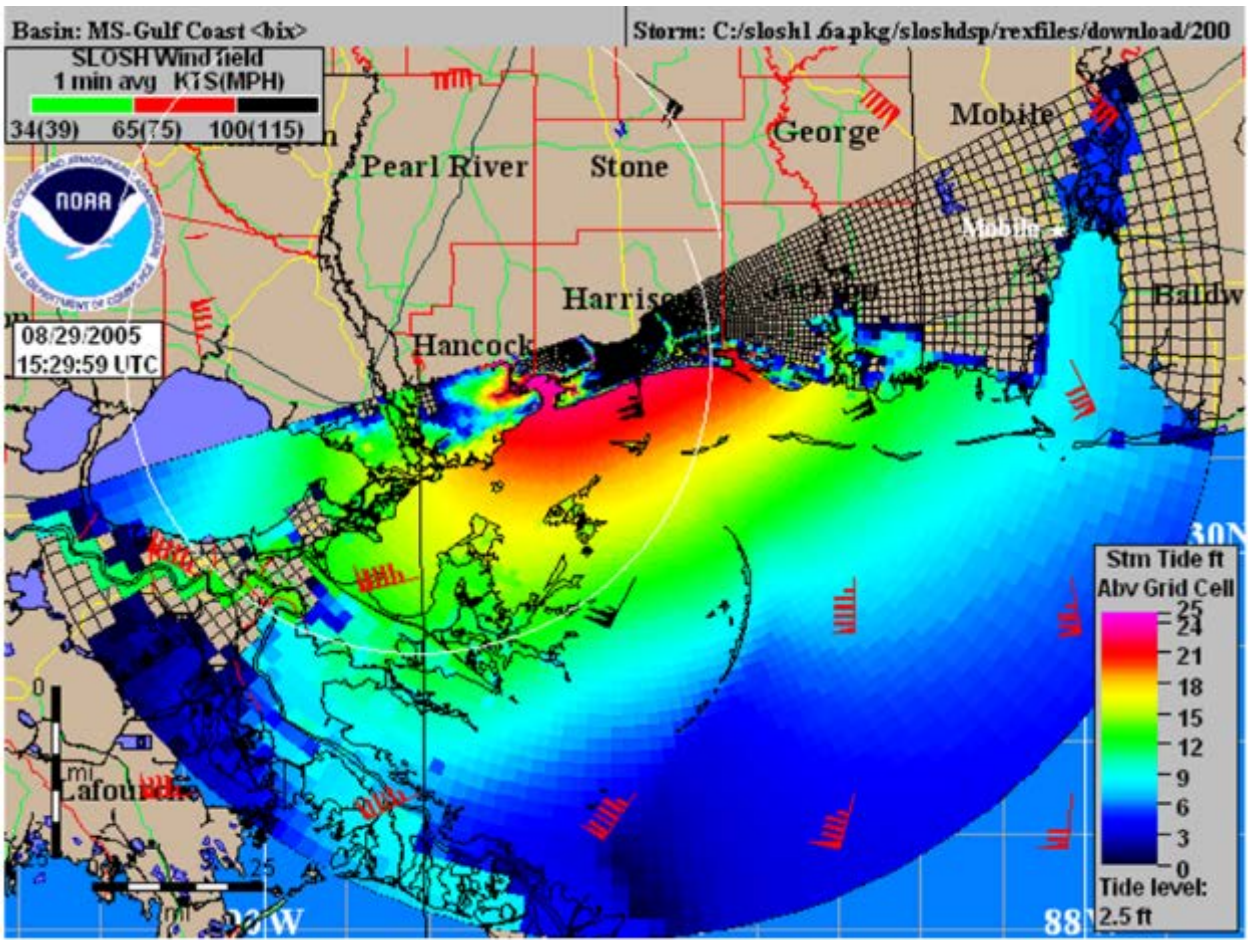

Figure 45 SLOSH Model – Aug 29, 2005 (NOAA)

4.3.9.5. Probability

Based on the data from the NCDC, between 1969 and 2017, the S&WB Planning Area 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 regionErosion 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 the S&WB Planning Area. 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.

Figure 46 shows elevations as they are impacted by subsidence. Red indicates the areas with the lowest elevations. Figure 47 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, which is within the S&WB Planning Area, has seen the greatest subsidence in southern Louisiana. This part of the S&WB Planning Area was 3 to 5 meters below sea level when Katrina struck and consequently saw some of the worst flooding.

4.3.10.2. Past occurrences

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

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 S&WB Planning Area. 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 the City of New Orleans.

Loss of land masses makes the S&WB Planning Area 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 facility properties / assets / service networks. Figure 49 shows the impact of this hazard within the S&WB Planning Area.

The S&WB has recently conducted forensic structural analysis of Sewer Pump Station (SPS) “A”, one of the oldest structures and major critical station in the S&WB sewerage pumping network. The building was constructed in the late 19th Century serving an area of 10-12 square miles, along the Mississippi River includes the City Center, the French Quarter including the boardwalk / river walk and Superdome. Large vertical cracks along with smaller cracks circumference a portion of the building. Finite analysis using STAAD Pro was performed. Roof / Wind loads, other horizontal loads and vertical loads were evaluated. The damage is caused by settlement / subsidence. The proposed mitigation is to reconstruct the foundation.

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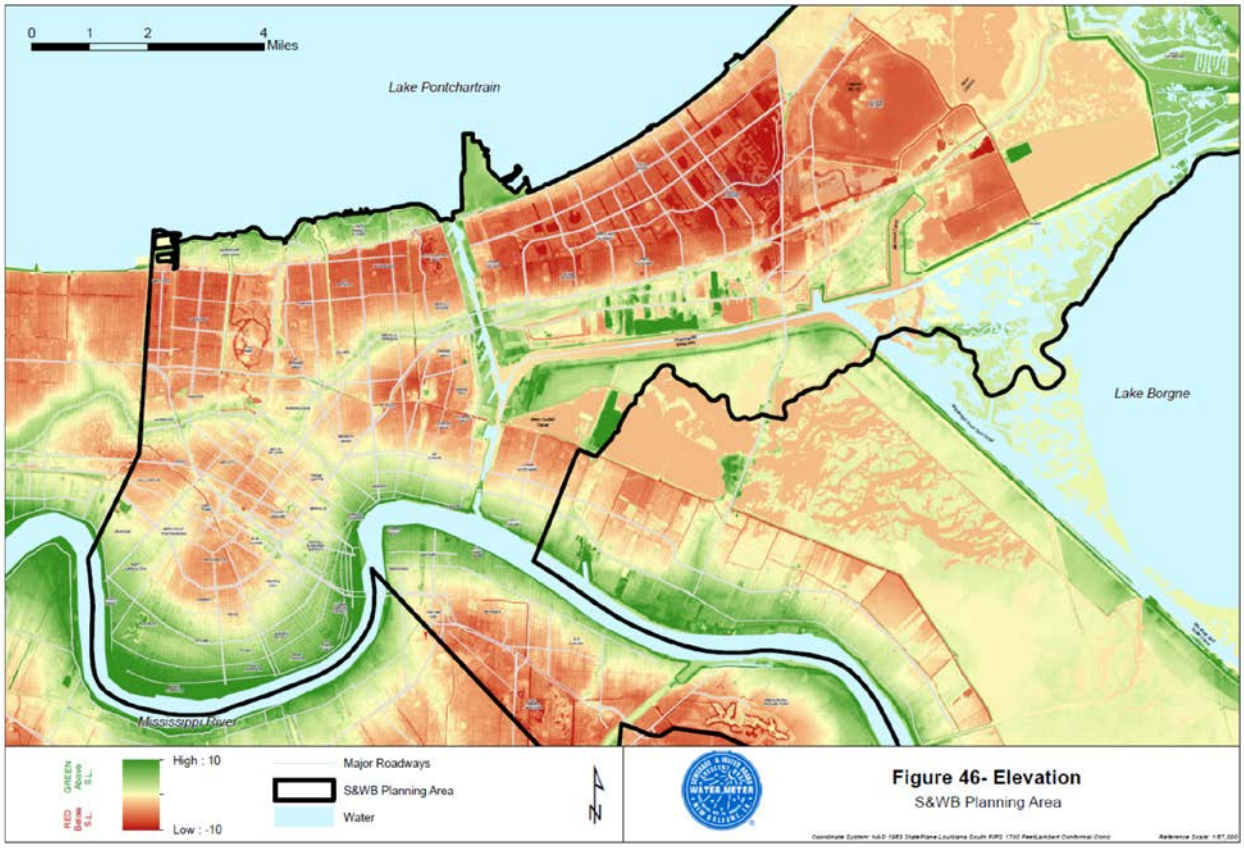

Figure 46 Elevation/Subsidence

4.3.10.4. Severity

While the effects on property in the S&WB Planning 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 S&WB Planning Area 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 50 illustrates the extent of the Subsidence Hazard in the S&WB Planning Area. Refer to Appendix 12 for detailed subsidence maps for S&WB Facilities by Council District.

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%.

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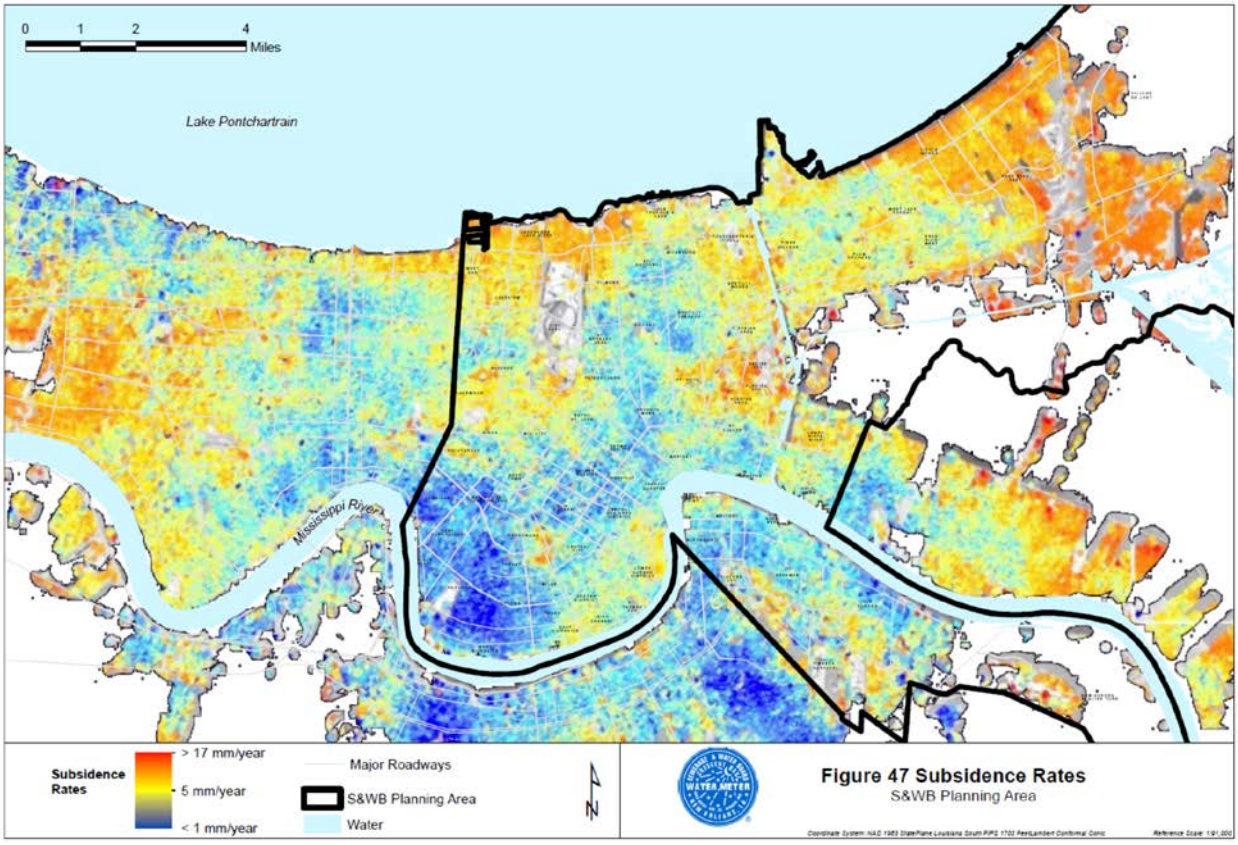


Figure 47 Subsidence Rates

4.3.11. Tornadoes

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." Tornadoes 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 tornadoes, 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 tornadoes 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.

Tornadoes 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, tornadoes can occur at any time of day, in any state in the union, and in any season. In Louisiana, tornadoes have a higher frequency in the spring months of March, April, and May. While the majority of tornadoes cause little or no damage, some are capable of tremendous destruction. Additionally, tornadoes are often generated from hurricanes so the entire hurricane season has to be viewed as risk period for this hazard.

The S&WB Planning Area 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 U.S.

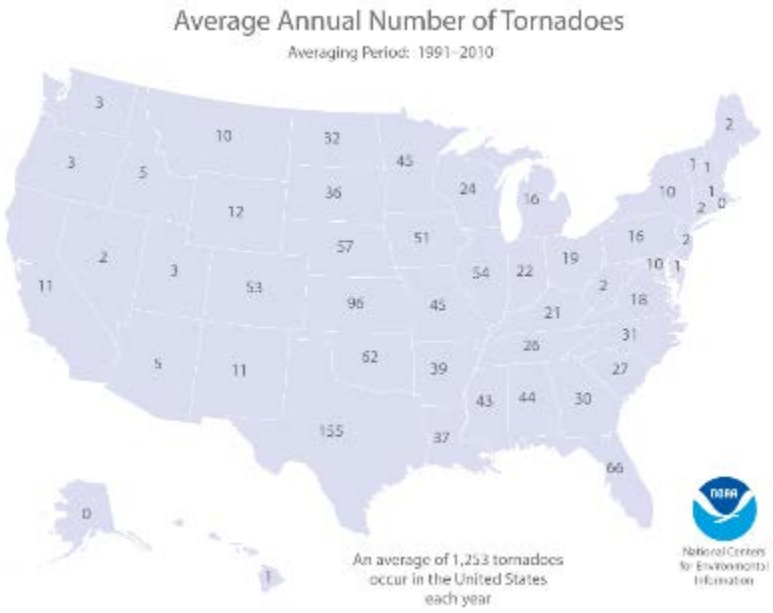


Figure 48 US Tornado Frequency (NOAA)

4.3.11.2. Past occurrences

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

On 2/7/2017, a EF3 tornado touched down in New Orleans East and ripped buildings from foundations and left power lines dangerously strewn across roadways.

On 12/6/1983, a Category 4 (max. wind speeds 207-260 mph) tornado, 22.9 miles away from the S&WB Planning Area, 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 S&WB Planning Area killed 22 people, injured 165 people, and caused between $500,000 and $5,000,000 in damages.

The S&WB assets have not been recorded as a direct hit from a tornado though power outages have occurred impacting the operations of various pumping systems. The S&WB alternative power sources, both existing and planned, mitigate against power outages in order to continue to provide needed water, sewer & drainage services throughout the S&WB planning area.

The following table identifies NCDC tracked tornado events impacting the S&WB Planning Area between 1969 and 2017.

Location	Area	Begin Date	Begin Time	Event Type	Magnitude	Scale	Deaths	Injuries	Damage Property
Orleans		3/10/1971	200	Tornado	0	F2	0	0	$ 2,500,000.00
Orleans		12/6/1971	1330	Tornado	0	F1	0	0	$ 25,000.00
Orleans		7/29/1977	1150	Tornado	0	F1	0	3	$ 25,000.00
Orleans		6/22/1981	1345	Tornado	0	F2	0	0	$ 25,000.00
Orleans		4/19/1991	1330	Tornado	0	F1	0	0	$ 25,000.00
Orleans	New Orleans	8/10/2000	1612	Tornado		F0	0	0	$ -
Orleans	Lake Catherine	6/30/2003	1145	Tornado		F0	0	0	$ 5,000.00
Orleans	New Orleans	2/2/2006	242	Tornado		F2	0	0	$ 500,000.00
Orleans	New Orleans	2/13/2007	303	Tornado		EF2	0	15	$ 2,000,000.00
Orleans	Gentilly	2/13/2007	310	Tornado		EF2	1	10	$ 1,000,000.00
Orleans	Gentilly	7/6/2010	844	Tornado		EF0	0	0	$ 10,000.00
Orleans	Vieux Carre	8/4/2016	1430	Tornado		EF0	0	2	$ -
Orleans	Lee	2/7/2017	1112	Tornado		EF3	0	33	$ -

Figure 49 Sample Tornado Events for the S&WB Planning Area (NCDC)

Figure 50 Funnel Cloud over Lake Pontchartrain

4.3.11.3. Location

Because there is no defined geographic boundary, all persons and property within the S&WB Planning Area are exposed to the risk of damage from tornadoes. The sub-surface assets 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 51 shows the Fujita Scale ratings for tornados from F0 to F5[11].

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 51 Fujita Scale

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

If a tornado hit a Drainage Pumping Station (DPS), it could prevent it from operating. A tornado could impact S&WB overhead High Voltage Power (HVP) lines that run throughout the S&WB Planning Area. Also, a tornado can impact the local power provider, thus limiting power to S&WB System such as Sewer Pumping Stations. 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 S&WB Planning Area has a Medium probability for the occurrence of this hazard. Based on NCDC data, the area 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.

4.3.12. Infrastructure Failure

Probability	Impact	Reoccurrence
Low	High	Rare

4.3.12.1. Description of hazard

Infrastructure failures include building collapses, water main breaks, gas pipe ruptures, dam failures, steam pipe explosions and related types of events. Recently failures in communications infrastructure have been added to this list.

Key Points

- Infrastructure is the network of utilities that supplies our basic needs for mobility, power, water, sewer and communications.
- This section of the Hazard Mitigation Plan covers the S&WB Drainage, Water, Power, and Sewer system that are not triggered by some other hazard (i.e., Hurricanes).
- Computer failure whether accidental or deliberate (i.e., Cyberattack) is a form of infrastructure failure.
- The American Society of Civil Engineers (ASCE) gives the infrastructure of the United States an overall D grade and estimates it will cost $2.2 trillion to fix. The main concerns for Washington State are roads, bridges and mass transit.
- Many problems due to poor infrastructure are individually small but quickly add up, e.g., a vast number of small leaks causing some municipal water systems to lose up to 20% of their water during transmission.
- Infrastructure can be damaged during construction e.g., a contractor breaking a water main, or fail when new due to a design flaw.

4.3.12.2. Location

- S&WB Information System Main Frame 625 St Joseph St, New Orleans, LA 70165
- S&WB Power House 8800 S Claiborne Ave, New Orleans, LA 70118

4.3.12.3. History

On December 11, 2016, the S&WB Main Computer server air-condition system failed, resulting in the main server shutdown. This shutdown resulted in the Board's email and internet being unavailable for 3 days until a temporary air conditioner unit could be installed. The server shutdown interrupted billing, emails and payroll. It should be noted that the server shutdown did not result in any critical system failure for the Water, Drainage, Power and Sewer systems.

On August 9, 2017, the S&WB Main power plant 25 cycle power failed. This power failure impacted the Board's ability to provided power to the Board's Drainage system 25 cycle power pumps.

4.3.12.4. Severity

Infrastructure failures cause outages in whatever utility or service the broken structure provides. Most are single-site incidents. Infrastructure failures have caused fatalities, injuries and economic losses in major municipality. They are one of the most common secondary hazards where multiple sites could be affected. The scenarios below outline cases where the failure itself is the primary hazard.

The most likely infrastructure failure scenario would resemble past events. Past failures have involved main server and the power system. Failures are more frequent in systems under construction or in older components. Consequences would be worse if the failure occurs during a severe weather incident.

4.3.12.5. Probability

Infrastructure failures are unavoidable. Even if our entire infrastructure system was in top shape, there would still be construction accidents, operations errors, design flaws and unanticipated environmental issues. These failures occur every year, but these can be handled through daily business procedures. The question is how likely major failures that precipitate large-scale emergencies are. Major infrastructure failures *seem* to happen very roughly once a decade on average but several can happen within a few years or decades can past without one.

The chance of a catastrophic infrastructure failure is much smaller than the failures described above. Most infrastructure failures are single-site incidents. Unless a single failure such as a dam failure or nuclear accident can affect a large area most infrastructure failures do not scale up to the catastrophic level. There are no dams in the City of New Orleans, and the City is far from the state's nuclear power plant.

SCADA systems make it theoretically possible to affect a whole infrastructure system at once. Despite the theoretical vulnerability, the world has never experienced a major computer-caused infrastructure failure. An attack is the most likely cause of cyber-induced infrastructure failure. Most analysts consider it a remote possibility because agents with the means (like states) lack the motivation to attack and those with the motivation (terrorist organizations) lack the means. However, the Board's Water, Drainage, Power, and Sewer system are not controlled by SCADA.

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 S&WB Planning Area'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 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.	**SPS** – 40 at $1.6M - $1.8M per station **DPS** – 23 stations at $15M/1000cfs **UPS** – 10 stations $1.3M/station **STP** – 2 plants. East bank at $500M West bank at $170M **WTP** – 2 plants. Carrolton at $500M Algiers at $170M **St Joseph Headquarters** – $5.4M **Central Yard** – $14M >$300,000,000 Note: The SPS, DPS, UPS assets of S&WB are spread throughout the S&WB Planning Area 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.	**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.	**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 than the worst-case amounts for replacement.** **SPS** – 40 at $1.6M - $1.8M per station **DPS** – 23 stations at $15M/1000cfs **UPS** – 10 stations $1.3M/station **STP** – 2 plants. East bank at $500M West bank at $170M **WTP** – 2 plants. Carrolton at $500M Algiers at $170M **St Joseph Headquarters** – $5.4M **Central Yard** – $14M
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 Cold / Winter Storm Damage Potential **LOW**	The infrastructure (pipes, valves, etc.) are subject to damage from extended freeze events. This hazard tends to be non-systemic and repair/maintenance oriented.	**Due to the spot nature of 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 saltwater 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 at $1.6M - $1.8M per station **DPS** – 23 stations at $15M/1000cfs **UPS** – 10 stations $1.3M/station **STP** – 2 plants. East bank at $500M West bank at $170M **WTP** – 2 plants. Carrolton at $500M Algiers at $170M **St Joseph Headquarters** – $5.4M **Central Yard** – $14M
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
Infrastructure Failure Damage Potential **HIGH**	Infrastructure failures cause outages in whatever utility or service the broken structure provides. Most are single-site incidents. Infrastructure failures have caused fatalities, injuries and economic losses in major municipality. They are one of the most common secondary hazards where multiple sites could be affected.	**Based on worst-case scenario of a Storm Surge** **SPS** – 40 at $1.6M - $1.8M per station **DPS** – 23 stations at $15M/1000cfs **UPS** – 10 stations $1.3M/station **STP** – 2 plants. East bank at $500M West bank at $170M **WTP** – 2 plants. Carrolton at $500M Algiers at $170M **St Joseph Headquarters** – $5.4M **Central Yard** – $14M

Figure 52 Estimated Impact and Losses by Structure

Refer to spreadsheets, titled Probability of Damage by Hazard(s) for Facilities in Appendix 13.

5.3. 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. Refer to Valuations in Spreadsheets, titled Probability of Damage by Hazard(s) for Facilities in Appendix 13.

5.3.1.1. 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 Water Treatment Plant (WTP) 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 Carrolton Water Plant (CWP) is estimated at $500-$600 million or more depending on the land costs.

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

5.3.1.2. Sewerage Stations

Loss of sewerage in the S&WB Planning Area 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[12].

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

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

5.3.1.3. 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 1000cfs.

5.3.1.4. Underpass Pumping Stations

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

5.3.1.5. 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 a third of the cost of the East Bank treatment plant.

5.3.1.6. 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).

5.3.1.7. Central Yard

Using historical contracts and current market data, the Central Yard Complex if completely rebuild would cost approximately $ 12 to 14 million.

5.4. 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). The S&WB structures insured under NFIP are listed in Figure 58 1st Public Meeting Notice

Figure 59 2nd Public Meeting Notice

Appendix 7 – NFIP Coverage.

5.5. 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.

5.5.1. Population [13]

The population of Orleans Parish which lies all within the S&WB Planning Area has steadily declined over several decades, falling from 625,000 in 1960 to 485,000 in 2000, and 343,829 in 2018. 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 the City of New Orleans did experience slight increase 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 the S&WB Planning Area directly impacts the service delivery of the S&WB network and the billing revenue associated with such delivery.

5.5.2. Land Use[14]

Understanding the physical characteristics of New Orleans is of critical importance, as it relates to the S&WB Planning Area, 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, and 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 heavily developed with the least amount of open space. Approximately one fourth to one-third (figure varies) of the City's

[13] Information provided by City of New Orleans
[14] Information provided by City of New Orleans

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 the S&WB Planning Area were expected. This projection was based on several factors. First, much of the S&WB Planning Area 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.

5.5.3. S&WB and Land Use Trends

As the provider of sewer, water and drainage services to the City of New Orleans, which lies within the entire S&WB Planning Area, 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 S&WB as part of its design practices always considers land purchases for future use to address development trends. For example the S&WB 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 the S&WB Planning Area 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 regards 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 S&WB 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 mitigate 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 53 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 Benefit/Cost Analysis (BCA) 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, Levee Failure, Wind, Tornados	1,3,4	1	S&WB Operations	FEMA, USACE	Completed
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.	Flooding, Storm Surge, Hurricane, Levee Failure, Wind, Tornados	1,3,4	2	S&WB Operations	USACE/SWBNO	Completed
Mitigate flood and other hazards by implementing protective measures for critical networks that include emergency dams and/or berm construction.	Flooding, Storm Surge, Hurricane, Levee Failure	1	1	S&WB Operations	S&WB, USACE, FEMA	Completed
Mitigate saltwater intrusion by construction of sill down river from water intakes	Saltwater Intrusion	1	1	S&WB Operations	USACE	ongoing
HMGP Power House Retrofit of Turbines and Harding of existing structure and River stations	Power Loss	1,3,4	1	S&WB Operations	FEMA/SWBNO	Q4 of 2021
Installation of 5 Backup generators at 5 underpass stations	Power Loss	1,3,4	1	S&WB Operations	FEMA/S&WB	2018
Installation of 5 Electric Motor Devices	Power Loss	1,3,4	1	S&WB Operations	S&WB	Spring of 2018
Water Hammer Tower for main water plant to reduce the risk of Boil Water and provided stability to water system when pressuring the water distribution system from loss of water pressure at the water plant.	Water Pressure Loss	1,2	1	S&WB Operations	FEMA/S&WB	2018
Resiliency Center	All	2,3,4,5,6	1	S&WB Engineering	S&WB	2022

6.5. Identified Mitigation Projects

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.

6.6. General Mitigation Projects

The Sewerage and Water Board (S&WB) Drainage, Water, Power and Sewer Systems suffered heavy damages as a result of the levee failures post-Hurricane Katrina. To protect systems in the case of reoccurrence, the mitigation strategy includes repairing and/or modifying facilities based on the respective record-level flood for each facility. For example, the East Bank Sewer Treatment Plant recorded a 12-foot storm surge during Katrina, overcoming the then-installed 12' berm, resulting in nearly $41 million of damages. Based on this record-level, the mitigation will include constructing a T-wall on top of the existing Berm, increasing the total height to 18' (6' greater than record-level flood).

The Sewerage and Water Board is built and designed to operate in severe conditions to ensure the continued delivery of water, sewer and drainage services. To support this goal, S&WB maintains an independent Power Production Plant to supply power in the event the local utility loses power. These high power distribution lines are encased in concrete and run underground throughout the city. In addition to this power source, the climate control systems utilize generators at various stations to mitigate against extreme high and low temperatures. The S&WB is currently implementing various projects to support and protect power generation and distribution.

The Safe House and Resiliency Center will provide alternate work locations for back-office roles in the event their permanent workplace becomes unavailable. The center will also house the S&WB Emergency Operations Center (EOC), safe house, and emergency food distribution center for essential employees during emergency incidents. This facility will also house the central computer servers.

Current status: Design

Estimated cost: $21 million

Estimated completion date: TBD

6.6.1. Water Projects

1) The USACE is currently installing a 15MW generator to operate the Carrollton Water Plant in the event of a power failure. This project will support two goals related to pump stations: protecting current power supply and enabling “black start” capability. This generator provides power through a 60Hz underground feeder (to be constructed by USACE) to run two pumps at DPS 1. Additionally, if the 25 Hz system is completely inoperable and no Entergy power is available, this generator has "black start" capability, which enables the generator to start without external power. This generator will power 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 procured to reduce the impact of flooding at the Main Water Plant Power House. The cost of the dams was $58,000. (Complete)

3) Tiger Dams have also been procured to reduce the impact of flooding at the Central Control Operations. The cost of the dams was $58,000. (Complete)

4) Water Hammer Project
The Water Hammer Project consists of upgrades to the water distribution facilities to reduce the occurrence of a "water hammer" effect. The water hammer effect is the abrupt, transient surges in water pressure caused by pump shut-downs due to loss of power or power surges. The force of the water hammer effect causes pipe joints to leak, and water mains and connections to break. The scope of this project includes:

    1. Replace eight existing water distribution pumps with new pumps of equal capacity.
    2. Install slow-opening / slow-closing ball valves with battery backup on each pump.
    3. Replace the existing motors with new 60Hz motors, equipped with anti-rotation devices and vacuum priming systems on each pump.
    4. Install six Variable Frequency Drives (VFD) and Programmable Logic Controllers (PLC) to regulate the speed of the motors and pumps, and minimize sudden pressure changes.
    5. Construct a new building within the Carrollton Water Treatment Plant to house the VFDs.
    6. Re-open the out-of-service 42" pipeline from the Steam Plant discharge to Claiborne Avenue. In a separate project, the SWBNO will repair an existing, damaged (non-storm related) valve located on this piping.
    7. Replace the existing horizontal shaft pumps at Claiborne Station with four vertical turbine pumps.
    8. Install one new vertical turbine pump at the Panola Station.
    9. Modify all pumps with anti-reverse ratchets.
    10. Install two 1,000 gallon bladder tanks, housed within a newly constructed facility, at each of two off-site locations described below.
    11. Install two 2.0 million gallon elevated tanks, one each within 200 feet of the Claiborne and

12. Panola Stations, within the S&WB Carrollton Water Treatment Plant.

Location:	East Bank Water Treatment Plan 8800 Claiborne Ave. New Orleans, LA 70118
Estimated Cost:	$90,000,000 (funded by FEMA 406 Hazard mitigation Program)
Current Status:	Under Construction
Estimated Completion:	2023

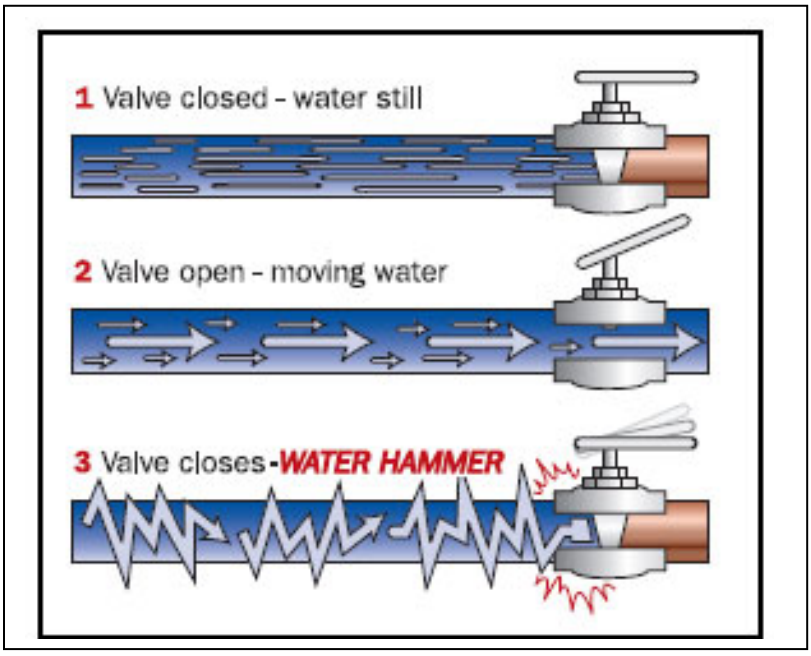


Figure 54 What is a Water Hammer ?

6.6.2. Drainage Projects

1) The USACE is currently installing a new pumping station for the 17th Street Canal, to reduce flooding from levee failure. The new structures, as designed, will permanently protect the canal by preventing hurricane storm surge intrusion from Lake Pontchartrain. The pumps will take stormwater from the canals around the structures, so the interior drainage system can continue to function after the structures prevent direct discharge to Lake Pontchartrain. The project is part of a multi-faceted approach to providing 100-year level of risk reduction for the Greater New Orleans Area. Due to a lack of hydraulic independence, commensurate upgrades are required at the East Jefferson Parish and Orleans Parish LPVs, in order to achieve 100-year level risk reduction.

The purpose of this 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 also maintaining functionality of internal drainage systems. This project is a direct response to the need and goal to achieve 100-year level risk reduction over the period of evaluation.

6.6.3. Underpass Station Backup Generators

The Federal Emergency Management Agency (FEMA) obligated $988,658 to the S&WB to be used for five permanent generators, under the Hazard Mitigation Grant Program (HMGP) 1792-022-0002 on March 30, 2016.

Locations:

Canal Blvd	5500 Canal Blvd	70124
Franklin Ave	3100 Franklin Ave.	70122
New Carrollton	Carrollton Ave and I-10 Exit	70118
Old Carrollton	Carrollton Ave and Tulane Ave.	70119
Hospital*	City Park	70124
Press Dr.	Press Dr. and Leon C Simon	70126
Paris Ave.	3200 Peoples Ave.	70122
St.Bernard*	3300 St.Bernard Ave.	70119

Cost: $1,962,210.00
Current Status: Completed
In Construction*
Estimated Completion: November, 2018

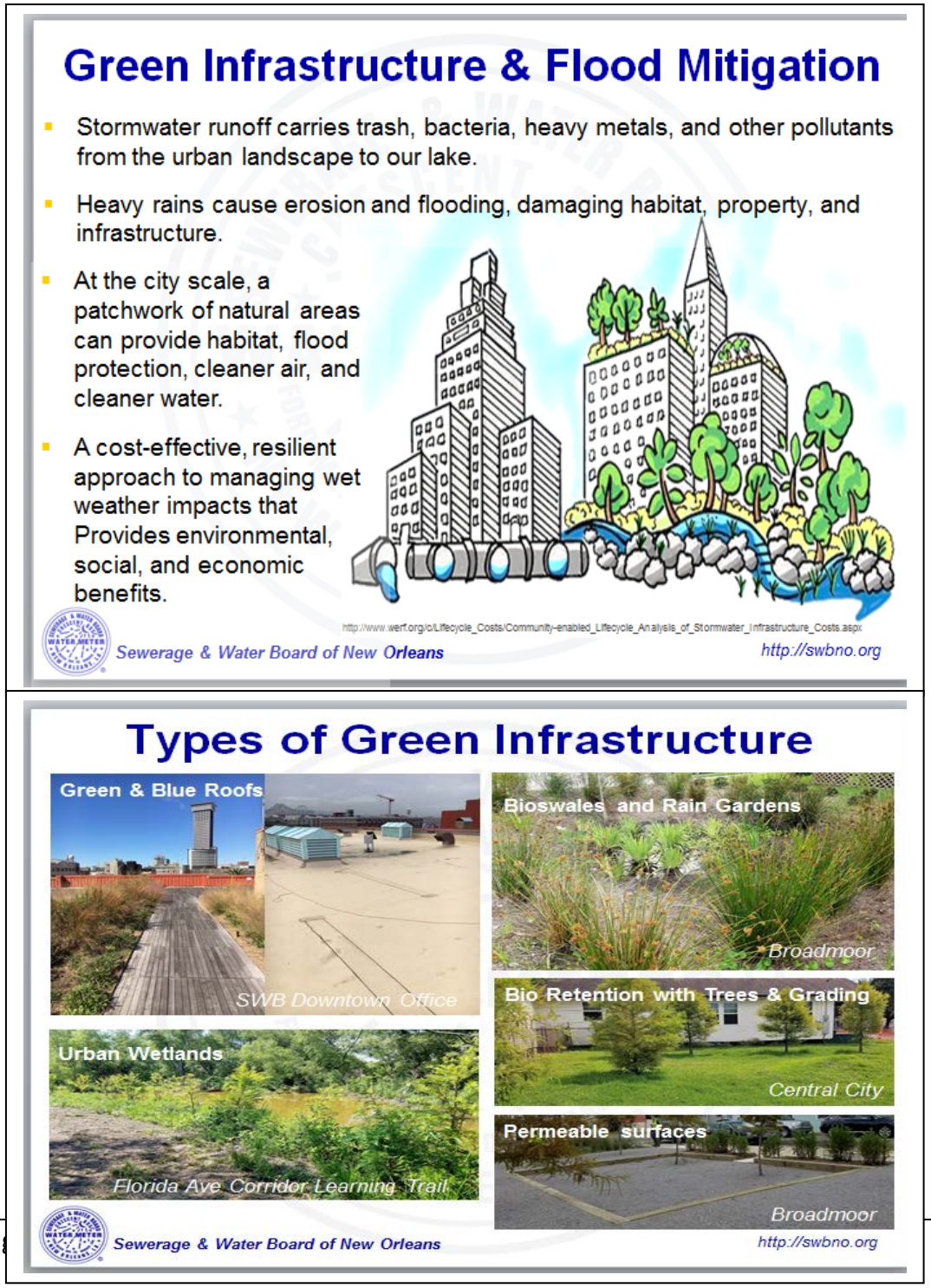
6.6.4. Drainage Green Infrastructure Projects

Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls on our roofs, streets, and parking lots in cities and their suburbs, the water cannot soak into the ground as it should. Stormwater drains through gutters, storm sewers, and other engineered collection systems and is discharged into nearby water bodies. The stormwater runoff carries trash, bacteria, heavy metals, and other pollutants from the urban landscape. Higher flows resulting from heavy rains also can cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

When rain falls in natural, undeveloped areas, the water is absorbed and filtered by soil and plants. Stormwater runoff is cleaner and less of a problem. Green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water.

At the neighborhood or site scale, stormwater management systems that mimic nature soak up and store water



S&WB Completed Green Infrastructure Projects

- **Carrolton - Hollygrove Greenline:** Monroe St & Forshey St (2017)
- **The WEB, Water Effectiveness in Broadmoor:** 3601 General Taylor (2017)
- **Central City Project:** 2433 S. Galvez St, (2017)
- **Aurora Rain Gardens:** Carlisle Ct & Westchester St. (2016)
- **Lower 9th Ward Earth Lab:** 1901 Caffin Ave (2017)
- **Florida Ave Corridor Learning Trail:** 6501 Florida Ave (2018)
- **SWB Downtown green Roof:** 625 St Joseph St. (2018)
- **Rabouin International High School Green Infrastructure Lab** (2017)

  727 Carondolet, New Orleans, LA, 70113

S&WB Green Infrastructor projects are listed below table

Title	Principal	Type*	District	Neighborhood	Description/Scope	Status
Education Program	Louisiana Urban Stormwater Coalition	3	All		Professional and community outreach workshops and tabling	Complete
Green Keepers	Parkway Partners	3	All		Community outreach workshops series	Complete
Ripple Effect	Ripple Effect	2	B - All	**Central City**	K-4 curriculum Teach-the-teacher workshops	Complete
Lower 9th Ward Earth Lab	Groundwork New Orleans	1,2,3	E	**Lower 9th Ward** 1901 Caffin Ave	Rain garden, green roof, pervious pavement install and monitoring. Green Team school program, professional outreach.	Complete
The WEB **Water Effectiveness in Broadmoor**	Land Trust for Louisiana	1,3	B	**Broadmoor** 3601 General Taylor	Rain garden installation Outreach WEB Soil testing WQ sampling	Construction and soil testing complete Monitoring and maintenance
Rabouin International High School GI Lab	Hanging Gardens	1 (2)	B	**CBD** 727 Carondolet	Green/blue roof installation on school w/ education	Construction Complete Monitoring and Maintenance
Central City Project	Dana Brown & Associates	1	B	**Central City** 2433/2427 S. Galvez	Bioretention cell installation on double lot Will pull stormwater off street for dry detention, filtration, and infiltration	Construction complete Monitoring
Florida Ave Corridor Learning Trail	Sankofa CDC	1,2,3	E	**Lower 9th Ward** 6501 Florida Ave	Educational stormwater lot in L9W. Lot located adjacent to SWB East Bank Sewer Treatment Facility and Wetlands Assimilation Project This is Phase I of an extended trail along Bayou Bienvenue Wetland Park	Grading complete Planting complete Monitoring and Maintenance
Hollygrove Greenline A Water Management and Community Education Initiative	Tulane City Center	1	A	**Hollygrove** Monroe St and Forshey St	Stormwater management on SWB site. Ommunity engagement Signage	Complete
Treme-St. Ann Street Rain Gardens	Historic Faubourg Treme Association	1	C	**Treme** 1500-1600 St. Ann St	Street right-of-way bioswales/rain gardens installation Corner bump-outs	Contract expired Funds to be re-allocated to 2018
SWB Downtown St. Joseph St. Administration Building Green Roof	Hanging Gardens	1	B	**CBD** 625 St. Joseph St	Green Roof 9,353 S.F. Outreach/education Monitoring Maintenance	Construction complete Tours have begun Budget increase to account for construction overages and extended warranty Maintenance ongoing through 2018
Aurora Rain Gardens	Gaea Consultants	1	C	**Algiers** Carlisle Court and Westchester Street	Flow-through planter Rain garden Bioswale Maintenance	Construction Complete Monitoring and Maintenance
Coliseum St. Bioswale	Gaea Consultants	1	B	**Lower Garden District** Coliseum Square Park	Right-of-way bioswale Monitoring Maintenance	Contract expired Funds to be re-allocated to 2018
Conrad Park	SWBNO	1,2,3	A	**Hollygrove** Edinburgh and Hamilton St	WEFTEC Green Infrastructure community service project	Waterpalooza 9/26/14 Installation 9/27/14 Need Job Number
SWBNO Green Infrastructure Monitoring Project EPA Urban Waters Small Grant	SWBNO - EPA Urban Waters Small Grant UW-00F85801-0	N/A 3	D	**Pontilly** Multiple Locations	Data collection GI Monitoring Outreach	Pre-project baseline monitoring is complete Pontilly construction delayed Re-scoping
EPA Environmental Education Local Grant **EE1530**	SWBNO NE-01F05001-0	2			Expand existing Ripple Effect Project, SWBNO Match	Project Complete
Rain Barrels	SWBNO	3	N/A		Purchase of rain barrels and fittings for educational outreach events	5 rain barrels purchased for WEFTEC events
Trees 2014	SWBNO	3	N/A	**Gentilly**	Purchase of trees to give away at community outreach event	Trees purchased.
Trees 2015	SWBNO	3	N/A	**Gentilly**	Purchase of trees to give away at community outreach event	Trees purchased.
Trees 2016	SWBNO	3	N/A	**Gentilly**	Purchase of trees to give away at community outreach event	Trees purchased
Trees 2017	SWBNO	3	N/A	**Gentilly**	Purchase of trees to give away at community outreach event	Trees purchased
Adaptation Support Tool	SWBNO	4			Hardware and software containing customized data sets to identify GI priority areas Targeting engagement with City and SWB project Managers, Private Developers, and Community Stakeholders and Homeowners	Development complete Scheduling workshops
Stormwater Toolkit	SWBNO	4			Green infrastructure standard details of 8 GI types Stormwater and pollutant load calculator	Final report is being reviewed
Soil Sampling/Analysis	SWBNO	4			Orleans Parish	Final report is being reviewed

Type 2: Develop a GI educational curriculum to be implemented in Orleans Parish schools.

Type 3: Develop GI workshops curriculum for educating professionals, commercial businesses, homeowners, and neighborhood groups.

6.6.5. Flood Risk Analysis

The City of New Orleans has partnered with the University of New Orleans' Center for Hazards Assessment, Response and Technology (UNO-CHART) external link to conduct a study of all buildings in New Orleans to better understand how well they are protected from flooding. The study will review photographs of homes and businesses taken from the street. In some cases there will be field checks, however no one will enter private property as part of this work. The information collected will provide summary data for over 90,000 buildings and will help the City set policies and programs to help owners protect their properties.

Additional Flood Projects are listed in the City of New Orleans Hazard Mitigation Plan (2015) Section 9 Mitigation Strategy page 238-270. https://www.nola.gov/nola/media/Homeland-Security/Files/Orleans-Parish-2015-HM-Plan-Final-v1.pdf

6.6.6. Southeast Louisiana Urban Flood Control Project

Public safety is the Corps of Engineers' top priority. The Southeast Louisiana Urban Flood Damage Reduction Project (SELA) reduces the risk of flood damages due to rainfall flooding in Orleans, Jefferson and St. Tammany parishes. The improvements generally support the parishes' master drainage plans and provide flood risk reduction up to a level associated with a 10-year rainfall event. A 10-year event is basically a rain storm that has a 10% annual probability of occurrence and equates to approximately 9 inches of rain over a 24-hour period for our area. The project includes a total of over $2 billion dollars of improvements in Jefferson and Orleans parishes. Work in St. Tammany Parish is not yet funded.

- In Orleans Parish, plans involve improving 16 major drainage canals, adding pumping capacity to two pump stations and the construction of two new pump stations.
- Of the 20 funded SELA projects in Orleans Parish, 16 projects are complete and four projects are under construction.

Project Status:

- SELA 20 - Florida Ave. Phases 2 & 3 (St. Ferdinand to Mazant / side streets: Montegut and Desire from Florida to N. Dorgenois) : spring of 2019*
- SELA 21 - Jefferson Ave. Phase 1 (Claiborne to Dryades): Fall of 2018*
- SELA 22 - Jefferson Ave. Phase 2 (Dryades to Constance): **completed end of 2016**
- SELA 23 - Napoleon Ave. Phase 2 (Claiborne to Carondelet): **completed summer 2016**
- SELA 23a - Napoleon Ave. Phase 3 (Carondelet to Constance): **completed beginning of 2017**
- SELA 24a - Claiborne Ave. Phase 1 (Monticello to Leonidas) **completed summer 2017**
- SELA 24b - Claiborne Ave. Phase 2 (Leonidas to Lowerline): **completed summer 2017**
- SELA 26 - Florida Ave. Phase 4: end of 2021*
- SELA 27 - Louisiana Ave. (Claiborne to Constance): end of 2018*

*Dates are estimated completion dates and are subject to change.

6.7. Power House

The primary purpose of the HMGP Project is to supply power independently from the local energy provider and maintain reliable operations of the Carrollton WTP and other important facilities throughout Orleans Parish. These upgrades will mitigate disruptions to the power system and the potable water supply service to Orleans Parish that would otherwise be impacted during flood, high wind, or other emergency events that cause damage to S&WB facilities.

- Action 1 - Identify and harden critical emergency management facilities. To the maximum extent possible, locate electrical and other critical building system hubs and sensitive equipment on upper floors. Renovate existing buildings and design new buildings to ensure the facilities remain operational during hazard events.
- Action 2 - Harden utility services and street infrastructure. Harden flood protection infrastructure including pump support with alternative energy sources. Establish an implementation plan giving priority to emergency evacuation routes and primary arterial streets.

General Scope of Work

CP-6247 Generator 4 Retrofit HMGP Phase

CP-6250 Generator Load Bank at Carrollton Water Plant

CP-6248 Feeders from Carrollton Water Treatment Plant

CP-6249 Harden Power Distribution Network – ONLY Design-Build Project

Phase 2 CP-1369 Emergency Fuel Storage

CP-1 CP-1371 Power House Structural Hardening

370 Power House Boiler and Auxiliary Equipment/Electrical and I&C Upgrade

CP-1372 Turbine Generator 5 Refurbishment (Major repairs completed in Spring 2018)

CP-1373 Turbine Generator 3 Refurbishment (Major repairs completed in Spring 2018)

Estimated Cost: $213,000,000
Current Status: Under Construction
Estimated Completion: Q4 2021

Electronic Motor Devices (EMD)

Five EMD's were installed at the S&WB Main Water Plant to provide backup 25-cycle power to the S&WB drainage stations. This mitigation project was the direct response to the loss of all 25 cycle power generation at the S&WB Main Power House during the August 9, 2017 event.

Current Status: Completion 2018
Total Cost: $22 Million

6.8. Sewer Projects

1) The S&WB is implementing measures to prevent and / or mitigate damage to sewer facilities similar to that which occurred during Hurricane Katrina. These include eliminating below-ground pumping stations and moving all pumps, motors, and electrical equipment above grade, including moving pumps 20-30 feet higher. 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 and are generally configured with a narrow access tube from ground surface, which opens to a larger room underground that houses pumps and motors. These stations are generally square or rectangular in nature with sides 10-12 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 at 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' above finish grade.
- Retrofit a galvanized rack of 4" channel, and install new electrical, control and SCADA panels on platform.
- Install aluminum canopy above electrical/controls platform.
- Supply and install SCADA antenna tower on concrete pad adjacent to electrical platform 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) S&WB has installed a 4MW Generator at the East Bank Waste Water Treatment Plant (EBWWTP) to reduce the risk of power failure and associated loss of sewer treatment for the East Bank area of New Orleans.

3) Berm Project

Work consisted of modification of existing flood protection system consisting of earthen berm and concrete flood wall by installing a concrete T-wall, metal floodgates and relocation of all utilities and associated work including removal of fence, excavation, installation of a perimeter access road, stairs, drainage, road re-pavement ,piling and other associated work. The plant was flooded by approximately 16 feet of water during Hurricane Katrina, and the new flood wall has raise the flood protection elevation to approximately 18 feet.

Location:	East Bank Waste Water Treatment Plant, 6501 Florida Ave
Current Status:	Completed
Cost:	$37,000,000 (funded by FEMA 406 and S&WB)

Figure 55 EBWWTP Berm

Generators and Transfer Switches for 64 Sewer Pumping Station

This project will install generators and transfer switches at 64 Sewer Pumping Stations. This project will provide uninterrupted power to 64 sewer pumping station, in case the local utility power becomes interrupted due to a power failure.

Current Status: Design
Estimated Cost: $25,000,000
Estimated Completion: December 20, 2019

7. Mitigation Implementation

Appendix 3 – Mitigation Projects List contains a list of active and proposed projects representative of the mitigation efforts at S&WB. Implementation of complex and robust mitigation actions can take up to several years. Other actions may be accomplished in a shorter timeframe, allowing for a time-phased approach to mitigation of risks.

Of the 111 projects summarized in this Plan, the breakdown is as follows:

- 72 projects completed since last HMP 2012
- 32 projects added to HMP Plan since 2012 update
- Total of Estimated Amounts for projects is $ $1.4 Billion[15]

Each of the construction-related mitigation projects follows the S&WB's standards for project implementation; in addition, each system has a contracted S&WB Project Manager. All the contracted firms adhere to requirements of 44.CFR and provide the required quarterly reports. The contracted firms oversee the implementation of all Project Worksheet and mitigation tasks via standardized tasks, as follows:

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

Each project 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 the 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 distributing revised drafts to the stakeholders.

The Sewerage and Water Board has incorporated Department of Emergency Management as part of the overall contract review process to ensure that any construction, new building or land purchases consider any hazard that may impact their function. As part of this hazard review, some facilities must be located in high vulnerability areas to ensure services reach the entire city. In such cases, Emergency Management ensures mitigation approaches are analyzed and implemented as appropriate.

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

8. 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 Office of Emergency Management. The Plan will be updated[16]:

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) 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.

8.1. Plan Maintenance Approach

- Incorporate hazard mitigation actions into existing planning mechanisms.
- Determine how mitigation projects and actions will be monitored.
- Establish indicators of effectiveness to judge success of projects.
- 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 throughout the planning cycle.

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

8.2. Monitoring

This Plan must be updated on a regular basis to remain an effective tool. The OEM will monitor the implementation of mitigation actions identified in the Plan.

During the first four years of the five-year planning cycle, the OEM 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 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 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.

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 hazards that threaten New Orleans or 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.

8.3. 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 if improvements are necessary. The OEM will also 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 questions as a guide:

- Are the mitigation actions effective, according to established evaluation criteria?
- 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 by FEMA 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?

8.4. 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 Year 4. 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 may 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 58.

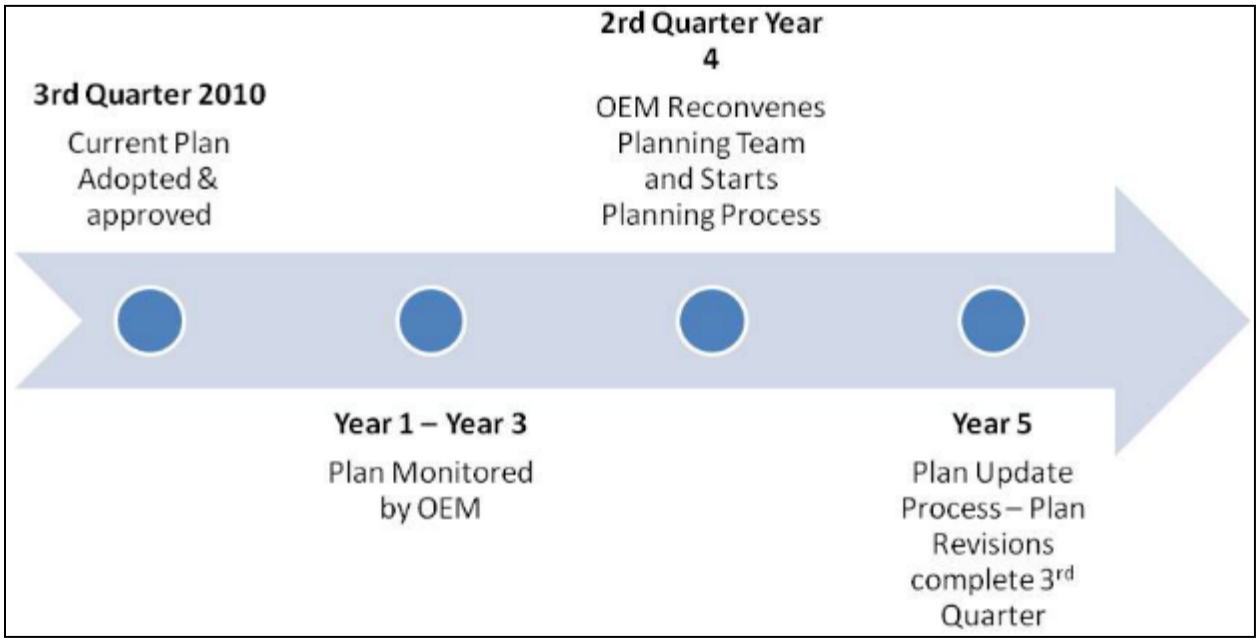


Figure 56 Plan Update Process Timeline

The S&WB begins its revision to its Emergency Plan's at the beginning of each year. Representatives from each department are on the Planning Team. These include the following groups:

- Command
- Operations
- Logistics
- Finance
- Communications

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

8.5. 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 LHMP, CEMP and EOP.

The Board holds two exercises each year: a tabletop and full scale exercise to test preparedness and disaster response capabilities. As part of the Board's overall Emergency Response Exercise Program it will incorporate the mitigation plan into the planning stages, exercise, and after action reports.

Mitigation and hazard avoidance are also now to be considered in the design of new building and infrastructure projects.

8.6. Continued Public Involvement

The S&WB will involve the public throughout the plan maintenance process 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.

9. Plan adoption

This section of the Plan documents the formal adoption of this Plan.

> **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 #163-2018 TO ADOPT THE UPDATE TO THE NEW ORLEANS SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN.

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Appendix 1 - RESOLUTION #163-2018 TO ADOPT THE UPDATE TO THE NEW ORLEANS SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN UPDATE

R-163-2018

APPROVAL OF THE UPDATE TO THE SEWERAGE AND WATER BOARD HAZARD MITIGATION PLAN

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

WHEREAS, The New Orleans Sewerage and Water Board has updated 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 Updated New Orleans Sewerage and Water Board Hazard Mitigation Plan would be in the best interest and protection of those located at 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 17 DAY OF OCTOBER 2018.

I, Ghassan Korban, P.E., Executive Director,
Sewerage and Water Board of New Orleans, do herby certify
that the above and foregoing is a true
and correct copy of a Resolution adopted at the Regular
Monthly Meeting of said Board, duly called and held,
according to law, On October 17, 2018

GHASSAN KORBAN, P.E. EXECUTIVE DIRECTOR
SEWERAGE AND WATER BOARD OF NEW ORLEANS

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	Hazards Identified
Sewer Operation		
West Bank STP	3501 E. Canal St.	ALL
East Bank STP	6501 Florida Ave.	ALL
Sta A SPS	1321 Orleans Ave.	H,T,F,S,W
Sat B SPS	4725 St. Claude At Jourdan	H,T,F,S,W
Sta C SPS	1107 Pacific St.	H,T,F,S,W
01 SPS	7336 Cohn At Lowerline	H,T,F,S,W
03 SPS	8720 Olive Near Eagle	H,T,F,S,W
04 SPS	5899 Fleur DE LIS	H,T,F,S,W
05 SPS	3912 Erato St	H,T,F,S,W
06 SPS	242 S. Solomon At Palmura	H,T,F,S,W
08 SPS	Corner of N. Broad & Toulose	H,T,F,S,W
09 SPS	2540 Annette At Law	H,T,F,S,W
14 SPS	4000 Clara Dr.	H,T,F,S,W
15 SPS	2431 Palmyra Near Rochblave	H,T,F,S,W
16 SPS	3751 N. Miro at Paulmyra	H,T,F,S,W
17 SPS	4975 Spain AT Selma	H,T,F,S,W
18 SPS	Vicksburg at Florida	H,T,F,S,W
19 SPS	3730 Jumonville At Milton	H,T,F,S,W
20 SPS	328 37th St.	H,T,F,S,W
21 SPS	6670 Memphis at Filmore	H,T,F,S,W
22 SPS	5705 Perlita Near Reynes	H,T,F,S,W
23 SPS	4500 Mithra	H,T,F,S,W
24 SPS	5827 N. Tonti. St.	H,T,F,S,W
25 SPS	2245 Charbonnet At Tonti	H,T,F,S,W
26 SPS	2244 St. Maurice at Tonti	H,T,F,S,W
Alcee Fortier	Alcee Fortier Blvd At Levee	H,T,F,S,W
America	6789 Dwyer at Westlake	H,T,F,S,W
America Marine	4045 Jourdan Rd.	H,T,F,S,W
Amid	6800 Almonster Blvd	H,T,F,S,W
Aurora	6000 Carlise Ct.	H,T,F,S,W
Berge	11501 Morrison Rd	H,T,F,S,W
Blvd X	4433 Chef Menteur Hwy	H,T,F,S,W
Bariarwood	13701 Morrison Rd	H,T,F,S,W
Bridge Plaza	2914 Vespasian St	H,T,F,S,W
Bullard	5501 Bullard Ave	H,T,F,S,W
Burke	9001 Morrison Rd	H,T,F,S,W
Castle Manor	4950 Gwain St	H,T,F,S,W
Cerise	5001 Cerise St	H,T,F,S,W
Chickasaw	Chicsaw & Metropolitan	H,T,F,S,W
City Park	5701 Marconia Ct.	H,T,F,S,W

Name	Full Address	Hazards Identified
Sewer Operation		
Crowder	5500 Crowder blvd	H,T,F,S,W
Dodt	8118 Chef Menteur Hwy	H,T,F,S,W
Eastover	6051 Eastover	H,T,F,S,W
English turn I	2201 Stanton Rd	H,T,F,S,W
English Turn II	123 1/2 Oak Alley	H,T,F,S,W
English Turn III	400 English Turn Parkway	H,T,F,S,W
Eton	3440 Eton St.	H,T,F,S,W
Folgers	14601 Gentilly Rd.	H,T,F,S,W
Forest Isle	5631 W. Forest Park Ln	H,T,F,S,W
France And Fla	2701 France Rd	H,T,F,S,W
Garden Oaks	3201 Memorial park Dr.	H,T,F,S,W
Gentilly Oaks	5000 Papnia Dr at Vienna	H,T,F,S,W
Holiday	2799 Holiday Dr.	H,T,F,S,W
Horace	3301 Lawrence St.	H,T,F,S,W
Huntlee	3201 Huntlee Dr.	H,T,F,S,W
Industrial Park	4200 Industrial Parkway	H,T,F,S,W
Kmart	Desire Pkwy at Gentilly Dr.	H,T,F,S,W
Lake Forest	10451 Lk Forest Blvd	H,T,F,S,W
Lakeland Terrace	5057 Warren Dr.	H,T,F,S,W
Lakewood South	Country Club Dr. And Marcia	H,T,F,S,W
Lamb	6450 Morrison Rd	H,T,F,S,W
Lawrence	7900 Morrison Rd	H,T,F,S,W
Liggett	12501 Morrison Rd	H,T,F,S,W
Lower Coast	3700 Old Woodland Hwy	H,T,F,S,W
Mccoy	Mccoy St. and Gentilly Rd	H,T,F,S,W
Mech Equip (Meco)	3855 France Rd	H,T,F,S,W
Memorial	2501 Memorial Pk.	H,T,F,S,W
Michoud	4400 Michoud Blvd	H,T,F,S,W
Oak Island	14201 Michoud Blvd	H,T,F,S,W
Paris Road	12001 Dwyer Dr.	H,T,F,S,W
Park Timbers	4100 Lennox Blvd	H,T,F,S,W
Pines Village	6155 Dwyer Rd	H,T,F,S,W
Plum Orchard	7300 Chef Menteur Hwy	H,T,F,S,W
Shorewood	14441 Morrison Rd	H,T,F,S,W
Southern Scrap	Harbor Rd	H,T,F,S,W
Tall Timbers	3800 Tall Pines Dr.	H,T,F,S,W
Venetian Isles No.2	20711 Old Spanish Trail	H,T,F,S,W
Victoria	Victoria St. at Old Gentilly Rd	H,T,F,S,W
Village De Lest	11324 Dwyer off Michoud	H,T,F,S,W
Webber	10141 Morrison Rd	H,T,F,S,W
Willowbrook	Willowbrook off Michoud	H,T,F,S,W
Wilson	7709 Wilson St	H,T,F,S,W
Woodland	4150 Woodland Dr.	H,T,F,S,W
Wright Rd.	Wright Rd at Lake Forest Blvd	H,T,F,S,W

Drainage Station	**Full Address**	**Hazards Identified**
01 DPS	2501 S.Broad St.	H,T,F,S,W
02 DPS	444 N. Broad St.	H,T,F,S,W
03 DPS	2251 N. Broad St.	H,T,F,S,W
04 DPS	5700 Warrington Dr.	H,T,F,S,W
05 DPS	4841 Florida Ave	H,T,F,S,W
06 DPS	345 Orphum	H,T,F,S,W
07 DPS	5741 Orleans Ave.	H,T,F,S,W
10 (Citrus)	9600 Haynes Blvd	H,T,F,S,W
11 DPS	5301 East Sixth Street	H,T,F,S,W
12 DPS	7223 Pontchartrain Blvd	H,T,F,S,W
13 DPS	4201 Tall Spruce	H,T,F,S,W
14 (Jancke)	12200 Haynes Blvd	H,T,F,S,W
15 DPS	Iwwy and Intercoastal Dr.	H,T,F,S,W
16 (St. Charles)	7200 Wales St	H,T,F,S,W
17 (Station D)	2800 Florida Ave	H,T,F,S,W
Pritchard	2901 Monticello	H,T,F,S,W
18 (Maxent)	Michoud Bayou and Levee	H,T,F,S,W
19 DPS	4500 Florida Ave	H,T,F,S,W
20 (Amid)	6300 Intercostal Water Way	H,T,F,S,W
Dwyer	4500 Dwyer Rd	H,T,F,S,W
Elaine	3100 Elaine St	H,T,F,S,W
Grant	3100 Grant St.	H,T,F,S,W
Oleander	9400 Oleander St.	H,T,F,S,W
Carrolton Frequency Changer	8400 Earhart Blvd	H,T,F,S,W

Underpass DPS	**Full Address**	**Hazards Identified**
Bay Street	Bay Street and R/R Track	H,T,F,S,W
Broad	2251 N. Broad	H,T,F,S,W
Canal Blvd	5500 Canal Blvd	H,T,F,S,W
Franklin Ave	3100 Franklin Ave.	H,T,F,S,W
Hospital	Gulf Dr. and I-610	H,T,F,S,W
Marconni Dr.	5741 Orleans Ave	H,T,F,S,W
New Carrollton	Carrollton Ave and I-10 Exit	H,T,F,S,W
Old Carrollton	Carrollton Ave and Tulane Ave.	H,T,F,S,W
Paris Ave.	3200 Peoples Ave.	H,T,F,S,W
Pontchartrain	Pontchartrain and I-10	H,T,F,S,W
Press Dr.	Press Dr. and Leon C Simon	H,T,F,S,W
St. Bernard Ave	3300 St. Bernard Ave.	H,T,F,S,W
I-10 Mounds	101 Academy Dr.	H,T,F,S,W
Support Facilities		
St Joseph HQ	625 St. Joseph St.	ALL
Central, Yard Complex	2900 Peoples Ave.	ALL

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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	1	1385	Chickasaw	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 526,000.00
1	1	914	City Park	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 665,000.00
1	1	825	Lakeview South	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 595,000.00
1	1	884	SPS #20	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1321	SPS#4	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1339	SPS #24	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1635	SPS #25	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1395	SPS #26	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	807	Alcee Fortier	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 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	1	1171	America	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	3355	Amid	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	2221	Castle Manor	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	2244	Cerise	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1184	Eastover	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 665,000.00
1	1	1191	Gentilly Oaks	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	2002	Industrial Parkway	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 665,000.00
1	1	1172	Lakeland Terrace	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1027	McCoy	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 12,267.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	1	910	Oak Island	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 665,000.00
1	1	1176	Paris Road	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 45,223.84
1	1	858	Willowbrook	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 130,246.13
1	1	1396	Wilson	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	1036	Wright	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 178,000.00
1	1	934	Pines Village	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 210,000.00
1	1	936	SPS # 18	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	892	SPS#19	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	1	862	SPS #21	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	921	SPS #22	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	875	SPS #17	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	1035	SPS #23	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	1375	SPS #9	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	805	SPS #16	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	1668	SPS B	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 999,000.00
1	1	4199	SPS #5	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 990,000.00
1	1	803	Michoud	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,600,000.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	1	87	Boulevard X	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 665,000.00
1	1	870	Bullard	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 635,250.00
1	1	907	Crowder	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 574,750.00
1	1	824	DODT	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 3,700,000.00
1	1	883	Lake Forest	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,280,621.00
1	1	873	Plum Orchard	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,280,621.00
1	1	1158	Victoria	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,280,621.00
1	1	821	Berg	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 713,900.00
1	1	872	Briarwood	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 592,900.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	1	814	Lawrence	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,280,621.00
1	1	878	Liggett	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 605,000.00
1	1	869	Shorewood	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 713,900.00
1	1	818	Weber	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 595,750.00
1	1	277	SPS A	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 350,000.00
1	1	1179	France and Florida	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 481,792.00
1	1	811	K-Mart	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 580,800.00
1	1	800	Meco	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 441,650.00
1	1	935	America Marine	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 435,600.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	1	806	Folgers	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 665,000.00
1	1	1186	Southern Scrap	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,045,128.00
1	1	804	Venetian Isles	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 532,400.00
1	1	801	Village D'Lest	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,521,400.00
1	1	889	Burke	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 586,850.00
1	1	625	SPS #8	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,280,621.00
1	1	627	SPS #1	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	621	SPS #3	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 765,000.00
1	1	4199	SPS #6	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,280,621.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	1	1834	SPS #15	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 990,000.00
1	1	11317	SPS D	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 860,488.31
1	1	863	Lamb	see 6.8	S&WB Sewer Ops	Hurricane, Flood, Levee Failure	PP, ES, S	PW	1, 3	7, 8	COMPLETED	$ 1,500,459.00
1	4	M101	Tiger Dams - Main Water Plant	See 6.6.1	S&WB Operations	Hurricane, Flood, Levee Failure	ES	S&WB	3	10	COMPLETED	$ 58,000.00
1	4	M102	Tiger Dams - Central Control Operations	See 6.6.1	S&WB Operations	Hurricane, Flood, Levee Failure	ES	S&WB	3	10	COMPLETED	$ 58,000.00
2	2	M103	Purchase and Implement WebEOC		S&WB Emergency Mgmt	All	ES, PI	NA	4,5,6	1,6,11	COMPLETED	NA
1	3	M104	15 MW generator - Carrollton Water Plant	See 6.6.1	S&WB Operations, USACE	All	ES, PP	NA	1,3	9,10	COMPLETED	$ 31,200,000.00
1	4		East Bank STP Berm	see 6.8	S&WB Operations	Hurricane, Flood, Levee Failure	ES, PP	FEMA	1,3	9,10	COMPLETED	$ 33,400,000.00
1	3		4MW generator East Bank STP (EBSTP)	See 6.5.2	S&WB Risk Mgmt	Hurricane, Flood, Levee Failure	ES, PP	S&WB	1,3	9,10	COMPLETED	$ 12,321,035.24
2	2	M106	Development of comprehensive risk policy		S&WB Operations	All	NA	S&WB	2,4,5	1,2,3,4,5	COMPLETED	$ -
2	2	M107	Development of agency specific COOP plan		S&WB Emergency Mgmt	All	ES, PP	HMP	2,4,5	5	8/1/2018	$ -

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
1	4	M105	Upgrades and Improvements to S&WB Drainage System. Including Canals Upgrades, Pump Station Rehabilitation, Pump Upgrades, and Power Controls	See 6.6.6	S&WB Operations, USACE	Hurricane, Flood, Levee Failure	ES,PP	USACE	1,3	9,10	On Going	$ 1,000,000,000.00
1	1		Generators and Transfer Switics at SPS	See 6.8	S&WB Operations	Hurricane, Flood, Levee Failure	PP, ES, S	PDM/S&WB	1,2,3	7, 8	TBD	$ 25,000,000.00
3	3	M109	Safe House and Resiliency center	See 6.5.2	S&WB Emergency Mgmt	All	ES,PP	PDM/S&WB	1,2,3	1,2,3,4,5	TBD	$ 21,000,000.00
1	1	HMP0002	Underpass Generators at 7 UPS Stations	See 6.6.3	S&WB Operations	Hurricane, Flood, Storm	PP, ES, S	HMP	2,4,5	9,10	11/1/2018	$ 1,962,210.00
1	1	18836v5	Water Hammer Mitigation	See 6.6.1	S&WB Operations	Hurricane, Flood, Storm	PP, ES, S	PW	1,2,3,6	9,10	12/30/2023	$ 90,000,000.00
1	1	HMP0039	Power House	See 6.7	S&WB Operations	Hurricane, Flood, Levee Failure	PP, ES, S	HMGP/S&WB	1,2,3,6	1,2,3,4,5	12/30/2021	$213,000,000.00
1	1	M110	Electric Motor Device (EMD)	See 6.7	S&WB Operations	Hurricane, Flood, Levee Failure	PP, ES, S	HMGP/S&WB	1,2,3,6	1,2,3,4,5	Spring 2018	$ 22,000,000.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
3	1	H0774	Education Program	See 6.63	Dana Brown Associates Global Green NPN Water Works	Flood	P, PI	S&WB	1,2,4,5,6	7	10/27/2017	$100,000.00
3	1	H0776	Green Keepers	See 6.63	Evans & Lighter Spackman, Mossop + Michaels PKW Urban Roots Groundwork E&E Strategies BaumGardens Landscape C.R.I.S.P. Urban Conservancy Dana Brown & Associates	Flood	P, PI	S&WB	1,2,4,5,6	7	4/1/2015	$26,350.00
3	1	H0775	Ripple Effect	See 6.63	Waggonner & Ball Architects KIPP Schools PlayBuild	Flood	P, PI	S&WB	1,2,4,5,6	7	3/1/2017	$75,500.00
3	1	H0773	Lower 9th Ward Earth Lab	See 6.63	Common Ground Relief NET Charter High School GAEA Engineering Consultants Waggonner & Ball Architects Deltares	Flood	P, PI	S&WB	1,2,4,5,6	7	5/25/2017	$100,000.00
3	1	H0777	The WEB Water Effectiveness in Broadmoor	See 6.63	BDC Evans & Lighter Trigon Associates The City of New Orleans E&E Strategies	Flood	P, PI	S&WB	1,2,4,5,6	7	2017	$82,750.00
3	1	H0933	Rabouin International High School GI Lab	See 6.63	Rabouin International High School VertiFarms	Flood	P, PI	S&WB	1,2,4,5,6	7	2017	$99,631.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
3	1	H0939	Central City Project	See 6.63	LPBF Civil Engineer Greenman Dan Hike for KaTREEna LUSC Global Green NPN NORA	Flood	P, PI	S&WB	1,2,4,5,6	7	10/27/2017	$40,094.80
3	1	H0901	Florida Ave Corridor Learning Trail	See 6.63	Evans & Lighter LA Dr. John Day Jr. Common Ground Relief Audubon Nature Institute Hike for KaTREEna Design Jones, LLC MDM Design Wetlands Resources, LLC	Flood	P, PI	S&WB	1,2,4,5,6	7	2018	$100,000.00
3	1	H0902	Hollygrove Greenline A Water Management and Community Education Initiative	See 6.63	Carrollton-Hollygrove CDC Dana Brown & Associates Engineers Without Borders Twin Shores Landscape & Construction Services, Inc. SWBNO	Flood	P, PI	S&WB	1,2,4,5,6	7	5/23/2017	$100,000.00
3	1	H0910	Treme-St. Ann Street Rain Gardens	See 6.63	Dana Brown & Associates Groundwork Global Green DPW	Flood	P, PI	S&WB	1,2,4,5,6	7	2017	$98,772.00
3	1	H0936	SWB Downtown St. Joseph St. Administration Building Green Roof	See 6.63	Evans + Lighter Morphy Makofsky Independent Roofing Systems	Flood	P, PI	S&WB	1,2,4,5,6	7	2018	$388,958.91
3	1	H0935	Aurora Rain Gardens	See 6.63	Greenman Dan Groundwork	Flood	P, PI	S&WB	1,2,4,5,6	7	2016	$66,095.00
3	1	H0937	Coliseum St. Bioswale	See 6.63	Evans + Lighter Groundwork DPW Coliseum Square Association	Flood	P, PI	S&WB	1,2,4,5,6	7	2016	$109,057.00

Priority	MA	ID	Project Name	Project/Program Description	Agency/Dept	Hazard(s)	Project Category	Funding Sources	Goals	Objectives	Timeframe/ Completion Dates	Estimated Amount
3	1	H0903	Conrad Park	See 6.63	WEF Dana Brown	Flood	P, PI	S&WB	1,2,4,5,6	7	9/27/2014	$5,000.00
3	1	H0797 Match H0798 Grant	SWBNO Green Infrastructure Monitoring Project EPA Urban Waters Small Grant	See 6.63	NORA LPBF LUSC EPA	Flood	P, PI	S&WB	1,2,4,5,6	7	12/31/2018	$45,383.00
3	1	H0916	EPA Environmental Education Local Grant EE1530	See 6.63	Ripple Effect	Flood	P, PI	S&WB	1,2,4,5,6	7	7/31/2017	$30,333.00
3	1	H0795	Rain Barrels	See 6.63	Global Green USA	Flood	P, PI	S&WB	1,2,4,5,6	7	2014	$500.00
3	1	H0794	Trees 2014	See 6.63	Dept. of Parks and Parkways Hike for KaTREEna	Flood	P, PI	S&WB	1,2,4,5,6	7	12/6/2014	$4,500.00
3	1	H0928	Trees 2015	See 6.63	Dept. of Parks and Parkways Hike for KaTREEna	Flood	P, PI	S&WB	1,2,4,5,6	7	12/4/2015	$5,000.00
3	1	H0954	Trees 2016	See 6.63	Dept. of Parks and Parkways NOLA Tree Project	Flood	P, PI	S&WB	1,2,4,5,6	7	12/3/2016	$5,000.00
3	1	H0979	Trees 2017	See 6.63	Dept. of Parks and Parkways NOLA Tree Project	Flood	P, PI	S&WB	1,2,4,5,6	7	12/7/2017	$5,000.00
3	1	H0922	Adaptation Support Tool	See 6.63	NORA Deltares City of NO Office of Resiliency and Sustainability	Flood	P, PI	S&WB	1,2,4,5,6	7	1/1/2017	$100,000.00
3	1	H0931	Stormwater Toolkit	See 6.63	City of NO CDM Smith Dana Brown and Associates	Flood	P, PI	S&WB	1,2,4,5,6	7	4/1/2017	$150,000.00
3	1	H0960	Soil Sampling/Analysis	See 6.63	City of NO Eustis Engineering EPA ORD	Flood	P, PI	S&WB	1,2,4,5,6	7	12/31/2019	$97,795.25
3	1	N/A	Flood Risk Analysis	See 6.6.4	NOHSEP, S&WB, UNO	Flood	P,PI	UNO Grant	1,2,4,5,6	7	TBD	
											Total	**$ 1,496,703,445.48**
				Added since 2012								

Appendix 4 – Pump Station Background

In 1913, A.B. Wood provided the solution to the problem of providing greater pumping capacity for the City of New Orleans as well as prevention for 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 alternating current (ac) power to the motor stator causing a rotating magnetic field to be set up around the rotor. The rotor is energized with direct current (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).

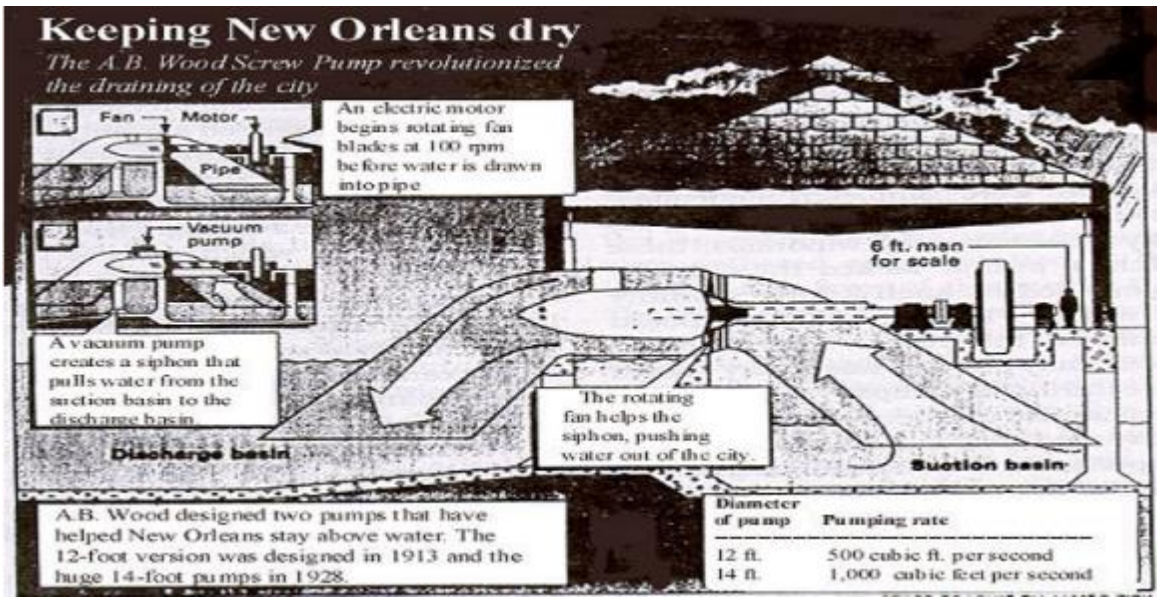


Figure 57 Wood Screw Pump

Appendix 5 – Planning Committee Meeting Agendas

This appendix contains the agendas of the S&WB Hazard Mitigation Planning Committee from Jan 2017 to July 2018

Hazard Mitigation Planning

Agenda

S&WB Hazard Mitigation Plan Update

Meeting Agenda

Date: January 26, 2017

Location: S&WB EOC

1: New Emergency Management Coordinators introductions

2: Business Continuity Plan Update Status

3: Equipment Evacuation Plan Update

4: Incident Command System Training Value to S&WB Presentation

5: NEW WEB EOC Overview

6: S&WB HMGP Plan Update

7: Other Matters

Hazard Mitigation Planning

Agenda

Date: July 27, 2017

Location: S&WB EOC

1: Mitigation Project Update

- SPS Mitigation Project Update
- Power House Mitigation Project Update

- Underpass Generator Project Update
- Water Hammer Project Update

2: Mitigation Plan Update

- Required Changes
- New Format

3: Next Action

- Make changes to Plan

4: Comments

5: **Next Meeting Date**

- Date: October 19, 2018
- Time: 9:00 am
- Location: S&WB EOC 8800 S Claiborne Ave, New Orleans, LA 70118

Hazard Mitigation Planning

Agenda

S&WB Hazard Mitigation Plan Update

Meeting Agenda

Date: November 30, 2017

Location: S&WB EOC

1: Special Note: The S&WB will merge its plan with that of the City of New Orleans 2020 update as a jurisdiction under one plan. NOHSEP will work with the state to ensure the Board remains in compliance via an annex to your plan until the city's update is complete.

2: Current Mitigation Project Schedule Update

3: New Mitigation Project Request (Generators, Temp pumps…)

Hazard Mitigation Planning

Meeting Agenda

Date: 3/22/18

Location: S&WB EOC 8800 S Claiborne Ave, New Orleans, LA 70118

1. **S&WB Hazard Mitigation Plan Update Presentation**
2. **S&WB HMP Timeline**
3. **S&WB HMP Items Needed**

Hazard Mitigation Planning

Meeting Agenda

Date: 8/9/18

Location: S&WB EOC 8800 S Claiborne Ave, New Orleans, LA 70118

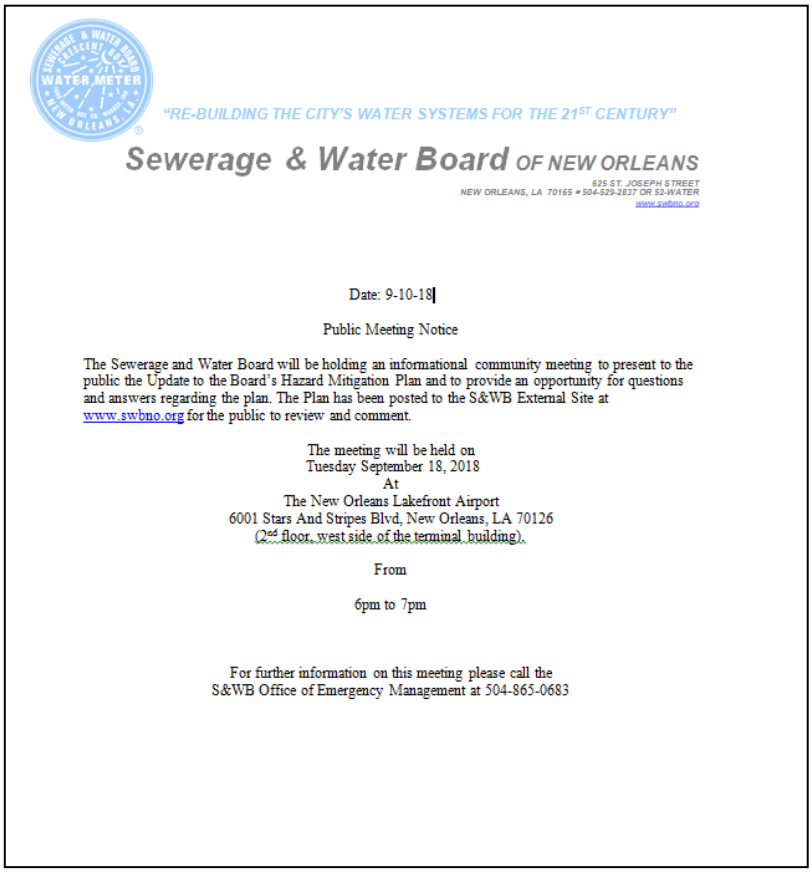
1. **S&WB Hazard Mitigation Plan Public Presentation**
2. **Set Date, Time, and Location for Public Meeting**
3. **Overview of the Draft Plan changes made sice last review**

Appendix 6 – Public Meeting Notices

Public Meeting

The initial public meeting was held at the New Orleans Lakfront Airport on September 27,2018 . The meeting was called to order at 6pm 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



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

Sewerage & Water Board OF NEW ORLEANS

625 ST. JOSEPH STREET
NEW ORLEANS, LA 70165 • 504-529-2837 OR 52-WATER
www.swbno.org

Date: 9-10-18

Public Meeting Notice

The Sewerage and Water Board will be holding an informational community meeting to present to the public the Update to the Board's Hazard Mitigation Plan and to provide an opportunity for questions and answers regarding the plan. The Plan has been posted to the S&WB External Site at www.swbno.org for the public to review and comment.

The meeting will be held on
Tuesday September 18, 2018
At
The New Orleans Lakefront Airport
6001 Stars And Stripes Blvd, New Orleans, LA 70126
(2nd floor, west side of the terminal building).

From

6pm to 7pm

For further information on this meeting please call the
S&WB Office of Emergency Management at 504-865-0683

Figure 58 1st Public Meeting Notice

Sewerage & Water Board of New Orleans

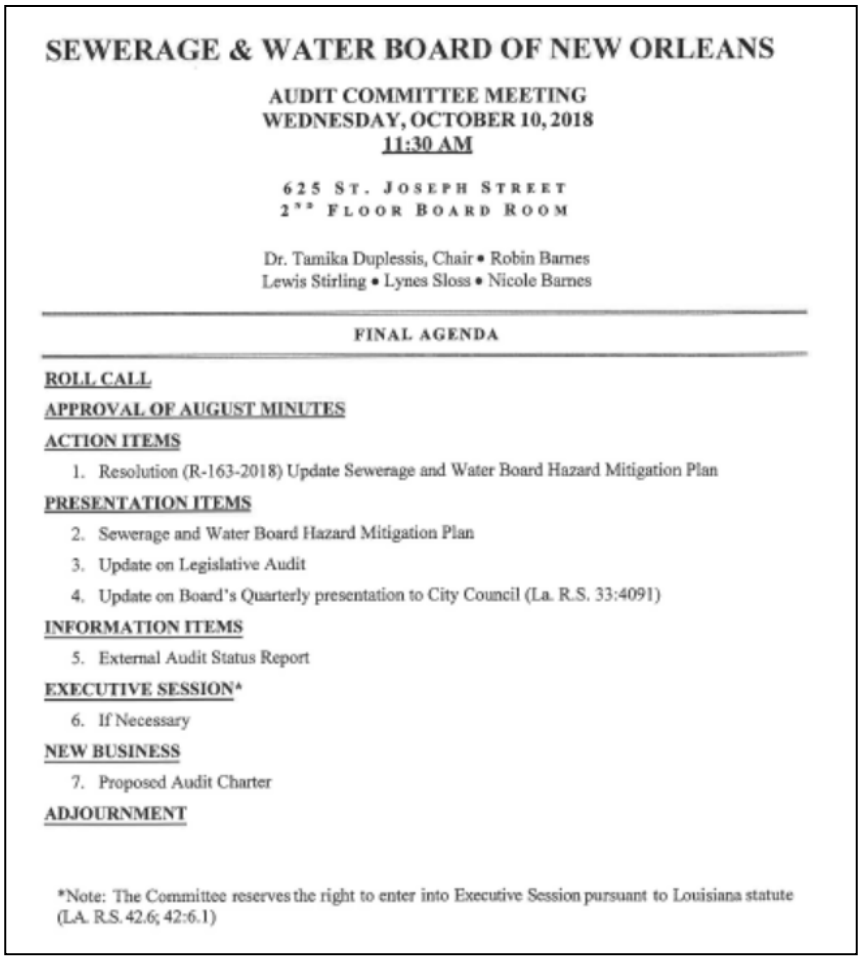
Office of Emergency Management

Meeting Sign in Sheet

Meeting Topic: S&WB Hazard Mitigation Plan Update Public Meeting

Date: 9-18-18 **Location: NO Lakefront Airport** **Time: 6pm**

Name	Address (Zip Code)	Contact Info (email)
JASON HUGHES	941 WASHINGTON AVE 70130	JHUGHES@THEGBBB.ORG
LEON CONTRERAS	4031 FAIRWOOD AVE NEW ORLEANS, LA 70131	LEONCONTRERAS45@GMAIL.COM
Kirk Burrell	2235 Beck St New Orleans, LA 70131	KBurrell2015@gmail.com
Ann Wilson	1022 St. Peter St, #205 NOLA	MsamWilson@aol.com
Randi Jones	7251 W. Jackson Dr, NOLA 70117	randi.giraud@gmail.com
Jennifer Perez	625 St Joseph St	jperez@subno.org
MARIA SIGUR	625 St. Joseph St	MSigur@Subno.org
Wilma Heaton	Wheaton@floodcoalition.org	
Tony Collins	7220 west Haven RD NOLA 70126	tcollins515@cox.net
Anna Patterson	931 N. Kennedy St #B NOLA 70119	acleve1287@gmail.com
TINA HAINES	6853 Lake Willow Dr NOLA 70126	thainesbrown@gmail.com
Nathan Lott	4902 Canal St 70119	nathan@urbanstrategies.org
Kerry Jackson	625 St. Joseph St.	kjackson@subno.org
JASON Hughes	8314 Aberdeen Rd	j.jasonhughes@gmail.com



SEWERAGE & WATER BOARD OF NEW ORLEANS

AUDIT COMMITTEE MEETING
WEDNESDAY, OCTOBER 10, 2018
11:30 AM

625 St. Joseph Street
2nd Floor Board Room

Dr. Tamika Duplessis, Chair • Robin Barnes
Lewis Stirling • Lynes Sloss • Nicole Barnes

FINAL AGENDA

ROLL CALL

APPROVAL OF AUGUST MINUTES

ACTION ITEMS

1. Resolution (R-163-2018) Update Sewerage and Water Board Hazard Mitigation Plan

PRESENTATION ITEMS

2. Sewerage and Water Board Hazard Mitigation Plan
3. Update on Legislative Audit
4. Update on Board's Quarterly presentation to City Council (La. R.S. 33:4091)

INFORMATION ITEMS

5. External Audit Status Report

EXECUTIVE SESSION*

6. If Necessary

NEW BUSINESS

7. Proposed Audit Charter

ADJOURNMENT

*Note: The Committee reserves the right to enter into Executive Session pursuant to Louisiana statute (LA. R.S. 42.6; 42:6.1)

Figure 59 2nd Public Meeting Notice

AUDIT COMMITTEE MEETING
Wednesday, October 10, 2018
11:30 A. M.

PLEASE PRINT

NAME	ORGANIZATION	PHONE
JASON HISSMOOTH	OEM	865-0686
LEON CONTRERAS	OEM	439-8815
RUSSELL KRAUV	ATCO	458-4604

SEWERAGE AND WATER BOARD OF NEW ORLEANS

Board of Director's Meeting
625 St. Joseph Street
New Orleans, LA 70165
9:00 AM
OCTOBER 17, 2018

PLEASE PRINT

NAME	ORGANIZATION	PHONE
Rev. Dr. Ernest Marcelle Jr	J+B, NAACP, SCLC, FABC, DAV.	504-570-8462
Dan. Wm Barnwell	Justice + Beyond	504-862-0311
Rev. [illegible]	Just. + Beyond	913-9405??
Russell Kelly	AFLO	458-4604
Lian Hassinger	SELA.10 OEM	865-0686
Sylvia McKenzie	Justice to Beyond	504)957-6704
Jason Anders	Plant N Power	(504) 606-4530
Randy Smith	Royal	(504) 283-9420
Rita Legrand	Lakeview	
Cecil Contreras	OEM	439-5915
Pat Bryant	J+B	905-4137
Kerry Nix	The Lens	978-505-8886
Geneva Coleman	The Hawthorne Agency, Inc.	504 488-6100 x 2169
Bambi Hall	GEC	504 207 6904

Appendix 7 – NFIP Coverage

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

Flood Schedule 84 Locations 2018-2019

Policy Number	Flood Zone	Flood Program	EC	Insured Location	Building	Building Coverage	Contents Coverage	Deductible	Premium	Expiration Date
171151313840 02	AE	Regular	No	8800 S Claiborne Ave	Claiborne Pumping Station	$ 500,000	$ 500,000	$ 10,000	$ 22,516	2/3/2019
171151313867 02	A01	Regular	No	8800 S Claiborne Ave	Panola St Pumping Station	$ 440,000	$ 420,000	$ 10,000	$ 19,266	2/3/2019
171151313872 02	A01	Regular	No	8800 S Claiborne Ave	Meter Shop	$ 500,000	$ 500,000	$ 10,000	$ 21,370	2/3/2019
171151313875 02	A01	Regular	No	8800 S Claiborne Ave	Machine Shop	$ 500,000	$ 500,000	$ 10,000	$ 21,370	2/3/2019
171151313882 02	A01	Regular	No	8800 S Claiborne Ave	Welding & Fab Shop	$ 500,000	$ 315,000	$ 10,000	$ 17,900	2/3/2019
171151313886 02	A01	Regular	No	8800 S Claiborne Ave	Electrical Storage Shed	$ 440,000	$ 315,000	$ 10,000	$ 16,953	2/3/2019
171151313888 02	A01	Regular	No	8800 S Claiborne Ave	New Garage	$ 75,000	$ 75,000	$ 2,000	$ 3,867	2/3/2019
171151313891 02	A01	Regular	No	8800 S Claiborne Ave	Dry Boat (Box) Storage	$ 75,000	$ 75,000	$ 2,000	$ 3,867	2/3/2019
171151313893 02	A01	Regular	No	8800 S Claiborne Ave	Metal Storage	$ 75,000	$ 75,000	$ 2,000	$ 3,867	2/3/2019
171151313897 02	A01	Regular	No	8800 S Claiborne Ave	Chlorine Building	$ 200,000	$ 75,000	$ 3,000	$ 5,989	2/3/2019
171151313899 02	A01	Regular	No	8800 S Claiborne Ave	New Chemical Building	$ 440,000	$ 315,000	$ 10,000	$ 16,413	2/3/2019
171151313903 02	A01	Regular	No	8800 S Claiborne Ave	Old Chemical Building	$ 385,000	$ 262,500	$ 5,000	$ 15,249	2/3/2019
171151313905 02	A01	Regular	No	8800 S Claiborne Ave	Switch Gear Building	$ 150,000	$ 150,000	$ 3,000	$ 7,148	2/3/2019
171151313909 02	A01	Regular	No	8800 S Claiborne Ave	Electrical storage-parts only	$ 40,000	$ 40,000	$ 2,000	$ 2,235	2/3/2019
171151313915 02	A01	Regular	No	8800 S Claiborne Ave	Claiborne substation	$ 150,000	$ 50,000	$ 2,000	$ 4,263	2/3/2019
171151313917 02	A01	Regular	No	8800 S Claiborne Ave	Sycamore Substation	$ 150,000	$ 50,000	$ 2,000	$ 4,263	2/3/2019

Flood Schedule 84 Locations 2018-2019

Policy Number	Flood Zone	Flood Program	EC	Insured Location	Building	Building Coverage	Contents Coverage	Deductible	Premium	Expiration Date
171151313920 02	A01	Regular	No	8800 S Claiborne Ave	Hamilton St Substation	$ 150,000	$ 50,000	$ 2,000	$ 4,263	2/3/2019
171151313924 02	A01	Regular	No	8800 S Claiborne Ave	Frequency Change Bldg	$ 411,800	$ 125,000	$ 5,000	$ 12,964	2/3/2019
171151313926 02	A01	Regular	No	8800 S Claiborne Ave	Hamilton St Warehouse	$ 500,000	$ 500,000	$ 10,000	$ 22,516	2/3/2019
171151313929 02	A01	Regular	No	8800 S Claiborne Ave	Gas Compressor Building	$ 125,000	$ 40,000	$ 2,000	$ 3,564	2/3/2019
171151313934 02	A01	Regular	No	8800 S Claiborne Ave	Electrical Shop	$ 300,000	$ 275,000	$ 5,000	$ 13,634	2/3/2019
171151313937 02	A01	Regular	No	8800 S Claiborne Ave	Central Control Building	$ 400,000	$ 300,000	$ 10,000	$ 15,620	2/3/2019
171151313939 02	A01	Regular	No	8800 S Claiborne Ave	Spruce St Warehouse	$ 500,000	$ 152,500	$ 10,000	$ 14,859	2/3/2019
171151329330 02	A01	Regular	Yes	8800 S Claiborne Ave	Lab/Engineering Building	$ 500,000	$ 500,000	$ 1,250	$ 1,931	2/3/2019
171151313947 02	A01	Regular	Yes	2900 Peoples Ave	Main Warehouse	$ 500,000	$ 500,000	$ 1,250	$ 1,924	2/3/2019
171151313952 02	A02	Regular	Yes	2900 Peoples Ave	Administration Building	$ 500,000	$ 500,000	$ 1,250	$ 1,696	2/3/2019
171151313957 02	A02	Regular	No	2900 Peoples Ave	Garage 1	$ 500,000	$ 500,000	$ 10,000	$ 21,370	2/3/2019
171151313961 02	A02	Regular	Yes	2900 Peoples Ave	Garage 2	$ 500,000	$ 500,000	$ 1,250	$ 1,931	2/3/2019
171151313964 02	A02	Regular	No	2900 Peoples Ave	Switch Gear	$ 150,000	$ 150,000	$ 2,000	$ 7,358	2/3/2019
171151313967 02	A02	Regular	No	2900 Peoples Ave	Mechanic/Body Shop	$ 350,000	$ 350,000	$ 5,000	$ 16,793	2/3/2019
171151313968 02	A02	Regular	No	2900 Peoples Ave	Labor Building	$ 500,000	$ 500,000	$ 10,000	$ 21,370	2/3/2019

Flood Schedule 84 Locations 2018-2019

Policy Number	Flood Zone	Flood Program	EC	Insured Location	Building	Building Coverage	Contents Coverage	Deductible	Premium	Expiration Date
171151313971 02	A02	Regular	No	2900 Peoples Ave	Pumping/Power Station	$ 500,000	$ 500,000	$ 10,000	$ 22,516	2/3/2019
171151329334 02	B	Preferred	Yes	900 Lamarque St	Chemical House	$ 400,000	$ 250,000	$ 1,250	$ 2,894	2/3/2019
171151313987 02	B	Preferred	No	900 Lamarque St	Head House/Filter Gallery	$ 500,000	$ 500,000	$ 1,250	$ 3,323	2/3/2019
171151313992 02	B	Preferred	Yes	900 Lamarque St	High Lift Pumping Station	$ 400,000	$ 250,000	$ 1,250	$ 2,894	2/3/2019
171151313995 02	B	Preferred	Yes	900 Lamarque St	Power Control	$ 400,000	$ 300,000	$ 1,250	$ 3,053	2/3/2019
171151313997 02	B	Preferred	Yes	900 Lamarque St	Recycle Basin Pump Room	$ 50,000	$ 50,000	$ 1,000	$ 1,052	2/3/2019
171151314001 02	B	Preferred	No	900 Lamarque St	Station C Building	$ 500,000	$ 500,000	$ 1,250	$ 3,804	2/3/2019
171151314002 02	A02	Regular	No	6501 Florida Ave.	Storage Building	$ 330,000	$ 315,000	$ 5,000	$ 15,411	2/3/2019
171151314003 02	A02	Regular	No	6501 Florida Ave.	General Receiving	$ 330,000	$ 315,000	$ 5,000	$ 15,411	2/3/2019
171151314004 02	A02	Regular	Yes	6501 Florida Ave.	Solids Handling Building	$ 500,000	$ 500,000	$ 5,000	$ 9,135	2/3/2019
171151314006 02	A02	Regular	Yes	3501 E. Canal St.	Emergency Diesel Generato	$ 400,000	$ 200,000	$ 1,250	$ 2,109	2/3/2019
171151314007 02	A02	Regular	Yes	3501 E. Canal St.	Office/Operations Center	$ 500,000	$ 500,000	$ 5,000	$ 9,135	2/3/2019
171151314009 02	A02	Regular	Yes	3501 E. Canal St.	Effluent Pump Building	$ 500,000	$ 500,000	$ 1,250	$ 2,570	2/3/2019
171151329317 02	B	Preferred	No	625 St. Joseph St.	625 St. Joseph	$ 500,000	$ 500,000	$ 1,250	$ 5,393	2/3/2019
171151053978 04	A01	Regular	Yes	8800 S Claiborne Ave	Power Bldg (Low-High Lift)	$ 500,000	$ 500,000	$ 5,000	$ 13,562	1/12/2019
171151054002 04	A01	Regular	Yes	8800 S Claiborne Ave	Turbine 6/Power House NO3	$ 500,000	$ 500,000	$ 10,000	$ 1,637	1/12/2019

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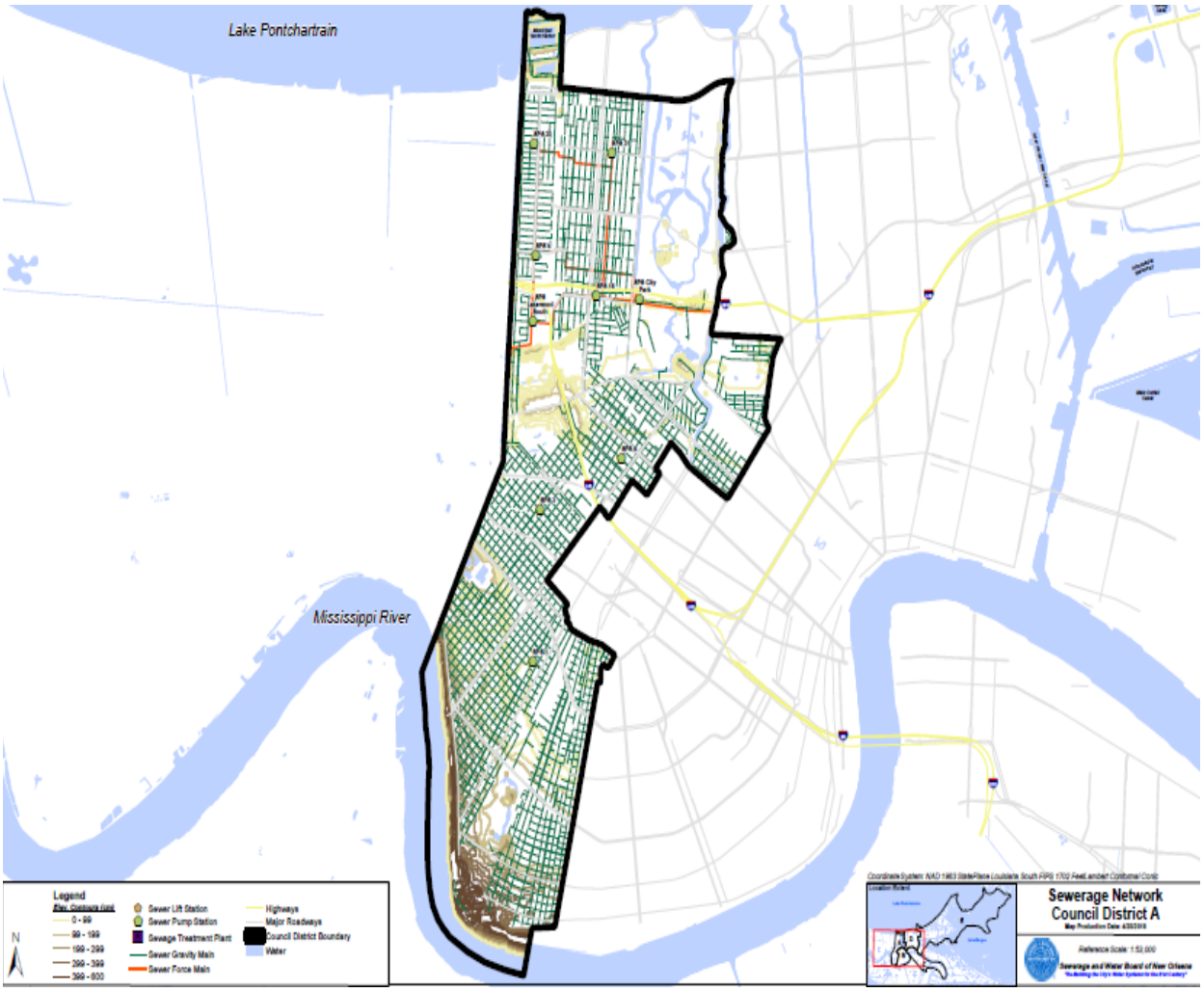
(Refer to following page for)

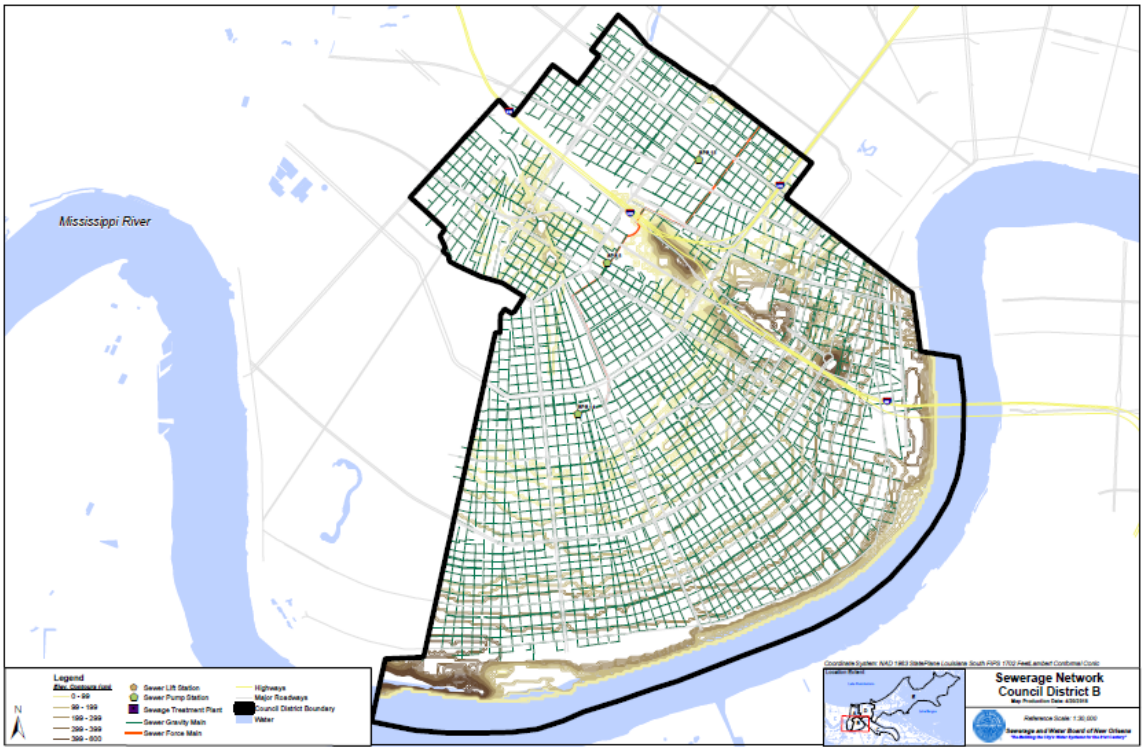
Appendix 8 - Hurricane direct hits on the mainland U.S. coastline

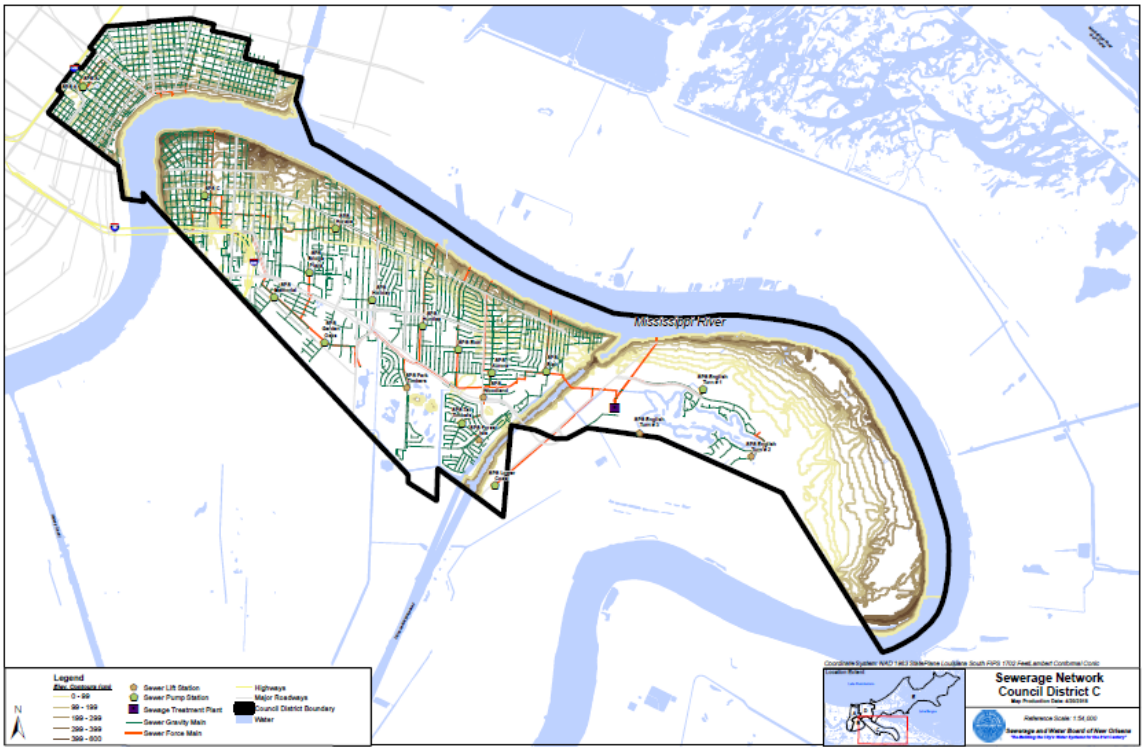
Hurricane direct hits on the mainland U.S. coastline and for individual states by Saffir/Simpson category
1851-2015

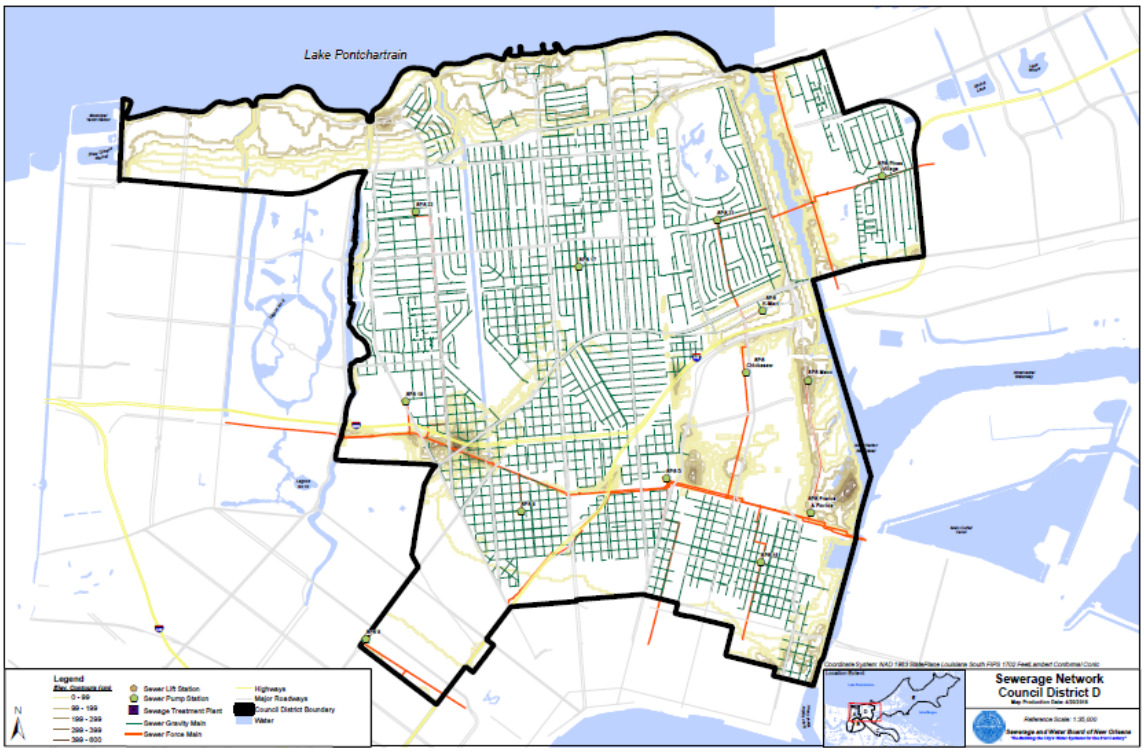
AREA	CATEGORY						Major Hurricanes
	1	2	3	4	5	ALL	
U.S. Coastline (Texas to Maine)	117	76	76	18	3	290	97
Texas	25	19	12	7	0	63	19
North	13	8	3	4	0	28	7
Central	7	5	2	2	0	16	4
South	10	5	7	1	0	23	8
Louisiana	19	15	15	4	1	54	20
Mississippi	2	5	8	0	1	16	9
Alabama	12	5	6	0	0	23	6
Florida	44	33	29	6	2	114	37
Northwest	27	16	12	0	0	55	12
Northeast	13	8	1	0	0	22	1
Southwest	16	8	7	4	1	36	12
Southeast	13	13	11	3	1	41	15
Georgia	12	5	2	1	0	20	3
South Carolina	19	6	4	2	0	31	6
North Carolina	24	14	11	1	0	50	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

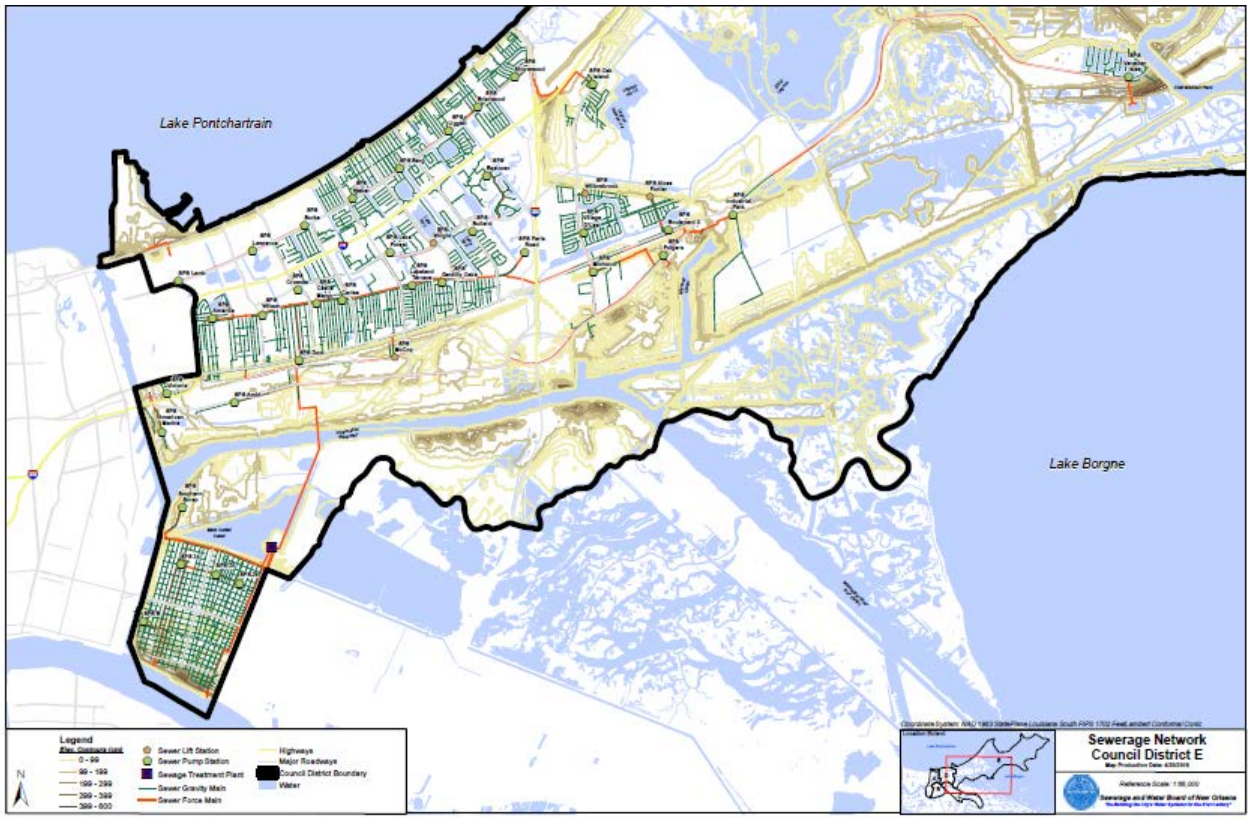
Appendix 9 - Detailed Maps of Sewer, Water & Drainage a by Council District

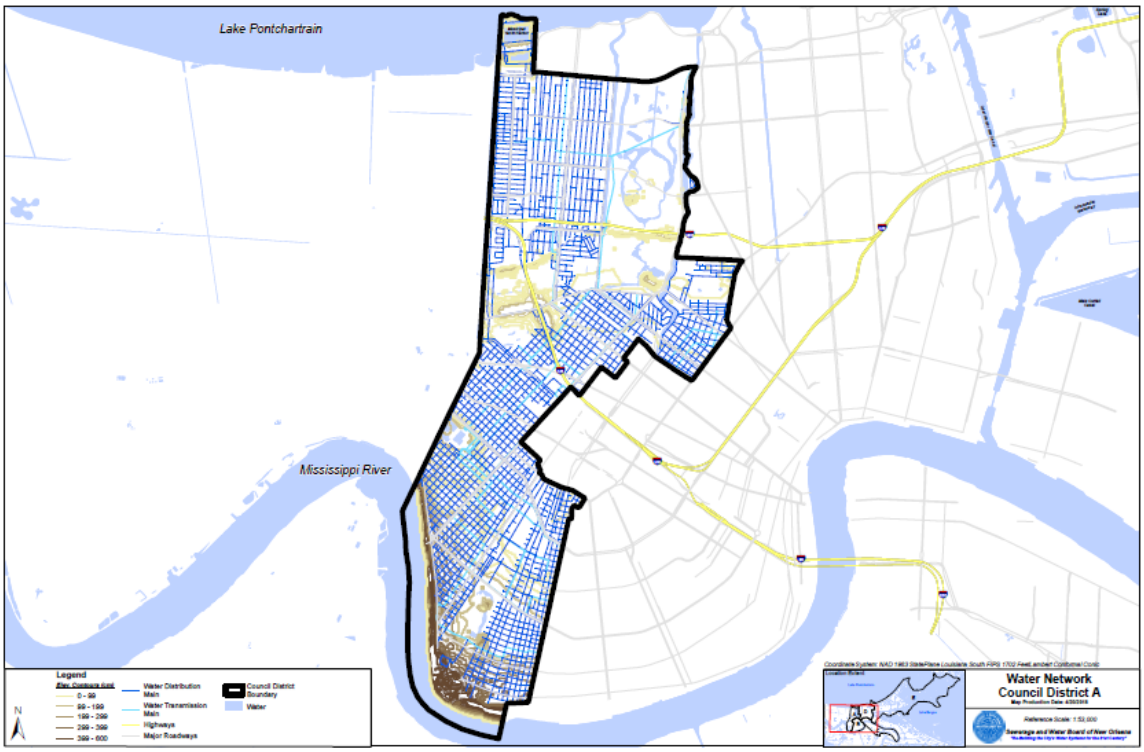


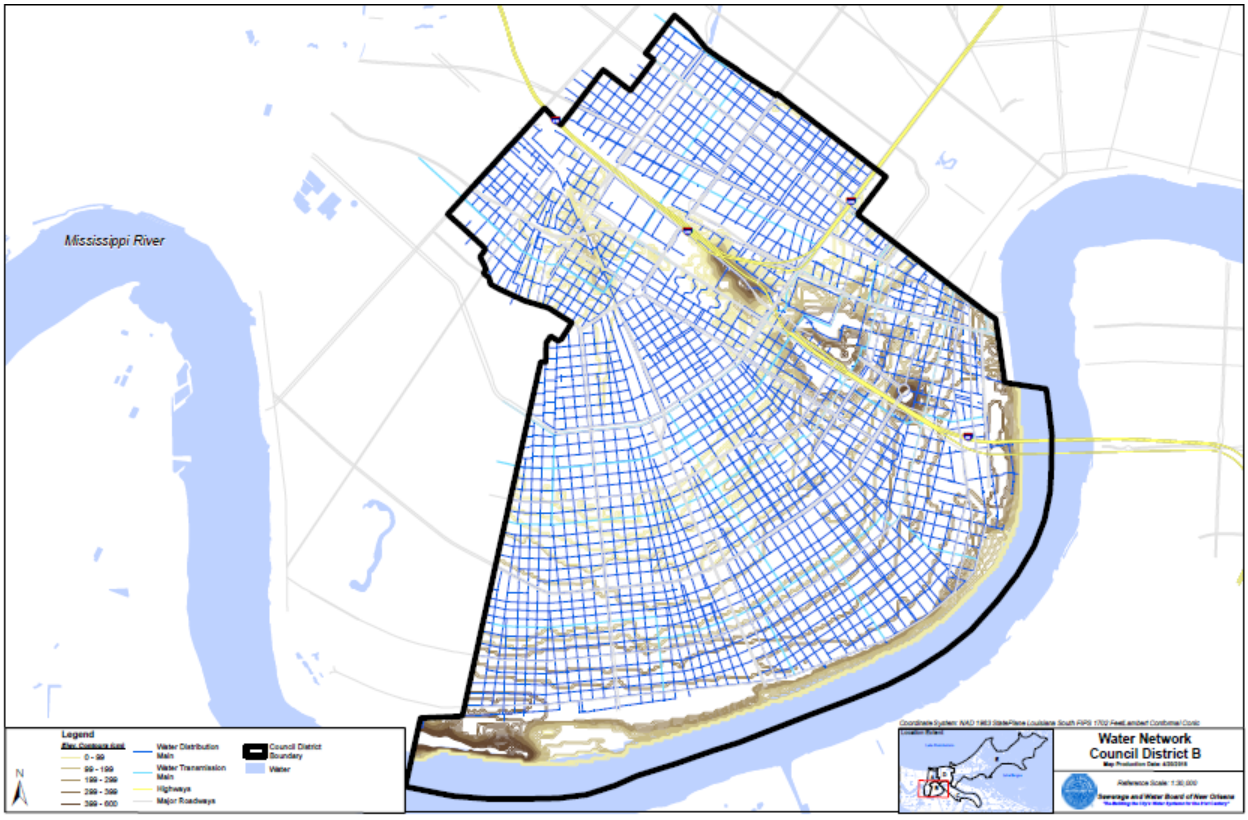

Mississippi River
Legend
Sewer Lift Station
Sewer Pump Station
Sewage Treatment Plant
Sewer Gravity Main
Sewer Force Main
Highways
Major Roadways
Council District Boundary
Water
Sewerage Network
Council District B

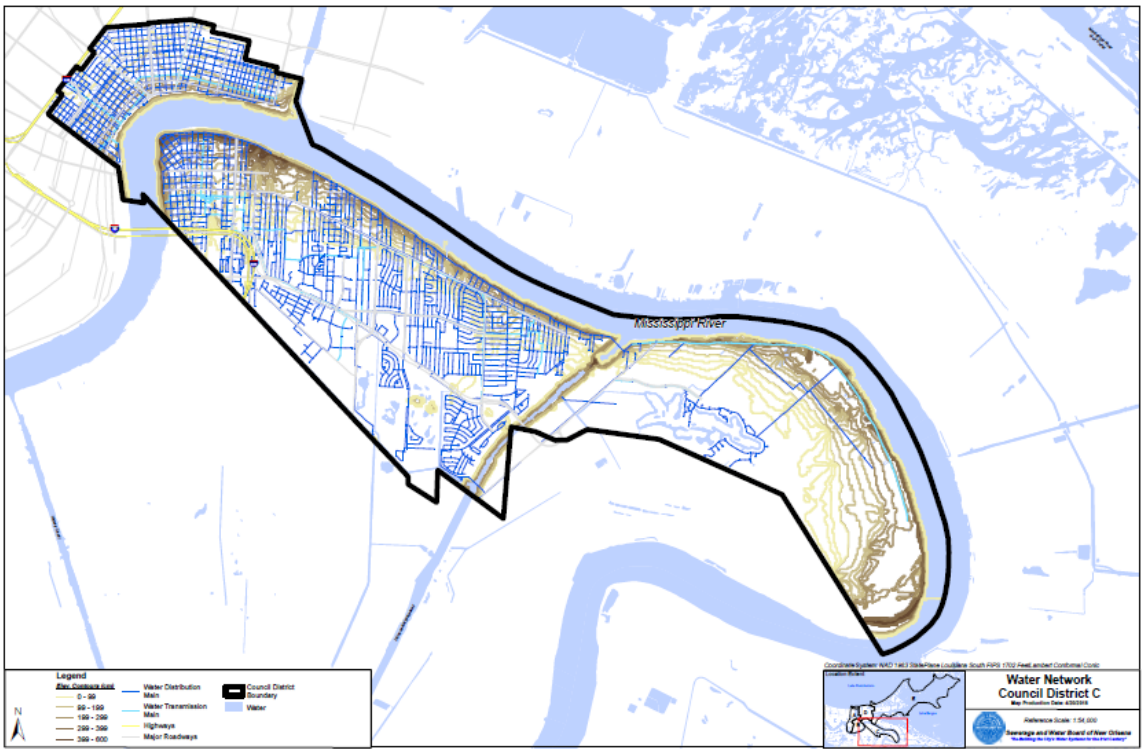

Mississippi River
Legend
Sewer Lift Station
Sewer Pump Station
Sewage Treatment Plant
Sewer Gravity Main
Sewer Force Main
Highways
Major Roadways
Council District Boundary
Water
Sewerage Network
Council District C

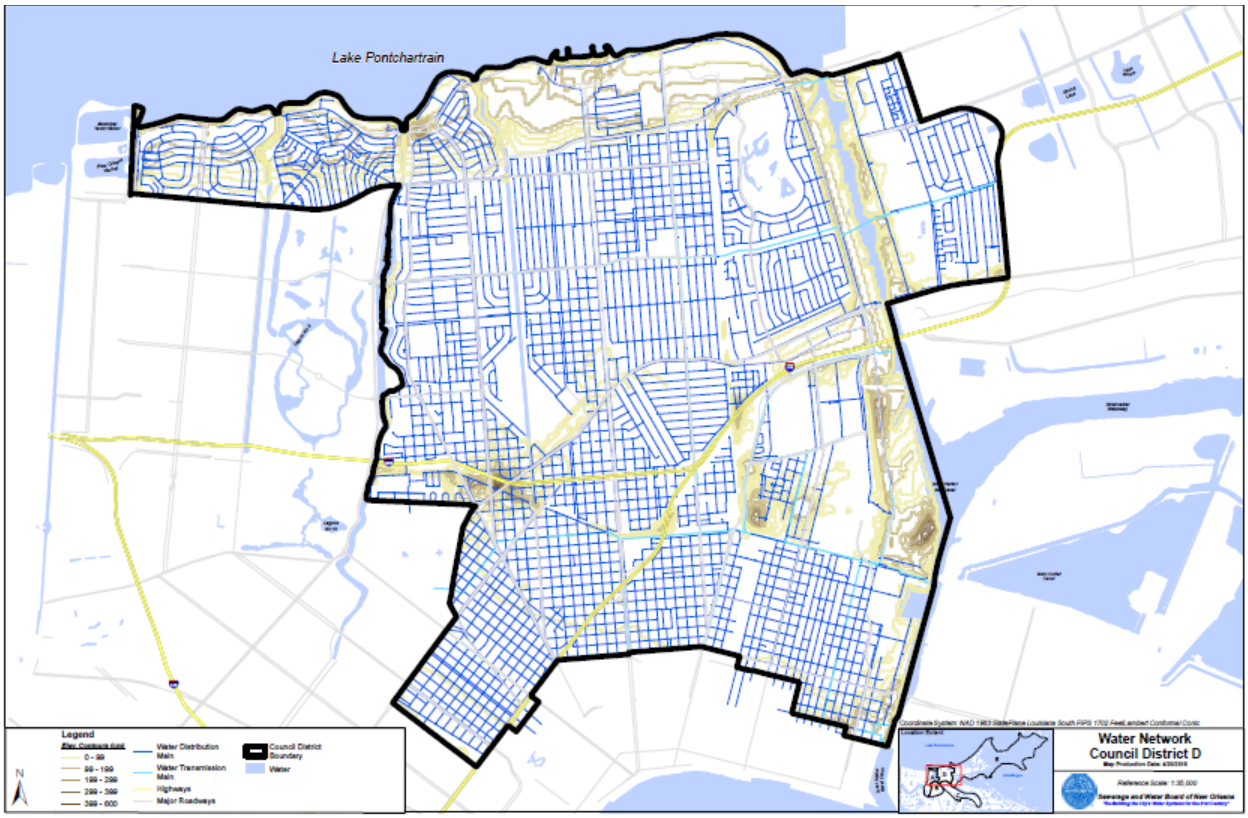

Lake Pontchartrain
Legend
Sewer Lift Station
Sewer Pump Station
Sewage Treatment Plant
Sewer Gravity Main
Sewer Force Main
Highways
Major Roadways
Council District Boundary
Water
Sewerage Network
Council District D

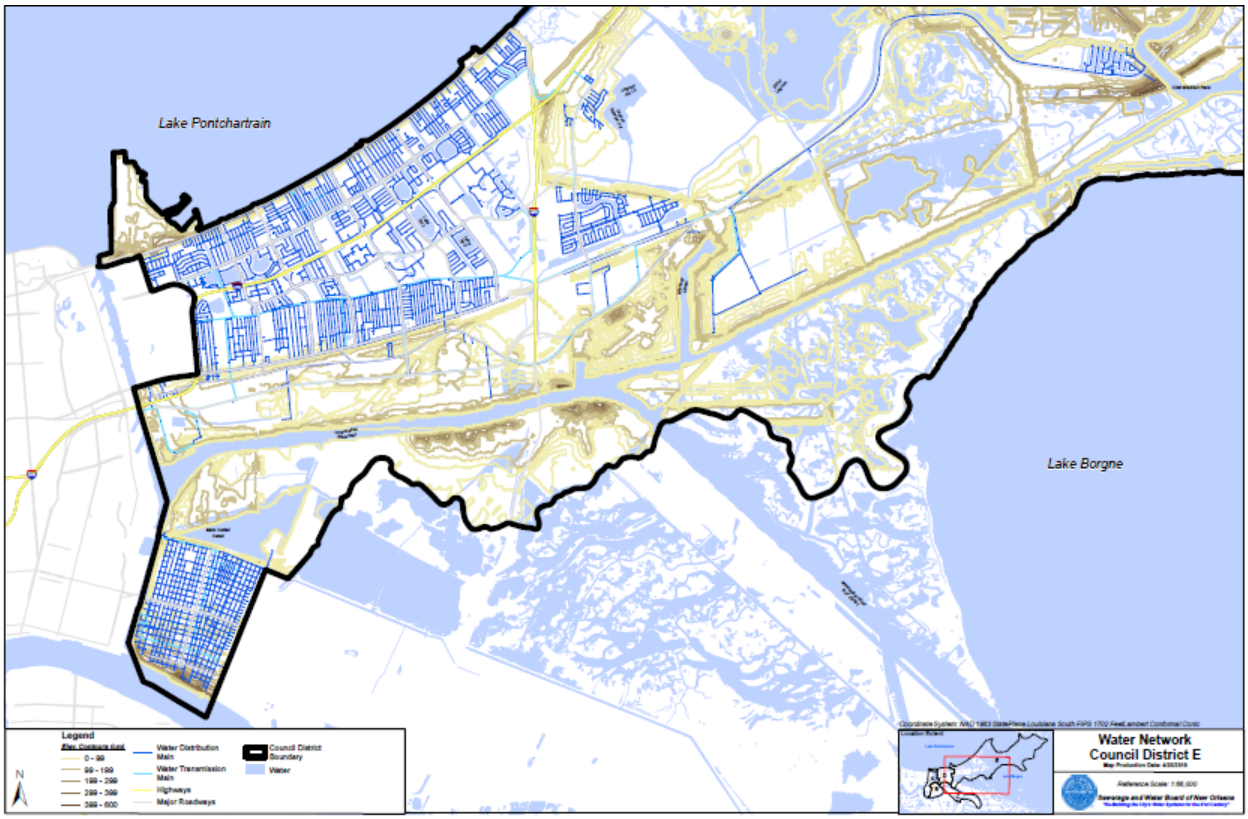

Lake Pontchartrain
Lake Borgne
Legend
Sewer Lift Station
Sewer Pump Station
Sewage Treatment Plant
Sewer Gravity Main
Sewer Force Main
Highways
Major Roadways
Council District Boundary
Water
Sewerage Network
Council District E

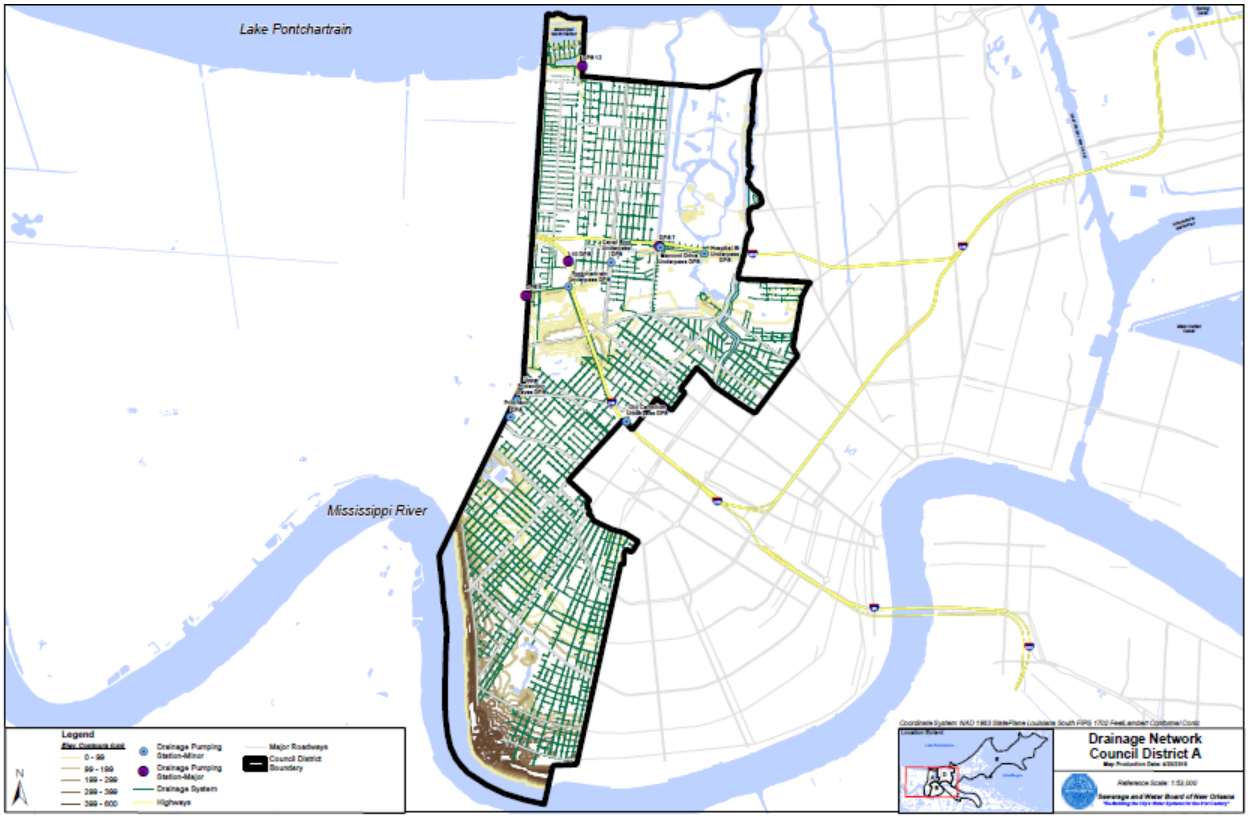

Lake Pontchartrain
Mississippi River
Legend
Water Distribution Main
Water Transmission Main
Highways
Major Roadways
Council District Boundary
Water
Water Network
Council District A

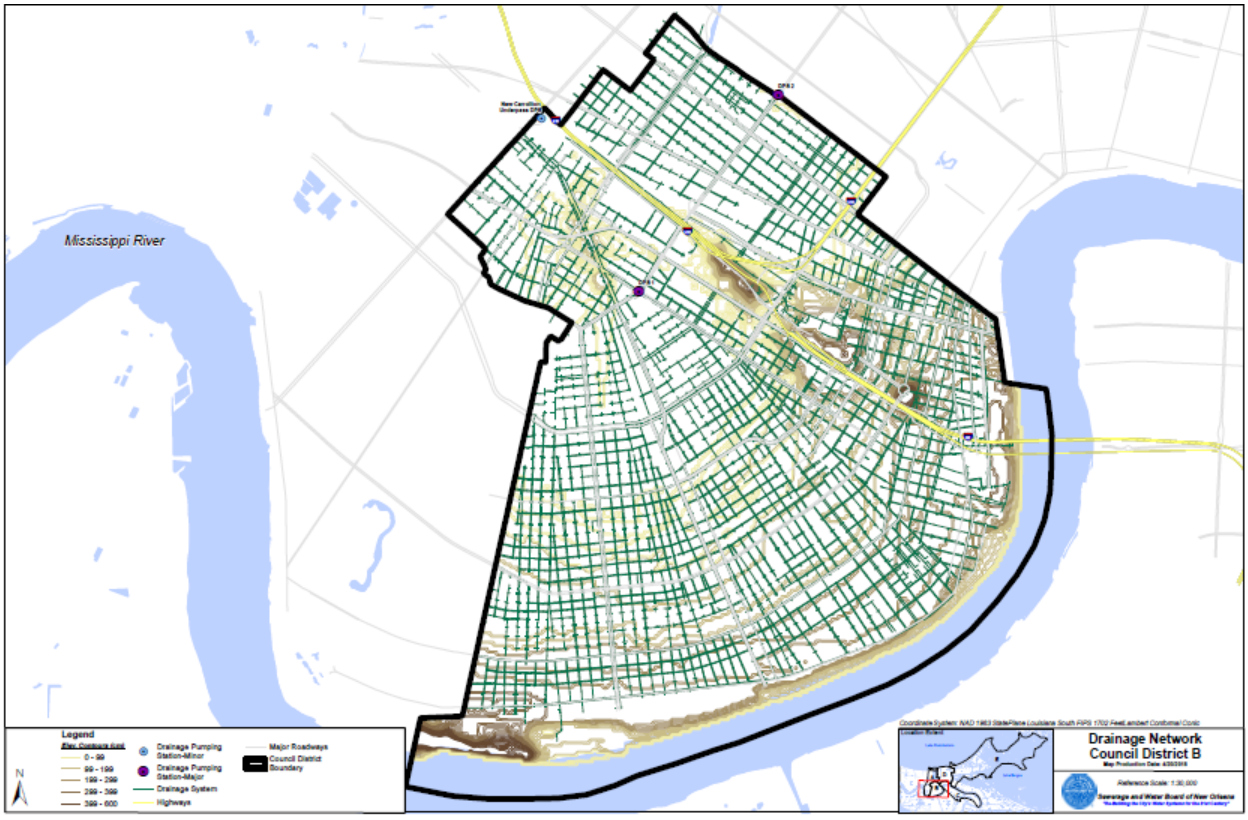

Mississippi River
Legend
Water Distribution Main
Water Transmission Main
Highways
Major Roadways
Council District Boundary
Water
Water Network
Council District B

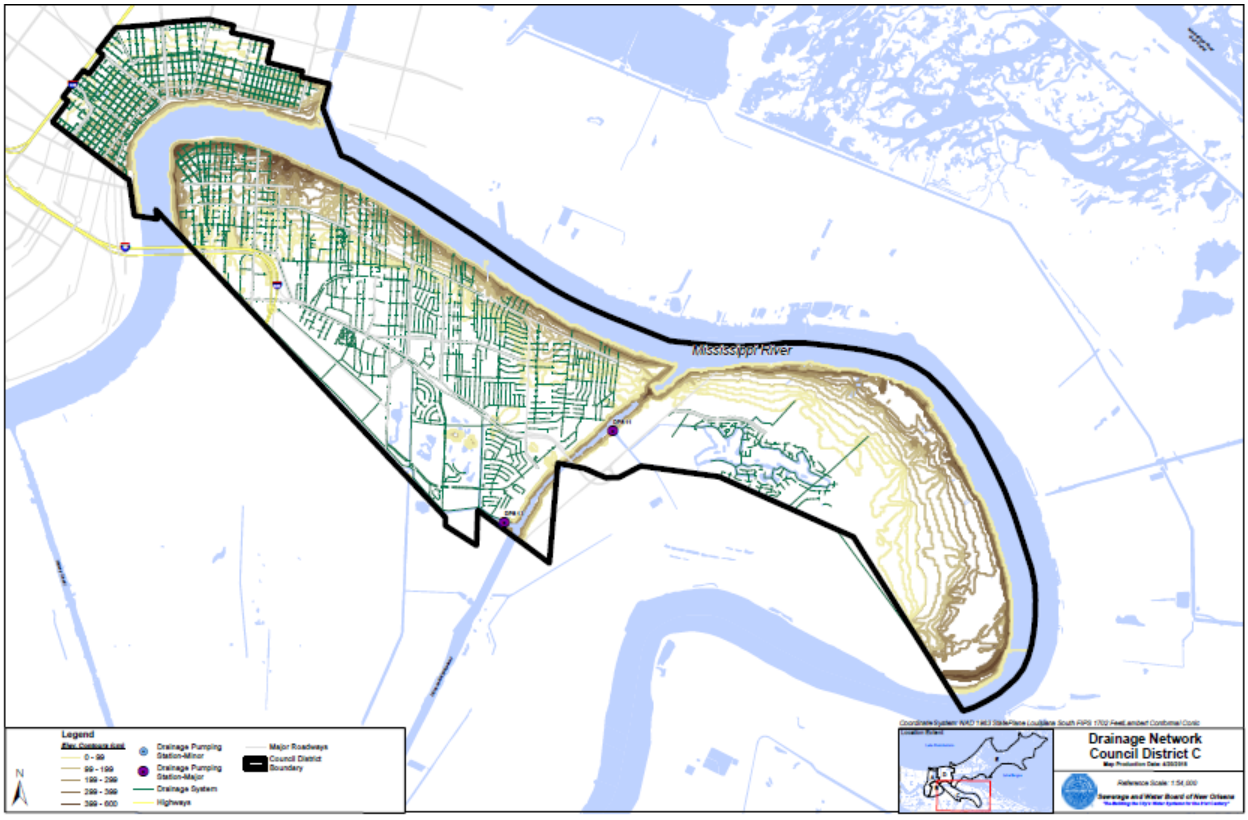

Mississippi River
Legend
Water Distribution Main
Water Transmission Main
Highways
Major Roadways
Council District Boundary
Water
Water Network
Council District C

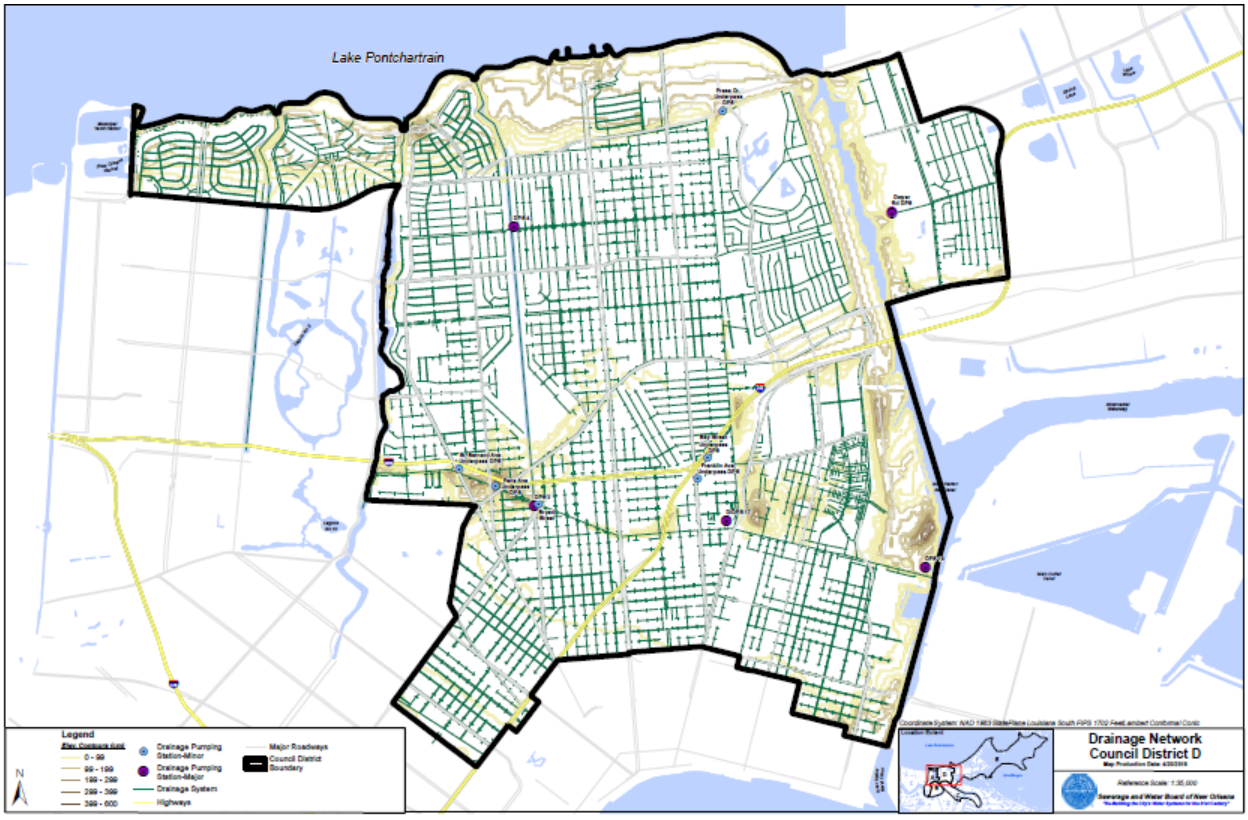

Lake Pontchartrain
Legend
Water Distribution Main
Water Transmission Main
Highways
Major Roadways
Council District Boundary
Water
Water Network
Council District D

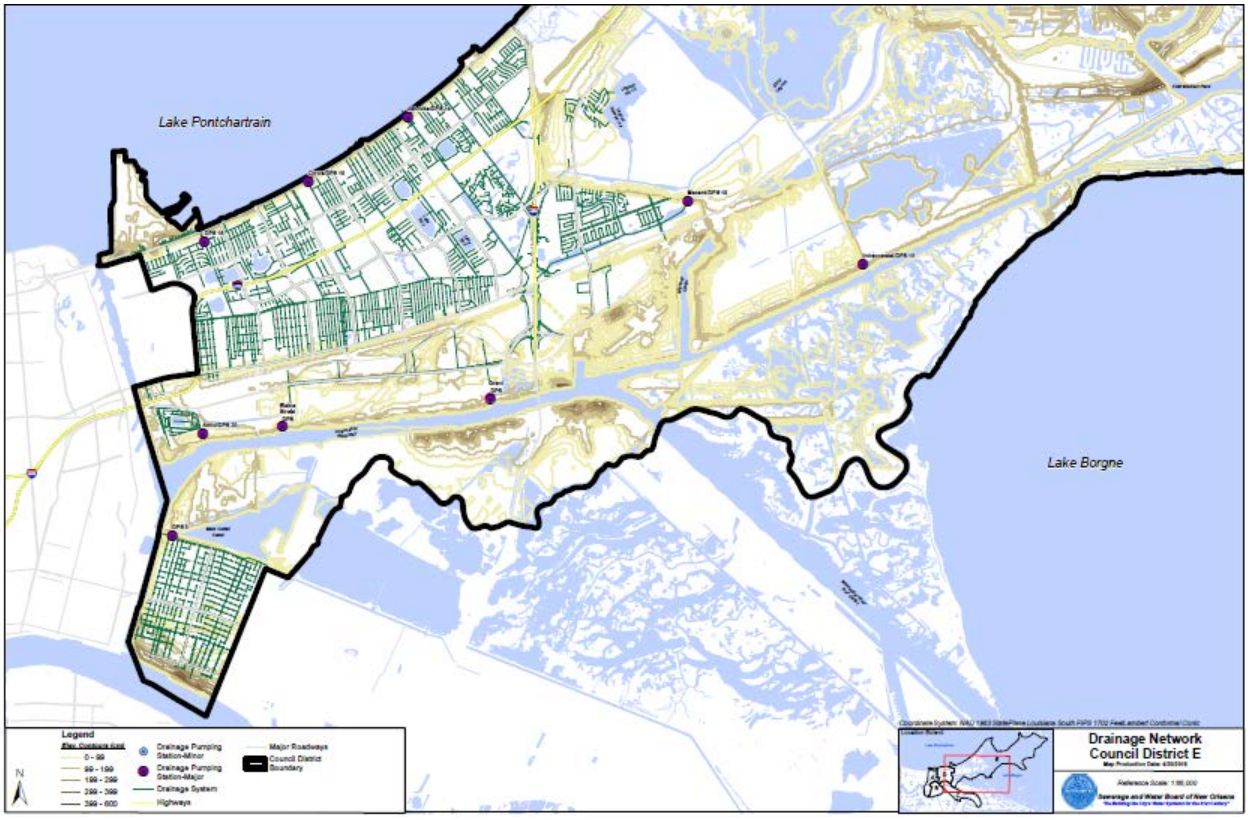

Lake Pontchartrain
Lake Borgne
Legend
Water Distribution Main
Water Transmission Main
Highways
Major Roadways
Council District Boundary
Water
Water Network
Council District E


Lake Pontchartrain
Mississippi River
Legend
Drainage Pumping Station-Minor
Drainage Pumping Station-Major
Drainage System
Highways
Major Roadways
Council District Boundary
Drainage Network
Council District A

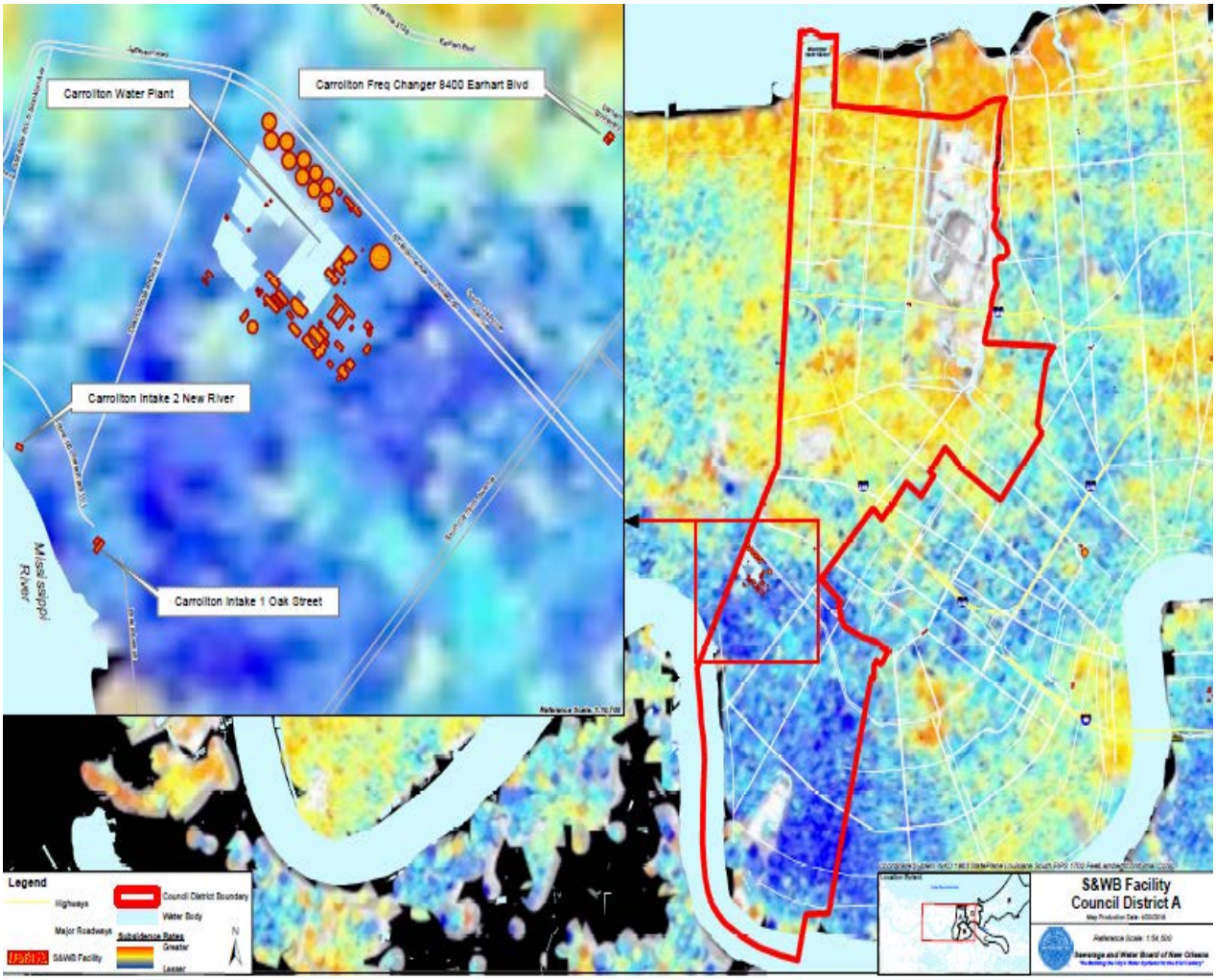

Mississippi River
Legend
Drainage Pumping Station-Minor
Drainage Pumping Station-Major
Drainage System
Highways
Major Roadways
Council District Boundary
Drainage Network
Council District B

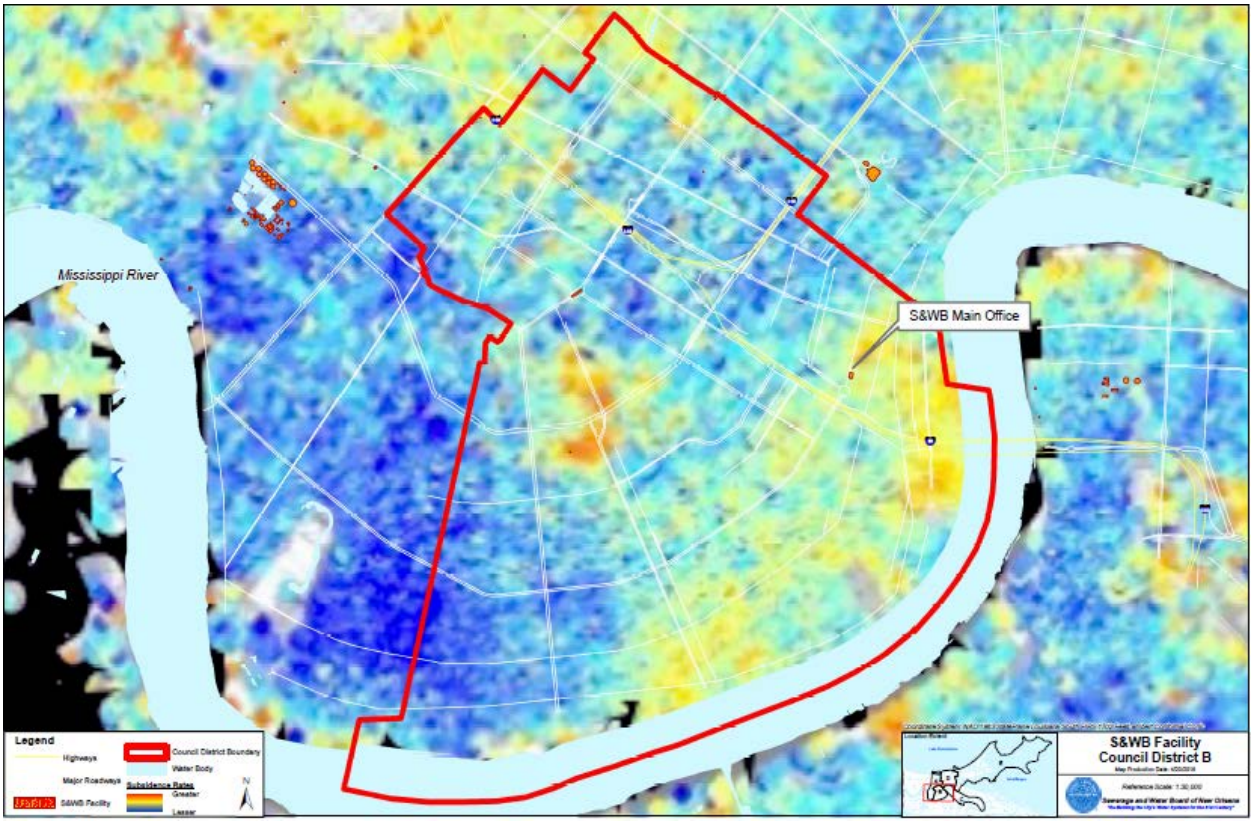

Mississippi River
Legend
Drainage Pumping Station-Minor
Drainage Pumping Station-Major
Drainage System
Highways
Major Roadways
Council District Boundary
Drainage Network
Council District C

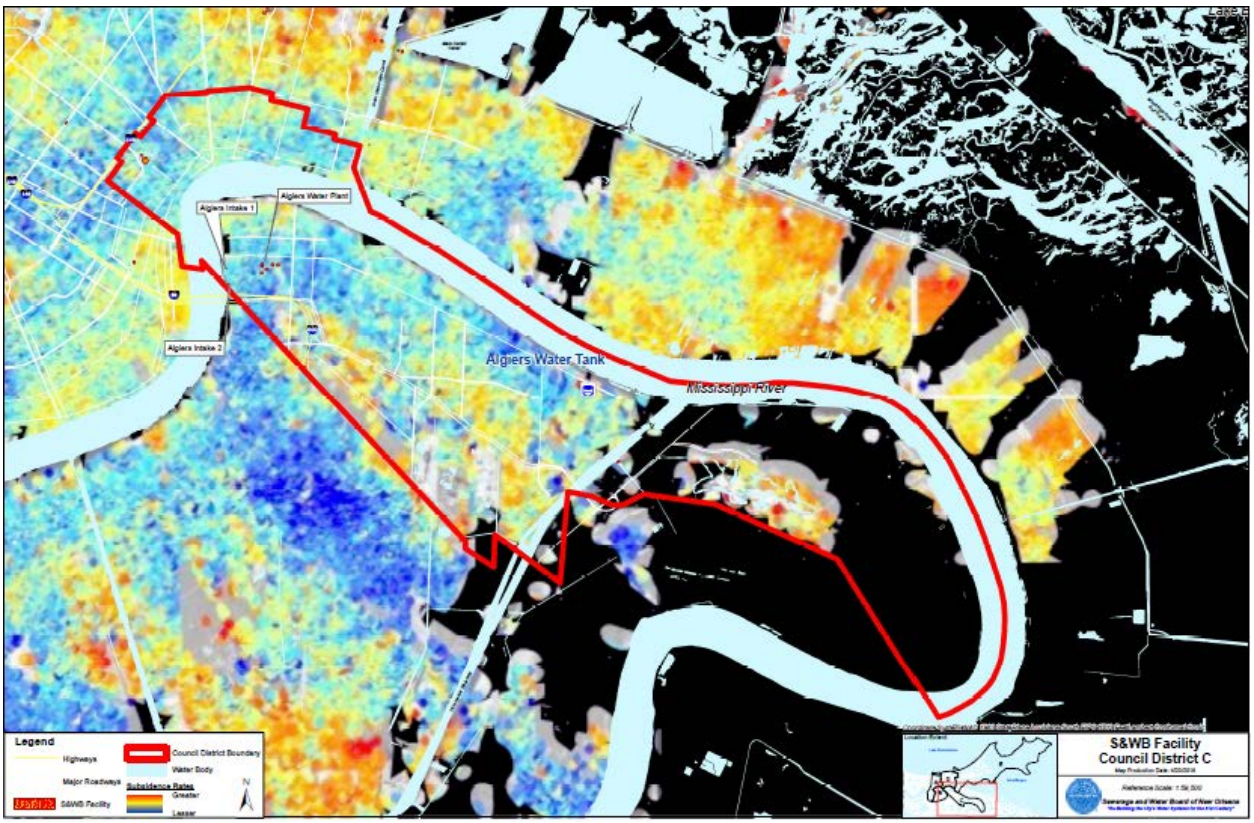

Lake Pontchartrain
Legend
Drainage Pumping Station-Minor
Drainage Pumping Station-Major
Drainage System
Highways
Major Roadways
Council District Boundary
Drainage Network
Council District D

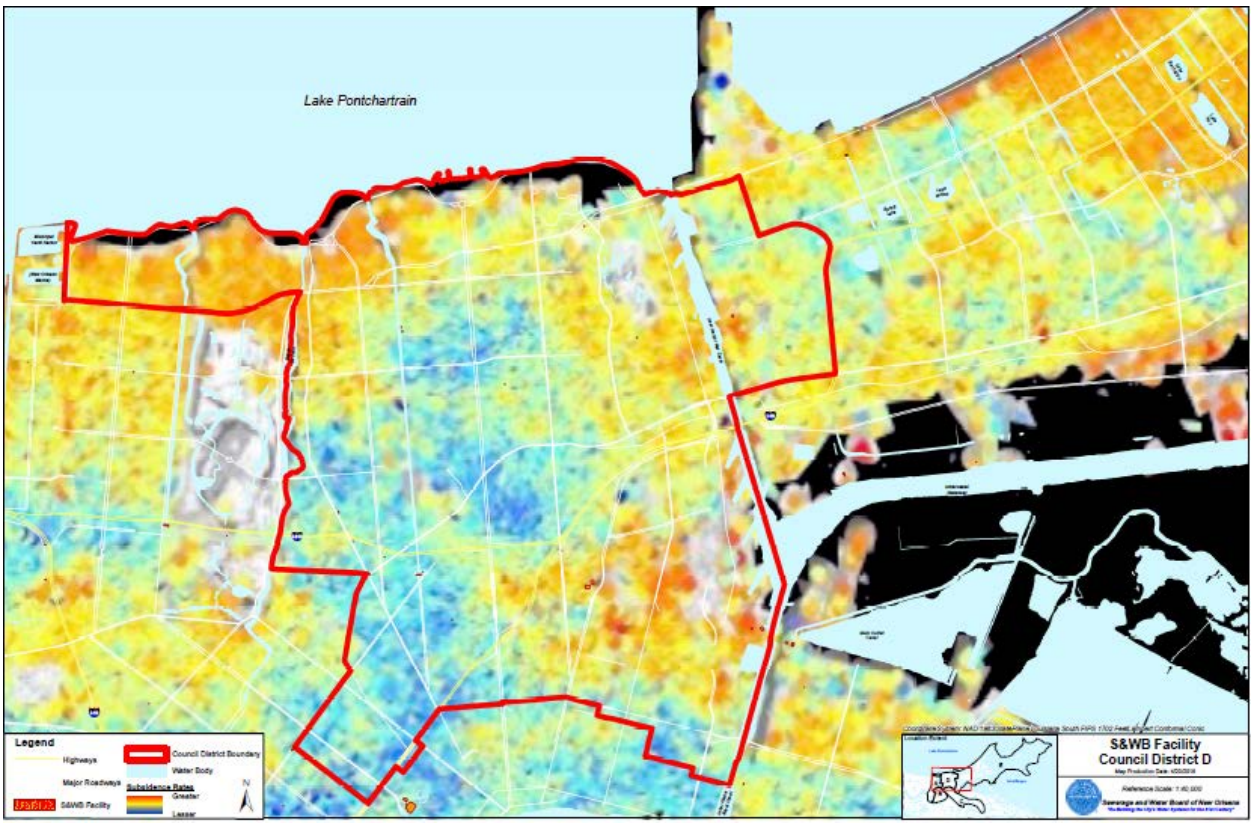

Lake Pontchartrain
Lake Borgne
Legend
Drainage Pumping Station-Minor
Drainage Pumping Station-Major
Drainage System
Highways
Major Roadways
Council District Boundary
Drainage Network
Council District E

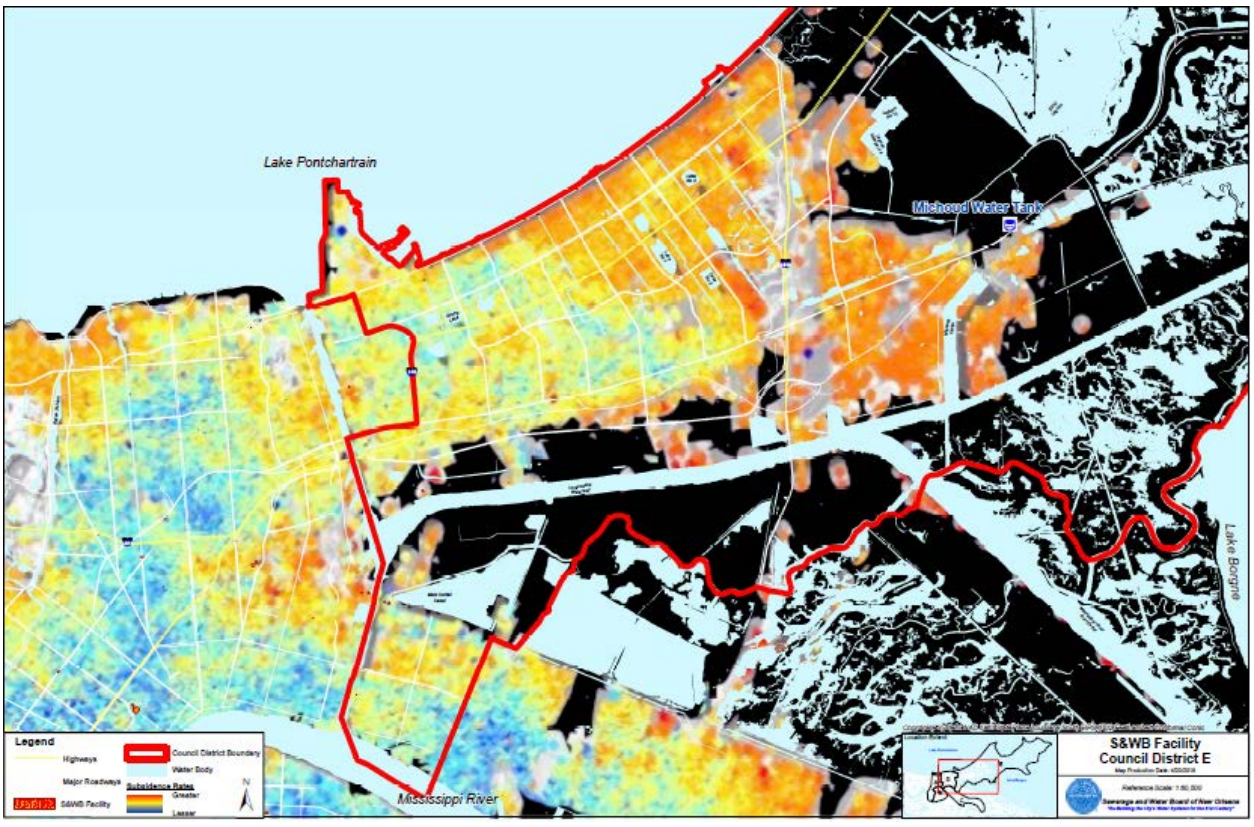
Appendix 10- S&WB Facility's by Council District




Mississippi River
S&WB Main Office
Legend
Highways
Major Roadways
S&WB Facility
Council District Boundary
Water Body
Subsidence Rates
Greater
Lesser
S&WB Facility
Council District B


Algiers Intake 1
Algiers Water Plant
Algiers Intake 2
Algiers Water Tank
Mississippi River
Legend
Highways
Major Roadways
S&WB Facility
Council District Boundary
Water Body
Subsidence Rates
Greater
Lesser
S&WB Facility
Council District C


Lake Pontchartrain
Legend
Highways
Major Roadways
Subsidence Rates
Greater
Lesser
S&WB Facility
Council District Boundary
Water Body
S&WB Facility
Council District D


Lake Pontchartrain
Michoud Water Tank
Lake Borgne
Mississippi River
Legend
Highways
Major Roadways
Subsidence Rates
Greater
Lesser
S&WB Facility
Council District Boundary
Water Body
S&WB Facility
Council District E

Appendix 11 - Probability of Damage by Hazard(s) for Facilities

Name	Full Adress														
Sewer Operation		Disaster Aftermath	Flood	Hailstorm	Hazardous Materials	Hurricane/ Tropical Flood	Hurricane/ Tropical Wind	Mississippi High River	Levee Failure	Lightning/Severe Storm/Thunderstorm	Severe Temperature Event	Saltwater Intrusion	Storm Surge	Subsidence	Tornado
West Bank STP	3501 E.Canal St.	10%	40%	20%	10%	40%	30%	30%	70%	75%	10%	0%	30%	60%	25%
East Bank STP	6501 Florida Ave.	10%	40%	20%	10%	40%	30%	30%	70%	75%	10%	0%	30%	60%	25%
Sta A SPS	1321 Orleans Ave.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Sta B SPS	4725 St.Claude At Jourdan	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Sta C SPS	1107 Pacific St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
01 SPS	7336 Cohn At Lowerline	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
03 SPS	8720 Olive Near Eagle	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
04 SPS	5899 Fleur DE LIS	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
05 SPS	3912 Erato St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
06 SPS	242 S. Solomon At Palmura	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
08 SPS	Corner of N.Broad & Toulose	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
9 SPS	2540 Annette At Law	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
14 SPS	4000 Clara Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
15 SPS	2431 Palmyra Near Rochblave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
16 SPS	3751 N. Miro at Paulmyra	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
17 SPS	4975 Spain AT Selma	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
18 SPS	Vicksburg at Florida	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
19 SPS	3730 Jumonville At Milton	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
20 SPS	328 37th St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
21 SPS	6670 Memphis at Filmore	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
22 SPS	5705 Perlita Near Reynes	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
23 SPS	4500 Mithra	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
24 SPS	5827 n.Tonti.St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
25 SPS	2245 Charbonnet At Tonti	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
26 SPS	2244 St.Maurice at Tonti	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Alcee Fortier	Alcee Fortier Blvd At Levee	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
America	6789 Dwyer at Westlake	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
America Marine	4045 Jourdan Rd.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Amid	6800 Almonster Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Aurora	6000 Carlise Ct.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Berge	11501 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Blvd X	4433 Chef Menteur Hwy	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Bariarwood	13701 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Bridge Plaza	2914 Vespasian St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Bullard	5501 Bullard Ave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Burke	9001 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Castle Manor	4950 Gwain St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Cerise	5001 Cerise St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Chicksaw	Chicsaw & Metropolitan	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
City Park	5701 Marconia ct	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Crowder	5500 Crowder blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Dodt	8118 Chef Menteur Hwy	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Eastover	6051 Eastover	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
English turn I	2201 Stanton Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
English Turn II	123 1/2 Oak Alley	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
English Turn III	400 English Turn Parkway	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Eton	3440 Eton st.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Folgers	14601 Gentilly rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Forest Isle	5631 W.Forest Park Ln	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
France And Fla	2701 France Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Garden Oaks	3201 Memorial park Dr.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Gentilly Oaks	5000 Papnia Dr at Vienna	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Holiday	2799 Holiday Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Horace	3301 Lawrence St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Huntlee	3201 Huntlee Dr.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Industrial Park	4200 Industrial Parkway	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Kmart	Desire Pkwy at Gentilly Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Lake Forest	10451 Lk Forest Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
LakeLand Terrace	5057 Warren Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Lakewood South	Country Club Dr And Marcia	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Lamb	6450 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Lawrence	7900 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Liggett	12501 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Lower Coast	3700 Old Woodland Hwy	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Mccoy	Mccoy St. and Gentilly Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Mech_Equip (Meco)	3855 France Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Memorial	2501 Memorial Pk	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Michoud	4400 Michoud Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Oak Island	14201 Michoud Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Paris Road	12001 Dwyer Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Park Timbers	4100 Lennox Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Pines Village	6155 Dwyer Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Plum Orchard	7300 Chef Menteur Hwy	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Shorewood	14441 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Southern Scrap	Harbor Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Tall Timbers	3800 Tall Pines Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Vent Isles no.2	20711 Old Spanish Trail	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Victoria	Victoria St. at Old Gentilly Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Village De Lest	11324 Dwyer off Michoud	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Webber	10141 Morrison Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Willowbrook	Willowbrook off Michoud	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Wilson	7709 Wilson St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Woodland	4150 Woodland Dr.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Wright rd	Wright Rd at Lake Forest Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%

Drainage Station		Disaster Aftermath	Flood	Hailstorm	Hazardous Materials	Hurricane/ Tropical Flood	Hurricane/ Tropical Wind	Mississippi High River	Levee Failure	Lightning/Severe Storm/Thunderstorm	Severe Temperature Event	Saltwater Intrusion	Storm Surge	Subsidence	Tornado
01 DPS	2501 S.Broad St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
02 DPS	444 N.Broad St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
03 DPS	2251 N.Broad St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
04 DPS	5700 Warrington Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
05 DPS	4841 Florida Ave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
06 DPS	345 Orphum	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
07 DPS	5741 Orleans Ave.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
10 (Citrus)	9600 Haynes Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
11 DPS	5301 East Sixth Street	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
12 DPS	7223 Pontchartrain Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
13 DPS	4201 Tall Spruce	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
14 (Jahncke)	12200 Haynes Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
15 DPS	Iwwy and Intercoastal Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
16 (St.Charles)	7200 Wales St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
17 (Station D)	2800 Florida Ave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
18 (Maxent)	Michoud Bayou and Levee	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
19 DPS	4500 Florida Ave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
20 (Amid)	6300 Interacoastel Water Way	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Dwyer	4500 Dwyer Rd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Elaine	3100 Elaine St	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Grant	3100 Grant St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Oleander	9400 Oleander St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
I-10 Mounds	101 Academy Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%

Underpass DPS		Disaster Aftermath	Flood	Hailstorm	Hazardous Materials	Hurricane/ Tropical Flood	Hurricane/ Tropical Wind	Mississippi High River	Levee Failure	Lightning/Severe Storm/Thunderstorm	Severe Temperature Event	Saltwater Intrusion	Storm Surge	Subsidence	Tornado
Bay Street	Bay Street and R/R Track	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Broad	2251 N.Broad	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Canal Blvd	5500 Canal Blvd	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Franklin Ave	3100 Franklin Ave.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Hospital	Gulf Dr and I-610	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Marconi Dr	5741 Orleans Ave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
New Carrollton	Carrollton Ave and I-10 Exit	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Old Carrollton	Carrollton Ave and Tulane Ave	10%	40%	20%	10%	`	30%	10%	70%	75%	10%	0%	30%	60%	25%
Paris Ave.	3200 Peoples Ave.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Pritchard	2901 Monticello Dr	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Ponchartrain	Pontchartrain and I-10	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Press Dr.	Press Dr and Leon C Simon	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
St.Bernard Ave	3300 St.Bernard ave.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%

Water Facilities		Disaster Aftermath	Flood	Hailstorm	Hazardous Materials	Hurricane/ Tropical Flood	Hurricane/ Tropical Wind	Mississippi High River	Levee Failure	Lightning/Severe Storm/Thunderstorm	Severe Temperature Event	Saltwater Intrusion	Storm Surge	Subsidence	Tornado
Carrollton Water Plar	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%
Claiborne Pump Stat	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%
Panola Pump Station	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%
Algiers Water Plant	900 Lamarque St.	10%	40%	20%	10%	40%	30%	70%	70%	75%	10%	20%	30%	60%	25%
Michoud Water Tank	15301 Chef Menteur Hwy	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Algiers Water Tank	Casmiere St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Carrollton Intake 1 O	General Ogdon	10%	40%	20%	10%	40%	30%	90%	70%	75%	10%	15%	30%	60%	25%
Carrollton Intake 2 N	Industrial Ct.	10%	40%	20%	10%	40%	30%	0%	70%	75%	10%	15%	30%	60%	25%
Algiers Intake 1	200 Dearmas St.	10%	40%	20%	10%	40%	30%	20%	70%	75%	10%	20%	30%	60%	25%
Algiers Intake 2	1401 Brooklyn St.	10%	40%	20%	10%	40%	30%	20%	70%	75%	10%	20%	30%	60%	25%

Support Facilities		Disaster Aftermath	Flood	Hailstorm	Hazardous Materials	Hurricane/ Tropical Flood	Hurricane/ Tropical Wind	Mississippi High River	Levee Failure	Lightning/Severe Storm/Thunderstorm	Severe Temperature Event	Saltwater Intrusion	Storm Surge	Subsidence	Tornado
St Joesph HQ	625 St.Joseph St.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Central, Yard Compl	2900 Peoples Ave.	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%

Power Facilities		Disaster Aftermath	Flood	Hailstorm	Hazardous Materials	Hurricane/ Tropical Flood	Hurricane/ Tropical Wind	Mississippi High River	Levee Failure	Lightning/Severe Storm/Thunderstorm	Severe Temperature Event	Saltwater Intrusion	Storm Surge	Subsidence	Tornado
Carrollton Power Pla	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%
Carrollton Freq Chan	8400 Earhart Blvd	10%	40%	20%	10%	40%	30%	25%	70%	75%	10%	0%	30%	60%	25%
Carrollton Plant freq	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%
Central Control	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%
DPS D Freq Changer	2800 Florida Ave	10%	40%	20%	10%	40%	30%	10%	70%	75%	10%	0%	30%	60%	25%
Power Distribution N	8801 Spruce St	10%	40%	20%	10%	40%	30%	80%	70%	75%	10%	15%	30%	60%	25%

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