



ST. TAMMANY PARISH COASTAL MASTER PLAN

EXECUTIVE SUMMARY AND FINAL REPORT

FEBRUARY **2024**

Prepared by





ST. TAMMANY PARISH COASTAL MASTER PLAN

EXECUTIVE SUMMARY AND FINAL REPORT



PREPARED FOR THE **ST. TAMMANY PARISH GOVERNMENT** IN COORDINATION WITH THE **ST. TAMMANY LEVEE, DRAINAGE AND CONSERVATION DISTRICT** BY **NEEL-SCHAFFER, INC.** AND FUNDED BY THE **COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA.**



ST. TAMMANY PARISH
 MICHAEL B. COOPER
 PARISH PRESIDENT

January 22, 2024

Dear Friends, Neighbors and Stakeholders:

It is my pleasure to introduce the inaugural St. Tammany Parish Coastal Master Plan! The development of planning initiatives, such as this Coastal Master Plan, has been a priority for my first term in office as St. Tammany Parish President. St. Tammany is now the fourth largest parish in the State of Louisiana by population and much of our growth has occurred within the Coastal Zone in the southern portion of our Parish. Implementing the initiatives and strategies presented herein as we plan for our future is imperative, especially as we make decisions that will have long lasting impacts for our community. Our beautiful parish boasts over 250 square miles of waterways including rivers, bayous, and the shores of Lake Pontchartrain. St. Tammany Parish is a coastal community and it's time that we start working *with* our natural elements, rather than against them.

The development of this comprehensive Coastal Master Plan represents the ongoing collaboration between St. Tammany Parish Government, Louisiana's Coastal Protection and Restoration Authority (CPRA), and the St. Tammany Levee, Drainage and Conservation District to ensure our community is better protected and able to be more resilient in the wake of natural disasters. I would like to thank all members of Team Tammany, outside consultants, policy makers and residents who worked together to bring this strategic initiative to fruition.

Now, as I embark on my second term as your Parish President, I look forward to utilizing this Coastal Master Plan to make informed decisions to better protect our residents and businesses, as well as the integrity of our coastal zones. I am confident that this Coastal Master Plan will be implemented as a strategic planning tool for many years to come as we work towards a more robust St. Tammany Parish.

Sincerely,

MICHAEL B. COOPER
 Parish President



ST. TAMMANY LEVEE, DRAINAGE AND CONSERVATION DISTRICT

December 18, 2023

Dear Friends & Neighbors in St Tammany Parish:

The St. Tammany Levee, Drainage, and Conservation District has worked closely with St. Tammany Parish Government, the Coastal Protection and Restoration Authority, and the community to develop this St. Tammany Parish Coastal Master Plan. Planning for this project has been underway for many years, as state and local officials have long recognized the urgent need to protect our community from flooding while also protecting this fragile coastal area for future generations.

As we finalize this effort, I encourage continued participation by voicing your ideas and opinions to reflect your preferences for flood risk reduction in your community. Your firsthand knowledge of the flooding issues facing our community is best expressed by you directly. I encourage you to continue the dialogue at all levels of this community including at our St. Tammany Levee, Drainage, and Conservation District meetings. Please join in our progress at our website: www.stldcd.com

Sincerely,

Suzanne Krieger, Chairman
 St. Tammany Parish Levee, Drainage and Conservation District

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Chapter 1 Executive Summary

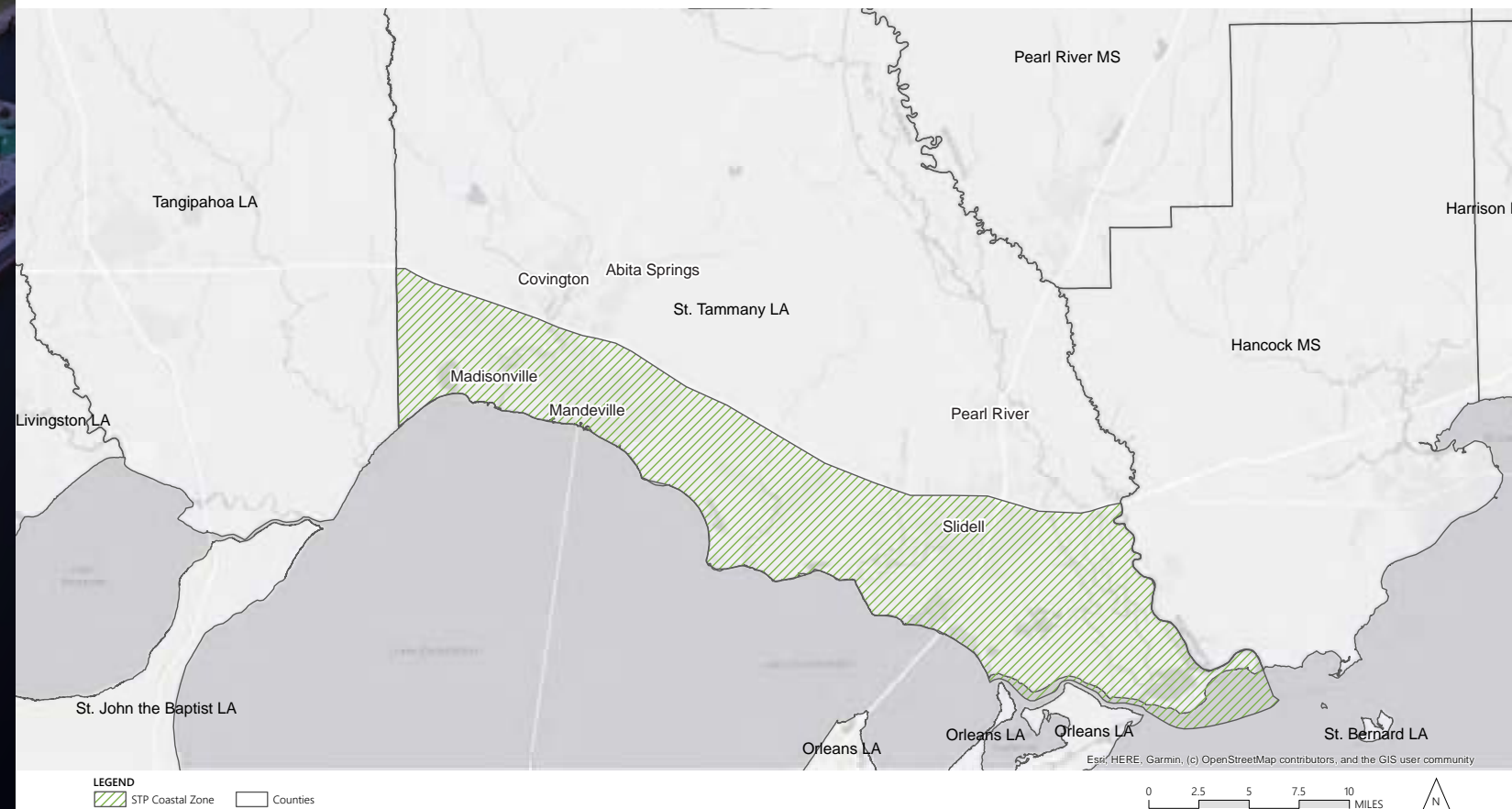
1.1 Introduction

St. Tammany Parish is located northeast of New Orleans on the shores of Lake Pontchartrain. Its population boomed following the opening of the Causeway Bridge in 1956. It is the fourth largest parish in the State of Louisiana with a population of 250,000 residents. Much of the growth in the Parish has occurred within the southern half of the Parish, within the Coastal Zone between Lake Pontchartrain and Interstate 12. St. Tammany Parish continues to be one of the fastest growing parishes in the State of Louisiana.

1.1.1 St. Tammany Levee, Drainage, and Conservation District

Created during the 2014 state legislative session, the nine-member St. Tammany Levee, Drainage and Conservation District is a political subdivision of the state and has the primary duty to "...establish, construct, operate, or maintain flood control works related to hurricane protection, tidewater flooding, saltwater intrusion, and conservation." The St. Tammany Levee, Drainage and Conservation District is populated by gubernatorial appointments from various communities throughout St. Tammany Parish.

Additionally, the St. Tammany Parish Coastal Zone is also the jurisdiction of St. Tammany Levee, Drainage and Conservation District.



The coastal zone of St. Tammany provides convenient access to metro New Orleans, affordable housing, and recreational opportunities with proximity to Lake Pontchartrain, rivers, bayous, parks, and greenspaces. This proximity to water provides lifestyle and recreational value but also presents challenges in water management. St. Tammany Parish frequently floods with 55 major flood events or disaster declarations since 1965. These events impact St. Tammany Parish's businesses, citizens, property values, and infrastructure.

1.2 Historic Flooding

Flood events over the past 55+ years, and growth in the Parish, necessitate a holistic planning approach for flood risk reduction, resiliency and long-term sustainability. Preventing additional contributors to flooding is a top four priority for future land use decisions in St. Tammany Parish Government's New Directions 2040 document, adopted in 2023.

Flooding in the Parish includes coastal, fluvial (riverine flood), and pluvial (flash flood), often with more than one of these occurring simultaneously. Hurricanes and tropical storms produce storm surges that extend well into the Coastal Zone often with significant rainfall leading to riverine and pluvial flooding. High tides and sustained south winds in the springtime also coastal flooding with streets near the lakefront experiencing nuisance flooding. Sea level rise, non-tropical high-intensity rain events, seasonal rises in rivers and bayous, and land use changes contribute to the periodic flooding.



HURRICANE KATRINA | 2005

AREA AFFECTED

Parish-wide

RAINFALL

14.92 inches

STORM SURGE

16 feet

PARISH DAMAGES

\$2.5 Billion¹

Severe storm surge damage occurred in St. Tammany Parish from Madisonville to Slidell with storm surge water moving inland as far as Old Towne Slidell with water up to 6 feet deep in some locations. In areas away from storm surge flooding, wind damage was widespread with fallen trees taking a heavy toll on houses and power lines.

Due to the power failure prior to the storm peak, data for wind, storm surge, pressure, and rainfall are incomplete. FEMA's post storm high water surveys indicate storm surge estimates: 11 to 16 feet in southeast and 7 to 10 feet in west part of St. Tammany Parish. A rainfall total of 11.63 inches was measured at the National Weather Service Office in Slidell and 14.92 inches of rain recorded at Big Branch NWR.

FLASH FLOOD/RIVERINE FLOODING | 2016

AREAS AFFECTED

Folsom, Walheim, Goodbee, Ramsay, Sun, Covington

RAINFALL

6-12 inches

PARISH DAMAGES

\$4 Million²

A closed upper low moving across the southern US caused widespread heavy rains with of up to 12 inches across northwest St Tammany Parish resulting in widespread flash flooding. The Bogue Falaya, Tchefoncté and Pearl Rivers reached major or historic flood levels. The gage at Pearl River, LA on the Pearl River reached 20.35 feet on the March 14th, its 2nd highest reading on record, only surpassed by the April 1983 flood. Flood water encroached onto the shoulders of Interstate 10 east of Slidell and a total of 625 structures within the parish flooded from flash flooding or riverine flooding with 425 classified as major flood damage. Approximately 150 people were rescued in the Folsom area. St. Tammany Parish Sheriff Office (STPSO) and United States Fish and Wildlife Services (USFWS) conducted rescue operations of 86 children and 4 counselors from the Camp Abbey Retreat Center in Covington.

TROPICAL STORM CLAUDETTE | 2021

AREA AFFECTED

Southeast St. Tammany Parish

RAINFALL

8-12 inches

STORM SURGE

2-4 feet

Rainfall of 8 to 10 inches over a four-hour period with localized higher amounts across the southeastern portion of the parish. The highest rainfall total was 10.23 inches 5 miles east of Slidell. The rainfall led to flash flooding across much of Slidell. Roads were closed and over 200 homes were affected with at least 100 having flood damage, and a few with as much as 1 to 2 feet of water. The hardest hit areas were generally along French Branch Channel from the Whisperwood subdivision through the Lake Village and Willowood subdivisions. Several high-water rescues were conducted in the hardest hit areas. The flash flooding was exacerbated by elevated water in the Pearl River due to storm surge preventing rainwater from draining.

1. [Storm Events Database - Event Details | National Centers for Environmental Information \(noaa.gov\)](#)

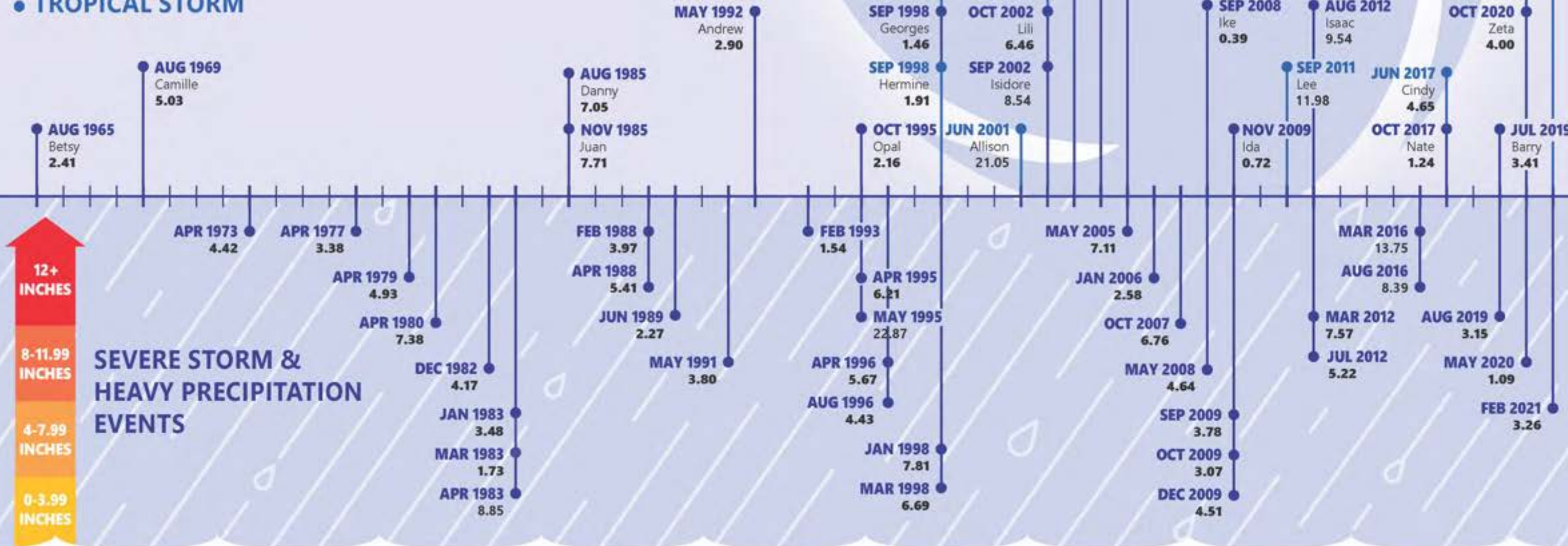
2. [Storm Events Database - Event Details | National Centers for Environmental Information \(noaa.gov\)](#)

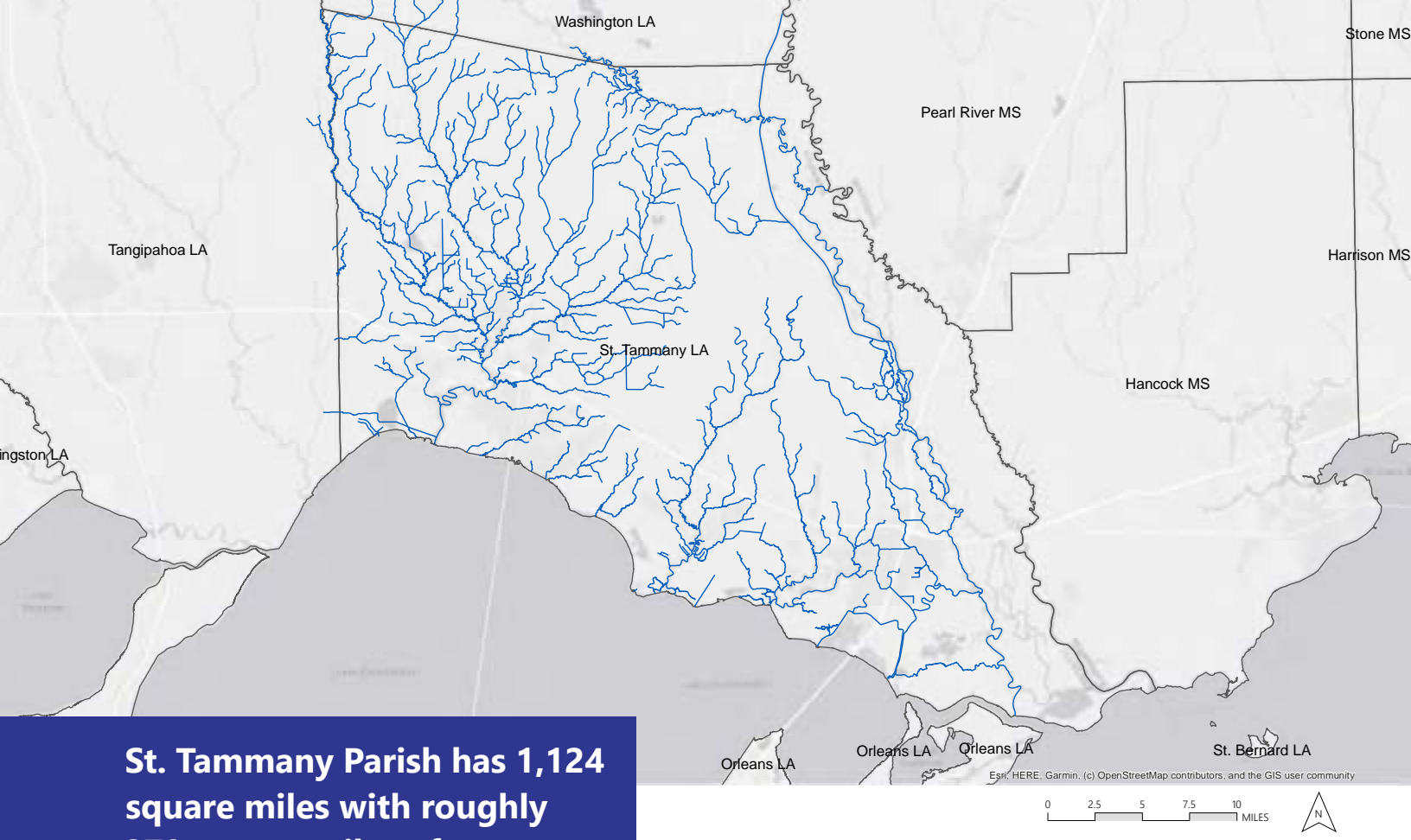


FREQUENCY OF HURRICANES, STORMS & OTHER HEAVY PRECIPITATION EVENTS

TOTAL RAINFALL LISTED IN INCHES

- HURRICANE
- TROPICAL STORM





St. Tammany Parish has 1,124 square miles with roughly 279 square miles of water³.

1.3 Flood Risk Reduction Strategy

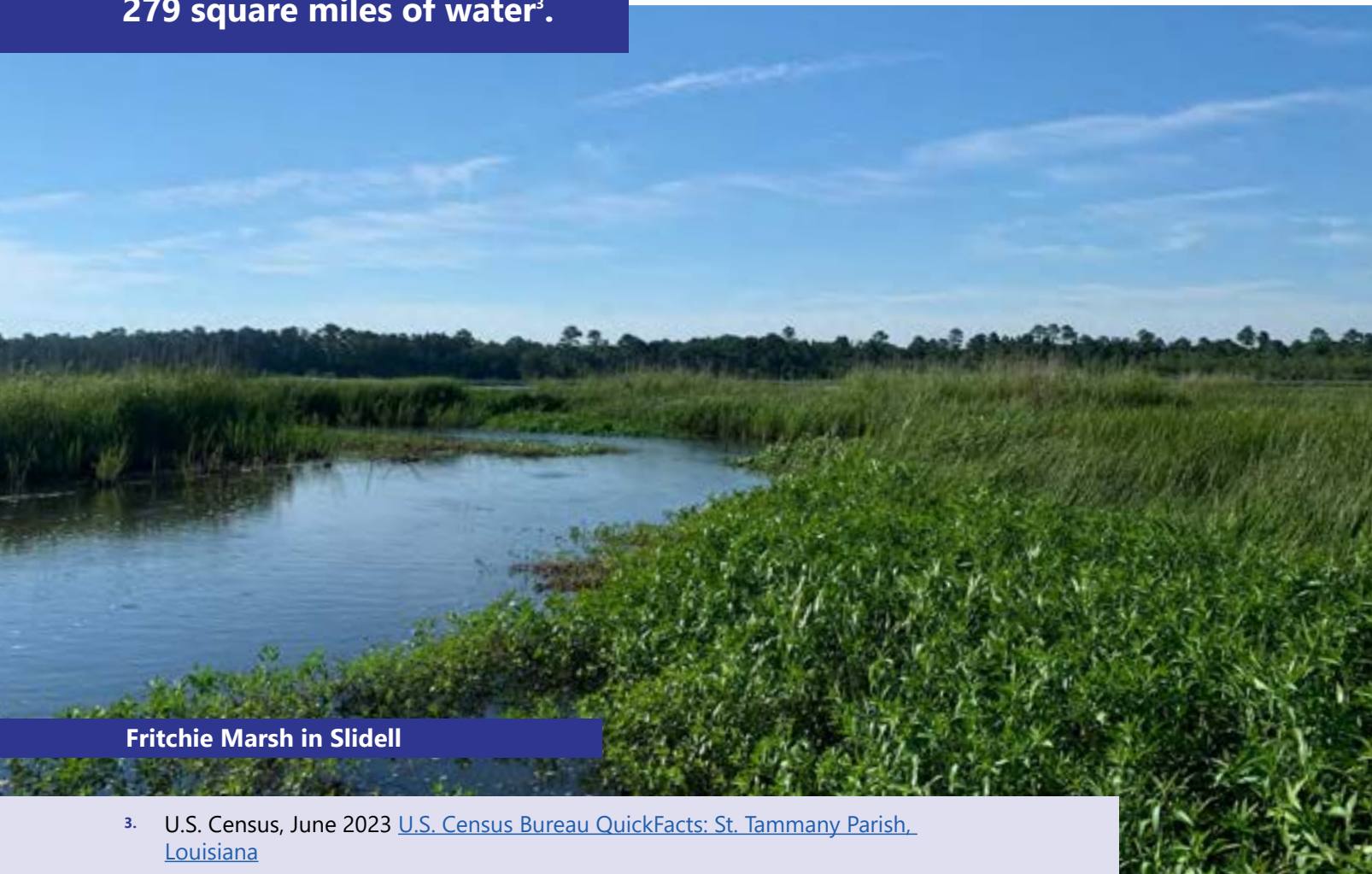
Flood risk reduction strategies are grouped into the following categories and subcategories:

- Flood Risk Reduction
 - Structural
 - Nonstructural
- Environmental/Ecosystem Restoration
 - Marsh Creation and/or Nourishment
 - Watershed and/or Stream Restoration

These strategies can be implemented independently but are more effective when implemented holistically. This study considers locations to implement these various strategies across the Parish.



Lakeshore Drive Flooding, Mandeville



Fritchie Marsh in Slidell



**Daily water levels are regularly close to roadway.
Highway 1077 in Madisonville**

³. U.S. Census, June 2023 [U.S. Census Bureau QuickFacts: St. Tammany Parish, Louisiana](#)

1.3.1 Flood Risk Reduction

Structural Improvements

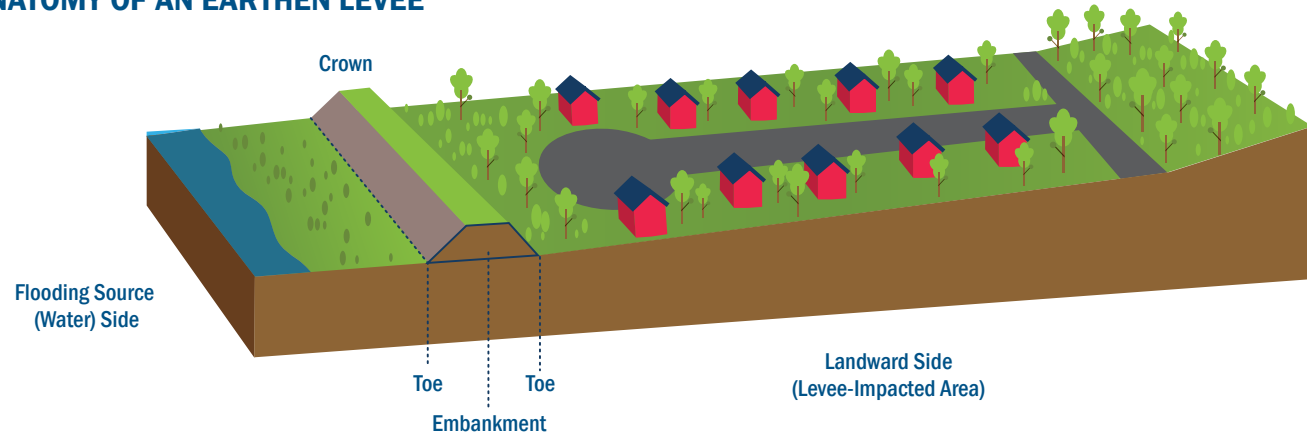
Structural flood risk reduction strategies include public works projects such as levees, flood gates, pump stations, and roadway drainage improvements. These strategies provide flood risk reduction to a community and are typically long-term projects with project life-cycles greater than 50-years.



Lakeshore Estates Pump Station (GEC 2019)

Mandeville Coastal Jetty Structure (NSI 2020)

ANATOMY OF AN EARTHEN LEVEE



Graphic Courtesy: FEMA RiskMAP

Nonstructural Improvements

Nonstructural flood risk reduction strategies include modifying at-risk structures by raising them above expected flood elevations or providing floodproofing adaptations to the structures. Property acquisitions or buyouts are also a nonstructural strategy in which residents or businesses are relocated, and the remaining structures are removed from the flood prone area.

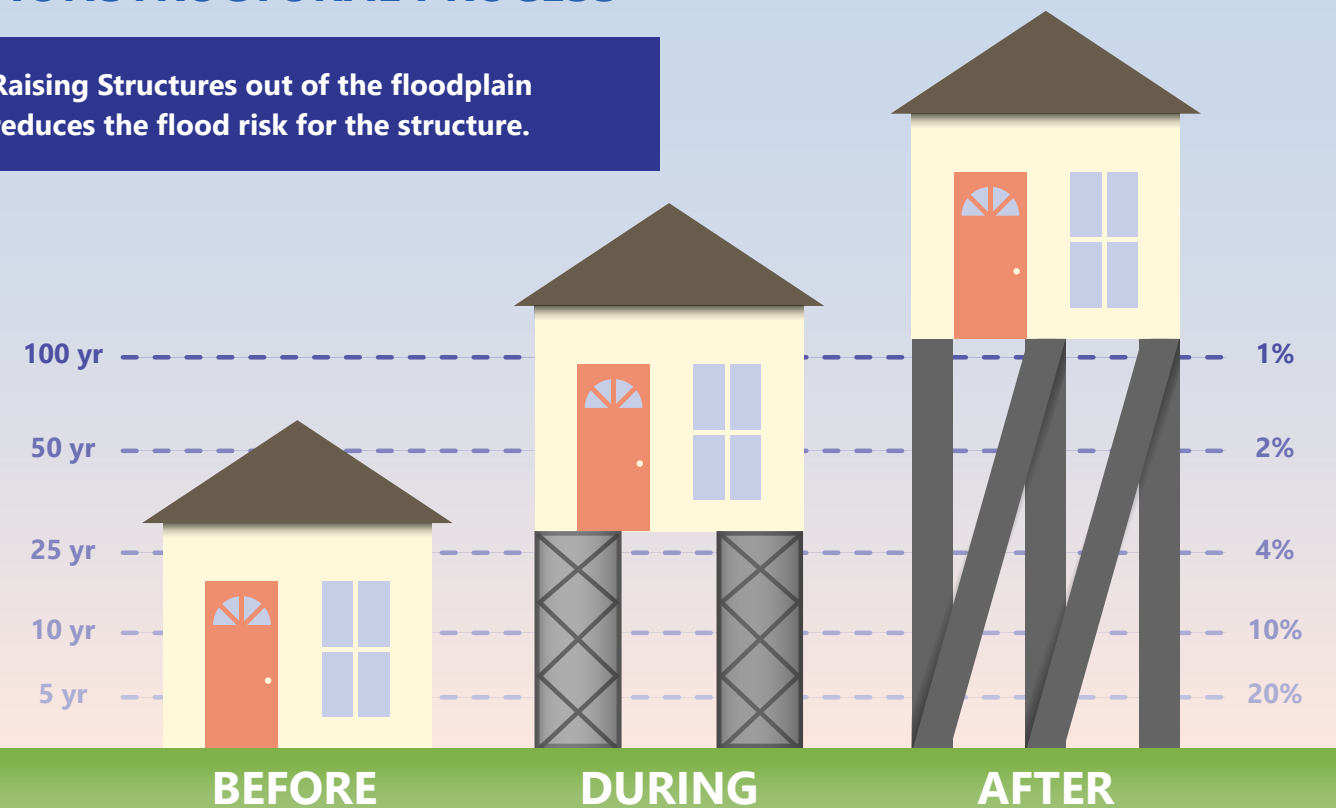


Above: Slidell Memorial Hospital Floodproofing (NSI 2007)
Below: Elevating a home to reduce flood risk



NONSTRUCTURAL PROCESS

Raising Structures out of the floodplain reduces the flood risk for the structure.

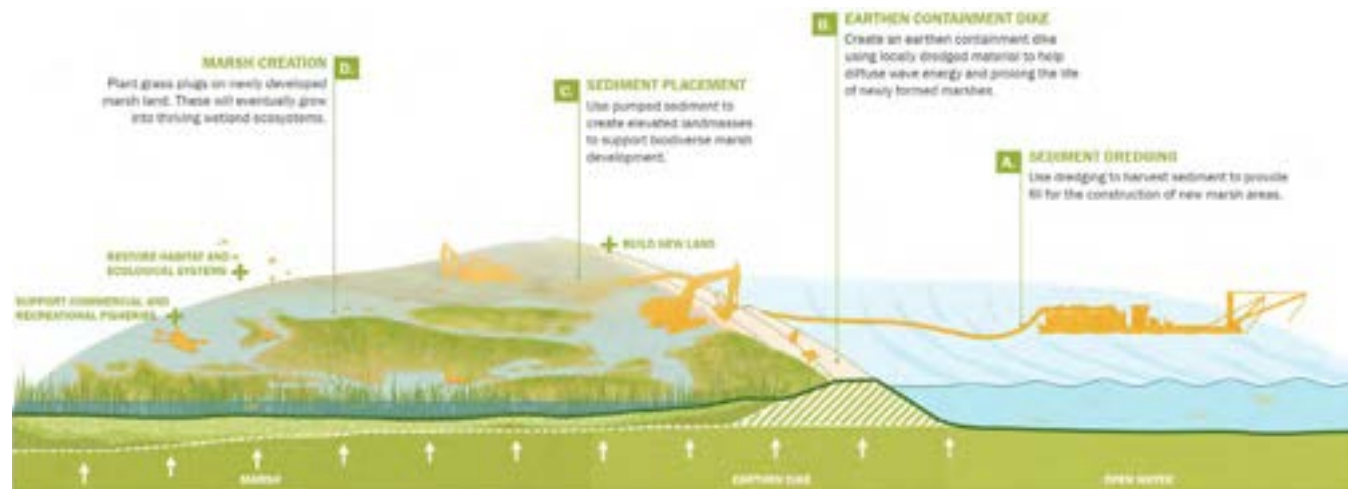


1.3.2 Environmental/Ecosystem Restoration

Environmental strategies include restoring a natural buffer or improving the watershed of a community.

Marsh Creation/Nourishment

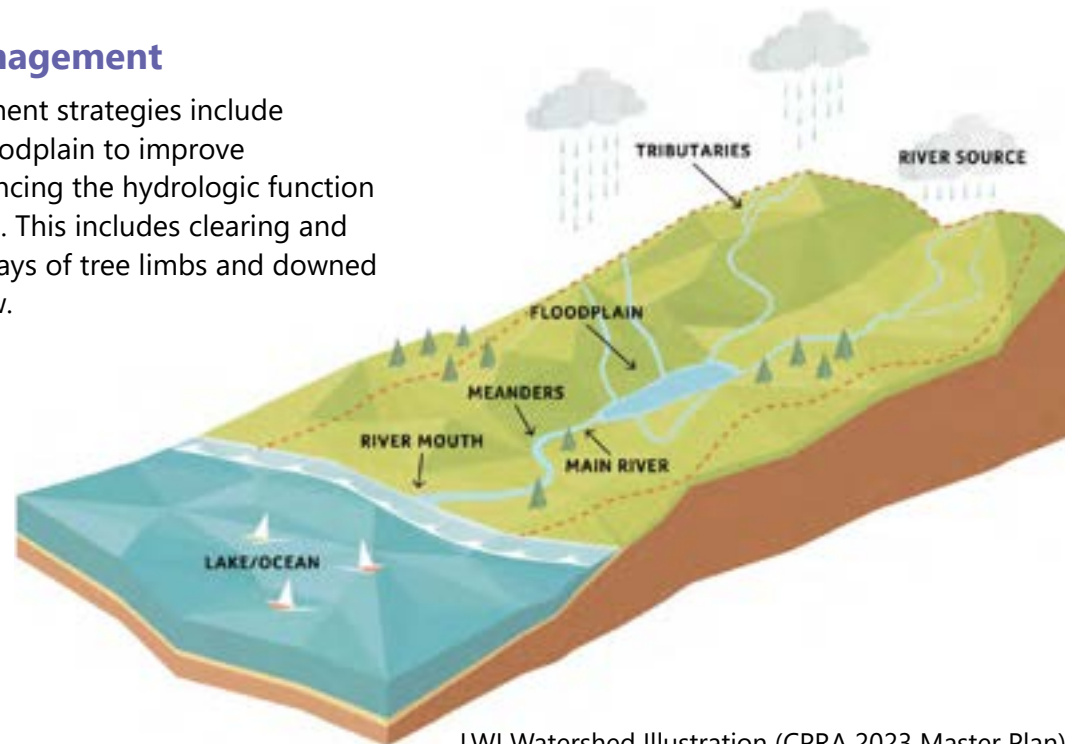
Restoration of marsh between a coastal shoreline and a community behind the marsh provides a natural buffer, reducing storm surge, increasing water quality, and providing a healthier natural habitat for plant and animal species. Shoreline protection projects also reduce storm surge and wave erosion and provide habitat for aquatic organisms.



Marsh Creation Project Type Visualization (CPRA 2023 Master Plan)

Watershed Management

Watershed management strategies include restoration of the floodplain to improve connectivity or enhancing the hydrologic function within the watershed. This includes clearing and de-snagging waterways of tree limbs and downed trees to improve flow.



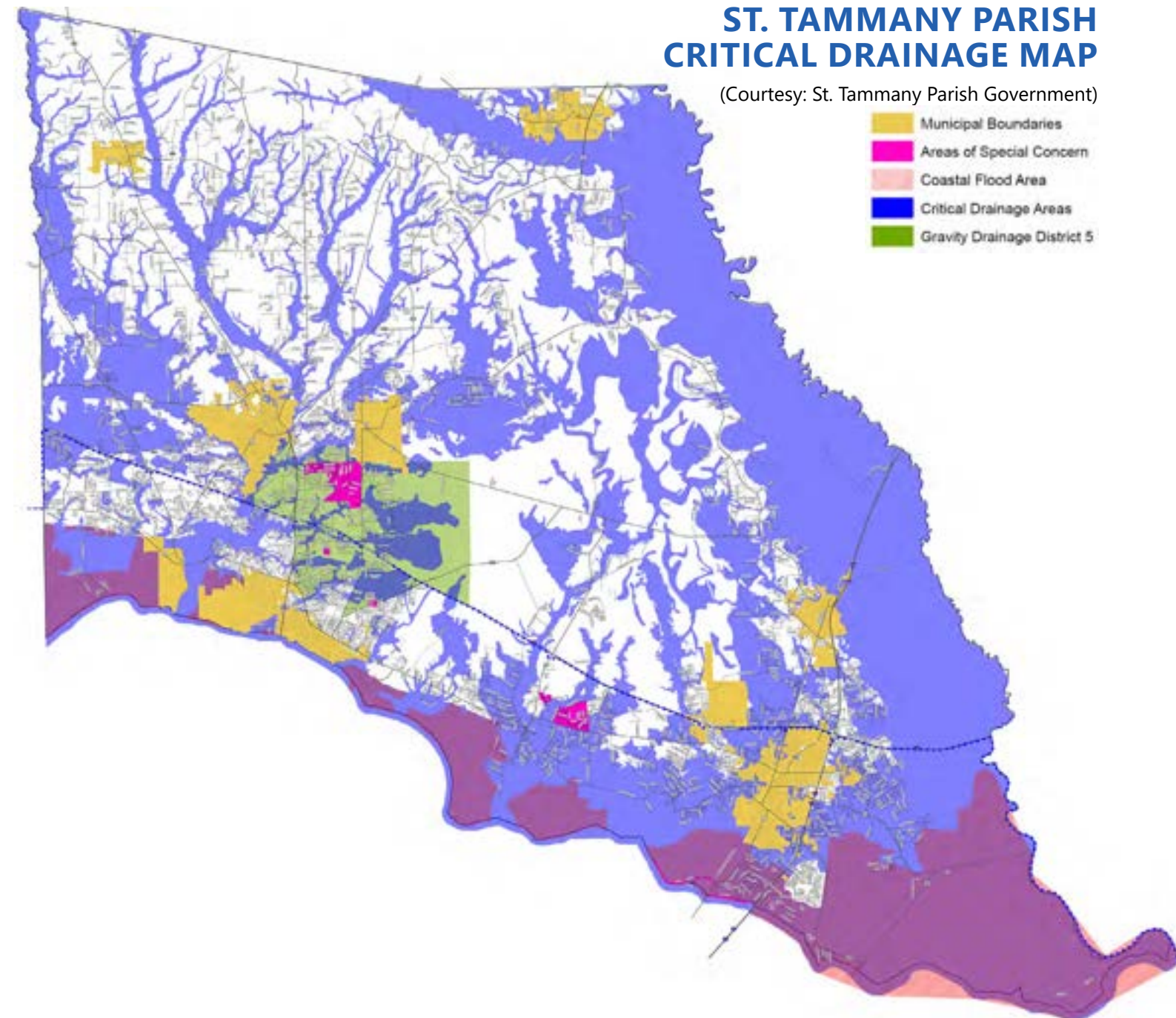
LWI Watershed Illustration (CPRA 2023 Master Plan)

1.4 Policy Considerations & Strategies

St. Tammany Parish's approach to flood risk reduction has evolved since 2005. As a result of Hurricanes Katrina and Rita, the State of Louisiana enacted stricter building codes and adopted conservative flood approaches statewide. At the Parish level, St. Tammany Parish Government identified Critical Drainage Areas and developed more stringent guidelines for development within these Critical Drainage Areas. Critical drainage areas have been determined by the St. Tammany Parish Government Department of Engineering, after careful consideration of the available data, to be of critical importance for its role in the conveyance, moderation or storage of stormwater. These requirements included reducing or eliminating development in flood prone areas, and hydraulic and hydrologic modeling for future developments documenting rainfall runoff rate reductions.

ST. TAMMANY PARISH CRITICAL DRAINAGE MAP

(Courtesy: St. Tammany Parish Government)



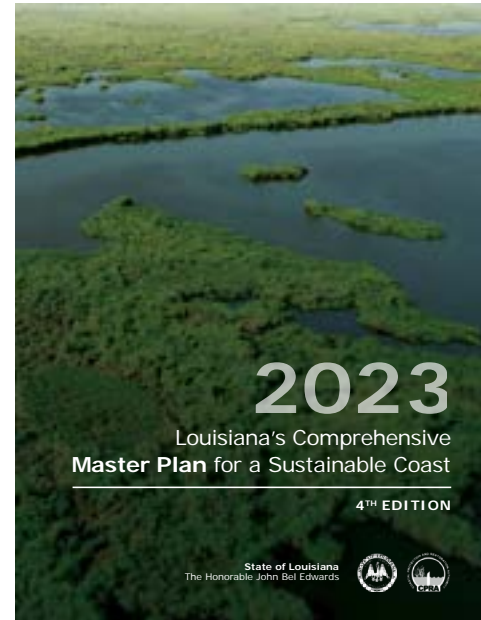
1.5 Other Studies

While local policy changes and strategies are being implemented by the Parish, other state and federal agencies recognize a need for investments in flood risk reduction projects in St. Tammany Parish. These projects will have a significant positive economic impact to the State of Louisiana and the nation.

1.5.1 CPRA

Louisiana’s Coastal Protection and Restoration Authority (CPRA) was established after Hurricanes Katrina and Rita in 2005. CPRA is responsible for the initiation of the Louisiana Coastal Master Plan. This plan is Louisiana’s cornerstone response to coastal (storm-surge based) flooding and land loss and is a \$50 billion, 50-year coastal restoration and flood risk reduction plan.

Since the initial plan in 2007, CPRA continues to refine it with new technology and stakeholder involvement over the years. The Master Plan also identifies the economic and infrastructure damages associated with storm events within the Coastal Zone throughout the state. The 2023 Master Plan estimates the Expected Annual Damage for St. Tammany Parish at over \$1 Billion⁴ over the next 50-years.



Expected Annual Damage Cost from CPRA’s 2023 Master Plan	
Community Name	EAD\$
Slidell/Eden Isle/Pearl River	\$845M
Destrehan/New Sarpy/Norco	\$294M
Luling/Boutte	\$271M
Morgan City/Berwick	\$245M
Mandeville/Covington/Madisonville/Abita Springs	\$234M
Houma	\$189M
Lafitte/Jean Lafitte/Barataria	\$165M
New Iberia	\$156M
Vermilion-UNC	\$139M
Larose	\$106M

The Master Plan uses a regional approach taking into account local variabilities in land loss rates, mechanisms, and effectiveness of different project strategies. These strategies reduce flood risk through marsh creation projects, nonstructural improvements, levees, pump stations, and property buyouts for flood prone areas.

4. CPRA 2023 Master Plan Expected Annual Damage Dollars (EAD\$) for Slidell/Eden Isle/Pearl River and Mandeville/Covington/Madisonville/Abita Springs collectively \$1,079 Million.

1.5.2 Louisiana Watershed Initiative (LWI)

In addition to the efforts by CPRA, the Louisiana Watershed Initiative (LWI) is a program to address flood risk in the State of Louisiana based on improved watershed management. This initiative was established after the flooding in March and August of 2016. These extreme rainfall events caused extensive damage in St. Tammany Parish. Transportation routes, homes, and commercial facilities were impacted and this flooding exposed the vulnerability of communities along rivers and bayous within the State prompting a need for improved watershed management. LWI has recommended a first round of “shovel-ready” projects that only need funding to implement. Subsequent phases of the program will further develop projects that reduce flooding impacts.



1.5.3 USACE St. Tammany Parish Feasibility Study

In 2020, the United States Army Corps of Engineers (USACE) initiated the *St. Tammany Parish, Louisiana Feasibility Study* to investigate flood risk management and coastal storm risk management solutions to reduce flood damages caused by rainfall and coastal storm flooding in St. Tammany Parish.



The TSP has a total project cost of approximately \$4,452,059,000 and is estimated to produce nearly \$237,083,000 in net benefits with a benefit-to-cost ratio (BCR) of 2.4 (greatest economic net benefits) and is consistent with USACE policies for protecting the environment. This study includes two primary approaches for flood risk management: (1) structural levee alignments including pump stations and floodgates and (2) nonstructural raising of structures out of the current and future flood plain.









1.6 This Study Effort

This Coastal Master Plan is part of the ongoing collaborative flood mitigation efforts by CPRA, St. Tammany Levee, Drainage and Conservation District, and St. Tammany Parish Government to increase the Parish's protection and resiliency to natural disasters. It is a continuation of the 2012 *Northshore Hurricane/Flood Protection/Restoration Plan* for the St. Tammany Parish Government (STPG).

This Plan identifies projects and strategies to approach flood risk reduction within its communities. This Master Plan reviewed historic data and studies, identified areas of concern and in need of flood risk reduction measures, and developed conceptual level costs and impacts for the suggested projects.

The STPG Coastal Master Plan considered the number of structures protected, the costs of land acquisition and construction, and negative environmental impacts along with associated costs for each project considered. An example can be found below.

Sample Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$16,030,000	\$6,300,000	\$560,000,000	\$2,800,000	\$140,000,000	\$725,130,000

The Master Plan considers multiple storm frequency levels of protection for each project. The storm event frequencies are the 4%, 2%, and 1% chance of storm occurrence within a given year also known as the Annual Exceedance Probability (AEP). These frequencies correspond to a 25-year, 50-year and 100-year levels of protection, respectively. Storm frequency data is based on modeling performed by CPRA and the USACE. Some areas have resiliency projects which may be a blended level of protection but increase community resiliency to flood conditions.



Illustration of Various Levels of Protection

This plan has developed a collection of projects with a variety of structural, nonstructural, and environmental strategies for flood risk reduction within that span the Coastal Zone of St. Tammany Parish. These projects include short-term, mid-term, and long-term projects that will provide protection to the coastal communities within St. Tammany Parish.

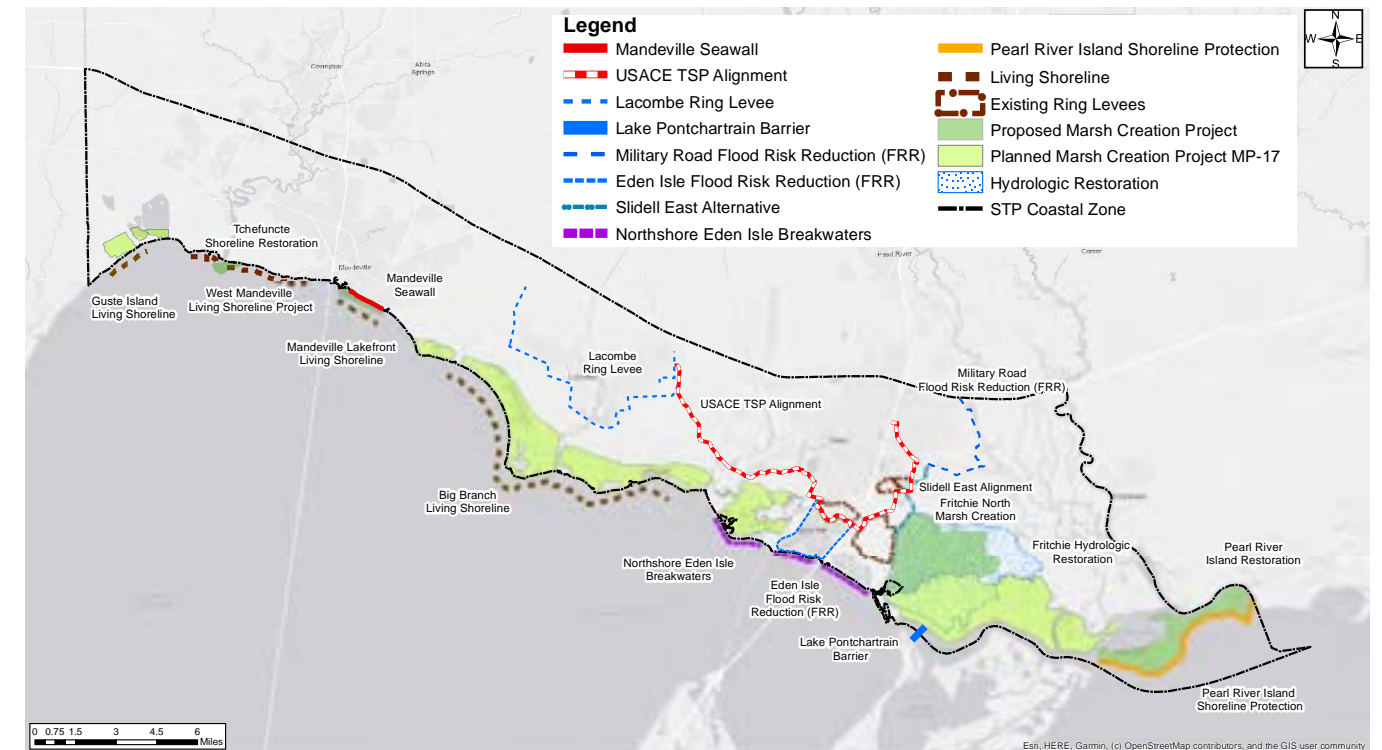
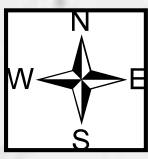


Figure 1-1 St. Tammany 2023 Coastal Master Plan Projects Evaluated

1.7 Flood Risk Reduction Strategies

This Master Plan provided a desktop assessment of the proposed structural and nonstructural flood protection projects, throughout the Parish, to identify potential issues. The following is a summary of the various flood risk reduction projects considered.










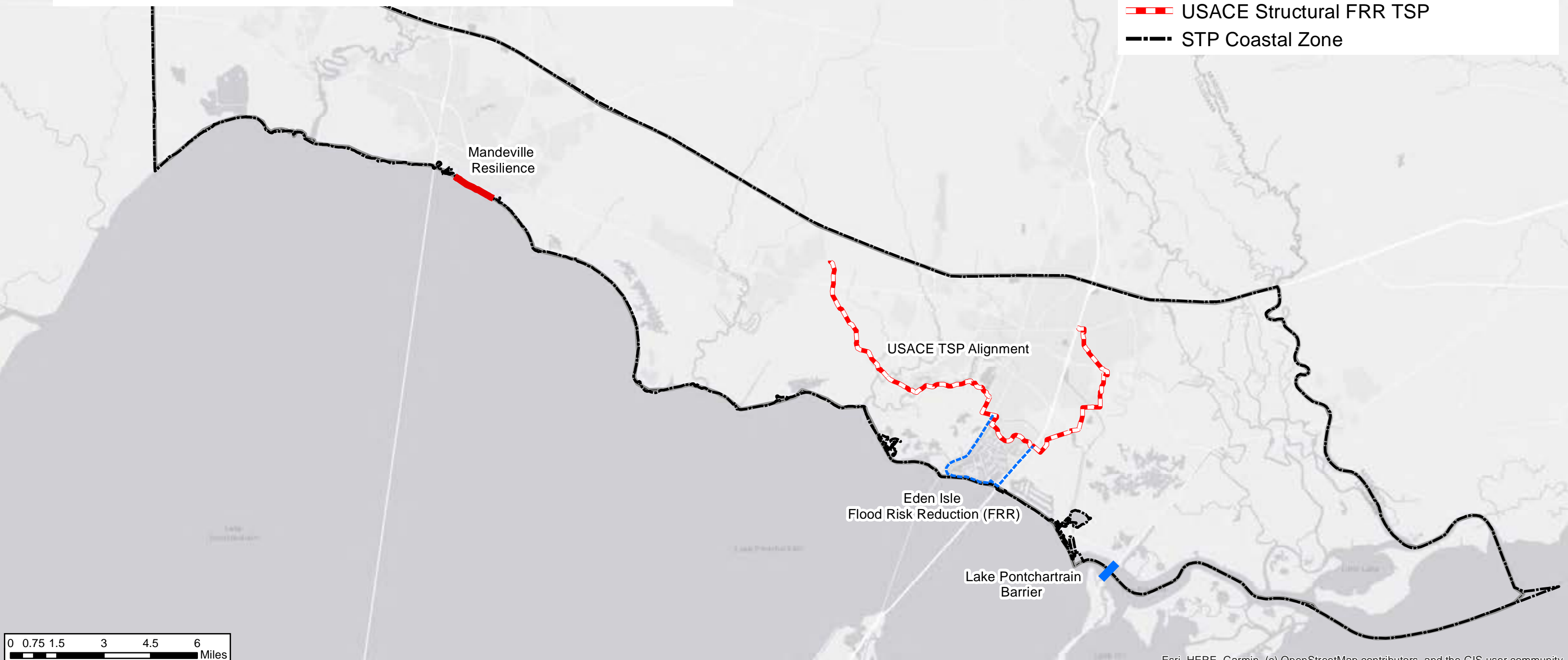
1.7.1 Structural Flood Risk Reduction Projects

Current Flood Risk Reduction Projects:

1. USACE Tentatively Selected Plan South Slidell with West Slidell Levee
2. Eden Isle Levee Flood Risk Reduction and Resilience Project
3. Mandeville Resilience Project
4. Lake Pontchartrain Barrier

Legend

-  Mandeville Resilience Project
-  Lake Pontchartrain Barrier
-  Eden Isle Flood Risk Reduction (FRR)
-  USACE Structural FRR TSP
-  STP Coastal Zone



Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Figure 1-2 Structural Flood Risk Reduction Projects

USACE Tentatively Selected Structural Flood Risk Reduction Plan

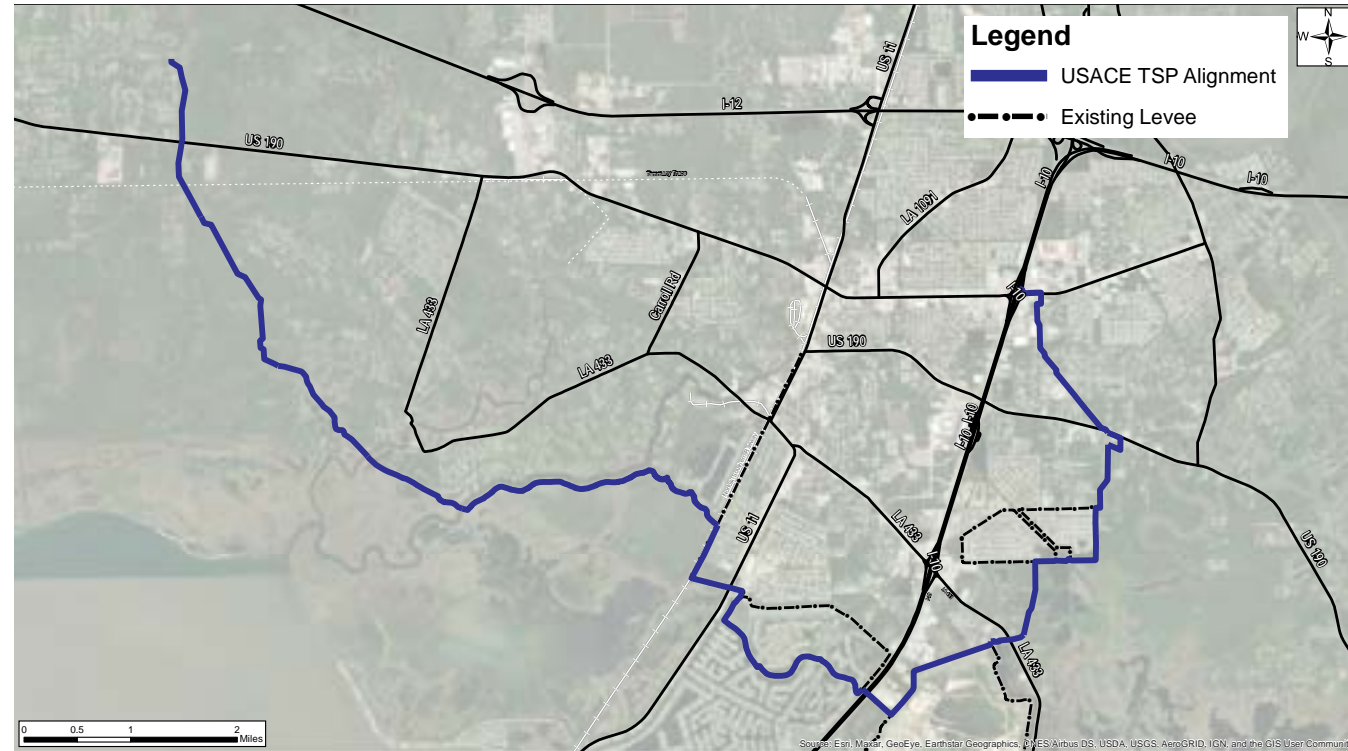


Figure 1-3 USACE TSP Structural Flood Risk Reduction Alignment

The St. Tammany Parish, Louisiana Feasibility Study for flood damage reduction in St. Tammany Parish, Louisiana was funded by the Bipartisan Budget Act of 2018. The goal of the St. Tammany Parish, Louisiana Feasibility Study is to reduce the severity of flood damages and risk to public health and safety, caused by heavy rainfall, riverine flooding, tropical storms, and hurricanes.

The USACE developed a Tentatively Selected Plan (TSP) to provide structural and nonstructural protection for St. Tammany Parish. Figure 1-3 shows the structural protection alignment for the TSP.

The USACE St. Tammany Parish, LA Feasibility Study is currently being finalized. The Draft Integrated Feasibility Report and Environmental Impact Statement was released for public comment in July 2023 and is expected to be finalized in December 2023. The Chief's Report is expected to be completed in May 2024.

Table 1-1 provides a summary of the total capital costs associated with the various alignments including real estate, environmental mitigation, utilities, engineering, planning, construction, and construction management.

Table 1-1 Summary of Total Cost and Benefits for USACE TSP Structural Flood Risk Reduction

USACE Structural TSP Summary	
Construction Costs	\$2,440,973,000
Net Benefits	\$68,415,000
Benefit/Cost Ratio	1.7

Data gathered from the published St. Tammany Parish, LA Feasibility Study, 2023 Revised Draft Integrated Feasibility Report and Environmental Impact Statement.

St. Tammany Parish can continue to make refinements to the USACE's Tentatively Selected Plan as part of its Non-Federal Sponsor cost share requirements. Additional information can be found in Chapter 5.1.1 and **Appendix C**.

Eden Isle Flood Risk Reduction and Resilience Project

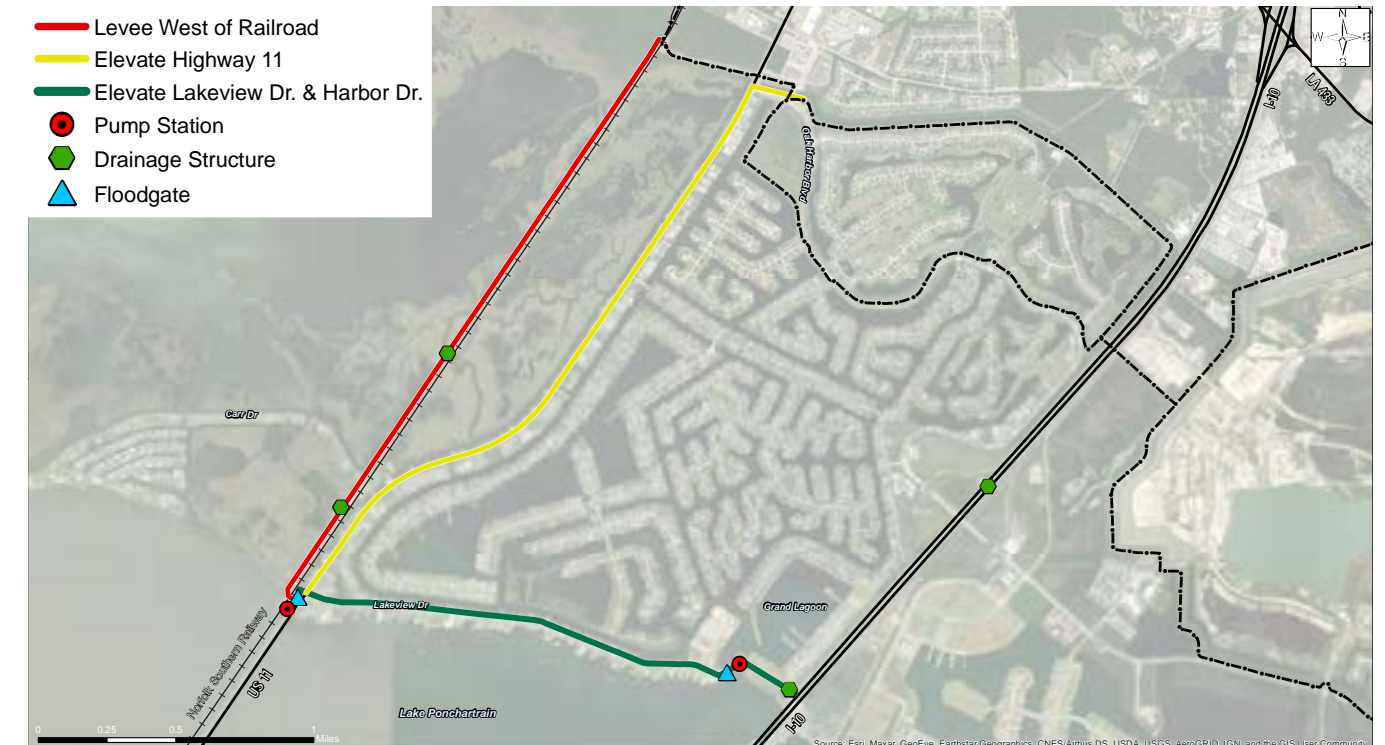


Figure 1-4 Eden Isle 25-Year Alignments

Eden Isles is a multiple subdivision community found in Slidell, Louisiana in the southeast corner of St. Tammany Parish. The development began in 1969 and is bound by Highway 11 on the west, Interstate 10 on the east, Lake Pontchartrain on the south, and Oak Harbor subdivision on the north. Eden Isle, the three exposed sides of the community (east, west, and south) are considered for resilience and up to 50 year level of protection. The alternatives take advantage of the existing topographic features to provide flood risk reduction and resiliency to the community. Table 1-2 provides a summary of the total costs associated with the alternative alignments including real estate, environmental mitigation, utilities, engineering, planning, construction, and construction management.

Table 1-2 Summary of Total Capital Costs Range for Eden Isle Alternatives

	Eden Isle FRR and Resilience Levee Alternatives	
	Low	High
10-YR to 50-YR Alternatives	\$115,000,000	\$385,000,000

Eden Isle is included in the USACE St. Tammany Parish, LA Feasibility Study nonstructural program. CPRA is also working with Eden Isle to provide resiliency options. Additional information can be found in Chapter 5.1.2 and **Appendix C**.

City of Mandeville Resilience Project



Figure 1-5 City of Mandeville Seawall Alignment

The City of Mandeville, founded in 1834 has an existing seawall, constructed in the 1930's, along the shoreline of Lake Pontchartrain, which has historically addressed shoreline erosion. CPRA and the City of Mandeville are considering resiliency options and non-structural projects to mitigate flooding impacts. The resiliency options are included in the Mandeville Flood Resilience Strategy published by CSRS in April 2023. This study can be accessed at the following link: https://www.cityofmandeville.com/sites/default/files/fileattachments/planning_and_development/page/2957/mandeville_flood_resilience_strategy_8.5x11.pdf

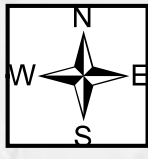
The City of Mandeville is included in the federal non-structural program for structure elevating and floodproofing opportunities. The City is also considering the pursuit of ecosystem projects, such as offshore coastal living shorelines, to extend the life of the seawall while addressing flood risk and environmental habitat restoration.

Lake Pontchartrain Barrier

The Lake Pontchartrain Surge Barrier proposes to reduce hurricane storm surge at the entrance to Lake Pontchartrain along the New Orleans East Landbridge. The barrier reduces storm surge along the north shore of Lake Pontchartrain and throughout the Lake Pontchartrain basin. The project is in the 2023 CPRA Master Plan but excluded from the USACE St. Tammany Parish Feasibility Study due to a low benefit cost ratio. However, the calculation only considered benefits to St. Tammany Parish and did not consider benefits in other Parishes. The cost for the project is \$2.4 billion in the CPRA's 2023 Master Plan. On September 13, 2022 the Regional Planning Commission (RPC) for Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. John the Baptist, St. Tammany, and Tangipahoa Parishes

unanimously approved a resolution requesting a new start study authorization and funding from the United States Congress and directs the USACE to evaluate the Lake Pontchartrain Barrier Project with consideration for potential damage avoidance for all of the Parish/Counties within or impacted by this project. A separate request was made by the RPC to the Lake Pontchartrain Basin Restoration Program for funding to perform hydrologic modeling to support project evaluation.



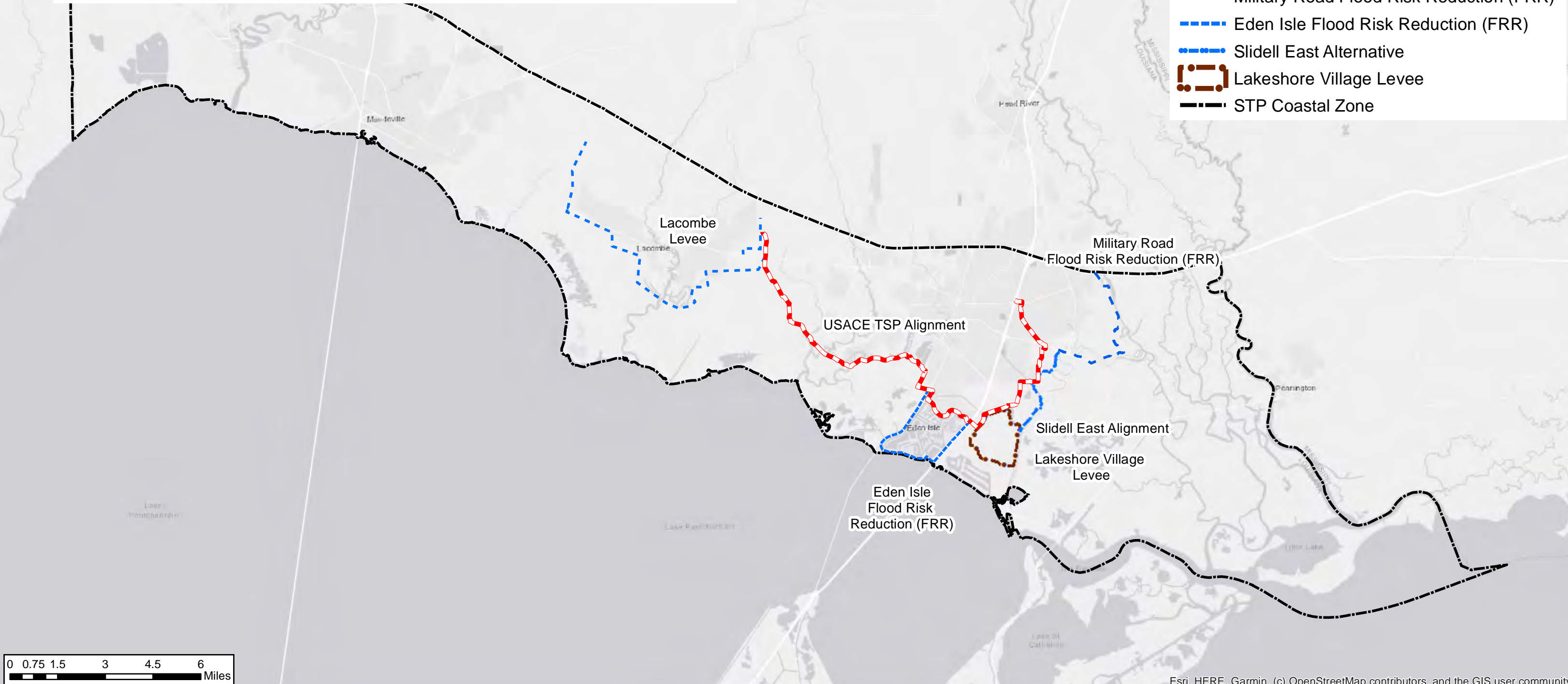


1.7.2 Additional Alternative Alignments and Future Flood Risk Reduction Projects Evaluated

1. Slidell Levee: East Segments
2. Military Road
3. Lacombe Levee

Legend

-  USACE TSP Alignment
-  Lacombe Levee
-  Military Road Flood Risk Reduction (FRR)
-  Eden Isle Flood Risk Reduction (FRR)
-  Slidell East Alternative
-  Lakeshore Village Levee
-  STP Coastal Zone



Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Figure 1-6 Structural Flood Risk Reduction Projects

Slidell Levee: East Segments Structural Flood Risk Reduction Alternatives Analysis

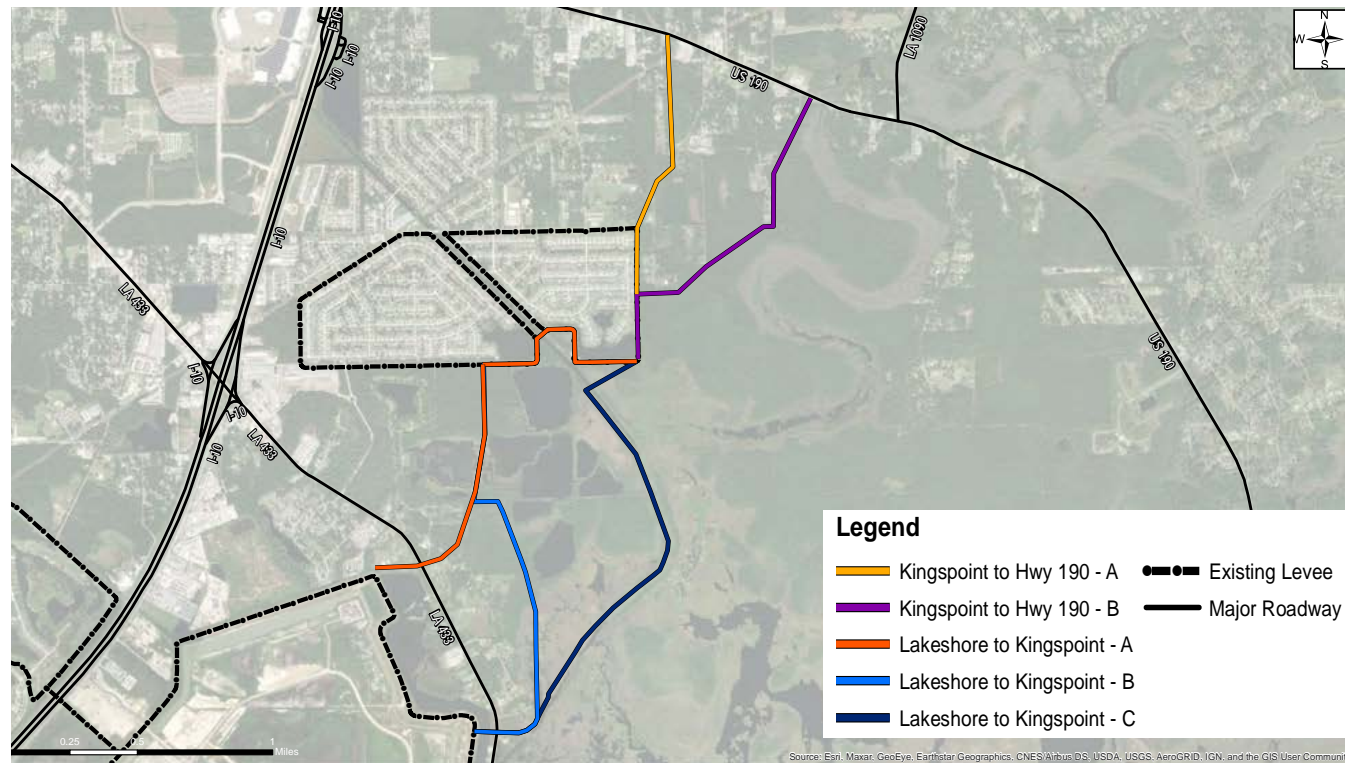


Figure 1-7 Slidell Levee: East Segments 100-Year Alignments

The Slidell Levee - East Segments Project (PO-184) includes levee segment alternatives providing flood protection and storm surge risk reduction around the eastern side of Slidell. The project from the CPRA's 2017 Coastal Master Plan (Project ID 001.HP.13) closes gaps in the existing Slidell Levee - East Segment System as seen in Figure 1-5. Table 1-5 provides a summary of estimated total capital costs for the alignments associated with the PO-184 alignments. The recommended alternative(s) were developed with CPRA's PO-184 study and in coordination with the USACE St. Tammany Parish Feasibility Study.

Table 1-3 Summary of Total Capital Costs Slidell Levee Project: East Segments

	Slidell Levee – East Segment	
	Low	High
Lakeshore Villages to Kingspoint Alignment	\$287,000,000	\$326,000,000
Kingspoint to Highway 190 Alignment	\$33,000,000	\$44,000,000

Slidell Levee - East Segment is included in the USACE federal structural program. The federal alignment most closely follows the Lakeshore to Kingspoint-A and the Kingspoint to Highway 190-A alignments as seen in Figure 1-4. With the approval of the Tentatively Selected Plan, St. Tammany Parish can continue to refine the proposed alignment as part of the Non-Federal Sponsor requirements.

Military Road Structural Flood Risk Reduction Alternatives Analysis

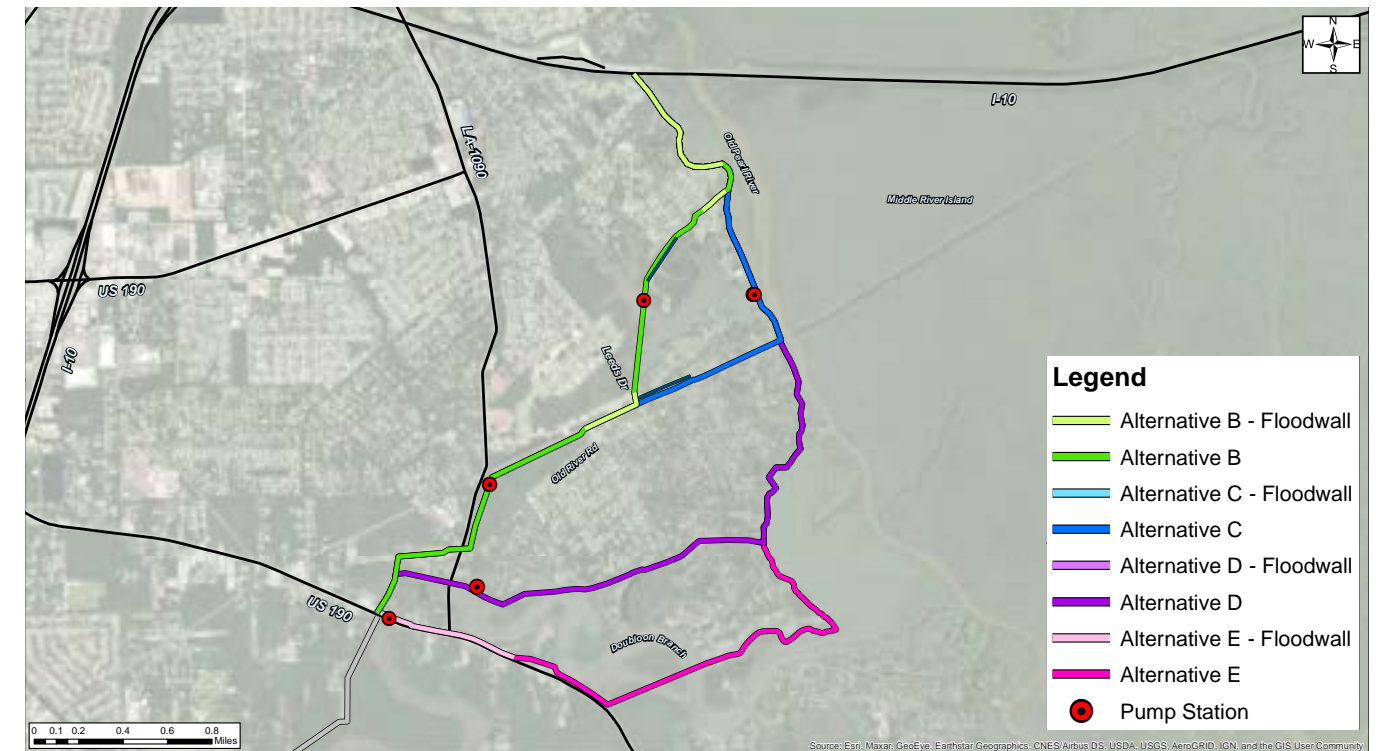


Figure 1-8 Military Road 100-Year Alignments

The Military Road community of East Slidell is bound by Military Road to the west and the Pearl River to the east. It extends from U.S. Interstate 10 at the northern edge to U.S. Hwy 190 on the south. Structural flood control measures were considered for the Military Road community at the 100-year and Interim Level of Protection. Table 1-6 provides a summary of the total capital costs associated with the various levels of protection considered including real estate, environmental mitigation, utilities, engineering, planning, construction, and construction management. Additionally, three (3) resiliency projects are considered to provide flood risk resiliency for the community.

Table 1-4 Summary of Total Capital Costs Military Road Project

	Military Rd Alignments	
	Low	High
100-Year Level of Protection	\$448,340,000	\$737,335,000
Interim Level of Protection	\$316,680,000	\$371,695,000

Military Road area is included in the federal non-structural program for structure elevating and floodproofing opportunities. Most structures in the Military Road area are near or above flood risk reduction elevations and will not offset the environmental impacts and mitigation costs associated with a structural levee feature. The economic benefits associated with the large-scale structural projects surrounding Military Road may not offset the costs associated with the alignments. The area can benefit from resiliency options to address localized flooding concerns at lower economic costs. It is recommended that these alignments be evaluated in further state and local studies to consider structural protection and resilience.

Lacombe Structural Flood Risk Reduction

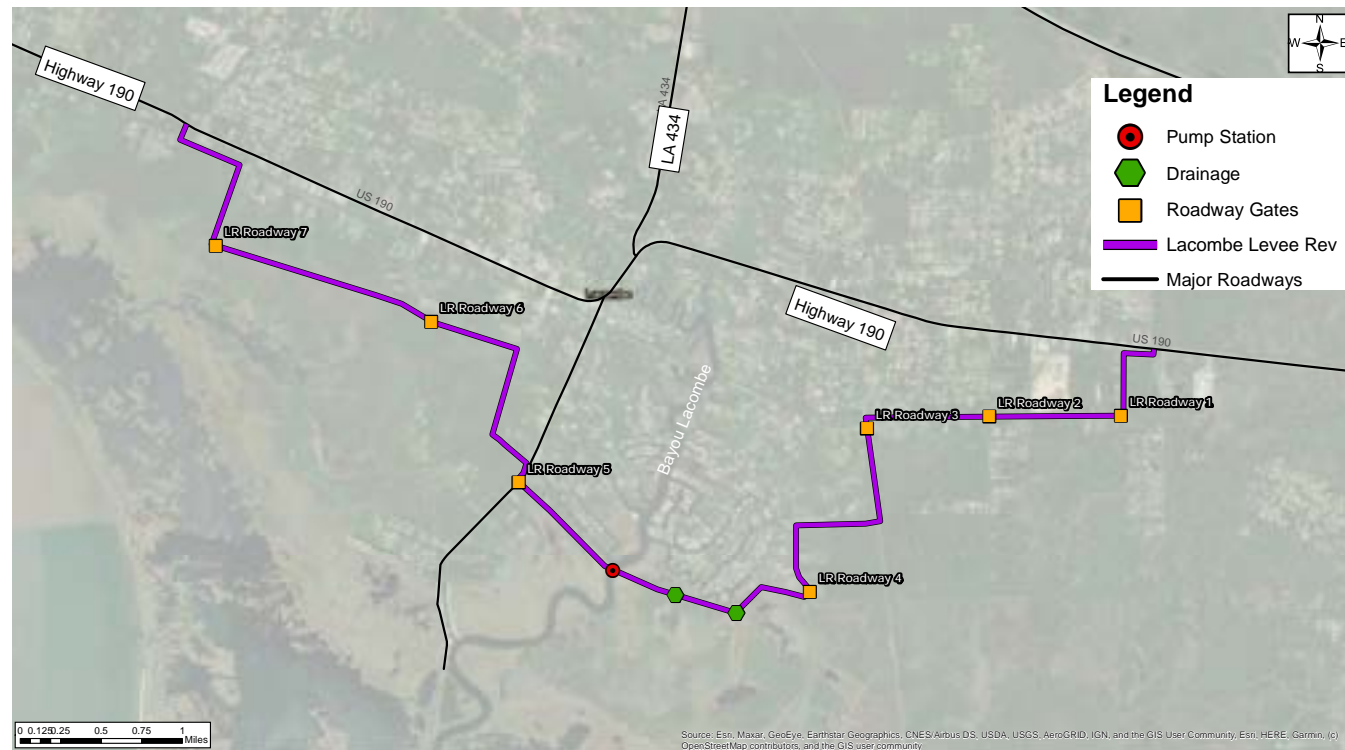


Figure 1-9 Lacombe Levee 100-Year Alignment

Lacombe is a community in Southern St. Tammany Parish that is located between Mandeville on the West and Slidell on the east, and is bisected Bayou Lacombe. The St. Tammany Coastal Study evaluated and considered a structural flood risk reduction alignment for the 50-year and 100-year levels of protection.

Table 1-5 Summary of Total Capital Costs Lacombe

	Lacombe Levee
100-Year Level of Protection	\$545,822,000
50-Year Level of Protection	\$528,769,000

A Lacombe Structural Flood Risk Reduction System was also evaluated in the USACE St. Tammany Parish, LA Feasibility Study.

It should be noted that the project has high costs associated with low-lying terrain and poor soil conditions. Additionally, there are limited benefits from the limited population and there are extensive environmental impacts and mitigation costs. For these reasons, it was not selected in the USACE Feasibility Study because of the low Benefits to Costs Ratio (BCR). However, this area is included in the Non-Structural protection program of the USACE Feasibility Study. It is recommend this levee alignment be re-evaluated in the future if conditions change.

1.7.3 Nonstructural Strategies

Nonstructural Risk Reduction strategies include elevating, flood proofing or acquiring structures in flood prone areas to reduce the impacts of flooding. Nonstructural renovations and acquisitions include residential and non-residential floodproofing, residential home raising, and residential voluntary acquisition. Multiple programs at the State and Federal level are currently pursuing nonstructural

measures of flood risk reduction in St. Tammany Parish with costs ranging between \$1,900,000,000 to \$2,200,000,000. It is recommended that the Parish continue to support these measures, promote equitable distribution of funds, and seek new funding opportunities for residences and other structures that lie outside existing and proposed structural protection systems.

Additionally, the USACE St. Tammany, Louisiana Draft Feasibility Study has included non-structural flood risk reduction measures in the recommended revised Tentatively Selected Plan. The non-structural effort includes residential elevations and commercial floodproofing for over 6,400 structures.

Table 1-6

USACE Nonstructural Summary	
Construction Costs	\$1,934,084,000
Net Benefits	\$168,300,000
Benefit/Cost Ratio	3.5

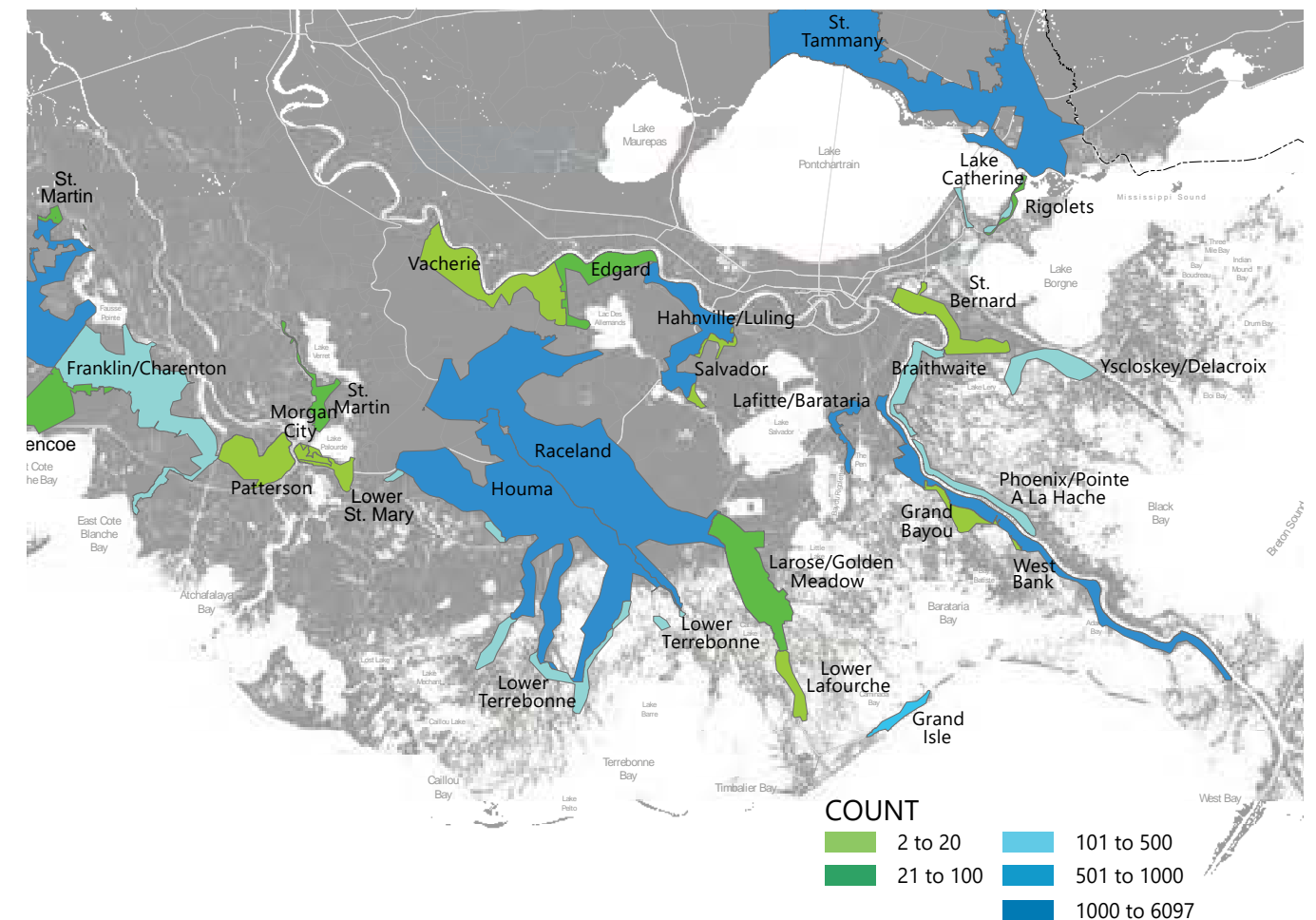


Figure 1-10 2017 Coastal Master Plan

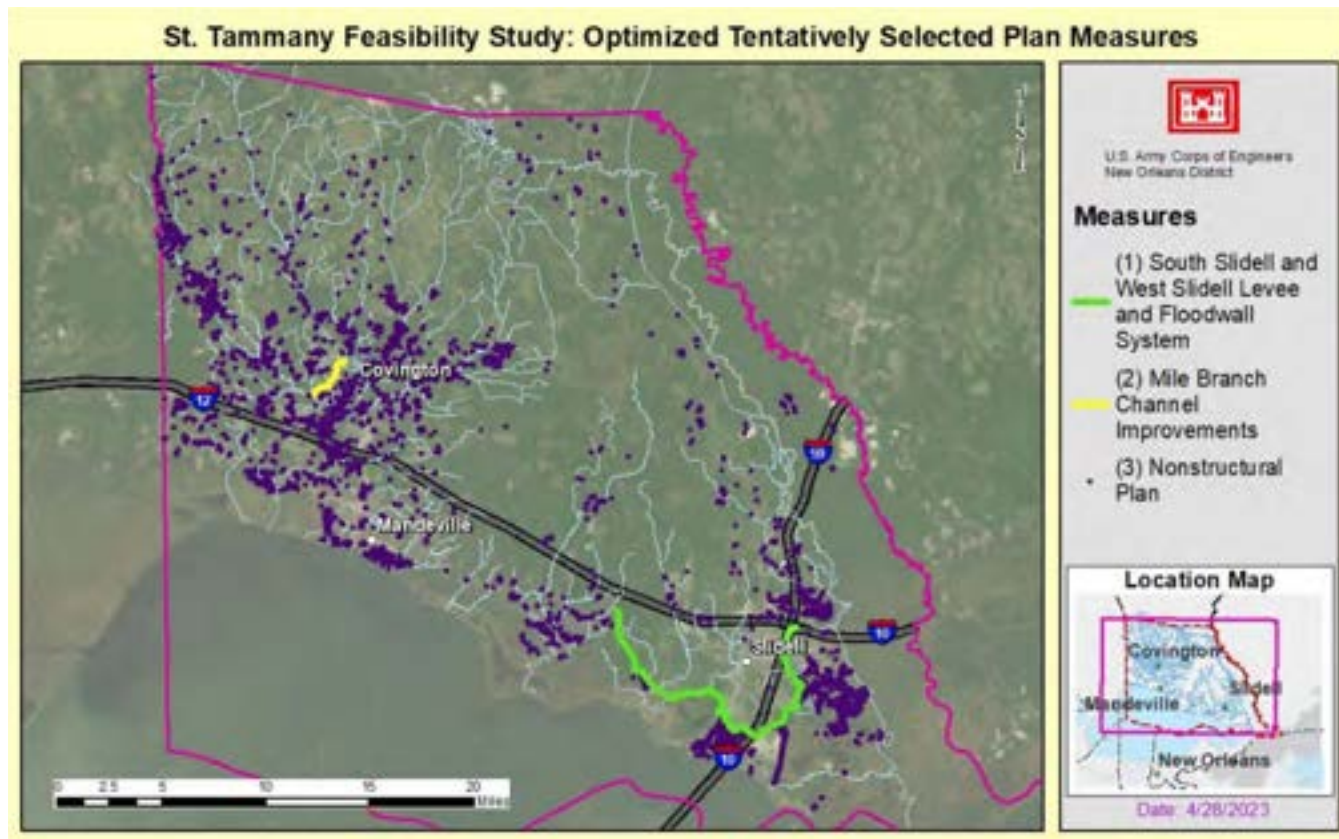
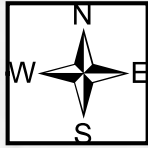


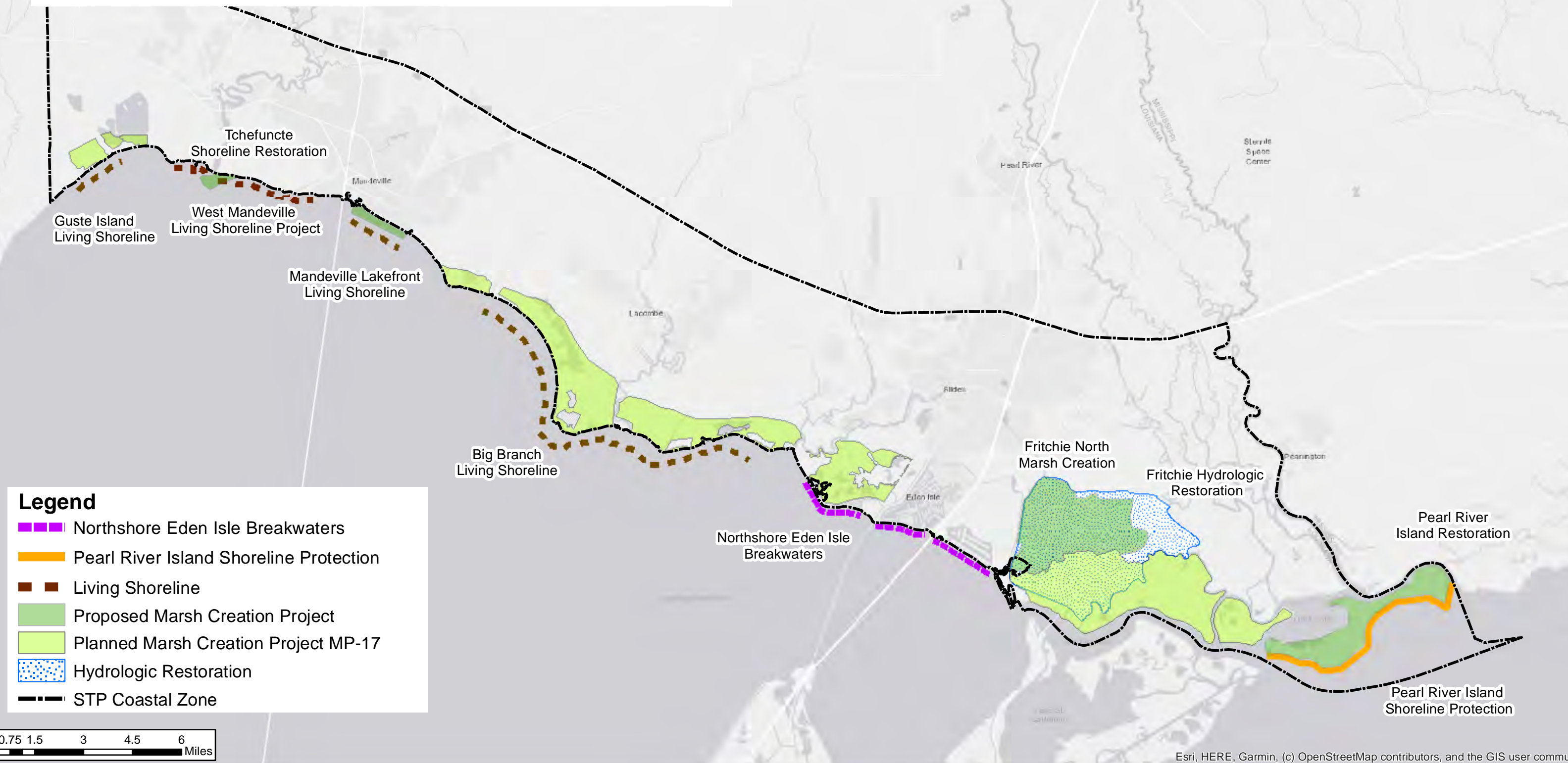
Figure 1-11 USACE Nonstructural Risk Reduction Tentatively Selected Plan





1.8 Environmental Restoration and Resilience Strategies

Environmental strategies include restoring a natural buffers to protect and improve watersheds.



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Figure 1-12 Recommended Restoration Projects

1.8.1 Marsh Creation & Restoration Projects

Marsh creation and wetland restoration projects include approaches to restore natural ecosystems, which can improve or curb land loss rates and reestablish natural buffers. These projects are widely accepted as a method to address flood concerns. Multiple programs at the State and Federal level are evaluating marsh creation and restoration projects to improve flood risk reduction in St. Tammany Parish. These actions provide increased natural habitat and restoration of historic ecosystems, providing long-term resiliency across the community. St. Tammany Parish should continue to pursue restoration projects across the Coastal Zone that provide recreational, environmental, and economic benefits. The following projects are recommended:

- Big Branch Living Shoreline
- Fritchie Hydrologic Restoration
- Fritchie North Marsh Creation
- Guste Island Living Shoreline
- Guste Island Marsh Creation
- Mandeville Lakefront Living Shoreline
- Mandeville Lakefront Wetlands Restoration
- New Orleans East Landbridge Restoration
- Northshore/Eden Isle Breakwater (Slidell Breakwaters)
- Pearl River Island Shoreline Protection and Restoration
- St. Tammany Marsh Creation
- Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement, and Marsh Restoration
- Vegetative Tree Planting Program
- West Shoreline Protection



Photo Courtesy Patrick M Quigley

1.8.2 Watershed Improvements

Watershed management is another nonstructural method widely accepted to address flood concerns. Multiple programs at the State and Federal level are evaluating improvements to watersheds to provide flood risk reduction in St. Tammany Parish. It is recommended that the Parish continue to support these measures, promote equitable distribution of funds, and seek new funding opportunities for residences and other structures that lie outside existing and proposed structural protection systems. These actions provide an additional benefit of increased natural habitat and a restoration of historic ecosystems.



1.9 Summary

The St. Tammany Parish Coastal Master Plan is a collection of projects with a variety of flood risk reduction and environmental/ecosystem strategies to improve resiliency spanning the Coastal Zone of St. Tammany Parish. These projects include short-term, mid-term, and long-term projects that will provide protection to the coastal St. Tammany Parish communities.

As studies by the USACE, CPRA, LWI, and other state or local agencies continue, maintaining consistency across the alignments within future design efforts will be necessary to avoid duplication of efforts. Additionally, for those areas that are no longer considered within those studies, St. Tammany Parish can pursue independent efforts at levels as described in the 50-year, 25-year, and resiliency scenarios as funding allows.

With continued growth and the ever-present flood risk within St. Tammany Parish, the proactive efforts outlined in this report will provide St. Tammany Parish officials a holistic approach for development. The approach provides increased habitats, stronger communities, and a more sustainable future.



Chapter 2 Introduction

2.1 Project Location

St. Tammany Parish, located northeast of New Orleans along the northern shores of Lake Pontchartrain, is one of Louisiana’s fastest growing parishes and the State’s fourth most populous. Much of the growth is along Lake Pontchartrain south of Interstate 12 in the Parish’s coastal zone (Figure 2-1).

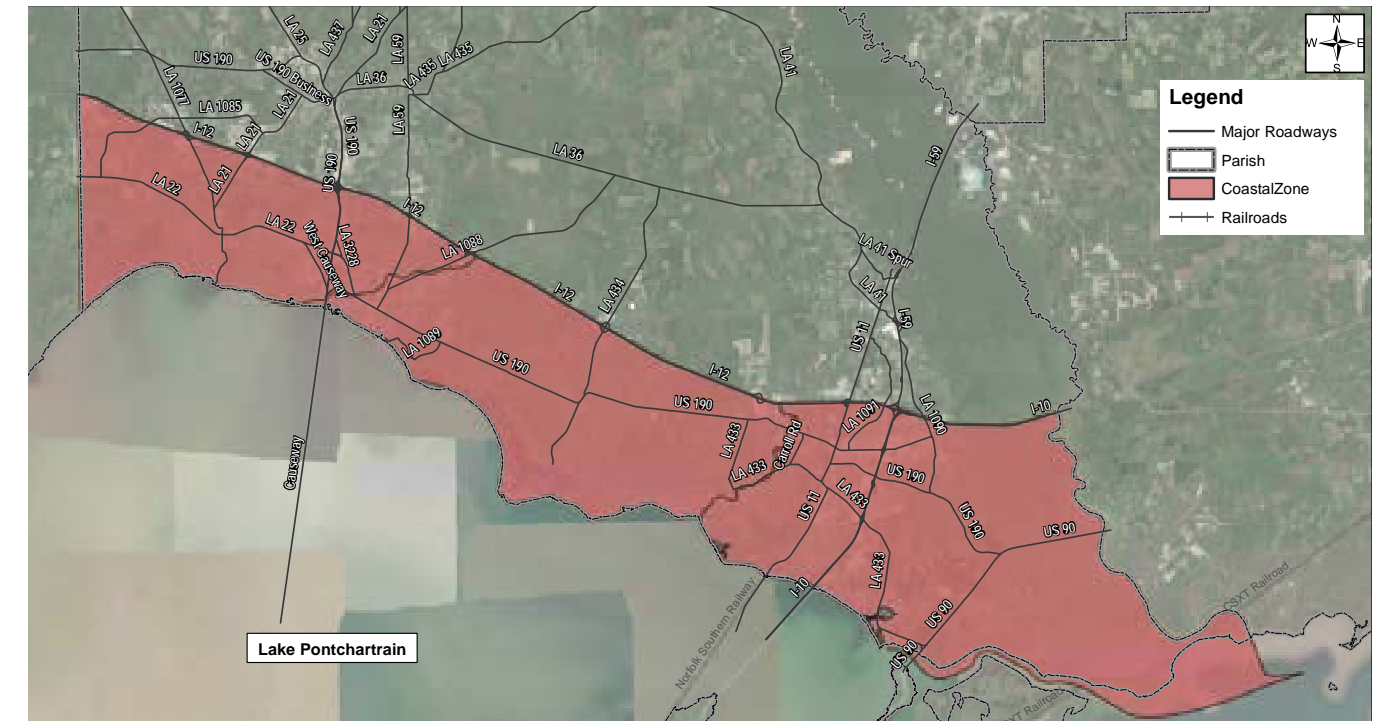


Figure 2-1 St. Tammany Parish Coastal Zone Boundary

St. Tammany Parish is 1,124 square miles in area with roughly 250 square miles of water⁵ that includes rivers, bayous, and the shoreline of Lake Pontchartrain (Figure 2-2). While proximity to water provides lifestyle and recreational values, it also presents challenges for water management. Tropical rain events and storm surge flooding significantly impact St. Tammany Parish’s businesses, citizens, property values and infrastructure.

⁵. U.S. 2020 Census, June 2023 [State of Louisiana Counties – 2020 Census – Data as of January 1, 2020](#) converted from square meters to square miles.

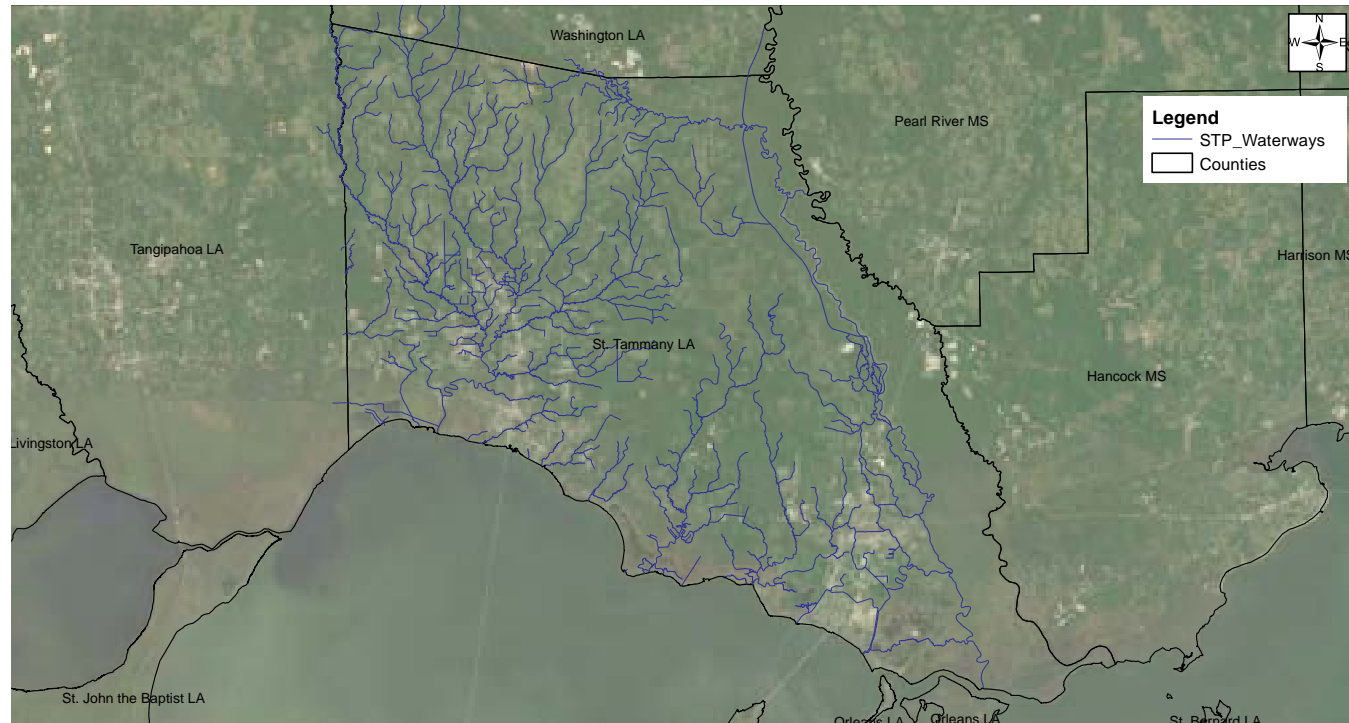


Figure 2-2 St. Tammany Parish Waterways



Figure 2-3 Lakeshore Dr. flooding in Mandeville (NSI 2020)

2.2 Flooding in St. Tammany Parish

Flooding in the Parish includes coastal, fluvial (riverine flood), and pluvial (flash flood), often with two or more of these occurring in unison. Hurricanes and tropical storms produce storm surges that extend well into the Coastal Zone often bringing significant rainfall leading to riverine and pluvial flooding further inland. High tides and sustained south winds in the springtime also result in coastal flooding and streets near the lakefront often experience nuisance flooding due to tidal changes. Increasing lake levels from sea level rise is exacerbating the flooding. Non-tropical high-intensity rain events, seasonal rises in rivers and bayous, and land use changes are also contributing to periodic flooding.

Frequent flooding is part of the region’s history. St. Tammany Parish has experienced roughly 55 major flood events or disaster declarations since 1965. Figure 2-4 is a timeline of historic flood events dating back to 1965. These events impact St. Tammany Parish’s businesses, citizens, property values and infrastructure and have long term economic consequences on the Parish.



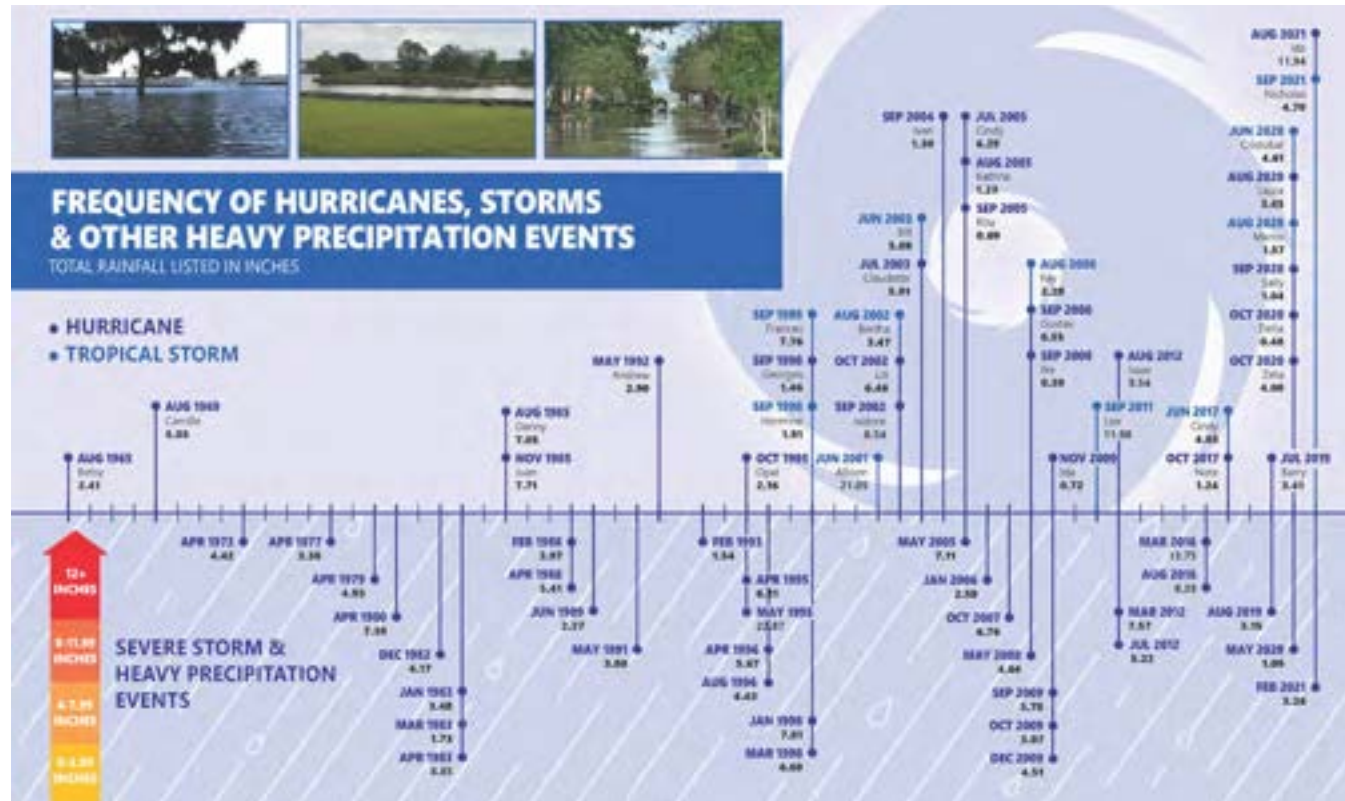


Figure 2-4 Historic Flood Events in St. Tammany Parish

Flood events over the past 55+ years and growth of the Parish necessitate planning a holistic approach for resiliency and long-term sustainability. Accordingly, preventing additional contribution to flooding is one of the top four priorities for future land use decisions in the Parish’s New Directions 2040 document, adopted in 2023.

2.3 Flood Risk Reduction Strategy

Flood risk reduction includes protection from storm surge and rainfall events. Flood risk reduction strategies require understanding the movement of water in and out of protected areas and the storm conditions under which these risk reduction strategies must perform. Each type of storm event can create different needs for developing flood risk reduction strategies. A coastal storm surge is associated with tropical systems while rainfall events are associated with weather patterns throughout the year including tropical events. This study focuses on flood risk reduction from coastal storm surge events.

To address flooding within a community, flood strategies are grouped into the following general categories and subcategories:

- Flood Risk Reduction
 - Structural
 - Nonstructural
- Environmental/Ecosystem Restoration
 - Marsh Creation and/or Nourishment
 - Watershed and/or Stream Restoration

These strategies can be implemented independently but are most effective when implemented holistically. For this reason, this study and previous studies consider the optimal locations to implement these various strategies across the Parish.

2.3.1 Flood Risk Reduction

Structural Improvements

Structural flood risk reduction strategies include large public works projects such as levees, flood gates, pump stations, and roadway drainage improvements. These strategies provide flood risk reduction to an entire community and are typically long-term projects with project life-cycles greater than 50-years.

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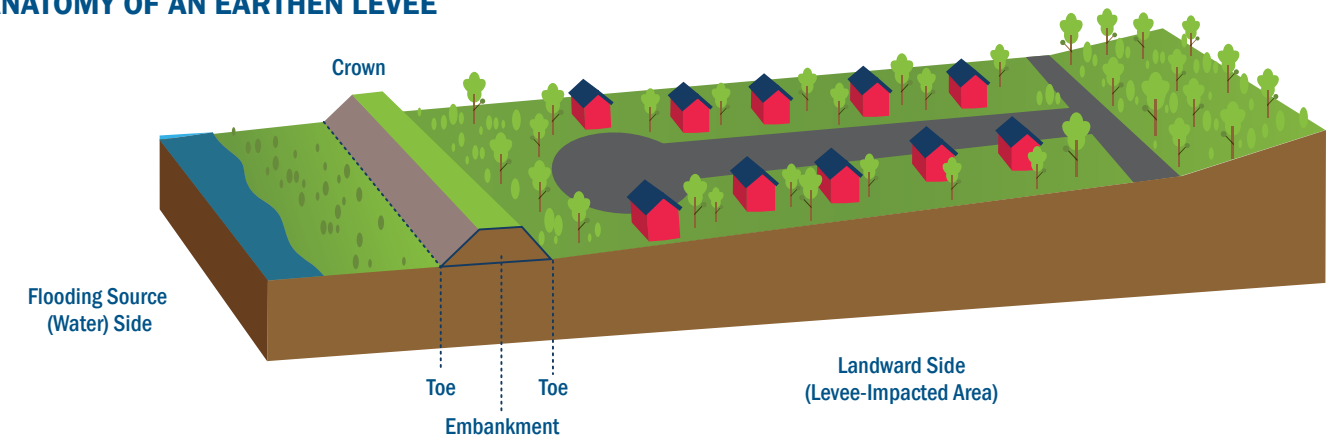


Figure 2-5 Levee Figure – FEMA Coastal Hazards Visual Guide (FEMA RiskMAP)



Figure 2-6 Lakeshore Estates Pump Station (GEC 2019)



Figure 2-7 Mandeville Coastal Jetty (NSI 2019)



Figure 2-9 Floodproofing Wall & Gates – Slidell Memorial Hospital (NSI 2007)

Nonstructural Improvements

Nonstructural flood risk reduction strategies include modifying at-risk structures by raising them above expected flood elevations or providing floodproofing adaptations to the structures to keep out floodwaters. Property acquisitions or buyouts is also a nonstructural strategy in which residents or businesses are relocated, and structures are removed from the flood prone areas.



Figure 2-8 CPRA 2023 Master Plan Nonstructural Risk Reduction Schematic

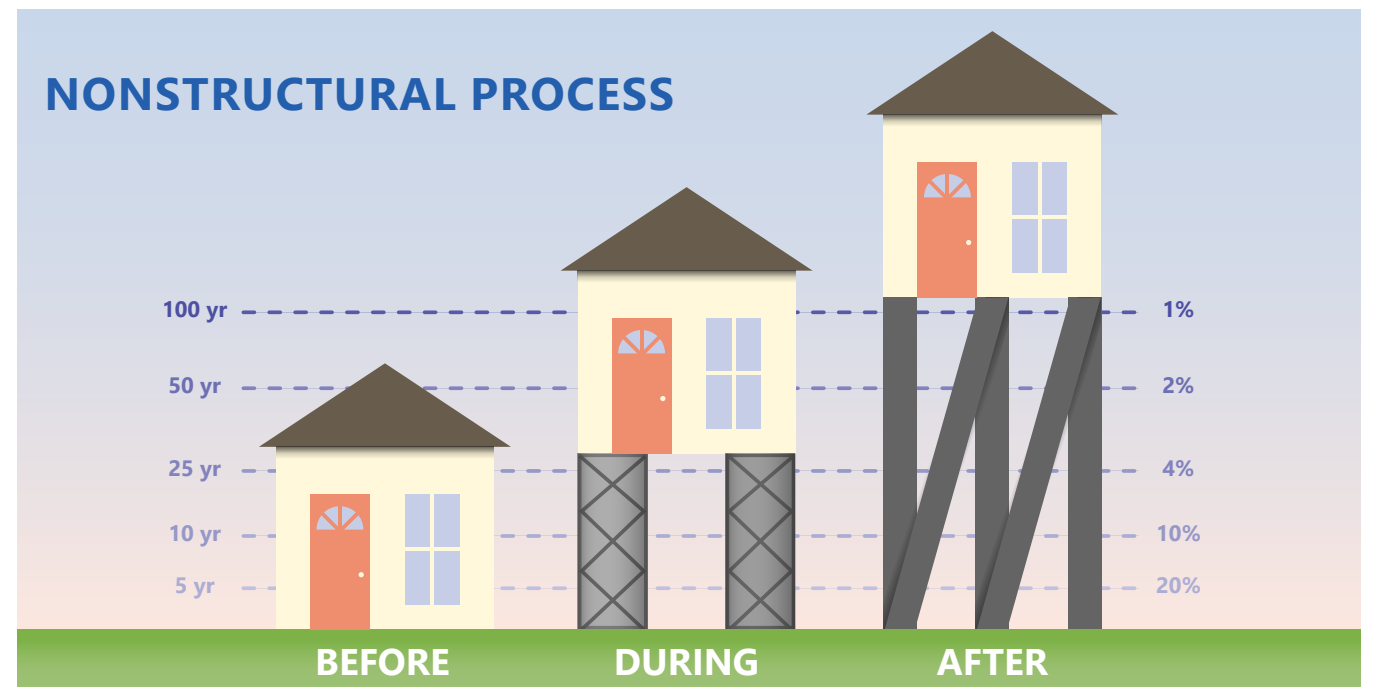


Figure 2-10 House Raising Strategy to remove structures from Flood Zones

2.3.2 Environmental/Ecosystem Restorations

Environmental strategies include working to restore a natural buffer that was historically in an area or to improve the watershed of a community.

Marsh Creation/Nourishment

Marsh restoration of marsh between a coastal shoreline and a community behind the marsh provides a natural buffer. It offers reduced storm surge, increased water quality, and a healthier natural habitat for plant and animal species. Shoreline protection projects can also reduce storm surge and wave erosion and can provide habitat for aquatic organisms.

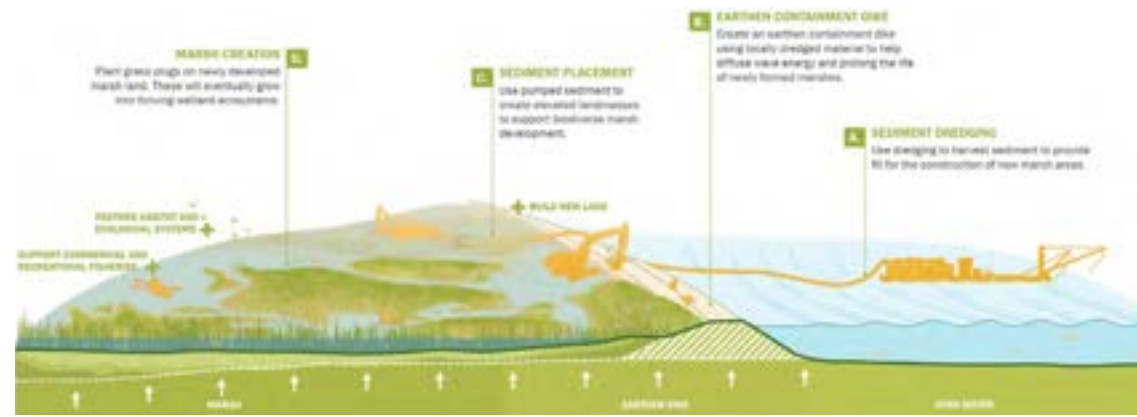


Figure 2-11 Marsh Creation Project Type Visualization (CPRA 2023 Master Plan)

Watershed Management

Watershed management strategies include restoration of the floodplain to improve connectivity or enhancing the hydrologic function of areas within the watersheds. This includes clearing and de-snagging waterways of tree limbs and downed trees. The goal is to restore the natural or historic flows within a watershed.



Figure 2-12 LWI Watershed Illustration

2.4 Policy Considerations & Changes

St. Tammany Parish's approach to flood risk reduction has been evolving since 2005. As a result of Hurricanes Katrina and Rita, the State of Louisiana enacted stricter building codes and adopted conservative flood approaches statewide. At the Parish level, St. Tammany identified Critical Drainage Areas within the Parish (see Figure 2-13) and developed more stringent guidelines for development within these critical drainage areas. These requirements included reducing or eliminating development in flood prone areas, and hydraulic and hydrologic modeling for future developments documenting rainfall runoff rate reductions.

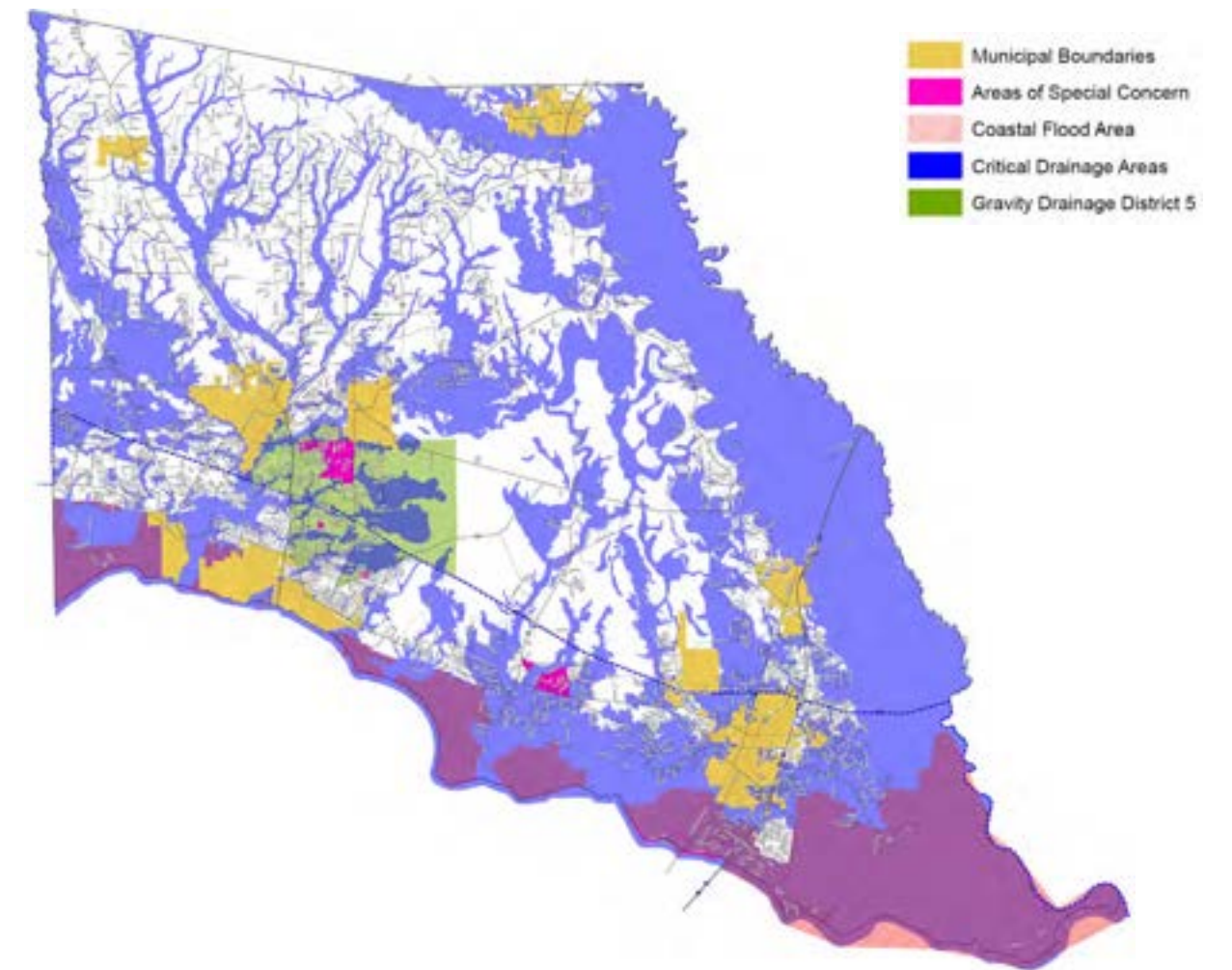


Figure 2-13 St. Tammany Parish Government Critical Drainage Map (Courtesy of St. Tammany Parish Government)

2.5 St. Tammany Parish Coastal Protection Project (PO-167)

Even with changes to policies and building codes, St. Tammany Parish is faced with increased coastal flood risk. St. Tammany Parish will remain highly flood prone in both its coastal zone and areas north for all three types of flooding. As such, St. Tammany Parish Government along with State and local partners, initiated efforts to develop a program that addresses flood risk, increase resiliency, and restore and maintain coastal wetlands throughout St. Tammany Parish.

Neel-Schaffer, Inc. (NSI) and its team (GEC, J.V. Burkes and Associates, and Eustis Engineering) were selected by St. Tammany Parish Government (STPG) to assist in developing the St. Tammany Parish Coastal Protection Project (PO-167). This report covers the steps taken to develop the comprehensive plan for St. Tammany Parish. Additionally, this report provides a summary of historic and current studies by state and federal agencies that consider flood risk reduction within the Parish. The report also provides a summary of work completed and recommendations for projects to be implemented. Detailed information for those projects, including the development of conceptual project alternatives, budgetary cost development, conceptual engineering requirements, and estimated environmental impact with associated costs are included.



Chapter 3 Previous & Ongoing Studies, Agency Coordination

While local efforts and strategies are being implemented at the Parish level, other state and federal agencies recognized a need for investments in flood reduction projects in St. Tammany Parish. Several studies started in the early 2000s are being updated as new modeling, data, and demographics become available.

3.1 2012 Northshore Hurricane & Flood Protection Study

In 2012, the Coastal Protection Restoration Authority (CPRA), St. Tammany Parish Government Officials, Tangipahoa Parish Government Officials, and Gulf Environmental Consultants (GEC), teamed on a project to assess flood risk, evaluate existing coastal/flood protection projects, look at long term growth and to prioritize future projects. The resulting Northshore Hurricane and Flood Protection Plan was considered a reconnaissance and guidance document for state and local officials seeking to gain a better understanding of the dynamic interface between the natural, anthropogenic, and hazard environments of the region. By summarizing existing conditions, identifying vulnerabilities, categorizing protection projects, the primary goal offered a path forward for hot-spots of flood activity.

The study ultimately recommended focusing efforts on localized smaller scale projects. Vulnerable areas across the Parishes with known flooding problems were characterized by flooding causes, type of flooding, social and economic vulnerability, and potential flood mitigation methods. It was recommended that stakeholders communicate and prioritize the areas of need, then implement projects over time as funding becomes available. In areas with multiple risks, it recommended addressing the most pervasive and significant hazard first. Beyond structural measures, adoption and enforcement of building codes and elevation of homes was also recommended. Finally, it suggested that the Parishes coordinate with the Federal government to identify, study, and fund large scale projects.

3.2 St. Tammany Parish Coastal Study (PO-167)

In 2018, St. Tammany Parish Government received State funding for a comprehensive flood protection plan to build upon the data collected in the 2012 Northshore Hurricane and Flood Protection Plan. This plan is a collaborative effort between St. Tammany Parish Government and the St. Tammany Levee, Drainage and Conservation District (STLDCD), funded from the Coastal Protection and Restoration Authority (CPRA) through an Intergovernmental Agreement. NSI and its team (GEC, J.V. Burkes and Associates, and Eustis Engineering) were selected by STPG to assist in developing the comprehensive plan, known as the St. Tammany Parish Coastal Protection Project (PO-167).

The initial phase of this study consisted of a comprehensive inventory of existing flood control assets. This included information on stakeholders, identification of flood prone areas, a summary of completed and proposed projects, descriptions of planning areas, and a creation of a GIS database. Next, information was compiled on completed hydrology and hydraulic modeling efforts, FEMA flood maps, existing repetitive loss data, historic flood events, existing levees within the coastal zone, existing drainage districts, non-structural projects for the Parish, and geotechnical investigations within the

Coastal Zone. Finally, the three coastal zone planning areas (West, Central, and East) were described including information on recently completed and proposed projects.

This was followed by a gap analysis to identify areas within the Parish that are vulnerable to flooding or in need of ecological restoration. This effort was completed in March 2020. Based on the findings, recommendations were made for further action and projects were provided to address the gap areas. The following projects were recommended:

3.2.1 Structural Projects

- Eden Isle Levee
- Lacombe Levee
- Mandeville Seawall Improvements and Shoreline Protection
- Slidell Levee – CPRA Master Plan Project (001.HP.13)
- West Slidell Levee

3.2.2 Nonstructural Projects

- Nonstructural Risk Reduction Master Planning

3.2.3 Watershed Projects

- W-14 Canal Drainage Improvements

3.2.4 Restoration Projects

- Big Branch Living Shoreline
- Fritchie Hydrologic Restoration
- Fritchie North Marsh Creation
- Guste Island Living Shoreline
- Guste Island Marsh Creation
- Mandeville Lakefront Living Shoreline and Marsh Creation
- Mandeville Lakefront Wetlands Restoration
- New Orleans East Landbridge Restoration
- Northshore / Eden Isle Breakwater
- Pearl River Island Shoreline Protection and Restoration
- St. Tammany Marsh Creation
 - Cane Bayou Marsh Creation
 - Bayou Lacombe Marsh Creation
 - Faciane Canal Marsh Creation
- Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement and Marsh Restoration
- Vegetative Tree Planting Program
- West Shoreline Protection

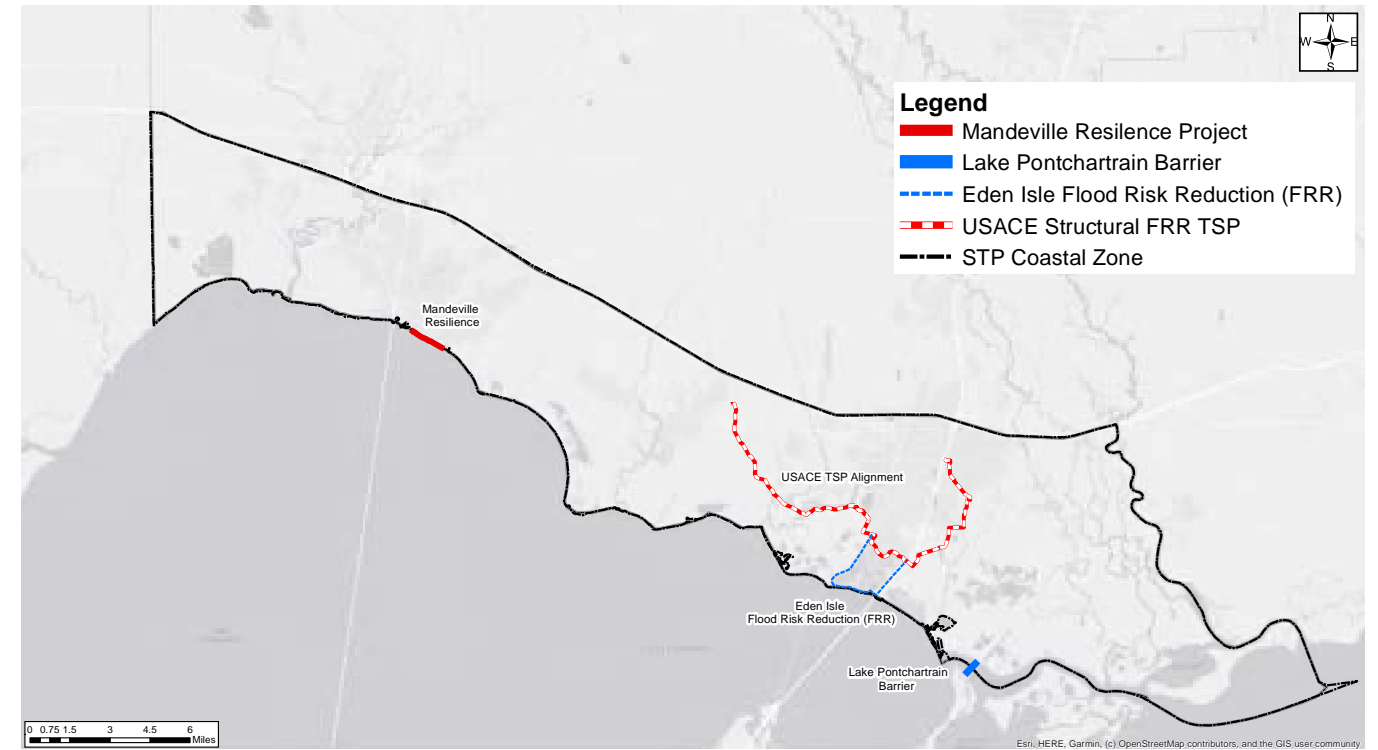


Figure 3-1 PO-167 Recommended Structural Projects

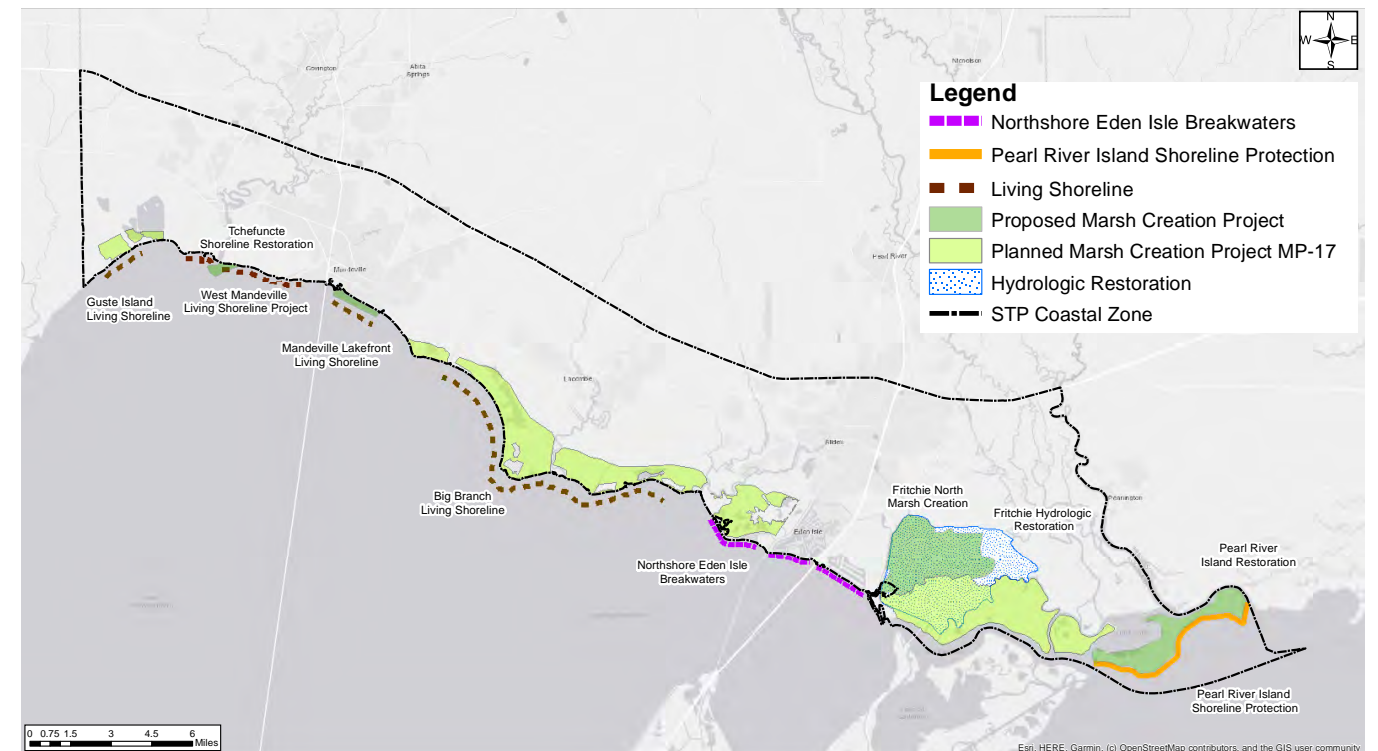


Figure 3-2 PO-167 Recommended Restoration Projects

At the completion of the data collection and gap analysis, the PO-167 project focused efforts on specific project features, costs, and benefits. Coordinating with St. Tammany Parish Government and the St. Tammany Levee, Drainage, and Conservation District, work started on the final phase of the PO-167 project in 2021. In addition to the structural projects listed in 3.2.1, levee alignments for Military Road and of the Lake Pontchartrain Barrier are considered. Conceptual engineering and design for a resiliency project in Eden Isle, and engineering support for the USACE West and South Slidell Alignment are also included.

This report provides a summary and recommendations of flood risk reduction (structural and nonstructural) and ecosystem restoration projects to be implemented with the goal of reducing flood risk, increasing resiliency, and restoring and maintain coastal wetlands.



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3.3 USACE St. Tammany Parish Feasibility Study

The St. Tammany Parish, Louisiana Feasibility Study (study) for flood damage reduction was authorized by Subtitle B, Section 1201 (14) of the Water Resources Development Act (WRDA) of 2016. The study, by the United States Army Corps of Engineers (USACE), includes all of St. Tammany Parish and will issue an Integrated Feasibility Report with Environmental Impact Statement once completed. An initial draft was published in June 2021 with a revised draft released in July 2023. The study is considering a 50-year period of analysis from 2032 to 2082.

3.3.1 Problems & Opportunities

The USACE Feasibility Study develops alternatives to reduce disruptions, damages, and economic impacts to the Parish from repeated, widespread flooding events caused by a variety of factors. Specific planning objectives to address this problem included:

- Public Safety – Decrease risk to public safety during flood events.
- Flood Damages – Reduce the risks of flood damage to public, governmental, commercial, and residential properties and infrastructure.
- Community Resilience – Improve the communities’ ability to prepare, mitigate, and recover from flood events.
- Evacuation – Increase the reliability of the national transportation corridors (I-10, I-12, and I-59) reducing interruptions and flooding to evacuation routes used for flood events.
- Natural Resources – Protect the function and increase the resiliency of the ecosystem to reduce flood damages.

3.3.2 Alternatives

Through the USACE’s comprehensive screening process various management measures were reduced to eight (8) alternatives that were evaluated in further detail. The selected alternatives were:

Alternative 1 – No Action – Future without project condition (FWOP)

A No Action alternative is required by the National Environmental Policy Act (NEPA). It forms a basis by which other alternatives are compared. Under the No Action Alternative for this study, no management measures would be implemented and flooding issues in the Parish would persist.

Alternative 2 – Nonstructural

Standalone nonstructural measures do not change the nature of the flooding but mitigate or prevent damages from the flooding. Examples include floodproofing, structure raising, property acquisition or buyouts, and relocations. This alternative was screened out as a standalone; however, nonstructural measures were included in the selected alternative.

Alternative 3 – Lake Pontchartrain Surge Reduction

Weirs and gates in the Rigolets and Chef Menteur Pass to reduce hurricane storm surge. This alternative had a negative benefit-cost ratio (BCR) *“based on the effectiveness of the measure reducing flood risk and the estimated implementation cost being higher than potential damages avoided.”*

Alternative 4 – Lacombe

Variations of a levee to reduce flooding in the Lacombe area. This alternative was screened out due to a negative BCR.

Alternative 5 – Bayou Liberty / Bayou Vincent / Bayou Bonfouca

A detention pond on Bayou Bonfouca, channel improvements along Bayou Liberty and Bayou Patassat, and a West Slidell Levee with floodgates and pump station. Of these, Bayou Bonfouca and Bayou Liberty were screened out while Bayou Patassat and West Slidell Levee were carried forward to the selected alternative in the June 2021 draft study. However, Bayou Patassat was screened out in the July 2023 draft, leaving only the West Slidell Levee in the selected alternative. Additionally, the West Slidell Levee was incorporated into the Alternative 6 during the Optimized TSP development conducted in 2022.

Alternative 6 – South Slidell Storm Surge

Variations of a levee system with pump stations in South Slidell incorporating most of the existing levees which surround the City of Slidell. One of the variations of this alternative was moved forward to the selected alternative.

Alternative 7 – Eastern Slidell

A diversion at Gum Bayou, improvements to Poor Boy Canal and Doubloon Bayou, and a levee along the Pearl River. This alternative was screened out due to a negative BCR.

Alternative 8 – Upper Tchefuncte / Covington

Channel modifications to Mile Branch River and Lateral “A” in Covington. The Mile Branch improvements were moved forward to the selected alternative, but the Lateral “A” improvements were screened out due to negative BCR and ineffectiveness of reducing flooding.

Alternative 9 – Mandeville Lakefront

Three variations of replacing and raising the existing seawall along the Mandeville Lakefront, along with other improvements including floodwalls, floodgates, or pumps. All measures of Alternative 9 were screened out due to negative BCR.

3.3.3 Tentatively Selected Plan

Selected measures from each of the alternatives considered in 3.3.3 were combined into a final Tentatively Selected Plan (TSP). This plan includes the construction of approximately 16.3 miles of hurricane and storm damage risk reduction levees and floodwalls extending from west Slidell to the east of Slidell, five (5) pump stations, five (5) floodgates, road ramps, channel improvements to Mile Branch in Covington, and nonstructural home elevations and floodproofing of structures in the Parish. The proposed action would reduce flood risk to approximately 26,600 structures in the study area. Table 3-1 shows initial construction costs and the number of structures benefitted for each project feature. Figure 3-3 shows mapped features of the TSP.

Table 3-1 Project costs and structure benefits

Project Component	First Cost	Structures Benefitted
South Slidell & West Slidell Levee	\$2,440,973,000	20,000
Mile Branch Channel Improvements	\$77,002,000	250
Nonstructural	\$1,934,084,000	6,410
TOTAL:	\$4,452,059,000	26,600

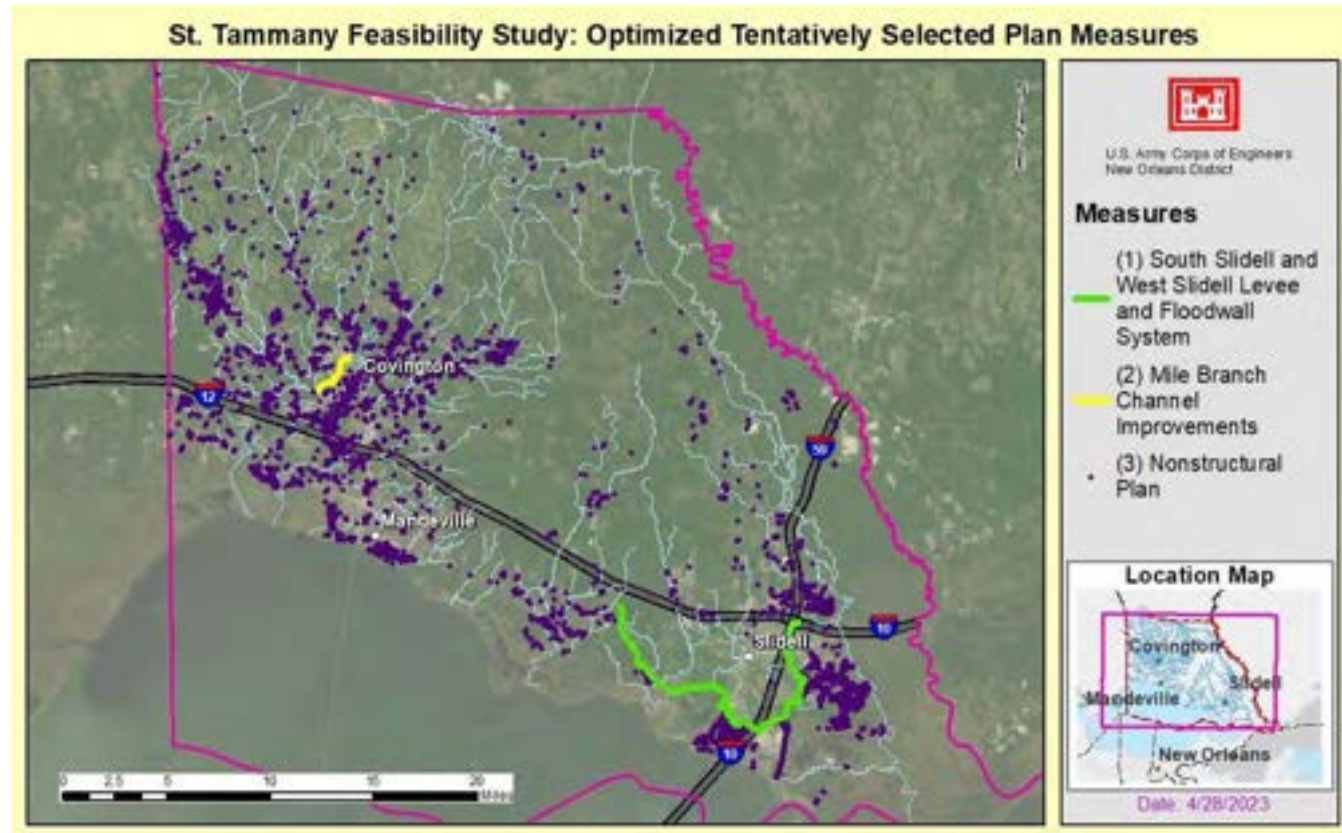


Figure 3-3 Tentatively Selected Plan

3.3.4 Next Steps

The revised July 2023 draft is currently out for public review. The comment period ends early September 2023. Finalization of the study expected by the end of 2023. A Chief of the Army report is expected by mid-2024 and subsequent inclusion in the WRDA bill in summer or fall of 2024.

3.4 Louisiana’s Comprehensive Plan for a Sustainable Coast (CPRA Master Plan – 2023)

The Louisiana Coastal Protection and Restoration Authority (CPRA) publishes a Coastal Master Plan every six (6) years as a guiding document for the State’s coastal protection and restoration efforts. Projects are developed using the available science and proposed for implementation during a 50-year planning period. The most recent version of the Master Plan was released in draft format in January 2023. Public comments were compiled, addressed, and the Plan was sent to the State Legislature. The 2023 Master Plan received approval by the State Legislature in May 2023.



The Master Plan uses a regional approach taking into account local variabilities in land loss rates, mechanisms, and effectiveness of different project strategies. Under this regional approach, St. Tammany Parish lies within the Pontchartrain/Breton region. This region includes Lake Pontchartrain, Lake Borgne, the Mississippi River, and the Pearl River, among others, that have a large effect on regional geomorphic processes. This area has some of the largest population densities in the state and susceptible to some of the largest storm surges in the state, resulting in unique challenges from a flood control standpoint.

3.4.1 2023 Master Plan Projects

The 2023 Master Plan includes three (3) projects in St. Tammany Parish: Lake Pontchartrain Barrier, Slidell Ring Levees, and Fritchie North Marsh Creation. Several projects were notably omitted from the 2023 Master Plan that are included in the 2017 Master Plan described in Section 3.4.2.

Flood Risk Reduction Projects Structural Projects

Lake Pontchartrain Barrier (Project ID #29) – Closure gates and weirs to an elevation of +2.0 feet across Chef Menteur Pass and the Rigolets for storm surge risk reduction, as shown in Figure 3-4. Most of this project is within Orleans Parish; however, it does tie-in to St. Tammany Parish north of the Rigolets and provides flood reduction benefits to St. Tammany. The total (planning, engineering, construction, and operations and maintenance) cost range for the project is \$1.9 – \$2.9 billion.

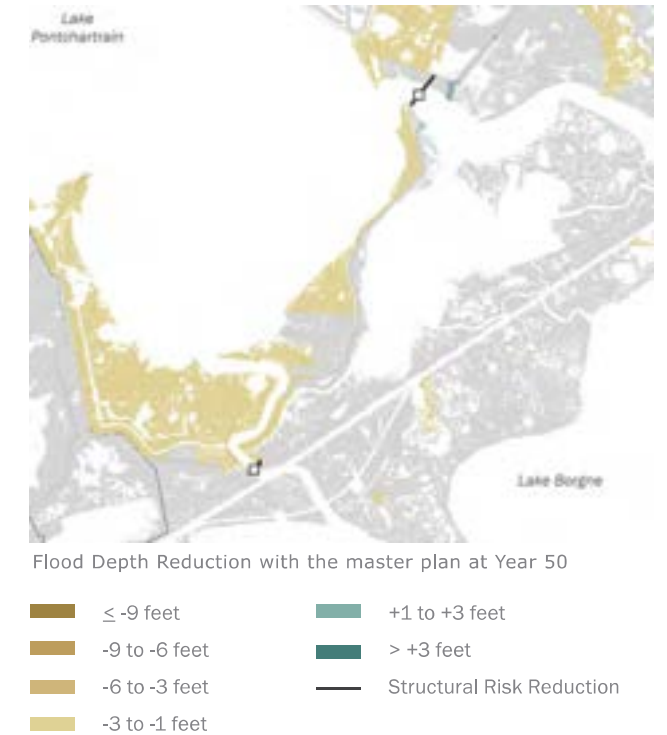


Figure 3-4 Lake Pontchartrain Barrier Project Features and Estimated Storm Surge Reduction. (CPRA 2023 Coastal Master Plan)

Slidell Ring Levees (Project ID #32) – A flood control system to an elevation of +13 to +17 feet around the City of Slidell, as shown in Figure 3-5. The system would include approximately 76,000 feet of earthen levee, 11,000 feet of T-wall, three barge gates, and two stop-log gates. The total cost range for the project is \$390 – \$460 million. The alignment of this proposed project is generally coincident with Alternative 6 – South Slidell Storm Surge from the USACE Feasibility Study.

Nonstructural Projects

Specific nonstructural projects are not identified, but are consistent with the Master Plan. This decision was based on the fact that most nonstructural projects are carried out at the local scale through a variety of State and Federal programs.

Non-structural measures include floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet. A total of \$11.2 billion for nonstructural projects coastwide are estimated.

Ecosystem Restoration Projects

Fritchie North Marsh Creation (Project ID #249) – The Fritchie North Marsh Creation Project consists of creation and nourishment of 4,400 acres of marsh east of Slidell, as shown in Figure 3-6. The total cost range for this project is \$99 – \$120 Million.

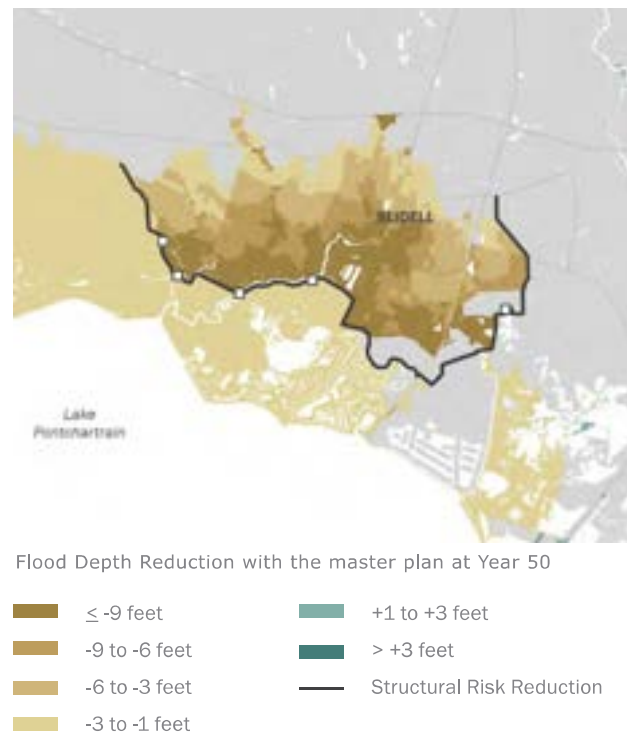


Figure 3-5 Slidell Ring Levees and Estimated Storm Surge Reduction.

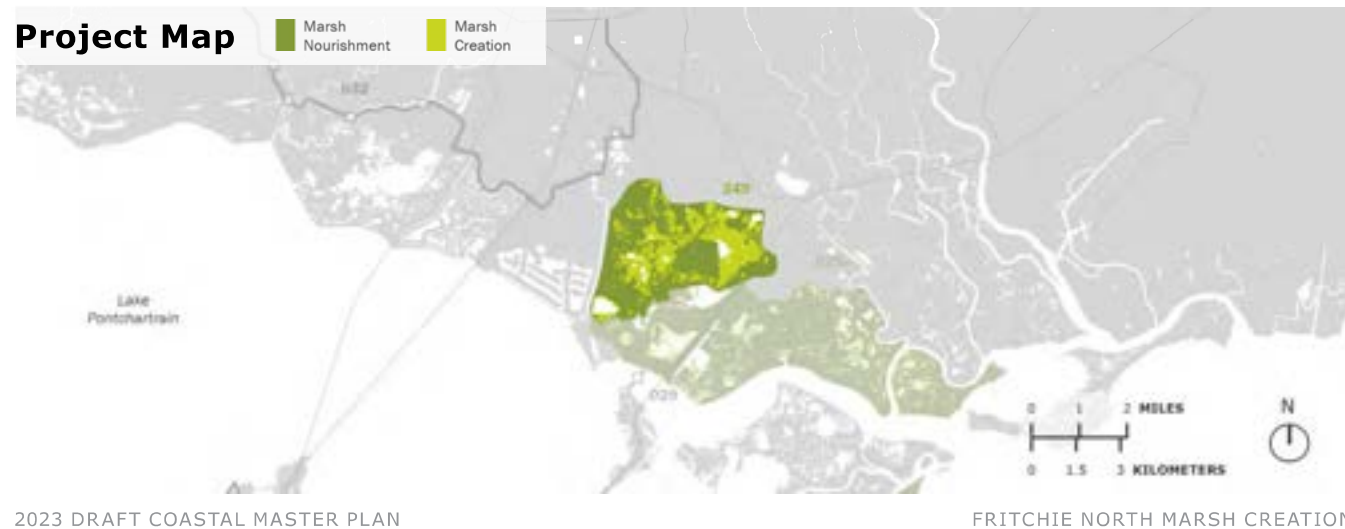


Figure 3-6 Fritchie North Marsh Creation Location.

3.4.2 2017 Master Plan Projects

The 2017 Master Plan evaluated nine (9) projects in St. Tammany Parish and ultimately included a combination of project types. They are described in the subsections below and shown in Figure 3-7. Note that project costs associated with each project are listed in 2017 dollars. As noted in Section 3.4.1, several of the projects listed here are not included in the 2023 Master Plan. These projects are described here for context and to show where emphasis has previously been placed by the State.

Flood Risk Reduction Projects

Structural Projects

Lake Pontchartrain Barrier (001.HP.08) – Closure gates and weirs to an elevation of 2 feet across the passes at Chef Menteur and the Rigolets for storm surge risk reduction within the Lake Pontchartrain Basin. Project features approximately 5,200 feet of earthen levee, 630 feet of a combi-wall weir constructed to 2 feet, a 150-foot closure gate at each pass for navigation, and multiple vertical lift gates to maintain tidal exchange through the passes. The 2017 cost for this project was \$2,409,600,000.

Slidell Ring Levees (001.HP.13) – A levee to an elevation of 16 feet for storm surge risk reduction around Slidell. Project features approximately 31,000 feet of earthen levee and 14,500 feet of T-wall. The 2017 cost of this project was \$181,300,000.

Nonstructural Projects

St. Tammany Nonstructural Risk Reduction (STT.01N) – Nonstructural project consisting of floodproofing, elevation, and acquisition. The 2017 cost for this project was \$1,611,300,000.

Restoration Projects

Guste Island Marsh Creation (001.MC.108) – 700 acres of marsh along the northwest Lake Pontchartrain shoreline to create new wetland habitat and restore degraded marsh. The 2017 cost for this project was \$64,400,000.

St. Tammany Marsh Creation (001.MC.106) – 6,700 acres of marsh in St. Tammany Parish along the northern shore of Lake Pontchartrain to create new wetland habitat and restore degraded marsh. The 2017 cost for this project was \$199,300,000.

New Orleans East Landbridge Restoration (001.MC.05) – 11,600 acres of marsh to create new wetland habitat and restore degraded marsh. The majority of this project is located in Orleans Parish, with only the northernmost portion of the project in the Fritchie Marsh Area within St. Tammany Parish. The 2017 cost for this project was \$396,500,000.



Figure 3-7 2017 CPRA Master Plan Projects.

3.5 Slidell Levee System – Eastern Segments (PO-184)

The gap analysis conducted the St Tammany Coastal Study (PO-167) provides recommendations for further actions to address flood protection and restoration gaps in the St. Tammany Coastal Zone that are vulnerable to coastal storm surge, flooding, and wetland loss/reduction and that lack either the assets or projects to address the concerns. CPRA selected an area on the eastern portion of the Slidell Levee System for additional analysis. This project became known as the Slidell Levee System - Eastern Segments or PO-184 project. The analysis performed within the PO-184 project concluded a need for flood protection on the eastern side of Slidell and developed two sections lacking flood protection: (1) Lakeshore Estates to Kingspoint and (2) Kingspoint to US Hwy 190.

3.6 Louisiana Watershed Initiative

As a result of two historic rainfall events in 2016, both of which severely impacted St. Tammany Parish, the state of Louisiana established the Louisiana Watershed Initiative (LWI), a statewide, watershed-based floodplain management program. This initiative is being managed by the Council on Watershed Management comprising the Office of Community Development, Coastal Protection and Restoration Authority, Governor’s Office of Homeland Security and Emergency Preparedness, Department of Transportation and Development, and the Department of Wildlife and Fisheries. The Council on Watershed Management is focused on empowering local jurisdictions and communities to implement regional, long-term solutions to flood risk reduction. This involves the delineation of programmatic policy and coordination strategies into four areas, beginning with those initiatives that represent high benefit, low risk actions. The four areas include: 1) watershed monitoring,



mapping and modeling; 2) cost share assistance and coordination; 3) watershed-based programs and projects; and 4) large scale projects and programs.

The \$1.2 billion program will primarily provide funding for planning, acquisition, infrastructure, code enforcement, public services, buyouts and housing activities related to resettlement, economic development and/or other public facilities projects that increase resilience to floods on a watershed level. The overall program consists of several sub-programs by which the funds will be disbursed:

1. Local and Regional Projects and Programs
2. State Projects and Programs including \$87 million in the Statewide Buyout Program
3. Regional Capacity Building Program
4. Statewide Data and Modeling Program
5. Nature-Based Solutions Program
6. Non-Federal Cost Share Assistance Program
7. Workforce Development Program Professional Resilience Occupations (PRO) Louisiana

The Council on Watershed Management has approved nine provisional watershed regions to coordinate flood risk reduction efforts among parishes and distribute project funds. St. Tammany Parish is part of Region 7, which consists of all or parts of St. Tammany, Washington, Tangipahoa, St. Charles, St. John the Baptist, Livingston, St. Helena, and West Feliciana Parishes. St. Tammany Parish, working with their regional partners through the framework of watershed management entities, is responsible for identifying and prioritizing the programs and projects to submit for funding opportunities that result in demonstrable flood mitigation.

3.6.1 Local & Regional Projects & Programs

In 2021, as part of Round 1 of this program, \$100 million was awarded for 29 projects. The focus of these projects was low risk projects ready for implementation. Of these projects, three were selected in St. Tammany Parish, all in Slidell:

1. **Dellwood Drainage Pump Station Hardening** – Construction of mechanical bar screens in front of the Dellwood Drainage Pump Station intake basin. Construction Cost is \$3.3 million.
2. **East Slidell Levee** – Construction of of earthen levees connecting the Kingsport East Levee to U.S. Highway 190. Construction cost is \$2.85 million. This project was initially selected as part of Round 1, but was subsequently removed because it did not progress to be ready for implementation. The project will be resubmitted in later rounds of funding requests.
3. **Lee Street Drainage Pump Station Hardening** – This project consists of construction of mechanical bar screens in front of the Lee Street Drainage Pump Station intake basin. Construction cost is \$1.83 million.

Round 2 of the Program will consist of a second \$100 million dollar funding opportunity. For this round, projects must benefit low to moderate income and disadvantaged communities that were most impacted by the 2016 floods. Round 2 funding is expected to be awarded in 2023.

Also ongoing as part of the Local and Regional Projects and Programs is the Design Support Program, that provides technical assistance for projects submitted in Round 1 but did not receive funding. This program focuses on HUD-identified most impacted and distressed areas and low to moderate income populations and projects that incorporate nature-based solutions. One such project was \$2.6 million to the City of Covington for assistance with their Lift Station Panel Elevations.

Round 3 is forthcoming and will award flood risk reduction projects justified by completed watershed models and nature-based solutions tools.

3.6.2 State Projects & Programs – Statewide Buyout Program

The LWI includes an \$87 million statewide buyout program. This program makes available funding for voluntary buyouts in flood-prone areas. It is designed to provide and incentivize (payment above market value) low to moderate income residents for relocation to areas of lower flood risk. St. Tammany Parish was awarded \$10 million for this program. The project area has been identified as the Averitt Estates neighborhood, and contract negotiations are underway.

3.6.3 Regional Capacity Building Program

This program will provide funding to help the nine watershed regions build staff capacity and provide technical assistance to partners throughout each region. Phase 1 will provide \$400,000 to aid in the formation of regional steering committees to develop work plans and make recommendations for long-term watershed coalitions. Phase 2 will provide \$800,000 to implement recommendations from Phase 1 and to develop regional flood risk reduction strategies, implement resilience standards, and advance steering committee recommendations. St. Tammany Parish will select personnel and attend these trainings and meetings to become integrated in this effort.

3.6.4 Statewide Data & Modeling Program

The Statewide Data and Modeling Program is underway to create models of Louisiana’s watersheds to simulate flood scenarios and analyze potential flood mitigation solutions. Development of base models with calibration and validation are expected to be complete by the end of 2023. The Water Institute for the Gulf will undertake the effort of tying together the inland models with coastal models in 2024.

3.6.5 Nature Based Solutions Program

This program focuses on prioritizing nature-based solutions to reduce flood risk and improve water quality. Projects accomplishing goals and training with technical resources will be made available to advance the understanding of nature-based solutions. Several training modules are currently available via the LWI website.

3.6.6 Non-Federal Cost Share Assistance Program

The state will provide \$112 million for cost-share assistance for eligible Federal programs. Programs include FEMA Hazard Mitigation Grant Program, FEMA Non-hazard mitigation programs, USDA Natural Resources Conservation Service grants, and other Federal programs. The state will use Community Development Block Grant funds to cover the home-owner required 25% cost share associated with Hazard Mitigation Grant Program funds received from FEMA as a result of the 2016 floods and 2020 hurricanes. St. Tammany Parish was awarded separate cost-sharing funds of \$3.7 million and \$2.3 million as a result of the 2016 floods. Projects implemented or discussed for implementation with the funds are raising of over 150 homes, floodplain storage in the Bogue Falaya Basin, and elevation of roads in eastern St. Tammany.

3.6.7 PRO Louisiana

PRO Louisiana is a workforce development program which supports training courses for occupational skills such as heavy equipment operations, resilient construction methods, and flood risk analysis. PRO Louisiana courses began in spring 2022, with six Louisiana community colleges offering the courses.

3.7 St. Tammany Comprehensive Drainage Plan

The St. Tammany Comprehensive Drainage Plan is the first parish-wide drainage plan to assess stormwater runoff across the entirety of St. Tammany Parish and its associated watersheds. The plan is focused on assessing the existing state of drainage (including flood risk), water quality, and development guidelines. The plan also will recommend capital projects and potential policy changes that will lead to reduced flood risk and increased public safety and welfare.

The Parish is currently in the data collection phase. Public meetings were held in Fall 2022. Public comments are being accepted for consideration via an interactive map. The next phase is expected to begin in mid-2023 and will involve more detailed analyses.

3.8 St. Tammany Parish New Directions 2040

New Directions 2040 is the Comprehensive Master Plan for St. Tammany Parish adopted in May 2022. The goal of the Plan is to guide public and private decision making about land use and changes in the community’s physical development. The Plan is required by St. Tammany’s Home Rule Charter to “prepare, enact, enforce and maintain comprehensive plans for the development of the Parish.” It includes “an overall plan for land use by public, commercial and residential interests; traffic and transportation issues; economic and demographic growth; water and drainage concerns”.

Specific plan elements are detailed in the document that will help achieve the larger vision of the Comprehensive Master Plan. These elements are:

1. Land Use and Development
2. Mobility, Transportation, and Utilities
3. Living with Nature
4. People and Communities
5. Business and Economy

Two of these plan elements – Land Use and Development and Living with Nature, relate to management of water and natural resources and have goals and policies that have some crossover with similar issues being addressed by other studies.

3.8.1 Land Use & Development

Land use and development is addressed as an element in the Comprehensive Master Plan to help guide future growth in the parish. Eight (8) land use goals are laid out in the Plan with related strategies or policies to achieve these goals. The goals that are directly or indirectly related to flood protection or restoration issues are listed below:

- **Goal 3:** The character of existing residential areas, expansive rural landscapes, and sensitive ecological areas will be preserved.
- **Goal 4:** Land and buildings will be developed in ways that lower the risk and incidence of flooding and flood damage caused by rainfall and storm surge.
- **Goal 6:** New development and redevelopment will be environmentally sustainable.
- **Goal 7:** Resilient building and land development practices will reduce or eliminate the potential impact of flood and wind hazards, particularly at critical facilities.

3.8.2 Living with Nature

Living with Nature is addressed as an element in the Comprehensive Master Plan to ensure that as the Parish grows, it can continue to live in harmony with nature and protect and preserve the natural environment. Seven (7) goals are laid out in the Plan to achieve this element. The goals that are directly or indirectly related to flood control or restoration issues are listed below:

- **Goal 1:** A robust, integrated system of publicly owned, nonstructural and structural flood protection and drainage infrastructure will minimize flash, riverine, and coastal flood risk and the frequency and severity of flood damage.
- **Goal 2:** Viable examples of critical and sensitive areas, including native plant and animal habitats, tree resources, and wetlands, will be conserved, protected, stable, and flourishing.
- **Goal 3:** Our waterways, watersheds, floodplains, and groundwater will be protected, maintained, and restored to maximize water quality and sustain a drinkable water supply.

3.9 2016 St. Tammany Coastal Master Plan

St. Tammany Parish previously published its Coastal Master Plan for the years 2016-2020. The Plan detailed nine (9) projects that would mitigate against further damage to the coast, wetlands, and watersheds of the Parish. The following table provides details and costs for the proposed projects.

Table 3-2 Projects included in 2016 St. Tammany Coastal Master Plan

Project Name	Description	Cost
Home Elevation Project	Elevation of 903 homes in the coastal surge zone.	\$180,600,000
West Shoreline Protection	24,773 linear feet of shoreline protection along Lake Pontchartrain south of Madisonville.	\$11,937,240
Cane Bayou Marsh Creation	4,117 acres of marsh creation and marsh nourishment along the Lake Pontchartrain shoreline near Cane Bayou in the Big Branch Marsh National Wildlife Refuge.	\$66,907,719
Bayou Lacombe Marsh Creation	3,114 acres of marsh creation and marsh nourishment along the Lake Pontchartrain shoreline near Bayou Lacombe in the Big Branch Marsh National Wildlife Refuge.	\$51,571,323
Faciane Canal Marsh Creation	2,853 acres of marsh creation and marsh nourishment along the Lake Pontchartrain shoreline near Bayou Bonfuca in the Big Branch Marsh National Wildlife Refuge.	\$74,222,179
South Slidell Levee Protection	Levee alignment to protect all of South Slidell east and west of I-10.	\$70,450,000
Fritchie North Marsh Creation	4,395 acres of marsh creation and marsh nourishment along the Lake Pontchartrain shoreline near Salt Bayou in the Big Branch Marsh National Wildlife Refuge.	\$104,106,224
Fritchie Hydrologic Restoration	Improved freshwater input to >8,000 acres of Fritchie Marsh via increased inputs from W-14 Canal.	\$4,818,000
Guste Island Marsh Creation	685 acres of marsh creation and marsh nourishment along the Lake Pontchartrain shoreline near Guste Island.	\$27,804,634

3.10 City of Mandeville Flood Resilience Strategy Plan

In April of 2023, the City of Mandeville published the City of Mandeville Flood Resilience Strategy plan, which outlined several key opportunities for flood risk reduction within the City of Mandeville. These strategies included regional scale modeling for watersheds that contribute to flooding within the City, continued adaptation of non-structural home raising throughout the City; establishing, or enhancing green spaces within the City for floodwater storage; and an update to the City of Mandeville’s Comprehensive Plan to guide development and growth. Improved conveyance and living shorelines were also considered flood risk reduction strategies within the plan.

3.11 References

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Genea Lathers, Office of Community Development, email communication, telephone, May 10, 2023.



Chapter 4 Project Approach

As discussed in Chapter 3.0, and in consultation with the St. Tammany Parish Government and St. Tammany Levee Drainage and Conservation District, multiple areas were selected for further evaluation as part of the PO-167 project. The initial effort included reviewing existing geotechnical data and environmental concerns; screening initial levee alignments; developing opinions of probable construction costs. Once poorly rated alignments were eliminated, the remaining alignments were further evaluated.

4.1 Project Datum

The North American Vertical Datum of 1988 (NAVD88) is the vertical datum used for elevations referenced within this report.

4.2 Levels of Protection

Three levels of storm frequency protection are considered for all flood protection projects in developing opinions of probable construction costs and real estate acquisitions. The storm event frequencies are the 4%, 2%, and 1% chance of storm occurrence within a given year also known as the Annual Exceedance Probability (AEP). These frequencies correspond to a 25-year, 50-year and 100-year levels of protection, respectively. Additionally, some areas have resiliency projects which may be a blended level of protection but increase community resiliency to flood conditions.

The selected levels of protection are consistent with the Hurricane Storm Damage and Risk Reduction System (HSDRRS) requirements for 100-year level, and the Louisiana Flood Protection Design Guidelines (LFPDG) for intermediate 50-year and 25-year levels of protection. This provides a range of options for flood protection.

The elevations for levels of protection may be increased to account for items such as wave action, freeboard, additional elevation tolerances to maximize structural life span also known as structural superiority, design factors of safety values, or to allow for settlement, depending on structure type and location.

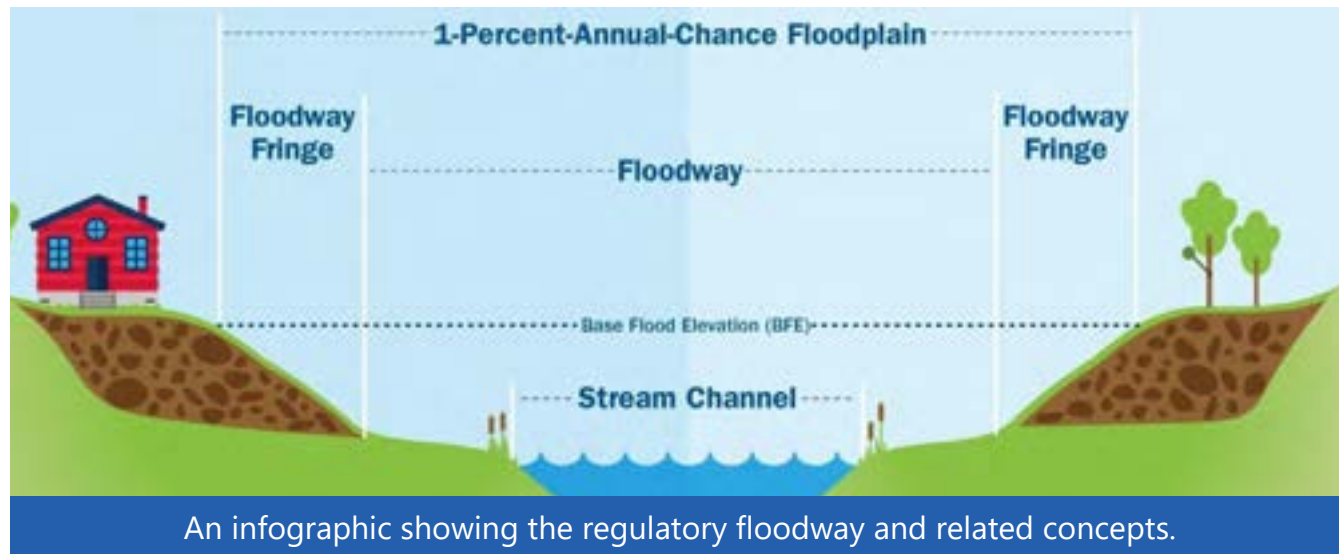


Figure 4-1 1-Percent Annual Chance Floodplain (Credit: FEMA Coastal Floodplain Mapping)

4.2.1 100-Year Design Storms Level of Protection

The 1% or 100-year design storm water surface elevation, or base flood elevation, is used by the USACE and FEMA as the standard for flood protection and risk management. See Figure 4-1. This is the target elevation used by FEMA as the basis for developing flood insurance premiums, as well as the minimum level of protection for federal flood protection projects per the Code of Federal Regulations (CFR). This level of protection is the most expensive and may result in a low benefit to cost ratio in comparison to lesser levels of protection.

The USACE St. Tammany Parish, Louisiana Feasibility Study established a range for the 100-year level of protection in the St. Tammany Parish Coastal Zone from +13.5 feet NAVD88 to +21 feet NAVD88. This range of elevations depend on area of protection and timeline for future flood conditions.

4.2.2 50-Year Design Storm Level of Protection

The 50-year design storm, or 2-percent-AEP, is an intermediate level of protection.

Per the CPRA 2017 Master Plan modeling data, the maximum 50-year still water elevation for a storm in Slidell is +8.3 feet NAVD88. Additionally, wave conditions provided by FEMA and St Tammany Parish and freeboard requirements from the CFR, the height for a 50-year level of protection is +11.0 NAVD88.

Appendix A provides additional details regarding 50-year level of protection.

4.2.3 25-Year Design Storm Level of Protection

The 25-year level of protection is a minimum level of protection to provide risk reduction for the 4% AEP storm (25-year design storm). This elevation is derived from the still water elevation of the 50-year AEP without additional wave conditions to be +8.50 NAVD88. Details regarding the 25-year level of protection can be found in **Appendix A**.



Figure 4-2 Illustration of Various Levels of Protection

4.3 Environmental Impacts

Environmental impacts include permitting and mitigation requirements for the levee alignments and coastal structural protection components.

The environmental review includes:

- Potential direct and indirect impacts or effects the proposed improvements will have on biological and environmental resources of the project and surrounding areas.
- Wetlands/Threatened and Endangered Species screening.
- Permitting coordination with agencies such as St. Tammany Levee, Drainage, and Conservation District, the Louisiana Department of Natural Resources, and the Regulatory Branch of the U.S. Army Corps of Engineers.
- Permitting and mitigation requirements associated with environmental impacts.
- Cost of permitting and mitigation requirements.

Preliminary opinions of probable costs for mitigation of environmental impacts are completed for each alternative.

4.4 Geotechnical Engineering

The geology of the area is based on previous geotechnical exploration investigations, geologic mapping, and geotechnical engineering experience.

The existing historic data, in addition to USACE geologic maps in the area, generally show stiff Pleistocene-aged clays at approximately elevation -7 feet NAVD88. In areas where softer soils are present near the surface and Pleistocene clays are at greater depths, there is a potential for greater settlement and lower factors of safety for levee stability than what is assumed.

Some soil design parameters were extrapolated from the nearest exploration borings, not directly within the footprint of proposed alignments. This representative data may vary from conditions beneath each alignment.

Geotechnical engineering performed for this effort included a geotechnical data gap analysis and conceptual-level geotechnical design recommendations for earthen levees without geotextile reinforcement and pile-supported concrete floodwalls (T-Walls). Also included are levee settlement estimates due to new loading, seepage evaluation for cutoff below the T-walls, deep-seated global stability analyses for levees and T-walls, and allowable axial pile load capacities for the T-walls. The geotechnical conceptual design report prepared by Eustis Engineering, LLC is included as **Appendix B**.

4.4.1 Future Geotechnical Exploration Considerations

Future geotechnical exploration for 1% AEP or 100-year protection should follow the USACE's HSDRRS Design Guidelines. Designs for the 2% AEP or 50-year protection should follow the State's Louisiana Flood Protection Design Guidelines (LFPDG).

4.5 Budgetary Construction Costs for Structural Components

Structural protection components reduce flood risk by acting as a physical barrier against storm surge. Structural protection typically includes one or more of the following components:

- **Earthen Levee** – Compacted earth in a trapezoidal shape that can either be linear or ring. Ring levees form a closed system around an area. Linear levees connect into topographical features. Earthen levees are typically the most cost-effective means of structural protection but require a wide footprint.

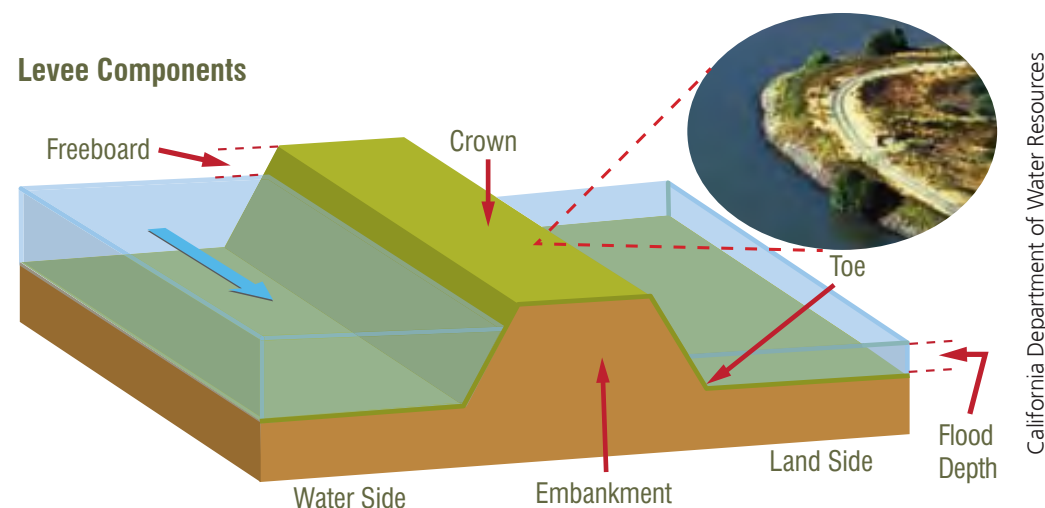


Figure 4-3 Levee Components (Credit: FEMA RiskMap Guide to Levees)

- **Concrete Floodwall** – Floodwalls are located at points along an earthen levee that have a high potential for erosion or insufficient space for the wide footprint of an earthen levee. Depending on the heights and design requirements, the designs considered by the Coastal Protection and Restoration Authority (CPRA) and the U. S. Army Corps of Engineers (USACE) are (in order of increasing levels of height and strength): I-walls, L-walls, and T-walls. Floodwalls are found in conjunction with roadway gates, floodgates, pump stations or other project features that transition through narrowed rights-of-way.

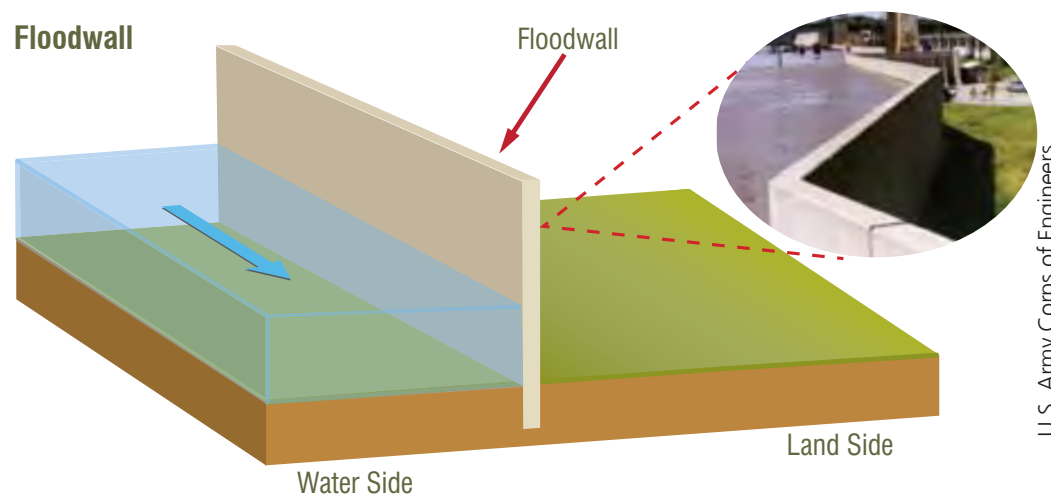


Figure 4-4 Floodwall Components (Credit: FEMA RiskMap, Guide to Levees)

- **Floodgate** – Floodgates are needed where levees and floodwalls intersect a road, railroad, or waterway. They remain open for car, train, or boat traffic but are closed during storm events.

- **Pump Stations** – Pumps are needed in enclosed risk reduction systems to remove rain falling inside the protected area of the levee system.

4.5.1 Development of Budgetary Construction Costs

Historical unit costs from the USACE, Louisiana Department of Transportation (DOTD), and local public agencies were used in developing the construction cost estimates. In addition, unit costs from recently published feasibility studies within the southeast portion of Louisiana were resourced. Unit costs are modified, where applicable, to consider inflation, supply constraints, and other economic influences. A 35% contingency on construction expenses is also included to reflect current uncertainties associated with the cost assumptions.

Typical major items and the unit costs associated with the structural flood protection for this study included:

1. Mobilization and Demobilization
2. Levees
 - a. Clearing and Grubbing
 - b. Geotextile Fabric
 - c. Levee Embankment Material
 - d. Seeding, Fertilizing, and Mulching
 - e. Limestone Surfacing
 - f. Excavation
3. T-Walls
4. Drainage Structures
5. Roadway Roller Gates
6. Navigable Floodgates including Steel Wing Barge Gates and Receiving Wall
7. Pump Stations
8. Miscellaneous Items

4.5.2 Real Estate, Environmental, Utility & Engineering Costs

The alternative development cost analysis includes land acquisition, environmental mitigation, utilities relocation and engineering, planning, and construction management.

Parcel and Property Estimates

The real estate costs are based on records from the St. Tammany Parish Assessor's database. A sampling of the land costs for developed and undeveloped property along each alignment, as well as the approximate structure costs in the area were used to develop unit costs. These values were crosschecked against real estate listed for sale in the same area to determine reasonableness for the values.

The St. Tammany Parish Assessor's Office GIS Parcel Viewer was used to identify the parcels within each proposed alignment footprint. The parcels were tallied and classified as residential or commercial. Structures within the alignment footprints were determined structure acquisitions. Property acquisitions are quantified on a per acre basis.

Using the Assessor's data, the average parcel costs are estimated to be \$186,915 per acre in developed areas. Comparing the Assessor's parcel costs, calculated to be \$39.97 per acre, to active real estate in the area, the undeveloped costs were increased to \$15,000 per acre. A unit cost of \$337,500 per structure was then added to the property acquisition costs to account for those structures directly impacted by an alignment.

Engineering, Design, and Construction Management

The costs for planning, engineering, design, and construction administration and management, are estimated to be 25% of the construction costs.

Utility Relocation

The alignments will cross utilities including telephone, fiber optic communication lines, electrical grid lines, as well as natural gas for end users or petroleum product distribution. Utility relocations are estimated to be 0.5% of construction costs for undeveloped lands and 1% of construction costs for developed properties.

Wetlands Mitigations

Many alignments traverse areas between developed community and undeveloped lands. The undeveloped property range from marsh lands to undeveloped parcels within subdivisions and communities. In general, areas that are considered undeveloped and outside of other developed areas are considered marsh for purposes of developing both real estate costs and mitigation acreage. Alignments with footprints within native wetlands have an environmental cost to rebuild or protect habitat that will be impacted. Current market value for environmental mitigation costs are estimated to be \$60,000 per acre of wetland mitigation.

4.5.3 References

U.S. Bureau of Labor Statistics website. May 2023. PPI Commodity Data for Inputs to other nonresidential construction, goods, not seasonally adjusted. (<https://data.bls.gov/timeseries/WPUIP2312301>)



Chapter 5 Flood Risk Reduction Projects

5.1 Structural Flood Risk Reduction Strategies

5.1.1 Existing Levee System

The existing flood protection in Slidell, and ultimately St. Tammany Parish, is comprised of a discontinuous series of locally owned and maintained levees constructed by local subdivisions, local agencies, and businesses over the years as seen in Figure 5-1. The levees range in elevation from +12.0 NAVD88 to +17.0 NAVD88 and are the basis for the many of the structural project projects in St. Tammany Parish such as CPRA's 2017 Master Plan alignment. With the addition of a series of new levees and floodwalls, the City of Slidell would received more complete protection from the existing structures. However, these systems are not part of the USACE Levee Safety Program. Levee systems providing sufficient risk reduction as measured by FEMA, can be considered for accreditation. The accreditation process, performed by FEMA, considers the operations and maintenance of existing levees. A levee system's accreditation status affects the insurance and building requirements for the community protected by the levee system.

A separate task within this study identified the ownership and funding sources for maintenance of these levees. Using records with the clerk of court offices and other land transaction records, Drainage Districts within the parish documented staffing and funding associated with the maintenance of the levees and pumping stations. These included South Slidell, Oak Harbor, Lakeshore Villages, and Kingspoint Levees.



Figure 5-1 Existing Levee Systems

South Slidell Levees

The South Slidell Levee follows the Norfolk Southern Railroad south from Highway 190, in downtown Slidell, then turns east to Highway 11 just south of Greencrest Drive as marked on Figure 5-1 in orange and yellow respectively, and has an elevation of +12.0 NAVD88. This parcel of land was acquired by St. Tammany Parish in 2010. Details regarding the South Slidell Levee ownership and maintenance are included within the Alford & Alford report in **Appendix D**.

Oak Harbor Levees

The Oak Harbor Levee surrounds the Oak Harbor neighborhood and golf club, outlined in green on Figure 5-1. This levee system, on the west side of Interstate 10 in Slidell, has an elevation of +12 feet NAVD88. A pumping station drains the neighborhood into the Schneider Canal on the northern boundary of Oak Harbor. Details regarding the Oak Harbor Levee ownership and maintenance are included within the Alford & Alford report in **Appendix D**.

Lakeshore Villages Levees

The ring levee surrounding the Lakeshore Villages, outlined in blue on Figure 5-1, is a privately owned levee owned by the Lakeshore Villages Community Development District. The levee was constructed to an elevation of +17.0 feet NAVD88 and has a Letter of Map Revision (LOMR) which allows the interior neighborhood to benefit from lower insurance premiums. Additional details regarding the Lakeshore Villages ownership and maintenance requirements are included within the Alford & Alford report in **Appendix D**.

Kingspoint Levees

The Kingspoint Levee, outlined on Figure 5-1 in purple, is within the boundaries of Drainage District No. 4 of the St. Tammany Parish. The earthen levee surrounds the Kingspoint neighborhood at an elevation of +12.0 feet NAVD88. There is an annual parcel fee per lot to address maintenance of the levees and pumping station. Details regarding the Kingspoint ownership and maintenance are provided in a separate report.

5.1.2 USACE Tentatively Selected Plan South Slidell with West Slidell Levee

Project Location

West Slidell

West Slidell, as seen in Figure 5-3, is a roughly 25 square mile area south of Highway 190 and north of the Big Branch Marsh National Wildlife Refuge. It is located east of Lacombe, west of the City of Slidell, and is a low-lying area with elevations ranging from +12 feet NAVD88 at Highway 190 down to +1.0 foot NAVD88 at the shoreline of Lake Pontchartrain. The Big Branch Marsh National Wildlife Refuge makes up the largest part of the West Slidell area with 11 square miles of marshland. The area north of the Big Branch Refuge consists of residential subdivisions such as Coin du Lestin, Ozone Acres, and Liberty Acres.

The West Slidell Ring Levee project alternatives provide structural coastal storm surge protection and include the watershed water outfalls of Bayous Liberty, Pacquet, and Bonfouca. These watersheds present tidal and riverine flooding concerns but drain over 34,000 acres of St. Tammany Parish. The area of residential and commercial development is located approximately 1.5 miles inland from Lake Pontchartrain and continues north along the banks of the bayous.

South Slidell

Slidell Levee protection, first proposed in the 2017 CPRA Master Plan encompasses large parts of central and east Slidell. The western side runs along the Norfolk Southern Railroad from Bayou Patassat through downtown Slidell. The eastern side ties into the high ground near Highway 190 (Gauze Boulevard) near Military Road and runs southward along Doubloon Bayou and the edge of the Pearl River Wildlife management area. The southern portion is the existing Schneider Canal and Oak Harbor system discussed in Chapter 5.1.3. This system protects 9 square miles, approximately 5,988 homes and 2,992 residents. The project focuses on alternative alignments for the south segment of this system. Figure 5-2 illustrates the CPRA Master Plan alignment.

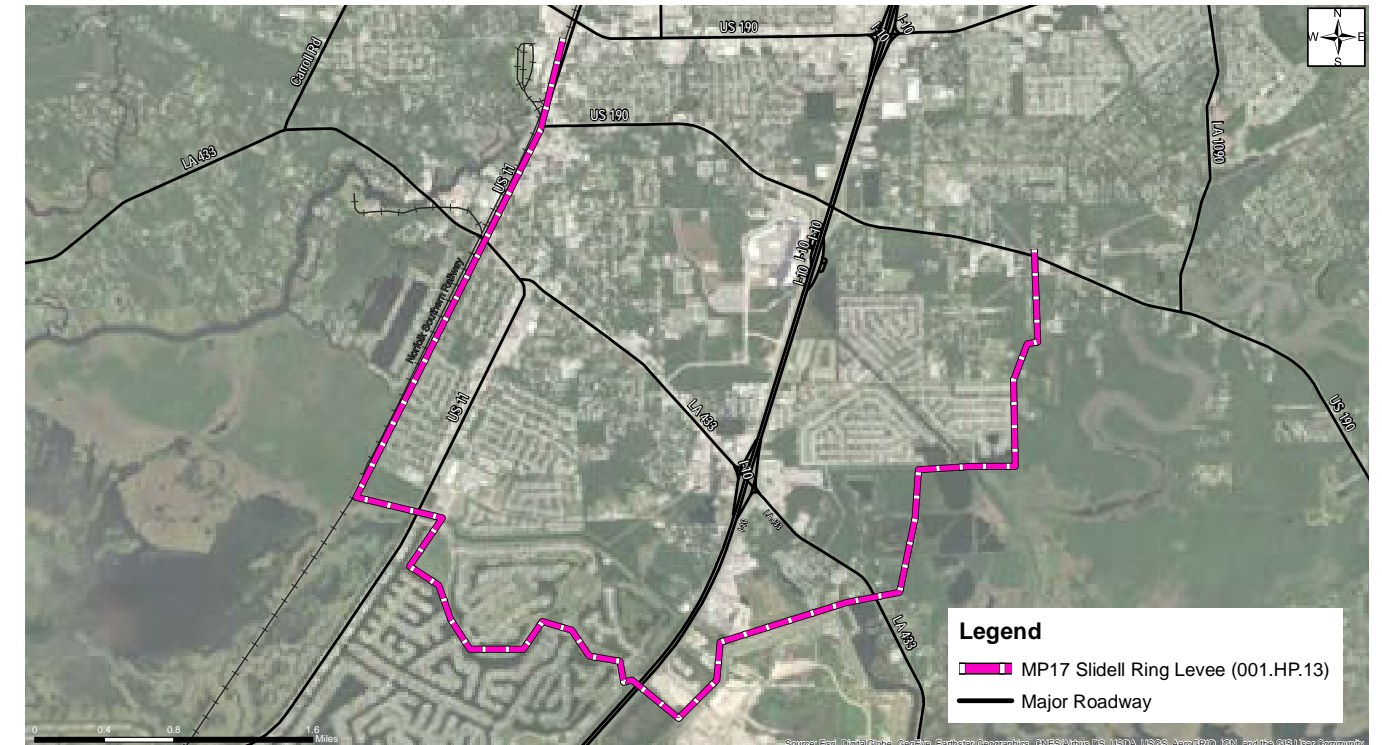


Figure 5-2 Slidell Levee - East Segment Protection Area (CPRA Master Plan Alignment)

Previous Efforts

To address this flooding for the City of Slidell, the CPRA selected the Slidell Levee (001.HP.13) system as a project for consideration in its 2017 Master Plan. The proposed levee system provides protection to an elevation of +16.0 feet NAVD88 for storm surge risk reduction around Slidell by linking together existing flood protection systems with new sections of levee and floodwall. The full Slidell Levee system features approximately 31,000 feet of earthen levee and 14,500 feet of T-wall. The 2017 Master Plan construction cost is estimated at \$141 million, and the total project cost is estimated to be \$181.3 million.

Historical Flooding

West Slidell has approximately 3,908 homes with 9,645 residents⁶. Unlike the eastern portions of Slidell, there is no existing structural storm surge protection, resulting in frequent coastal inundation and flooding. Many of the residences and commercial properties are classified as repetitive loss or severe repetitive loss properties. A repetitive loss (RL) property is any insurable building for which two or

⁶. www.city-data.com, Census tracts 22103.41101.1, 22103.41101.2, 22103.41102.5, 22103.41102.4, 22103.41104.1, 22103.41102.1, June 2020.

more claims for more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Based on the 2019 repetitive loss data, structures that flood in this area have averaged 3 losses and an average payment of \$54,786 in flood claims⁷.

The Big Branch National Wildlife Refuge is natural, brackish marsh between Lake Pontchartrain and the West Slidell project area that provides a minimal amount of protection from storm surge.

The City of Slidell floods frequently due to its low ground elevation. The flooding events are caused by rain events, hurricane storm surge, and backwater flooding from Bayou Bonfouca.

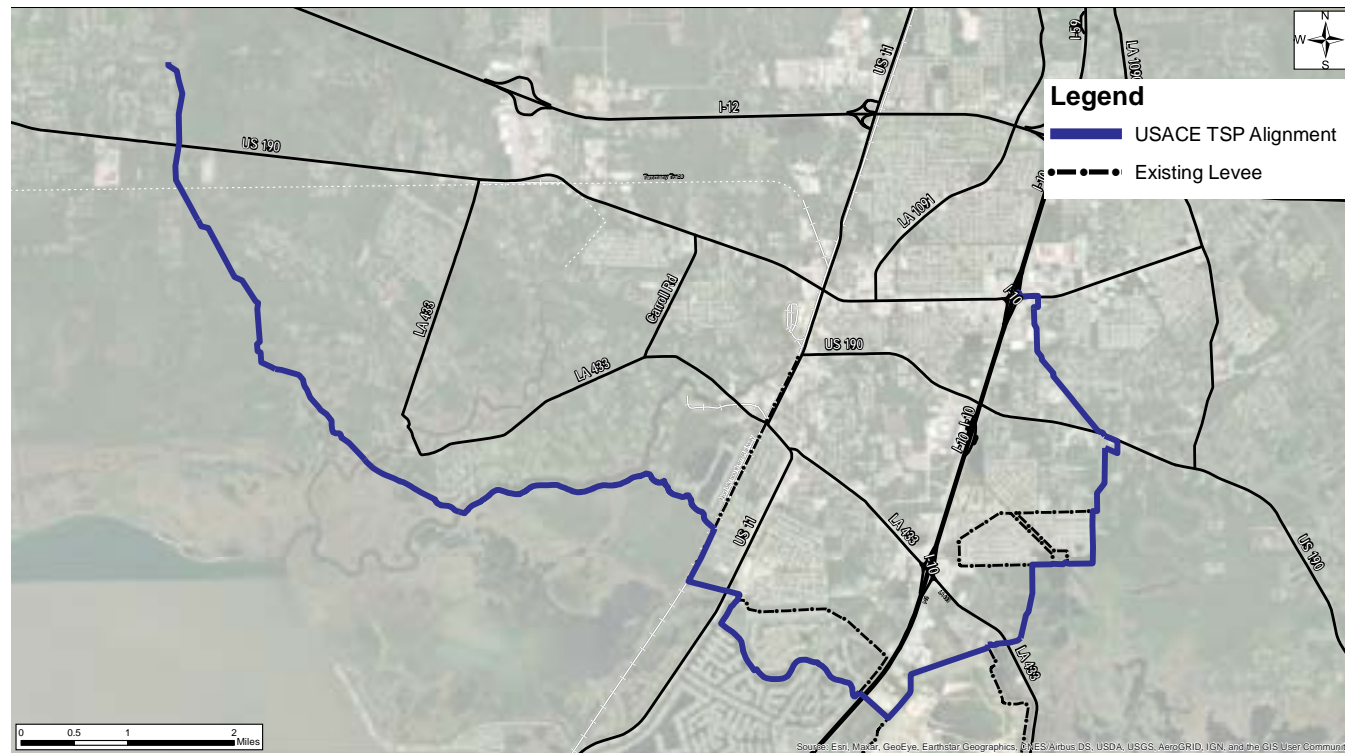


Figure 5-3 West and South Slidell Project Alternatives

Detailed analyses of each alignment is found in the following sections.

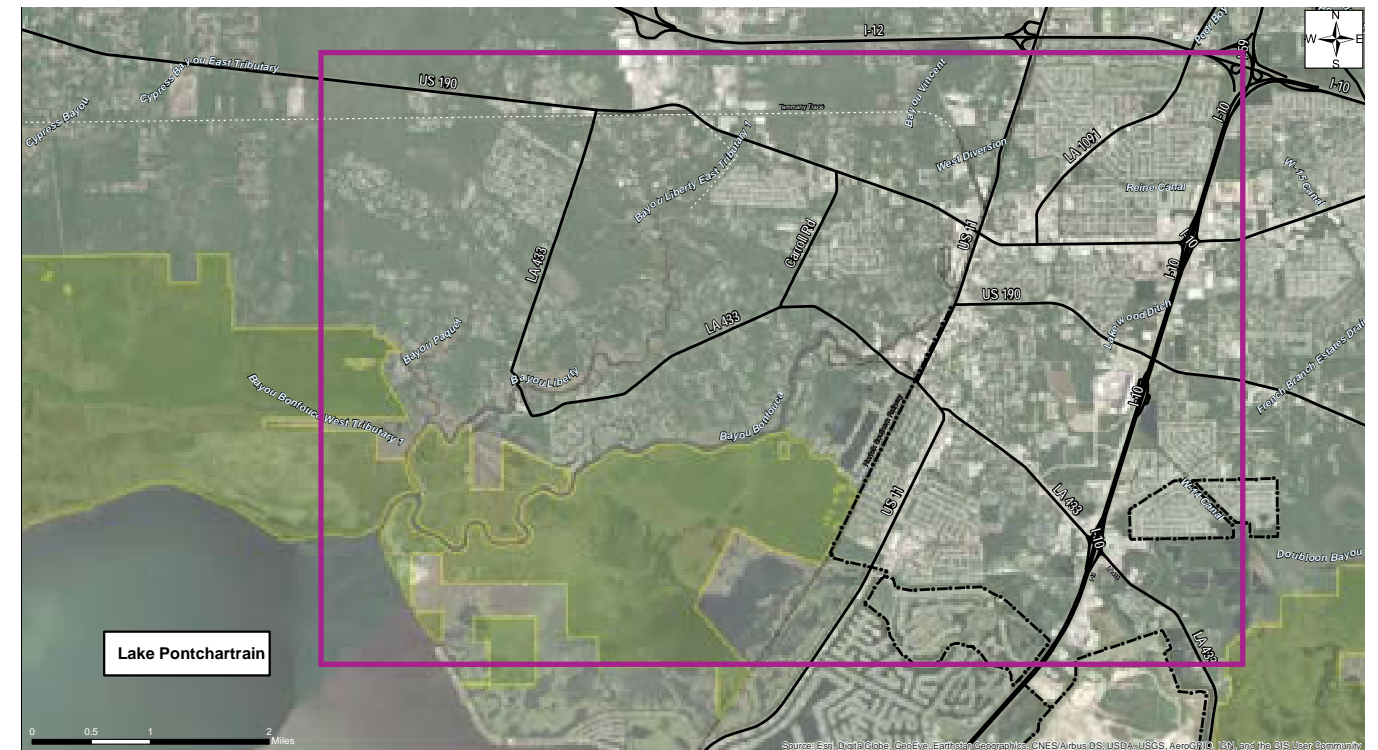


Figure 5-4 West and South Slidell Area and Big Branch National Wildlife Refuge

Existing Conditions

Hydraulics, Hydrology and Watersheds

West Slidell

Bayous Liberty, Pacquet, and Bonfouca flow through West Slidell draining the region and creating the watersheds shown in Figure 5-5. The Bayou Pacquet watershed is on the west side of the project area and drains land from the east side of Lacombe. Bayou Liberty stretches from Hwy 36 to Lake Pontchartrain and Bayou Pacquet converges with Bayou Liberty approximately 1.5 miles inland of Lake Pontchartrain. The Bayou Liberty and Bayou Pacquet watersheds are 19,000 acres of wooded and sparsely developed lands on the eastern side of Lacombe. The Bayou Bonfouca watershed extends from north of Interstate-12 to Lake Pontchartrain and the western edge of Highway 11 to the city limits of Slidell. This watershed is 15,000 acres of developed lands.

South Slidell

The City of Slidell is covered by the Bayou Bonfouca watershed on the west and the East Slidell watershed on the east. The watershed to the south, drains to the existing pumping station in Schneider Canal.

⁷ Repetitive Loss Data received St. Tammany Parish as part of Task 2 Data Gap Analysis

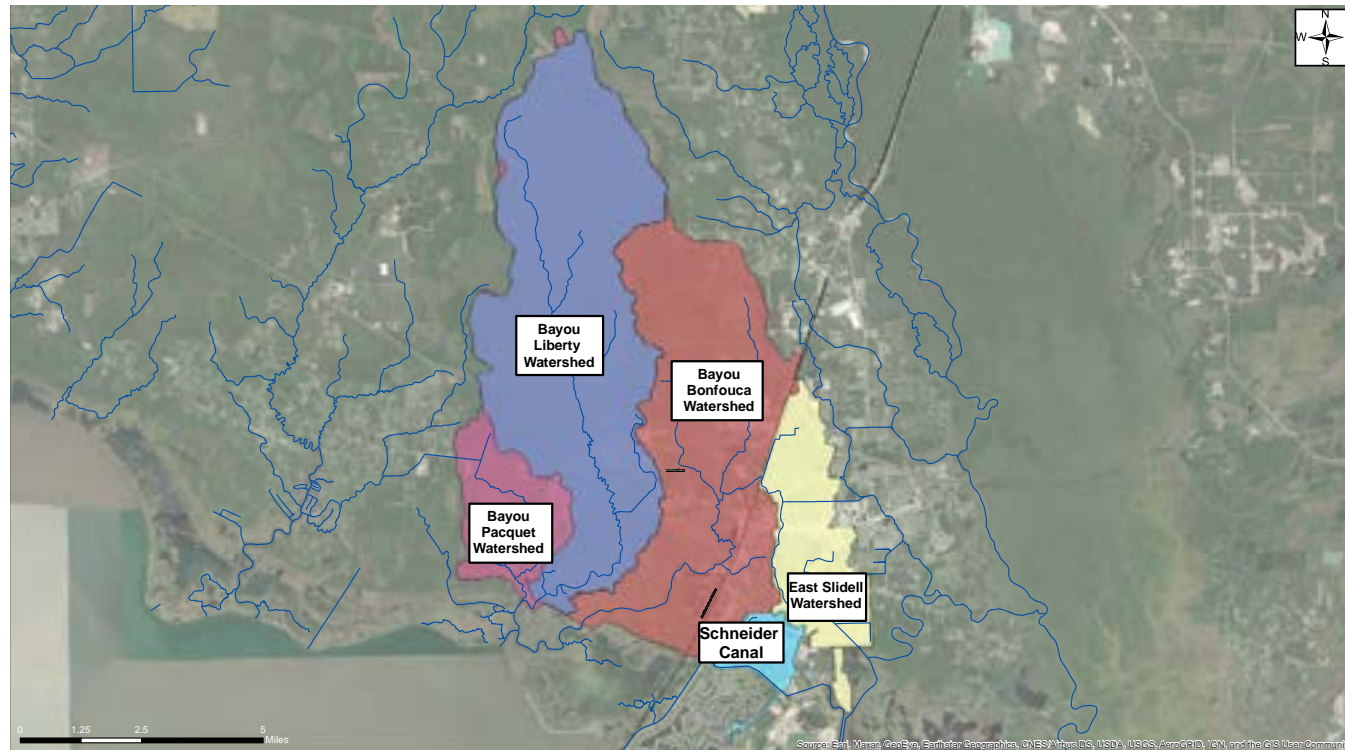


Figure 5-5 Bayous Liberty & Bonfouca Watersheds

Existing Soil Conditions

The proposed West Slidell Levee is located within marsh areas. Based on geologic mapping and recent soil boring data, the near surface soils in the marsh areas consist of several feet of organic clay, humus, or peat with interbedded sand and silt strata. Beneath the marsh deposits, stiffer Pleistocene clays or substratum sands will be encountered. On the west side of the alignment, the geology transitions from the marsh deposits to fill materials overlying Pleistocene-Age deposits, or near surface Pleistocene soils. Additional details regarding the geotechnical analysis can be found within **Appendix B**.

Existing Topography

The City of Slidell topography ranges from +2 feet NAVD88 to +10 feet NAVD88 not including existing levee systems. It is heavily developed with multiple drainage canals and pump stations throughout the city limits.

The West Slidell area topography ranges from +1 feet NAVD88 to +19 feet NAVD88 north of Highway 190. Developed areas are found closest to the City of Slidell and become less frequent further west.

Design Considerations

The West Slidell area, found within this section, was considered to expand the western protection of the City of Slidell to include areas along Bayous Bonfouca, Liberty, and Paquet which are repetitive loss areas. The alternatives considered connect to the existing western levee, formed by the Norfolk Southern Railroad that runs parallel with Highway 11, to high ground along Highway 190 west of the City of Slidell. These alternatives consider a single segment of levee for the alternative considered.

The East Slidell Segments, found in section 5.2.1, utilizes the existing levee system and expands the eastern protection with multiple levee segments. These segments connect the existing levee systems and forms a continuous levee on the eastern side of the City of Slidell.

Storm Surge Level of Protection – West Slidell

Based on CPRA’s 2017 Master Plan ADCIRC model for the West Slidell area, the flood risk reduction elevation ranges from +8.5 feet NAVD88 to +14.5 feet NAVD88 depending on location and desired level of protection for the area.

Geotechnical Considerations

The settlement of the levee alignment will be governed by the thickness of marsh deposits within the levee alignment footprint. Only limited data was collected along these alignments and additional data will be required per the LFPDG or HSSDRS guidelines. Therefore, the geotechnical findings and results are considered conceptual and could change based on future geotechnical explorations.

Because the levee alignment alternatives are located within marsh areas. Special adaptive equipment such as marsh buggies may be required. Geotextile fabric or local dewatering strategies may also be required for construction.

Levee Construction Overbuild and Settlement

Estimated vertical overbuild required for levee flood protection is 1.5 feet to address the levee settlement over time. The overbuild is based on a single levee overbuild life without future levee raises. It is also likely that lateral spreading and mud-waves will induce more settlement of the levee during construction and immediately post construction. The estimates of overbuild do not incorporate any potential lateral spreading or mud-wave action caused by marsh construction. If the marsh options are chosen, additional analyses should be performed once data is collected in the marsh to evaluate the potential for lateral spread and settlement during construction. **Appendix B** provides the geotechnical analysis performed for the West Slidell Ring Levee project.

Levee Slope Stability

The estimated levee overbuild for flood protection on the developed east side of West Slidell is one to two feet due to the lack of previously improved soil conditions through the marsh. These estimates of overbuild do not include adjustments for lateral spreading or mud-waves associated with marsh construction. Please see the levee results in **Appendix B** includes the West Slidell slope stability analysis and results. Preliminary analyses do not indicate a need for geosynthetic fabric beneath the levee but it may be required in the marsh to reduce the amount of lateral spread/settlement during construction. Detailed design efforts should review and address these concerns.

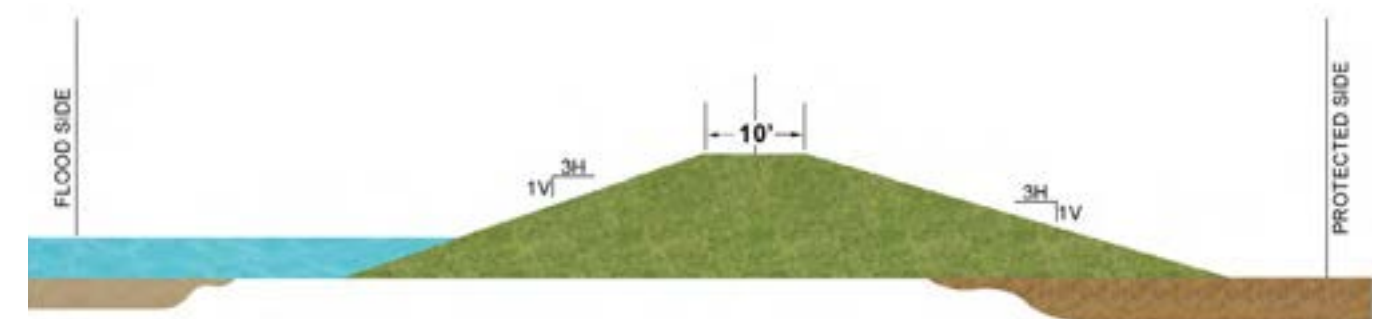


Figure 5-6 Typical Cross Section – West Slidell

Existing Utilities

In addition to the utilities commonly found along roadway corridors and rights-of-way within residential areas, such as cable, natural gas, electricity, and telephone, there is a large natural gas pipeline running north from Lake Pontchartrain through the proposed alignments as seen in Figure 5-7. There will be restrictions with levees crossing the pipeline and coordination and relocation for this gas line will be developed in future phases of study and design.

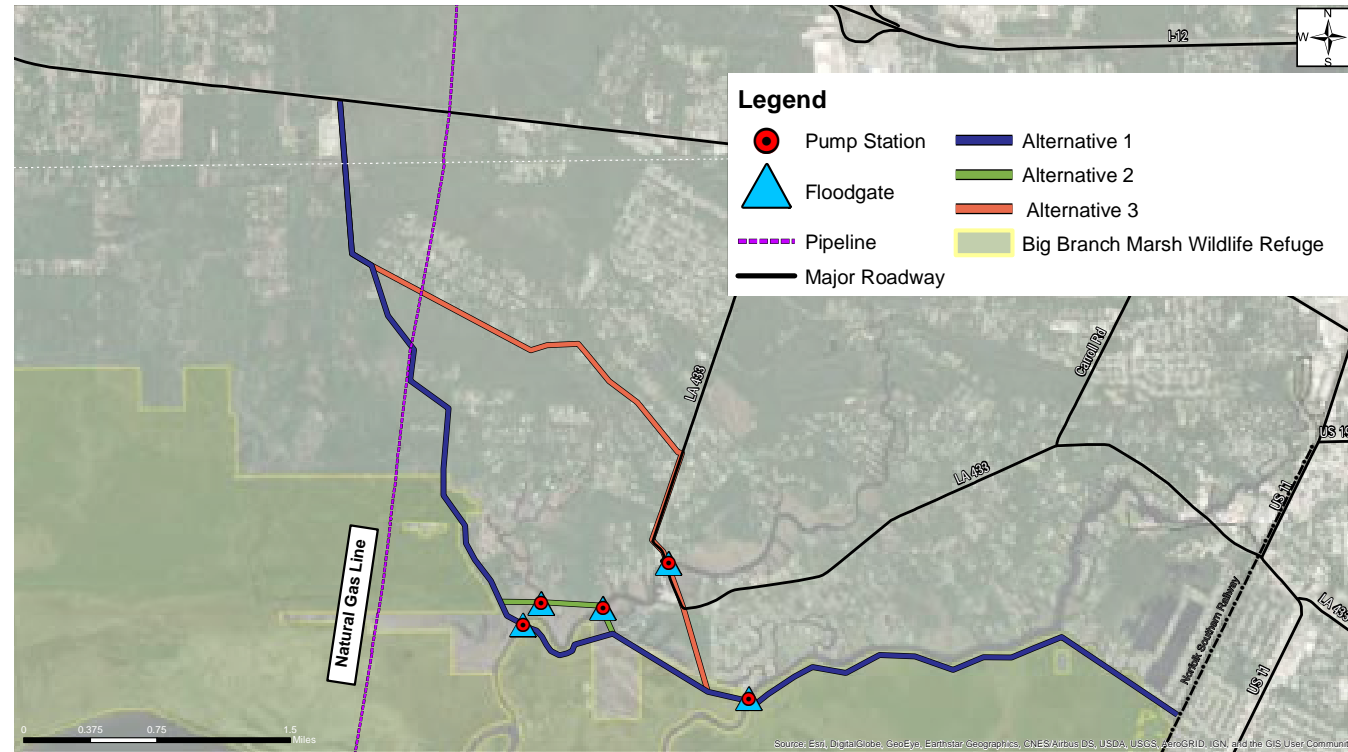


Figure 5-7 Natural Gas Utility along Alignments

Other Considerations

A bike path gate may be required as the levee alignment crosses the Tammany Trace near the Highway 190 at the northwest corner of the alignments. This tie-in location will be better refined in once survey and final project elevations are gathered.

The eastern connection for all the alternative levee alignments must incorporate vertical and horizontal transitions to the Norfolk Railroad corridor on the east through the modification of the levee or with a gate structure crossing the rail line. This effort is being evaluated as a component of the USACE *St. Tammany Parish, Louisiana Feasibility Study* currently underway and is not included in this effort. No cost impacts have been included in this study.

Alternative Alignments for West Slidell Levee

Three alternative alignments are considered for the West Slidell levee alignment:

- Alternative 1 – Keller Road Alignment
- Alternative 2 – Bayou Pacquet
- Alternative 3 – Norfolk Southern Railroad/Hwy 190/Bayou Bonfouca

These alignments are shown in Figure 5-8.

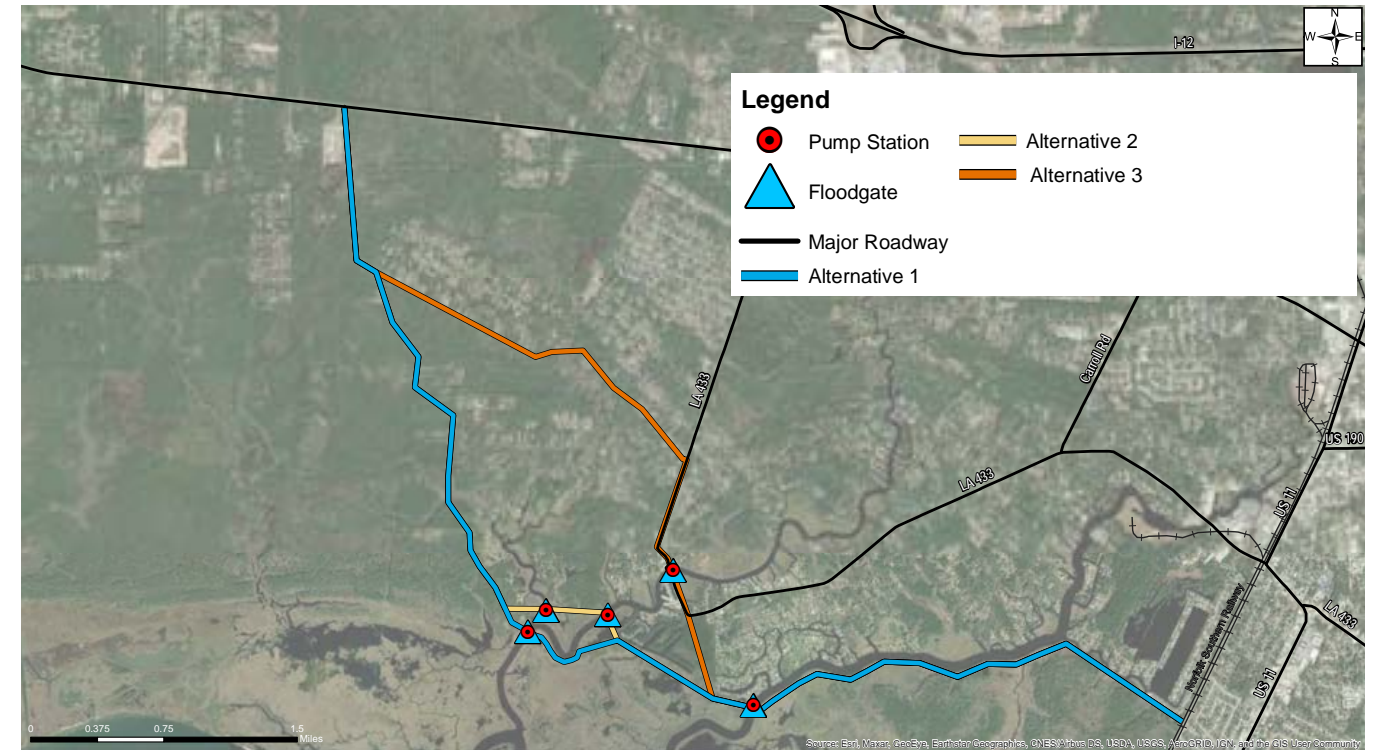


Figure 5-8 Alternative Alignments for West Slidell Levee

The three alternative alignments have the same start and end points. The starting point is the Norfolk Southern Railroad and the end point for the alignments is Louisiana Highway 190 approximately 2.5 miles west of Highway 433. Each alignment was reviewed to quantify the structural components and protection features that would incorporate a 100-year level of protection plan.

All alternatives will require coordination with the United States Fish and Wildlife Service (USFWS) with respect to the nearby National Wildlife Refuge (NWR). Norfolk Southern, in addition to, other agencies identified require coordination include St. Tammany Parish Public Works, the Louisiana Department of Transportation and Development, and the US Coast Guard. Additional details regarding the alignments can be found in **Appendix C** along with an enlarged map, the specific components details, and detailed cost analysis.

Summary

For the West Slidell study area, three alignments were developed for consideration at each level of protection. Additional information can be found **Appendix C**. Table 5-1 provides a summary of the total capital costs associated with the various alignments considered including real estate, environmental mitigation, utilities, and engineering, planning, construction, and construction management.

Table 5-1 Summary of Total Capital Costs West Slidell Alternatives

	West Slidell Alignments	
	Low	High
100-Year Level of Protection	\$900,140,000	\$1,210,080,000
50-Year Level of Protection	\$819,995,000	\$1,154,710,000
25-Year Level of Protection	\$790,405,000	\$1,129,445,000

West and South Slidell Next Steps

The USACE developed a Tentatively Selected Plan (TSP) to provide structural and nonstructural protection for St. Tammany Parish. The Draft Integrated Feasibility Report and Environmental Impact Statement was released for public comment in July 2023 and is expected to be finalized in December 2023. The Chief’s Report is expected to be completed in May 2024.

The West and South Slidell area is included in the USACE St. Tammany Parish Feasibility Study through the structural protection features. With the approval of the Tentatively Selected Plan, St. Tammany Parish will be able to continue to refine the proposed alignments and work towards the Non-Federal Sponsor requirements.

5.1.3 Eden Isle Levee Flood Risk Reduction and Resilience Project Location

Eden Isle subdivision is located in Slidell, Louisiana in the southeast corner of St. Tammany Parish. It is bound by Highway 11 on the west, Interstate 10 on the east, Lake Pontchartrain on the south, and Oak Harbor subdivision on the north as seen in Figure 5-9. It is a community of 3,434 residential properties and 7,163 residents⁸. The residential tax base contributes \$6.3 million in annual parish property tax revenue⁹. Many of the residences have access to Lake Pontchartrain by way of canals and a Grand Lagoon waterway connection.

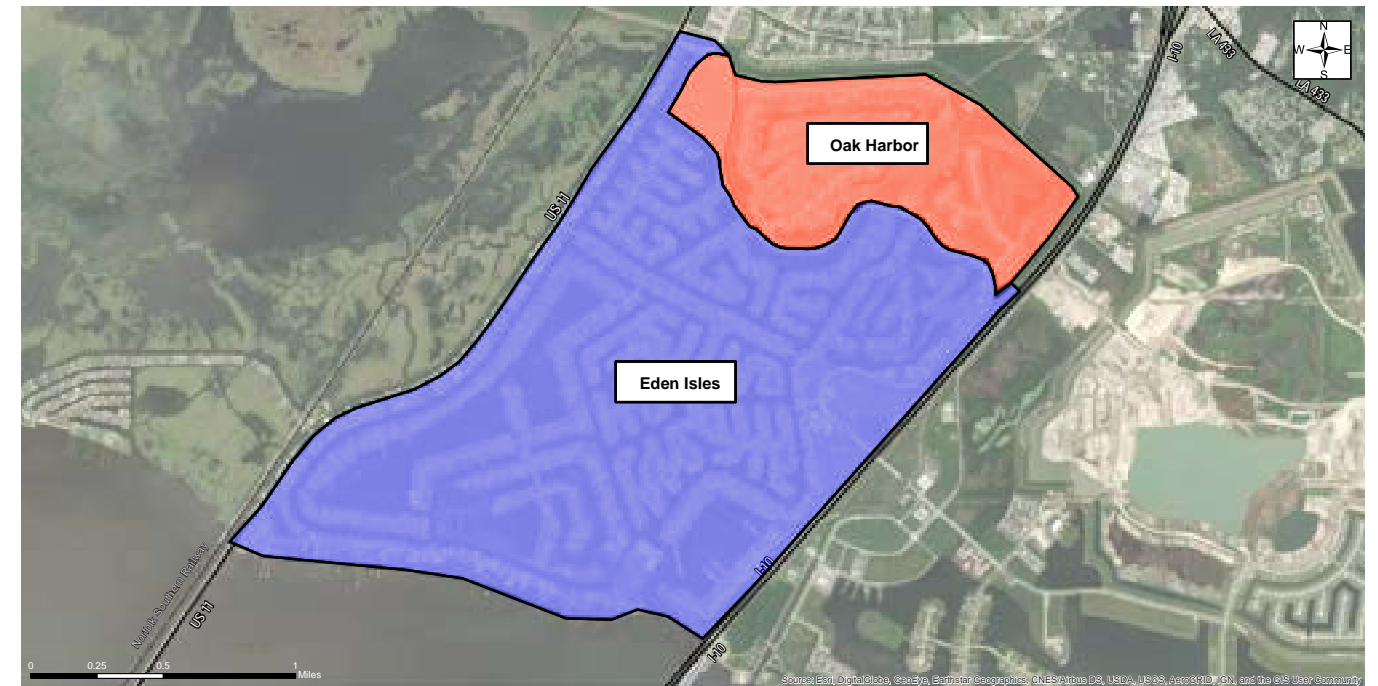


Figure 5-9 Eden Isle and Oak Harbor Communities

The adjacent community to the north, Oak Harbor, constructed a ring levee in the early 1990’s with a levee top elevation of +12 feet NAVD88. CPRA and the USACE are considering extending the Oak Harbor levee to protect downtown Slidell as part of the CPRA Master Plan and the USACE St. Tammany Parish Feasibility Study respectively. This would exclude Eden Isle from federally funded coastal storm surge protection. These proposed Eden Isle Ring levee alternatives consider the feasibility of incorporating various levels of protection with respect to coastal storm surge.

Historical Flooding

With its connection to Lake Pontchartrain, Eden Isle has experienced significant flooding events, including Hurricanes Katrina and Isaac. These flood events were driven by winds from the southeast and southwest direction. The winds pushed water levels up along the northern section of Lake Pontchartrain and into Eden Isle through Grand Lagoon. Hurricane Katrina’s 16-foot tidal surge pushed two to six feet of water into many homes. Depending on their proximity to the lake, many of these homes are repetitive loss structures and were flooded again damaged in Hurricane Isaac seven years later.

8. www.city-data.com, Census tracts 22103.40802.1, 22103.40802.2, 22103.40802.3, 22103.40802.4, June 2020.

9. St. Tammany Parish Assessor’s Office, 2019

Alternatives Considered

Multiple alignments of structural flood protection were developed and analyzed for Eden Isle. These alignments consisted of levees, floodwalls, floodgates, pump stations, and structural tie-ins. Alignments were developed and analyzed with consideration of constructability, cost, and impacts to property, roadways, and environment.

Three alternatives for the east, west, and south sides of Eden Isles were developed for the 100-year level protection. Two additional alternatives were developed for the south and west side that utilized the existing I-10 corridor for 50-year level protection. Several roadway improvements were proposed to obtain an interim level of protection.

Details regarding the alignments can be found in **Appendix C**.

Existing Conditions

Hydraulics, Hydrology and Watersheds

The four watersheds associated with Eden Isle are connected through a network of canals and drainage features. These watersheds are impacted by any structure features, such as levees, that would comprise structural flood protection around Eden Isle.

The Oak Harbor watershed to the north is pumped into the Schneider Canal which runs westward. The Schneider Canal watershed receives storm waters from downtown Slidell, as well as the pumped water from Oak Harbor. The western end of the Schneider Canal has a pump station near the intersection of the Schneider Canal and Highway 11 which moves the water out of the Oak Harbor and Schneider watersheds. The station has a pumping capacity of 850 cubic feet per second and discharges into the marsh west of Highway 11. The Highway 11 watershed is approximately 443 acres and is the narrow marsh land between Highway 11 and the Norfolk-Southern Railroad. The Eden Isle and Highway 11 watersheds are tidally connected to Lake Pontchartrain.



Figure 5-10 Eden Isle and Surrounding Area Watersheds

Existing Soil Conditions

Eden Isle was developed by dredging marsh soils to form the canals and lagoons and using the dredge spoil to build the land. Additional fill material was brought in to construct roads and lots. Geotechnical investigations support this history showing non-native imported sand, silt and clay materials. These fill materials range in depth from approximately 6 to 16 feet below existing grade.

Beneath the fill materials and in areas where no fill has been placed (e.g., the marsh area along the western edge of Highway 11) are marsh soils consisting of organic clay, humus, or peat. This marsh stratum exists throughout Eden Isle and is approximately 4 to 8 feet thick. The marsh stratum is not as thick in fill sections due to consolidation. Beneath the marsh soils are stiffer Pleistocene age clays and/or substratum sands.

Existing Topography

Eden Isle started development in 1969, in 5,300 acres of open marsh owned by Leisure Incorporation. The marsh was dredged to create canals and the dredged material was processed for use in the road and residential lots. The canals range in depth from 10 to 15 feet. The roads, as seen in Figure 5-11, in the community vary in elevations ranging from +5.0 to +7.0 feet NAVD88 and the house slabs are at elevation +8.0 feet or greater.

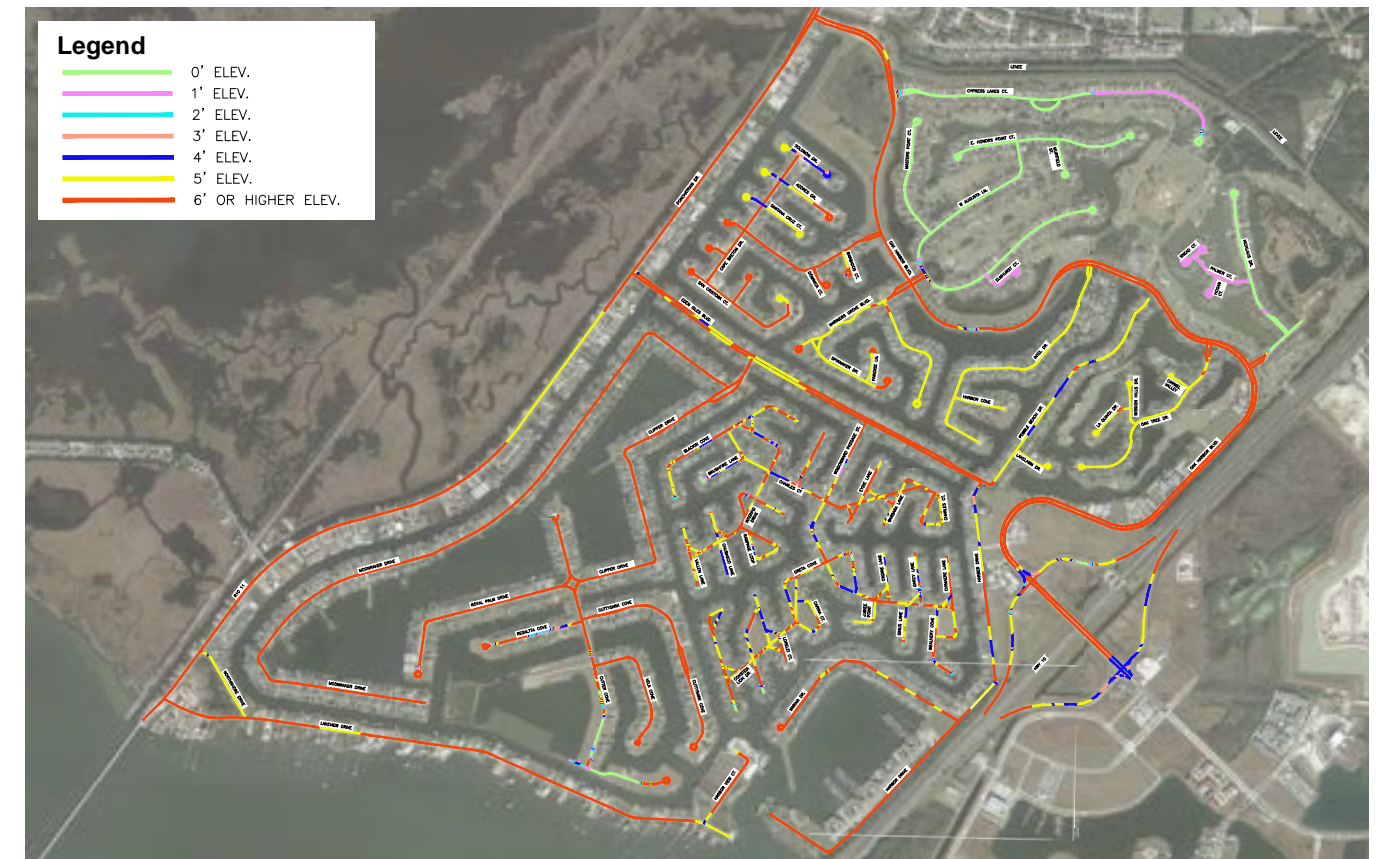


Figure 5-11 Existing Roadway Elevations – Eden Isle Community

Design Considerations

Storm Surge Levee of Protection – Eden Isle

Based on CPRA’s 2017 Master Plan ADCIRC model for the Eden Isles area, the flood risk reduction elevation ranges from +8.5 feet NAVD88 to +18 feet NAVD88 depending on location and level of protection.

Geotechnical Considerations

Geotechnical considerations include the need for geotextile fabric and/or dewatering for levees constructed in the marsh. In addition, lateral spreading and mud-waves may cause settlement of the levee during and immediately after construction. Additional analyses will be required to evaluate the lateral spread and settlement depending on selected alignment. The geotechnical report can be found within **Appendix B**.

Levee Construction Overbuild and Settlement

The estimated levee overbuild for flood protection on the developed east side of Eden Isles is one foot. Estimated overbuild for flood protection in marsh areas, on the west side of Eden Isles, is one to two feet due to the unimproved soil conditions through the marsh. These estimates of overbuild do not include adjustments for lateral spreading or mud-waves associated with marsh construction. Refined settlement analyses for pre- and post-construction will be made during the design phase of the future project.

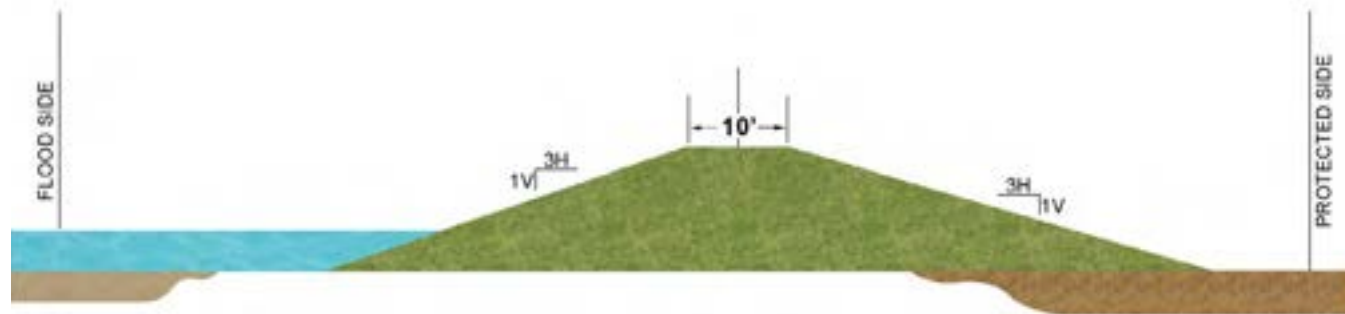


Figure 5-12 Typical Levee Section Eden Isle

Levee Slope Stability

Slope stability analysis was performed using the Still Water Level (SWL) condition to consider the failure of the levee due to the weight of the flood side water on the soil conditions beneath the structure. Preliminary results do not indicate a need for geosynthetic fabric beneath the levee, but it may be required in the marsh for constructibility reasons.

Concrete T-Wall Analyses

Stability analysis for the proposed concrete T-Walls followed the criteria provided in the HSDRRS design guidelines and uses the Spencer’s Method for non-circular failures. Analysis using the Janbu’s method was neglected due to the conceptual level of this study. The analysis evaluated the Q-case (Undrained loading) condition with the storm loading levels at the Top of Wall for the 100-year level of protection and at the Still Water Level (SWL) for the intermediate level following the HSDRRS and LFPDG guidelines respectively. Refer to **Appendix B** for details related to the geotechnical analysis.

Seepage Cutoff for Concrete T-walls

The sheet pile cutoff elevations for concrete T-walls were analyzed using Lane’s Weighted Creep Ratio (LWCR). This method, adopted by the HSDRRS, provides the factor of safety against under seepage for a concrete T-wall. The sheet pile tip penetrations provide a minimum LWCR of 3 based on the predominant clay strata. A summary of the required sheet pile tip elevations based on LWCR is presented in Table 5-2.

Table 5-2 Required Minimum Sheetpile Tip Elevations for Concrete T-Walls

Structure	Existing Ground Surface (NAVD 88)	Estimated T-Wall Bottom Elevation (NAVD 88)	Minimum Sheetpile Tip Elevation (NAVD 88)	Water at Top of Wall Elevation (NAVD 88)	Water on Protected Side Elevation (NAVD 88)	Differential Height Analyzed in Feet
Eden Isle Levee Wall – East Case 2	+6	+1	-26	+18	+6	12
Eden Isle Levee Wall – South Case 1	-6	-11	-38	+18	0	18
Eden Isle Levee Wall – South Case 2	+6	+1	-26	+18	+6	12
Eden Isle Levee Wall – West Case 3	+8	+3	-24	+18	+8	10

Utilities

Utilities such as cable, natural gas, electricity, and telephone are expected to be in most of the proposed alignments. No pipelines or other special utilities are anticipated within Eden Isle.

Other Considerations

A drainage pumping station and floodgate closure structure is required at the Grand Lagoon entrance. The closure structure will block storm surge from Lake Pontchartrain while the pump station maintains water levels within the canals during rain events.

Summary

For the Eden Isles Levee study area, the three sides of the community (east, west, and south) were individually considered for alignment development for 100-year level protection. Two alternatives were developed for the south and west side and utilizing the existing I-10 corridor for 50-year level protection and several roadway improvements were evaluated to obtain interim protection for the community. Additional information can be found in **Appendix C**.

Interim Protection Alternative Alignments for Eden Isle

The interim protection alternatives will protect against nuisance flooding, such as minor flooding on streets and lawns. The interim alignments incorporate the raising of Highway 11 that has been previously considered by LaDOTD. The raising of Highway 11 may be eligible for funding as a roadway project with a flood control project.

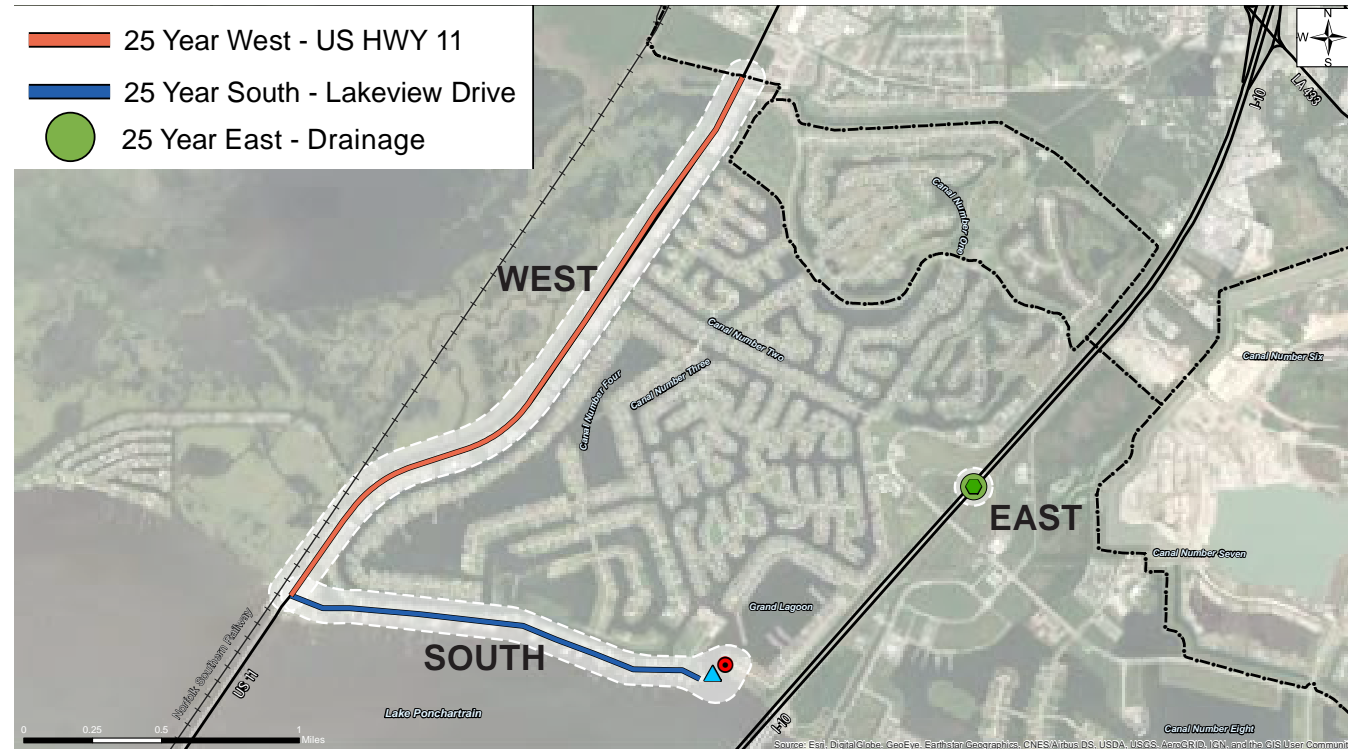


Figure 5-13 25-YR Alternatives

Interim Alternatives – East

The interim protection east alignment utilizes a box culvert for drainage in the ditch north of Oak Harbor Blvd. The estimated construction costs range between \$1,000,000 and \$2,000,000 with additional costs associated with environmental mitigations, utility relocations, engineering, planning, and construction management. See **Appendix C** for the summary of estimated costs for this alignment.

Interim Alternatives – South

This alternative raises the elevation of Lakeview Drive to an elevation of +8.5 and includes a pumping station and navigation gate closure at Grand Lagoon. There is a small levee from the closure structure eastward towards the I-10 shoulder on the east until the grade is achieved. This elevated roadway will overtop when the lake levels exceed the design elevation and the roadway design will need to incorporate scour protection.

The majority of the expenses, roughly \$114,750,000, for this alignment are found within the gate closure and pump station structure located at the Grand Lagoon waterway. The costs of raising Lakeview Drive is estimated to be \$9,950,000. It is estimated to have \$46,198,000 in costs associated with property acquisition of 16 acres, environmental mitigation expenses, utility relocation costs, as well as engineering, planning, and construction management. See **Appendix C** for the full summary of estimated costs for this alignment.

Interim Alternatives – West

This alternative raises Highway 11 to a minimum elevation of +8.5. This elevated roadway will overtop when the lake levels exceed elevation of +8.5 will require scour protection. In 2016, DOTD developed costs associated with the construction of Highway 11 to raise the roadway to an average of +8 feet NAVD88. Based on DOTD’s estimated construction costs, inflated to 2023 dollars, this project is estimated to range from \$44,000,000 to \$59,000,000. It is also estimated to have additional costs associated with environmental mitigations expenses, utility relocation costs, as well as engineering, planning, and construction management. See **Appendix C** for the summary of estimated costs for this alignment.

Table 5-3 Interim Alternatives Estimated Total Capital Costs

		Eden Isle Alignment Alternatives (Interim)		
		West Alternative Highway 11 Raising	East Alternative East Drainage	South Alternative Lakeview Dr Raising
	Real Estate	\$0	\$0	\$2,650,000
	Environmental Cost	\$0	\$0	\$120,000
	Construction Costs	\$35,400,000	\$2,930,000	\$174,380,000
	Utility Relocation Costs	\$350,000	\$30,000	\$1,740,000
	Engineering, Planning & Construction Management	\$8,850,000	\$730,000	\$43,590,000
	Total	\$44,600,000	\$3,690,000	\$222,480,000

Eden Isles Next Steps

The St. Tammany Parish Coastal Project is supporting the efforts underway by the USACE in their independent evaluation for the parish-wide structural and non-structural storm risk reduction program. Eden Isles is included in the federal nonstructural program. Additionally, the St. Tammany Coastal Plan has paved the way for a State led resilience and structural flood risk reduction effort for the Eden Isle community. CPRA is actively working with STLDCD and STPG to provide resiliency options.

5.1.4 Mandeville Seawall and Resilience Project

Project Location

The City of Mandeville, founded in 1834, is on the north shore of Lake Pontchartrain in St. Tammany Parish. In the 1930's a seawall was constructed along the shoreline of Lake Pontchartrain, in an area known as Old Mandeville, to address shoreline erosion.

The seawall was rebuilt in 1995 and consists of vertical steel sheet piles with concrete cap, steps, and groins extending 150' into the lake.

The seawall top of concrete elevation is 5.5 feet NAVD88 and provides limited shoreline and flood protection to the community located behind it as seen in Figure 5-14 below.



Figure 5-14 Mandeville Area of Frequent Flooding

Historic Flooding

The seawall elevation is not sufficient to provide protection during low frequency and high magnitude hurricanes such as Katrina and Isaac. The flooding associated with these storms extended from the lake to north of Monroe Street approximately 4 blocks away.

Flooding also occurs along Lakeshore Drive due to waves crashing and overtopping the seawall caused by strong southerly winds pushing water in Lake Pontchartrain to the north shore. This flooding prevents the use of both the lakefront area and Lakeshore Drive. This nuisance flooding occurs several times each year. These strong southerly winds also push water into Ravine aux Coquilles and Little Bayou Castine causing flooding in the upstream areas of Old Mandeville.



Figure 5-15 Flooding of Lakeshore Dr (NSI 2021)

The City of Mandeville Comprehensive Plan in 2007, the St. Tammany Parish Hazard Mitigation Plan in 2020, the USACE Silver Jackets program in 2016, and the USACE St. Tammany Parish Feasibility Study in 2023 all considered raising the seawall in Old Mandeville. Recommendations to raise the seawall have been met with resistance from the community based on potential impairment to viewshed along the seawall. The recent Flood Resilience Plan considered additional flood risk reduction strategies such as non-structural home raising as well as living shorelines to manage flood risk without impacts to the existing seawall.

Alternatives Considered

This study initially considered structural flood risk reduction measures along the historic seawall along Lakeshore Dr. for the 100yr level of protection and resilience and nuisance flood risk reduction measures. This alignment consists of an increase to the existing floodwall, floodgates, pump stations, and structural tie-ins. As seen in Figure 5-16, the alignment considered constructibility, cost, and impacts to property, roadways, and environment. Details regarding the alignments can be found in **Appendix C**.



Figure 5-16 Mandeville Resilience Alignment

Existing Conditions

Hydraulics, Hydrology and Watersheds

The Castine-Cane Bayou watershed along with multiple small waterways, cover the City of Mandeville as seen in Figure 5-17. Starting in the west, Ravine aux Coquilles outfalls into Lake Pontchartrain between Lafayette Street and Coffee Street in Old Mandeville. Ravine aux Coquilles is located completely within the City of Mandeville and has an east and west branch providing drainage within the city.

Little Bayou Castine extends north from Lake Pontchartrain west of Jackson Avenue to US 190, and then through St. Tammany Parish north of US 190 to the LA 1088 corridor.

Bayou Castine defines the eastern edge of Old Mandeville and outfalls near Lakeshore Dr and Jackson Ave. The bayou stretches from Lake Pontchartrain northeast to Highway 190 then continues northeast towards Interstate 12 outside of the City of Mandeville limits.

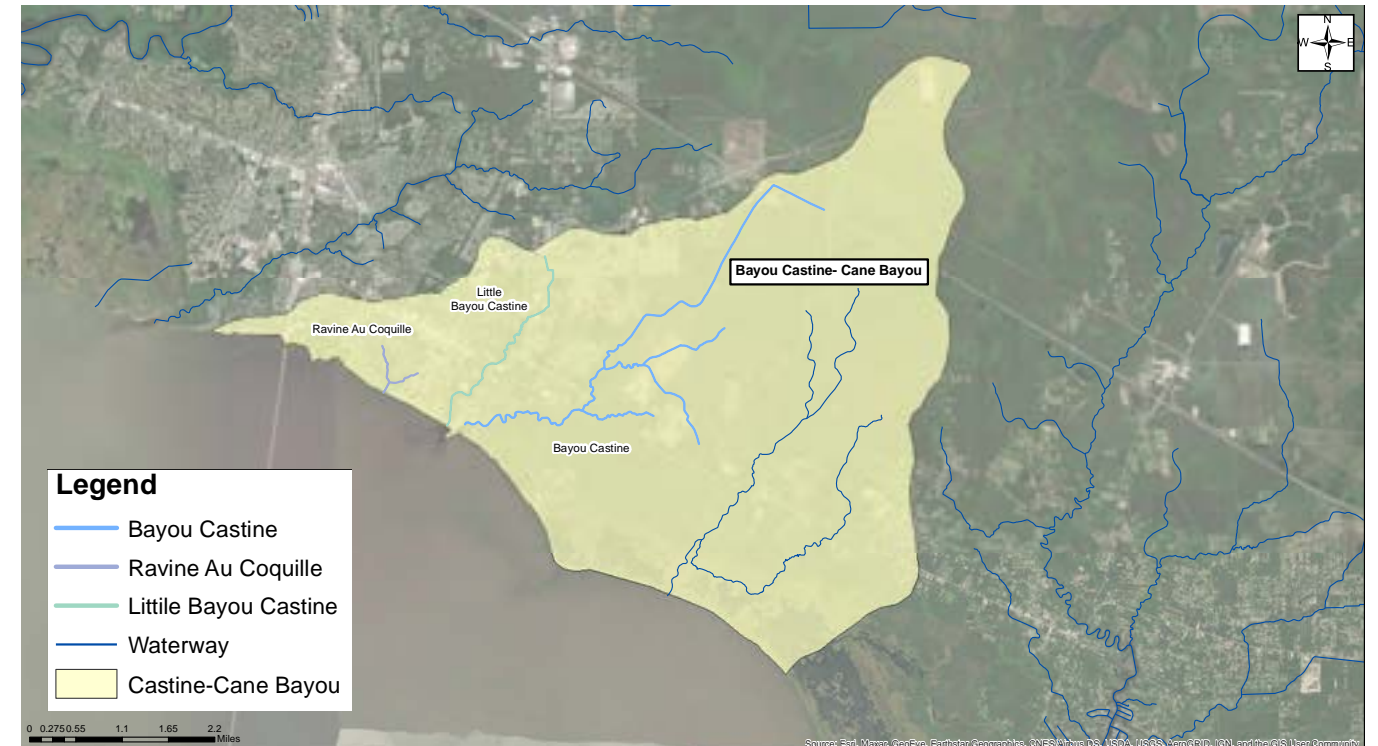


Figure 5-17 Bayou Castine Watersheds

Existing Soil Conditions

Based on soil borings taken for the City of Mandeville in 1985 by Eustis Engineers, the top 3 feet of soil is silty sand, humus, and shells. The next 30 feet consists of medium stiff clays with increasing strength. The deepest layer collected to a depth of -40 feet is very dense sands.

Design Considerations

Storm Surge Level of Protection

Based on CPRA's 2017 Master Plan ADCIRC model, the flood risk reduction elevation ranges from +7.3 feet NAVD88 to +18 feet NAVD88. As stated previously, the community does not support the 100-year level of protection that would impair the viewshed of the Lakefront area.

The 100 year level of protection has been considered through several federal programs and have been met with strong community resistance. The required elevations for that level are considered extreme and would impact the park like feel found along the lakefront area. Additionally, the community has been proactive in raising individual structures thus reducing potential benefits that could offset the costs for the 100 year level of protection. With these reasons in mind, this plan considered lower levels of protection than the 100 year.

Mandeville Resilience Alignment

Structural protection for the City of Mandeville was considered due to the existing structural seawall feature. This feature’s design life is past the halfway point and is starting to show damage due to the environmental conditions since its installation in 1995. With the potential for replacement of this structure within the next 10 to 20 years, increases to the structural protection provided by this structural feature were considered.

The structural flood risk reduction resilience alignment consists of replacing the existing structure along Lake Pontchartrain with floodwalls along the west side of Little Bayou Castine and the east side of the Galvez Canal, a sluice gate, located at Ravine aux Coquilles for closure purposes during storm events, as well as two (2) pump stations located near Girod St. (200cfs) and at Ravine aux Coquilles (500cfs). A 30ft wide vehicular access gate and a pedestrian access gate is located near Little Bayou Castine.

Table 5-4 Alternative A - Structural Components

Mandeville Seawall Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Steel Sheetpile Wall with a Concrete Cap
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at West of Lakeshore Dr. Southern Tie-in at East of Lakeshore Dr.
Footprint	<ul style="list-style-type: none"> Floodwall Length – 12,900 LF Seawall Width – 3 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station (2) Roadway Roller Gate (30FT) (1) Drainage Structure (3)

Property Impacts

Per the St. Tammany Assessor’s website, the City of Mandeville is the property owner of the land along the seawall. This area is designated as a public space and the seawall will be replaced in kind; therefore, no other landowners are affected. The viewshed from the lakefront area is impacted by changes to the seawall. This impact is extremely important to the Mandeville community and should be minimized where best possible.

Roadways Impacts

Based on the proposed alignment, minimal roadway impacts on Lakeshore Drive. The associated roadway impacts include the general use of the road for the construction access and a vehicular gate at Little Bayou Castine.







Environmental Concerns

The project is anticipated to replace the existing structure with a similar structure at the same location. Therefore, there are minimal environmental impacts expected with the construction of this project.

Resilience Protection Budgetary Costs

For an resilience level seawall, drainage structures and closures, and two (2) pump stations located at Girod St. (200cfs) and Ravine aux Coquille (500cfs), the estimated construction costs ranged from \$104,000,000 to \$140,000,000. Additional costs have been estimated for utility relocation costs, and engineering, planning, and construction management efforts. Refer to **Appendix C** for the detailed summary of estimated costs.

Table 5-5 Mandeville Seawall Interim Level Alternative A - Estimated Total Capital Costs

Mandeville Seawall Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$0	\$0	\$122,000,000	\$1,220,000	\$30,500,000	\$153,720,000

City of Mandeville Next Steps

CPRA and the City of Mandeville are both considering resiliency options and non-structural projects to mitigate flooding impacts. The resiliency options are included in the Mandeville Flood Resilience Strategy published by CSRS in April 2023. This study can be accessed at the following link: https://www.cityofmandeville.com/sites/default/files/fileattachments/planning_and_development/page/2957/mandeville_flood_resilience_strategy_8.5x11.pdf

Regional scale modeling of watersheds that flow through the City of Mandeville to Lake Pontchartrain will allow the City the ability to plan for water flows through existing drainage systems. This also ties in to the recommended flood risk reduction strategy of establishing or enhancing existing green spaces throughout the City of Mandeville to capture and store water during rainfall events. Additionally, improved conveyance and increased channel capacity were also resilience strategies recommended for the City of Mandeville along with living shorelines and other nature based approaches to living with water.

The St. Tammany Parish Coastal Study is supporting efforts underway by the USACE in their independent evaluation for the parish-wide structural and non-structural storm risk reduction program. The City of Mandeville is included in the federal non-structural program for structure raising and floodproofing opportunities. The City of Mandeville is also pursuing ecosystem projects to extend the life of the seawall while addressing the flood risk concerns for the community.

Additionally, the community is very supportive of nature based approaches and living shoreline projects for coastal resilience. Several environmental projects for the City of Mandeville can be found in Chapter 6. More information regarding nonstructural recommendations or environmental projects identified for the City of Mandeville can be found within Chapter 5.2 and 6 respectively.

5.1.5 Lake Pontchartrain Barrier

The Lake Pontchartrain Surge Barrier proposes to reduce hurricane storm surge using barriers at the entrance to Lake Pontchartrain along the New Orleans East Landbridge. The barrier would reduce storm surge along the north shore of Lake Pontchartrain including the towns of Covington, Mandeville, and Slidell and throughout the Lake Pontchartrain basin.

Background

In response to Hurricane Katrina in 2005, Congress authorized and funded the Hurricane and Storm Damage Risk Reduction System (HSDRRS). The system, completed in 2018, consists of levees, floodwalls, pump stations, and gate closure providing the Greater New Orleans area with protection from a 1% annual exceedance chance hurricane storm surge event.

Surge Barrier History

The idea of a flood barrier across the New Orleans East Landbridge extends back to at least 1967. The Lake Pontchartrain Surge Barrier has been proposed and evaluated in various capacities at both the State and Federal levels as a feature to tie in and/or extend the HSDRRS system and provide additional protection to the Lake Pontchartrain Basin. A U.S. Army Corps of Engineers (USACE) schematic from that year, shown in Figure 5-18, includes control structures across Chef Menteur Pass and the Rigolets.

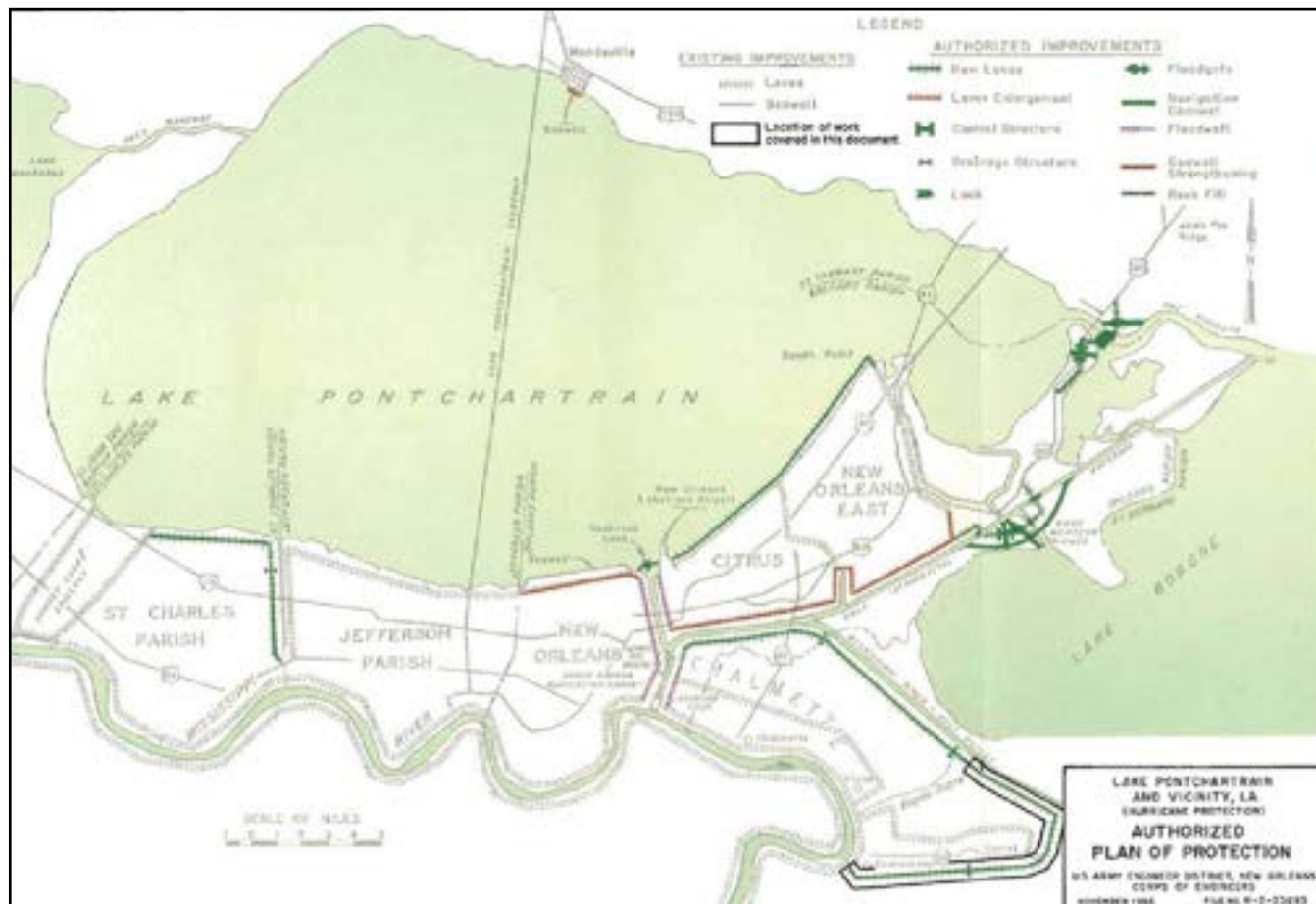


Figure 5-18 1967 USACE Proposed Hurricane Protection Schematic

The Lake Borgne Surge Barrier was presented as part of CPRA’s Master Plan from its first release in 2007 to the recently released 2023 version. The USACE St. Tammany Parish Feasibility Study also considered the project.

2007 CPRA Master Plan

In 2007, CPRA submitted the State’s first Master Plan, includes the first iteration of the Lake Pontchartrain Surge Barrier. The project was envisioned as a “Barrier Levee” extending from Caernarvon to I-59 north of Slidell to protect Metro New Orleans and Vicinity from a 0.2% chance annual exceedance event (500-year storm event). Although Metro New Orleans was specifically listed, the north shore of Lake Pontchartrain is expected to benefit from the project, with further analyses recommended.

The 2007 CPRA Master Plan presented three alignments with variations in the vicinity of Lake Borgne and the tie-in location to the HSDRRS system south of Lake Borgne.

Alignment 1, Figure 5-19, roughly follows the alignment of the Inner Harbor Navigation Canal – Lake Borgne Surge Barrier. This alignment requires gated structures at the Gulf Intracoastal Waterway (GIWW), Mississippi River Gulf Outlet (MRGO), Chef Menteur Pass, and the Rigolets. By following existing roadways, this alignment has the least direct impact to the environment.



Figure 5-19 Alternative 1 Alignment from 2007 CPRA Master Plan

Alignment 2, Figure 5-20, is similar to alignment 1 with the structure locations however, rather than following existing roads, it follows the shoreline of Lake Borgne known as the Golden Triangle area.



Figure 5-20 Alternative 2 Alignment from 2007 CPRA Master Plan

Alignment 3, Figure 5-21, consists of a significant variation south of the Rigolets. After crossing the Rigolets and the GIWW it crosses Lake Borgne to the southwest and ties back in to the HSDRSS system. This alignment requires structures at the Rigolets and the GIWW and Lake Borgne requires a robust design to withstand the open water environment.



Figure 5-21 Alternative 3 Alignment from 2007 CPRA Master Plan

The 2007 Master Plan does not include a cost for the Lake Pontchartrain Surge Barrier.

2012 CPRA Master Plan

The 2012 Master Plan includes the Lake Pontchartrain Surge Barrier (Project No. 001.HP.08P) as a recommended project for accelerated planning in the First Implementation Period (2012 – 2031). In this version, the project is described as a levee across the mouth of Lake Pontchartrain from the New Orleans Landbridge to Interstate 59 north of Slidell. Figure 5-22 shows the alignment included in the Master Plan. Two levee heights are evaluated (24.5 feet and 33 feet) using the Coastal Louisiana Risk Assessment (CLARA) model. Both options show substantial risk-reduction benefits, and the 24.5 feet height option was ultimately selected.

The project reduces risk to the Lake Pontchartrain basin with annual damage reduction values estimated between \$2.1 billion and \$10.4 billion in Year 50 of the project. Increased flood levels and potential negative impacts in Mississippi are not considered. As a result of this uncertainty, the Master Plan did not include a construction cost estimate. An estimate of \$76 million is included for planning and design of the project.

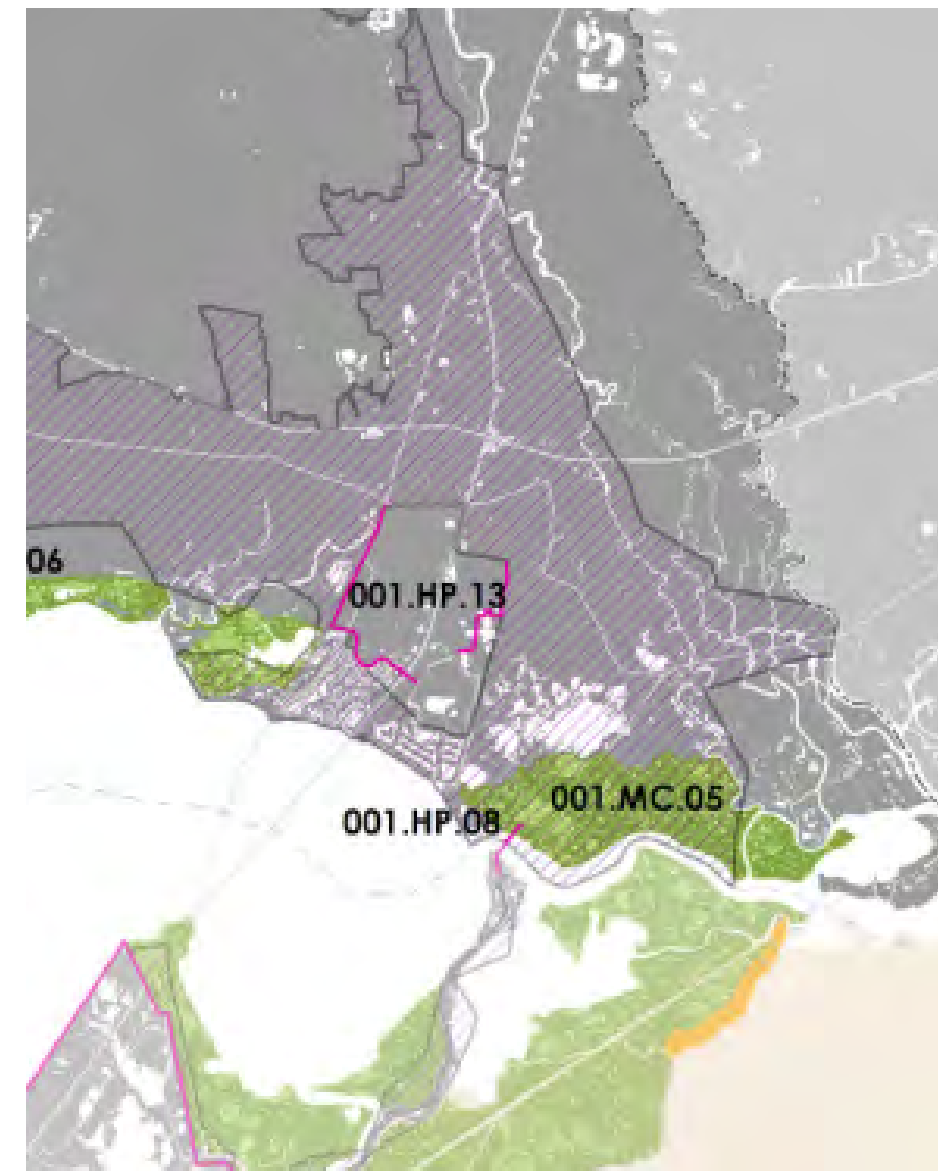


Figure 5-22 Lake Pontchartrain Surge Barrier Alignment from 2012 CPRA Master Plan

2017 CPRA Master Plan

To address the concerns of increased flooding in Mississippi, CPRA developed a configuration of the Lake Pontchartrain Surge Barrier that reduced storm surge while minimizing negative impacts along the Mississippi Coast.

All the scenarios considered involved simulating a levee alignment along either the existing US Highway 90 or CSX Railroad alignments. Various combinations of levee heights and gate heights at Chef Menteur Pass and the Rigolets were analyzed to determine the best configuration. Figure 5-23 shows the two alignments and Table 5-6 shows the barrier configurations considered.



Figure 5-23 Lake Pontchartrain Surge Barrier Alignments considered for the 2017 Master Plan

Table 5-6 Lake Pontchartrain Barrier Configurations Considered for the 2017 CPRA Master Plan

Name	Location	Road Height (Feet)	Gate Height (Feet)
FWOA	Not applicable	No change	Not applicable
Hwy 90/0/2	Highway 90	No change	2.0
Hwy 90/10/0	Highway 90 to Slidell	10.0	Not applicable
CSX/10/10	CSX railroad to Slidell	10.0	10.0
Hwy 90/10/10	Highway 90 to Slidell	10.0	10.0
Hwy 90/24.5/24.5	CSX railroad to Slidell	24.5	24.5

NOTE: FWOA=Future without action. Hwy 90/10/0=Highway 90 with 10-ft. crown, no gates, and Slidell extension. Hwy 90/0/2=Highway 90 with existing crown and 2-ft. gates. CSX/10/10=CSX railroad with 10-ft. crown, 10-ft. gates, and Slidell extension. Hwy 90/10/10=Highway 90 with 10-ft. crown, 10-ft. gates, and Slidell extension. Hwy 90/24.5/24.5=Highway 90, 24.5-ft. gates, and Slidell extension.

The potential benefits are greater for St. Tammany Parish than all other Parishes. Potential annual flood reduction benefits (in 2015 dollars) are shown in Table 5-7.

Table 5-7 Expected Annual Damage Reduction, by Parish or County, for Four Proposed Barrier

State	Parish/County	Alignment			
		Hwy 90/0/2	Hwy 90/10/10	CSX/10/10	Hwy 90/24.5/24.5
Louisiana	St. Tammany	620	712	696	539
	St. John the Baptist	209	258	252	267
	Ascension	86	105	103	107
	Jefferson	150	149	140	152
	Orleans	142	155	175	129
	Livingston	17	28	27	32
	Tangipahoa	6	11	10	15
	St. James	5	5	5	6
	St. Charles	-1	-1	-3	0
	Plaquemines	0	0	0	0
	St. Bernard	-14	-20	-25	-48
	Total	1,220	1,403	1,380	1,199
Mississippi	Hancock	-14	-23	-22	-42
	Harrison	-5	-10	-11	-23
	Jackson	-2	-3	-4	-18
	Total	-22	-35	-38	-84

NOTE: Because of rounding, totals might not sum precisely. This table shows the reduction, or inducement, in expected annual damage for coastal parishes and counties in Louisiana and Mississippi from four proposed Lake Pontchartrain barrier alignments as estimated in this analysis: For clarity, we omit Hwy 90/10/0 results because this option provided no depth or damage reduction benefit. We project the values for each scenario 50 years into the future, representing one set of assumptions about uncertain future sea level rise, landscape subsidence, asset growth, and performance of hurricane protection levees during flood events. The table shows the median (50th percentile) values. Green shading indicates positive damage reduction (benefit); red shading indicates induced damage (disbenefit).

RAND Corporation, 2017

Although the Hwy 90/10/10 and CSX/10/10 alignments provide the highest benefits, the Hwy 90/0/2 provide nearly as much damage reduction while minimizing capital costs and impacts to St. Bernard Parish and the adjacent Mississippi counties. As a result, this alternative was selected for inclusion in the 2017 Master Plan.

This option consists of two (2) low level (+2.0 feet NAVD 88) gate structures at Chef Menteur Pass and the Rigolets; however, unlike previous Master Plan versions, does not include tie-ins to other flood protection systems. The project is in the 2017 Master Plan (project no. 001.HP.08) and described as follows:

Construction of closure gates and weirs to an elevation of 2 feet NAVD88 across the passes at Chef Menteur and the Rigolets for storm surge risk reduction within the Lake Pontchartrain Basin. Project features approximately 5,200 feet of earthen levee, 630 feet of a combi-wall weir constructed to 2 feet, a 150-foot closure gate at each pass for navigation, and multiple vertical lift gates to maintain tidal exchange through the passes.

The project cost is \$2,409,600,000.

Current Status

2023 CPRA Master Plan

The 2023 CPRA Master Plan released in early 2023 was unanimously approved by the Legislature on April 19, 2023. The Lake Pontchartrain Barrier Project is once again included in the Master Plan. The project description in the 2023 Master Plan is less detailed than in the 2017 Master Plan, describing the gates across the passes as follows:

“Construction of closure gates and weirs to an elevation of 2 feet NAVD 88 across the passes at Chef Menteur and the Rigolets for storm surge risk reduction within the Lake Pontchartrain Basin.”

The cost for the project was listed as \$2.4 billion. Inclusion of the project in the 2023 Master Plan allows it to be eligible for State funding, if such funding becomes available, for the next six years.

USACE Feasibility Study

The Draft Feasibility Study for flood risk reduction in St. Tammany Parish was released by the USACE in July 2023, evaluates an array of alternatives to reduce or mitigate flooding damages in the Parish, including the Lake Pontchartrain Surge Reduction Project. Although considered, this alternative, referred to in the study as Lake Pontchartrain Surge Reduction, was removed during a screening process. The following explanation is provided:

“Structural measures including the weir and gates were removed from consideration based on the effectiveness of the measure reducing flood risk and the estimated implementation cost being higher than potential damages avoided.”

In accordance with the USACE, scoping documents for the Feasibility Study, the calculation of benefits only considers potential damage reduction estimates in St. Tammany Parish, and not the surrounding parishes that would also benefit. Therefore, benefits to other parishes are not allowed and the cost of the structure is compared only to the benefits in St. Tammany Parish, resulting in a poor benefit to cost ratio.

Regional Planning Commission Resolution

On September 13, 2022 the Regional Planning Commission (RPC) for Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. John the Baptist, St. Tammany, and Tangipahoa Parishes unanimously approved a resolution requesting a new start study authorization and funding from the United States Congress. This study would direct the USACE to evaluate the Lake Pontchartrain Barrier Project with consideration for potential damage avoidance for all of the Parish/Counties within or impacted by this project. Additionally, a separate request was made by the RPC to the Lake Pontchartrain Basin Restoration Program for funding to perform hydrologic modeling to support project evaluation.

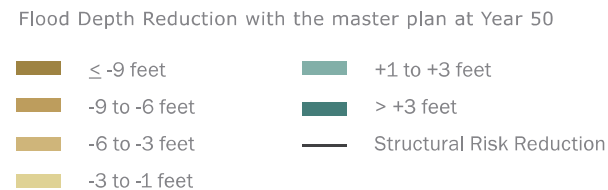


Figure 5-24 Lake Pontchartrain Barrier Project Features and Estimated Storm Surge Reduction. (CPRA 2023 Coastal Master Plan)

5.2 Additional Alternative Alignments and Future Flood Risk Reduction Projects Evaluated

5.2.1 Slidell Levee: East Segment Alternatives

Project Location

Slidell Levee protection, first proposed in the 2017 CPRA Master Plan encompasses large parts of central and east Slidell. The western side runs along the Norfolk Southern Railroad from Bayou Patassat through downtown Slidell. The eastern side ties into the high ground near Highway 190 near Military Road and runs southward along Doubloon Bayou and the edge of the Pearl River Wildlife management area. The southern portion is the existing Schneider Canal and Oak Harbor system discussed in Chapter 5.1.2. This system protects 9 square miles, approximately 2,992 homes and 5,988 residents. The project focuses on alternative alignments for the east segment of this system. Figure 5-25 illustrates the CPRA Master Plan alignment.

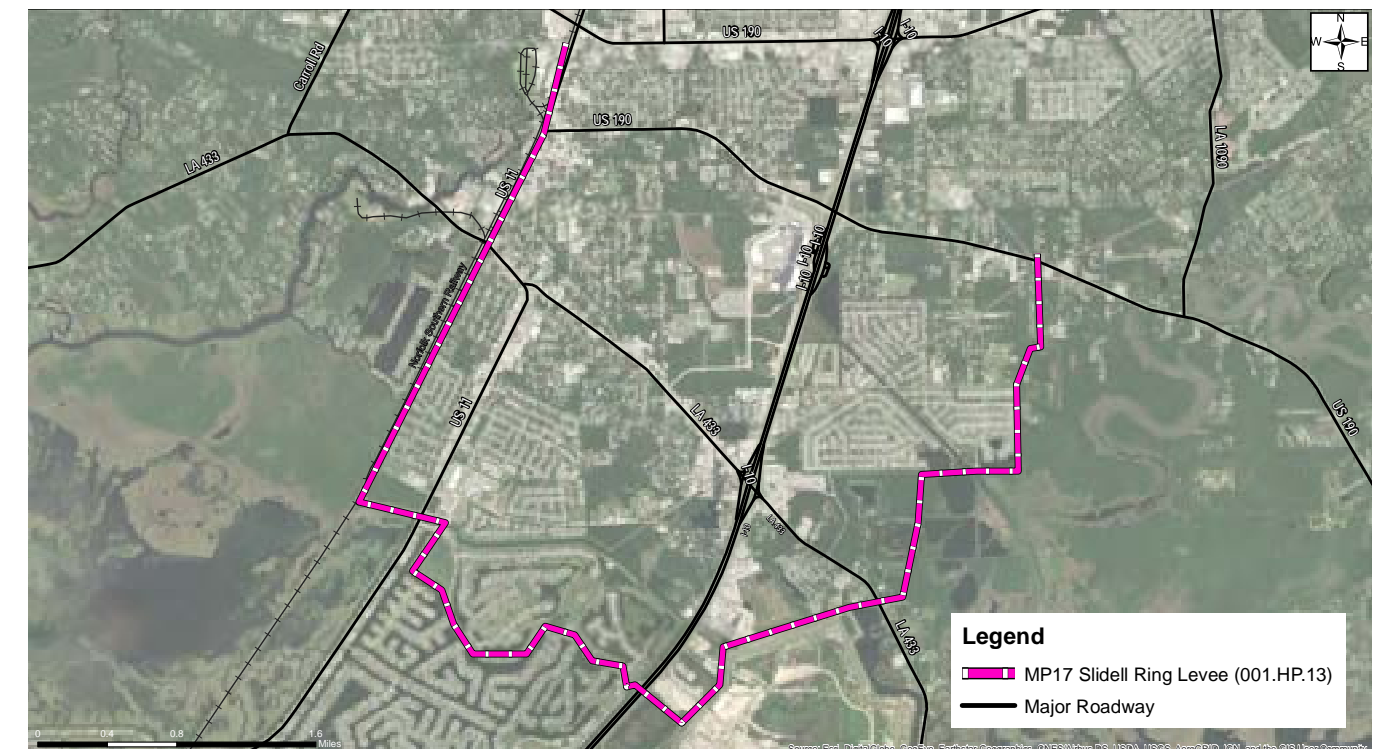


Figure 5-25 Slidell Levee - East Segment Protection Area (CPRA Master Plan Alignment)

Historical Flooding

The City of Slidell floods frequently due to its low ground elevation. The flooding events are caused by rain events, hurricane storm surge, and backwater flooding from Bayou Bonfouca.

Existing Conditions

Hydraulics, Hydrology and Watersheds

Waterways within the Slidell Levee - East Segment include W-14 Canal; W-15 Canal; Reine Canal, which links W-14 and W-15; Bayou Vincent; Doubloon Bayou; and various contributing drainage laterals. The area encompasses unincorporated areas of St. Tammany Parish and the City of Slidell south of I-12 and

east of I-10. The protection system includes an existing pumping station in Schneider Canal as well as the Delwood Pump Station on the southwest end.



Figure 5-26 East Slidell Watershed

Existing Topography

The City of Slidell topography ranges from +2 feet NAVD88 to +10 feet NAVD88 not including existing levee systems. It is heavily developed with multiple drainage canals and pump stations throughout the city limits.

Existing Levee Systems

As mentioned in section 5.1.1, the city of Slidell has a discontinuous series of locally owned and maintained levees constructed by local subdivisions, local agencies, and businesses over the years. For the area on the eastern side of Slidell, these existing levee systems include the Lakeshore Villages Levees and the Kingspoint Levees.



Figure 5-27 Existing Levee Systems

Lakeshore Villages Levees

The ring levee surrounding the Lakeshore Villages, outlined in blue on Figure 5-27, is a privately owned levee owned by the Lakeshore Villages Community Development District. The levee was constructed to an elevation of +17.0 feet NAVD88 and has a Letter of Map Revision (LOMR) which allows the interior neighborhood to benefit from lower insurance premiums. Additional details regarding the Lakeshore Villages ownership and maintenance requirements are included within the Alford & Alford report in **Appendix D**.

Kingspoint Levees

The Kingspoint Levee, outlined on Figure 5-27 in purple, is within the boundaries of Drainage District No. 4 of the St. Tammany Parish. The earthen levee surrounds the Kingspoint neighborhood at an elevation of +12.0 feet NAVD88. There is an annual parcel fee per lot to address maintenance of the levees and pumping station. Details regarding the Kingspoint ownership and maintenance are provided in a separate report.

PO-184 Slidell Levee - East Segments

The Slidell Levee - East Segments Project (PO-184) includes levee segment alternatives that provide flood protection and storm surge risk reduction around the eastern side of Slidell. The project from the CPRA's 2017 Coastal Master Plan (Project ID 001.HP.13) closes gaps in the existing Slidell Levee - East Segment System as seen in Figure 5-28.

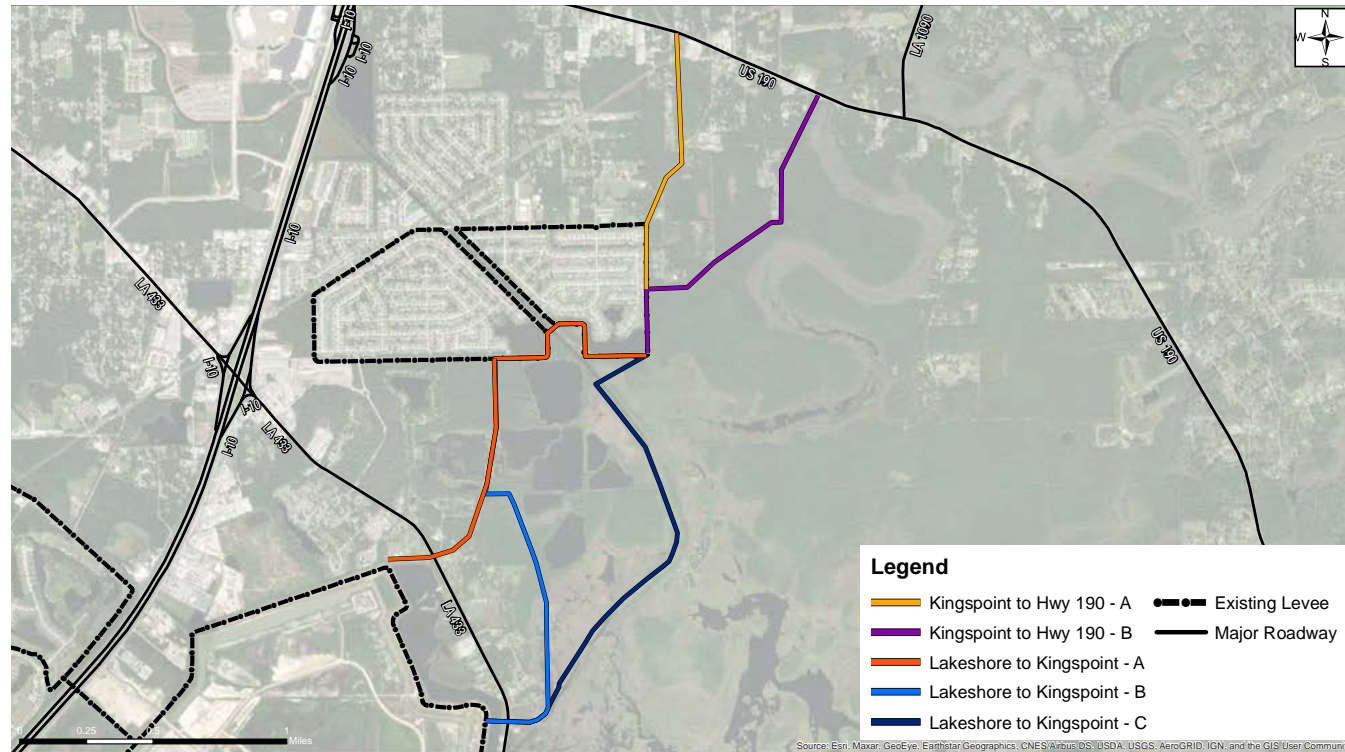


Figure 5-28 Slidell Levee - East Segment

This project considered the feasibility of the alternative alignments and provides conceptual planning and engineering for the required alignment features. The alternative alignments for PO-184 are divided into two (2) segments:

- Lakeshore Villages to Kingspoint
- Kingspoint to US Highway 190

Table 5-8 is a summary of estimated total capital costs for the PO-184 alignments. These costs are dependent on the preferred alternative selected.

Table 5-8 Summary of Total Capital Costs Slidell Levee - East Segment Project: East Segments

	Slidell Levee – East Segment	
	Low	High
Lakeshore Villages to Kingspoint	\$287,000,000	\$314,000,000
Kingspoint to Highway 190	\$33,000,000	\$44,000,000

Slidell Levee - East Segment Next Steps

There are two ongoing engineering studies that impact the Slidell Levee system. The United States Army Corps of Engineers (USACE) St. Tammany Parish, Louisiana Feasibility Study and the CPRA PO-184 Slidell Levee - East Segments Study.

Slidell Levee - East Segment is included in the USACE federal structural program providing flood risk reduction for the community. The federal alignment most closely follows the Lakeshore to Kingspoint A and the Kingspoint to Highway 190 A alignments as seen in Figure 5-37. With the approval of the Tentatively Selected Plan, St. Tammany Parish can continue to refine the proposed alignment as part of

the Non-Federal Sponsor requirements. Additionally, the existing levees that are incorporated into the federal system will go through the federal accreditation process.

5.2.2 Military Road

Project Location

The Military Road community east in Slidell is bound by Military Road to the west and the Pearl River to the east. It stretches from U.S. Interstate 10 at the northern edge downward toward U.S. Hwy 190 to the south as seen in Figure 5-38. It is over 2,300 acres of residential subdivisions with some commercial businesses along Military Road. This community has approximately 2,235 homes with 4,671 residents¹⁰.

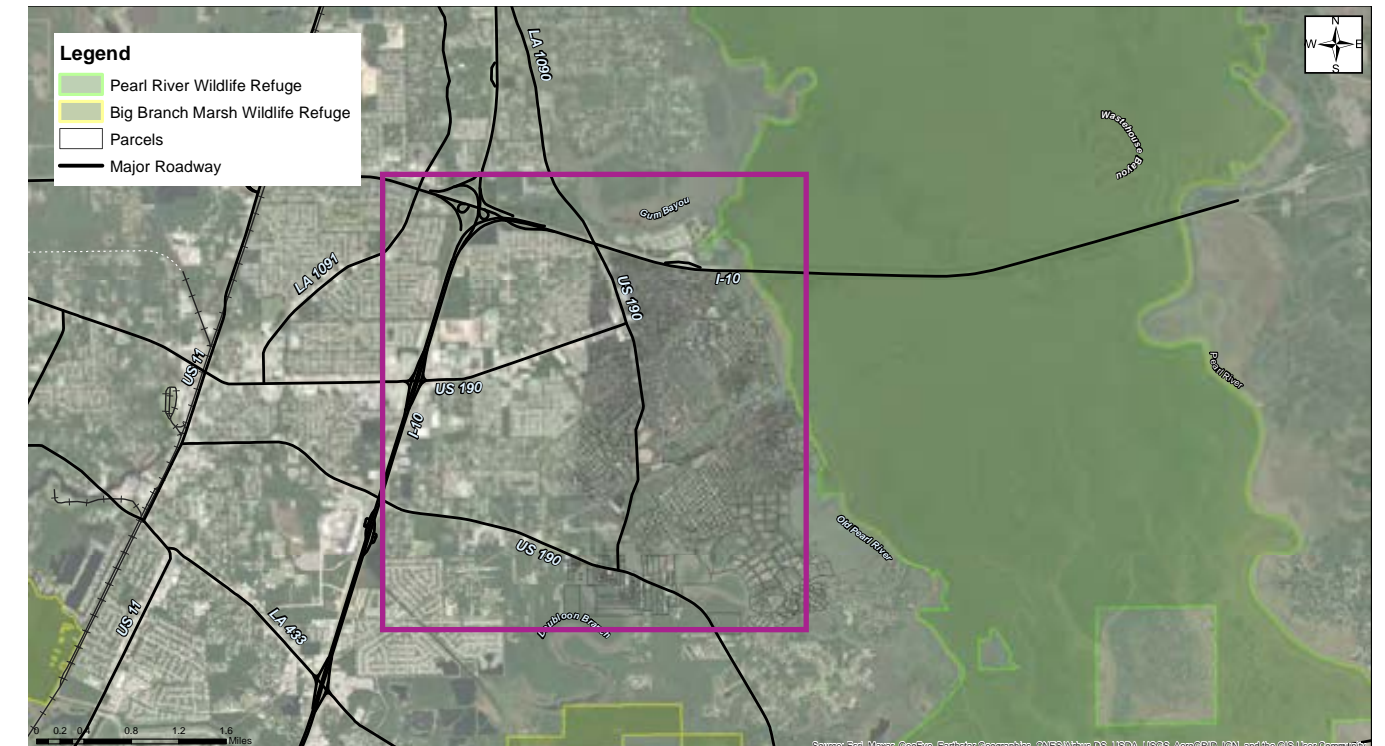


Figure 5-29 Military Road Area

Historical Flooding

The Military Road community historically floods due to coastal and riverine flooding. The lower portion of the W-15 Canal, locally called French Branch, contributes to the flooding due to its connection to Doubloon Bayou. The French Branch tributary funnels coastal storm surge inland into low-lying communities such as French Branch Estates and Willow Wood subdivisions. This surge of water reduces of the tributaries capacity to carry rainfall out of the northern portions of the watershed, causing flooding inland.

¹⁰. data.census.gov, Census tracts 22103.40708.1, 22103.40708.2, September 2022.

Alternatives Considered

Five alignments of structural flood control measures were considered for the Military Road community. These alignments consist of various combinations of levees, floodwalls, floodgates, pumpstations, and structural tie-ins. Consideration included constructability, cost, and impacts to property, roadways, and environment.

- Alternative A – Military Road Alignment
- Alternative B – Bluffs Subdivision Alignment
- Alternative C – Old River Road Alignment
- Alternative D – Doubloon Bayou Alignment
- Alternative E – US Highway 190 Alignment

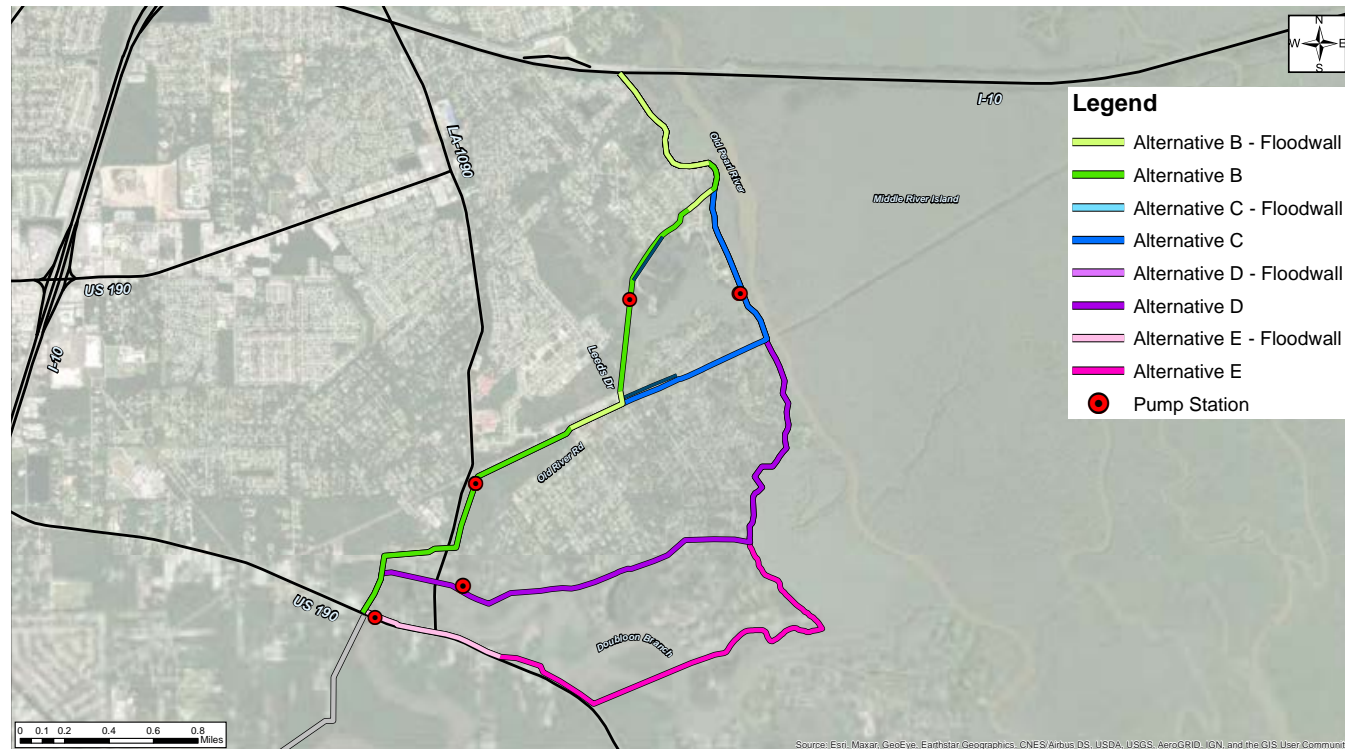


Figure 5-30 Military Road Project Alternatives

Existing Conditions

Hydraulics, Hydrology and Watersheds

The W-15 Canal is a natural stream modified in the 1930's & 1940's to facilitate drainage for the City of Slidell¹¹. It is approximately 8.76 miles long and includes multiple retention and detention ponds along its path from north Slidell to Doubloon Bayou. It encompasses 7,300 acres and connects to the W-14 Canal through the Reine Canal. The Reine Canal provides for flow east and west from W-14 and W-15 for watershed management of peak flows during rainfall. These canals provide drainage for roughly 12,000 acres within St. Tammany Parish.

The W-15 canal crosses US Highway 11, US Interstates 12 & 10, and US Highway 190 (Gause Boulevard) before connecting to the French Branch Estates Drainage Lateral. It then crosses Military Road and Old River Road within the last 3,500 feet before its confluence with Doubloon Bayou. The W-15 watershed

is developed with residential and commercial facilities through much of the basin. Its elevation ranges from +29.0 feet NAVD88 at its source to +3.0 feet NAVD88 at its confluence with Doubloon Bayou. Overall, the W-15 Canal crosses through the western portions of the Middle Pearl River Watershed and into the Pearlington-Pearl River Watershed before draining into Doubloon Bayou near US Highway 190 as seen in Figure 5-31.

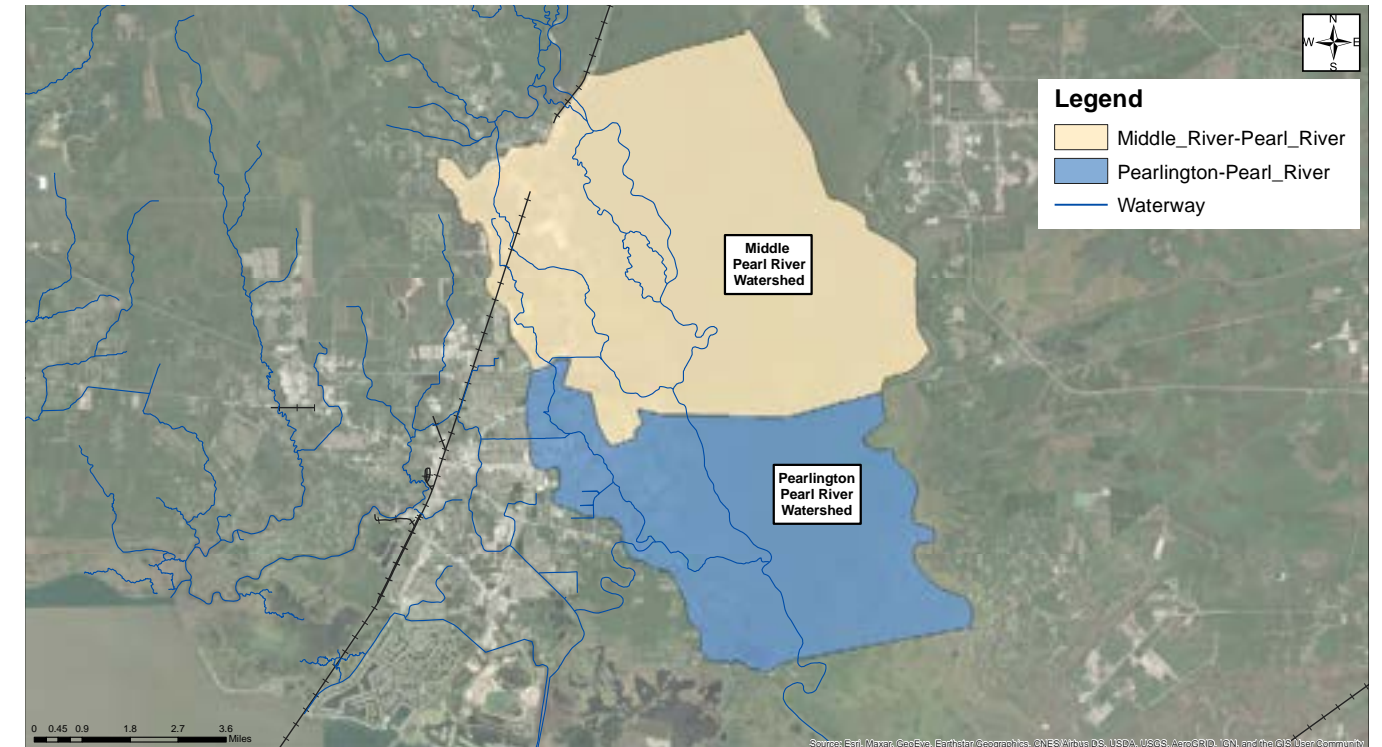


Figure 5-31 Pearl River Watersheds

Existing Soil Conditions

The proposed Military Road levee alignments lie in developed and marsh areas. Based on USACE geology maps and previous borings in the area near-surface fill materials of sand and clay of variable depth are present in the developed areas, and near surface marsh deposits are present in the marsh. Beneath these deposits, are stiffer Pleistocene clays or substratum sands.

Design Considerations

Storm Surge Levels of Protection

Based on CPRA's 2017 Master Plan ADCIRC model for the Military Road area, the flood risk reduction elevation ranges from +12 feet NAVD88 to +18.5 feet NAVD88 depending on location and level of protection. For each of the Alternatives shown on Figure 5-30, cost and impact analysis for both an interim and 100-year level of protection. Alignments for interim and 100-year levels terminate beyond interim protection to existing ground elevations at the 100-year level of protection elevation.

The slab elevation for most structures in the area are near elevation +12-foot NAVD88 based on LiDAR and a sampling of FEMA Letter of Map Revision Documents (LOMR) data. Because these slab elevations are at or above the interim level of protection, only communities along French Branch/W-15, will benefit from lower levels of protection such as a 25-yr or 50-yr level.

Figure 5-32 shows the estimated Hurricane Katrina inundation limits from FEMA within this community. This is considered by the community as an identifiable level for protection. This elevation was selected

11. St. Tammany Parish Watershed Management Study, Coastal Restoration and Protection Authority, December 2014.

for the development of the costs associated with the lower level or Interim Level of Protection for the Military Road Corridor.



Figure 5-32 Estimated Hurricane Katrina Inundations Limits and FEMA Flood Zones

Geotechnical Considerations

Geotechnical analyses performed for these alternative analyses are based on geologic mapping and data collected in the general area and may not represent conditions along the alignment. Additional data will be required per the LFPDG or HSSDRS guidelines. These geotechnical findings are considered conceptual and may change based on site-specific geotechnical explorations.

Levee Construction Overbuild and Settlement

Levee settlement is estimated to be approximately one-half foot¹². Given the extent of the project and number of alignments, an overbuild of one foot is assumed for the Military Road levee alignments. The analysis does not consider lateral spread of soft surficial deposits that may occur during construction. The extent and magnitude of lateral spread is dependent upon the contractor's means and methods. The foundation soils appear to be overconsolidated and relatively stiff; and is not anticipated to be an issue. **Appendix B** of this report provides details regarding the geotechnical analysis performed for the Military Road project area.

Levee Slope Stability

Slope stability analysis performed using the Still Water Level (SWL) condition considered the failure of the levee due to the weight of the flood side water on the soil beneath the structure. The levee results are in **Appendix B**. The analyses do not require a geosynthetic fabric on the levee but the fabric may be required in the marsh to reduce lateral spread/settlement during construction. Future design efforts should review and address these concerns.

¹² Based on CPRA's PO-0184 geotechnical analysis of the Kingspoint to US Hwy 190 alignment by GeoEngineers in 2022.

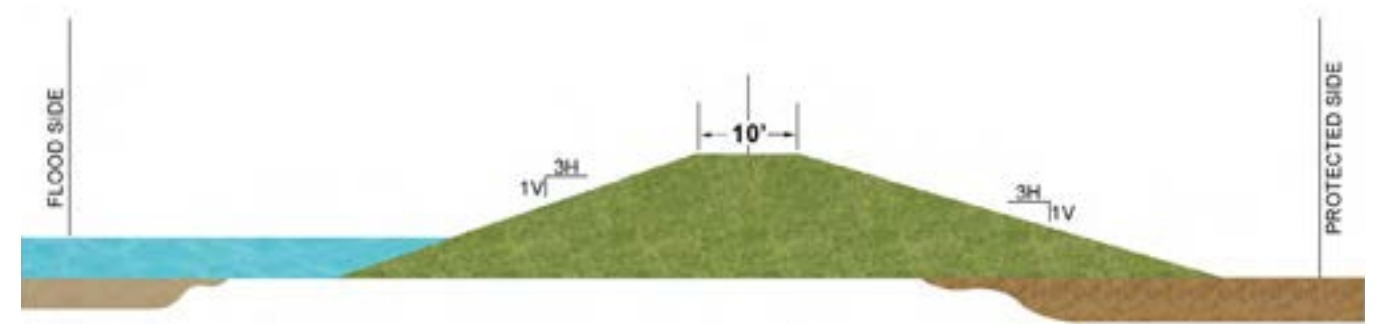


Figure 5-33 Typical Cross Section – Military Road

Existing Utilities

The utilities include cable, natural gas, electricity, and telephone, and electrical substations. These substations feed multiple high voltage transmission lines that traverse the Military Road corridor just north of Old River Road. Figure 5-34 shows the electrical transmission lines in the project area. There are restrictions associated with utilizing the transmission line rights-of-way. Coordination and/or relocation information for these utilities will be developed in future phases of design.

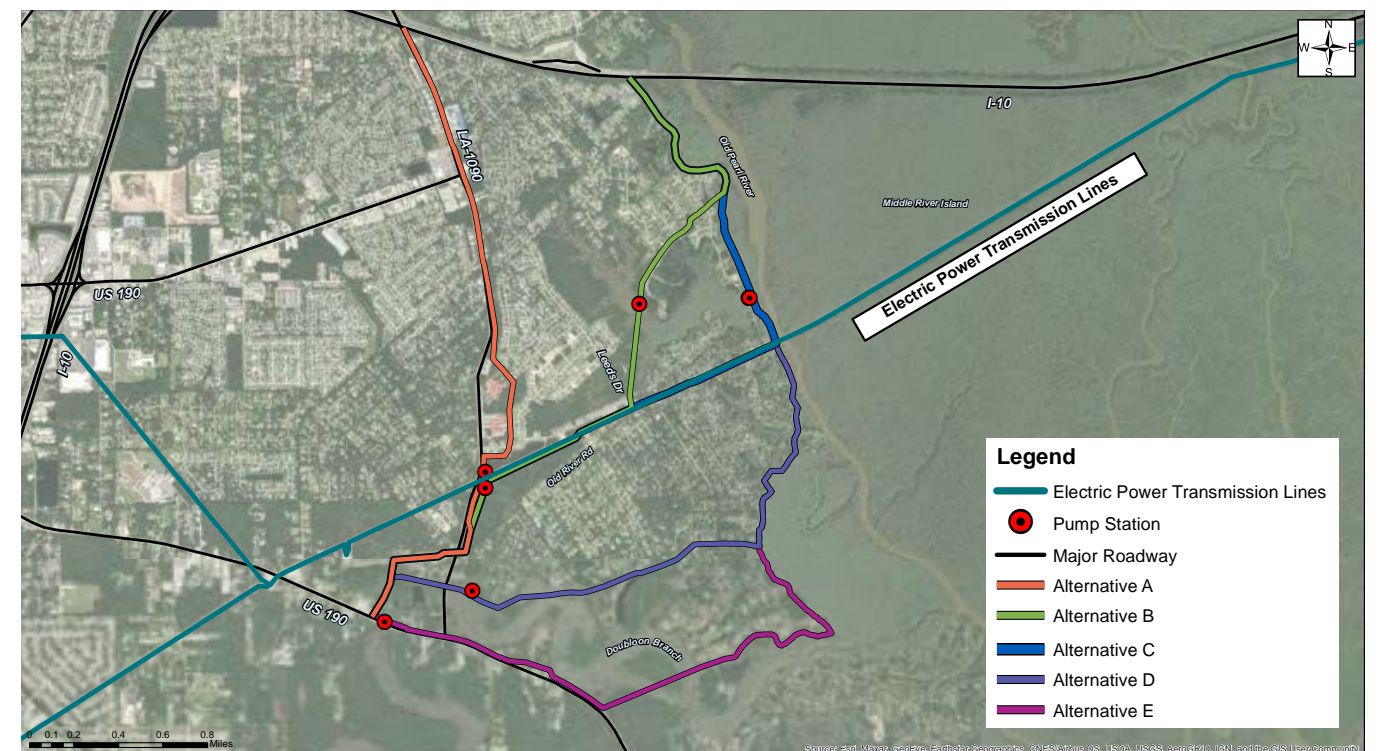


Figure 5-34 Electric Power Transmission Lines along Alignments

Other Considerations

Doubloon Bayou Hydraulic Contributions

Doubloon Bayou affects each of the alignments. It is a tributary from the Pearl River flows water westward through culverts along Military Road and then southward under the bridge at Highway 190. French Branch is the lower portion of the W-15 Canal and runs northwest to southeast and discharges into Doubloon Bayou on the east side of Military Road. The lands surrounding these natural features are the lowest elevations found within the Military Road corridor. Both features provide drainage to the

area and should be modeled to consider both the surrounding flood risk as well as the upstream flood risk for the broader Slidell community.

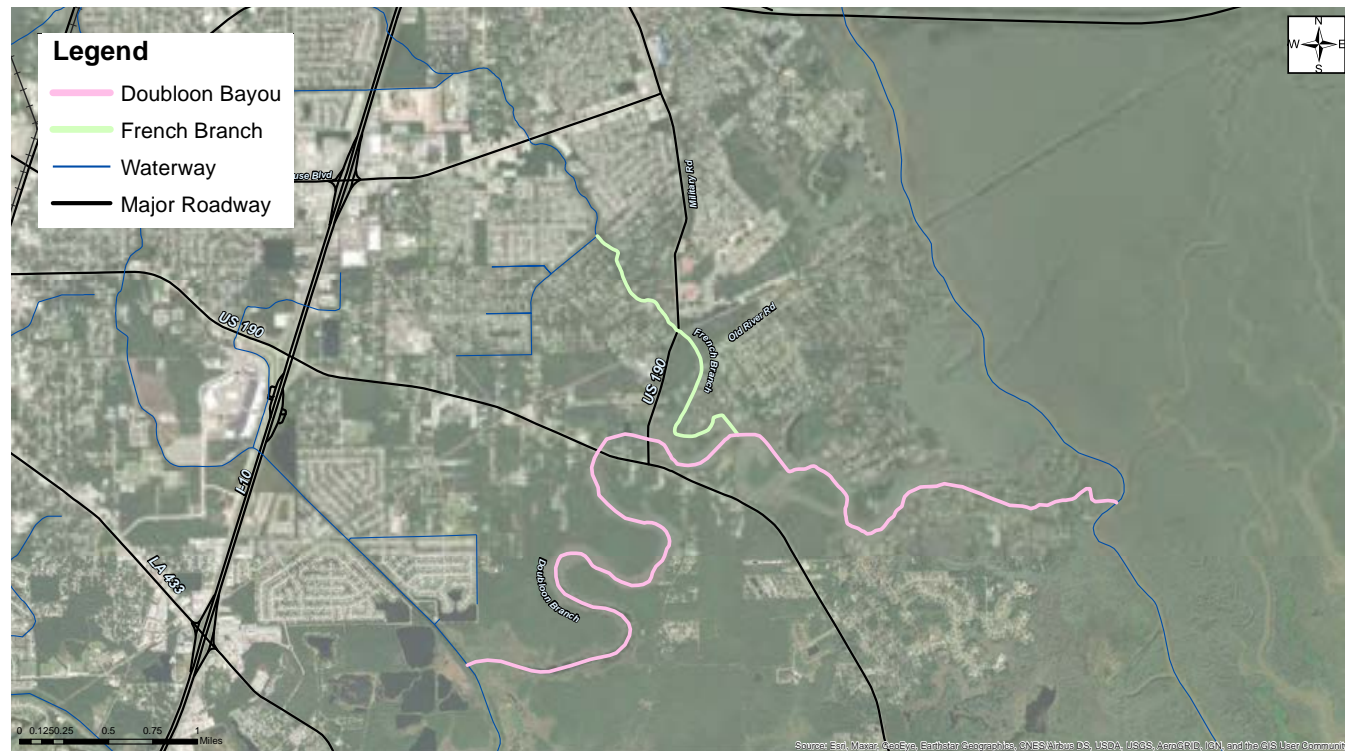


Figure 5-35 Doubloon Bayou Map

Alternative Alignments for Military Road Corridor

The five alternatives considered span from the east side of Military Road eastward to Highway 190. The components, protection features, number of structures protected, the costs of land acquisition and construction, and negative environmental impacts are considered for each alignment. The 100-year alternatives are summarized below.

For the Interim Level of Protection, the structural components for each of the five 100-year alternatives were reduced based on the limitations established by the Interim Level of Protection inundation line in the area. The revised structural components for the Interim Level of Protection alternatives are summarized in Figure 5-37.

100-Year Alternative Alignments for Military Road

The five alternative alignments all commence at the termination point of the Slidell East Levee alignments on the south side of US Highway 190. They cross Hwy 190 with a roadway gate structure and four continue north while Alternative E goes east. Figure 5-39 shows the various alternative alignments around the Military Road area. Alternatives B-E use the marsh interface along the Pearl River, in some capacity, for their eastern edge. This requires coordination with the Louisiana Wildlife and Fisheries (LDWF) with respect to the nearby Pearl River Wildlife Management Area. Other agencies requiring coordination are St. Tammany Parish Public Works, the Louisiana Department of Transportation and Development, and the US Federal Highway Association. Details regarding the alignments can be found in **Appendix C** along with an enlarged map, component details, and cost analysis.

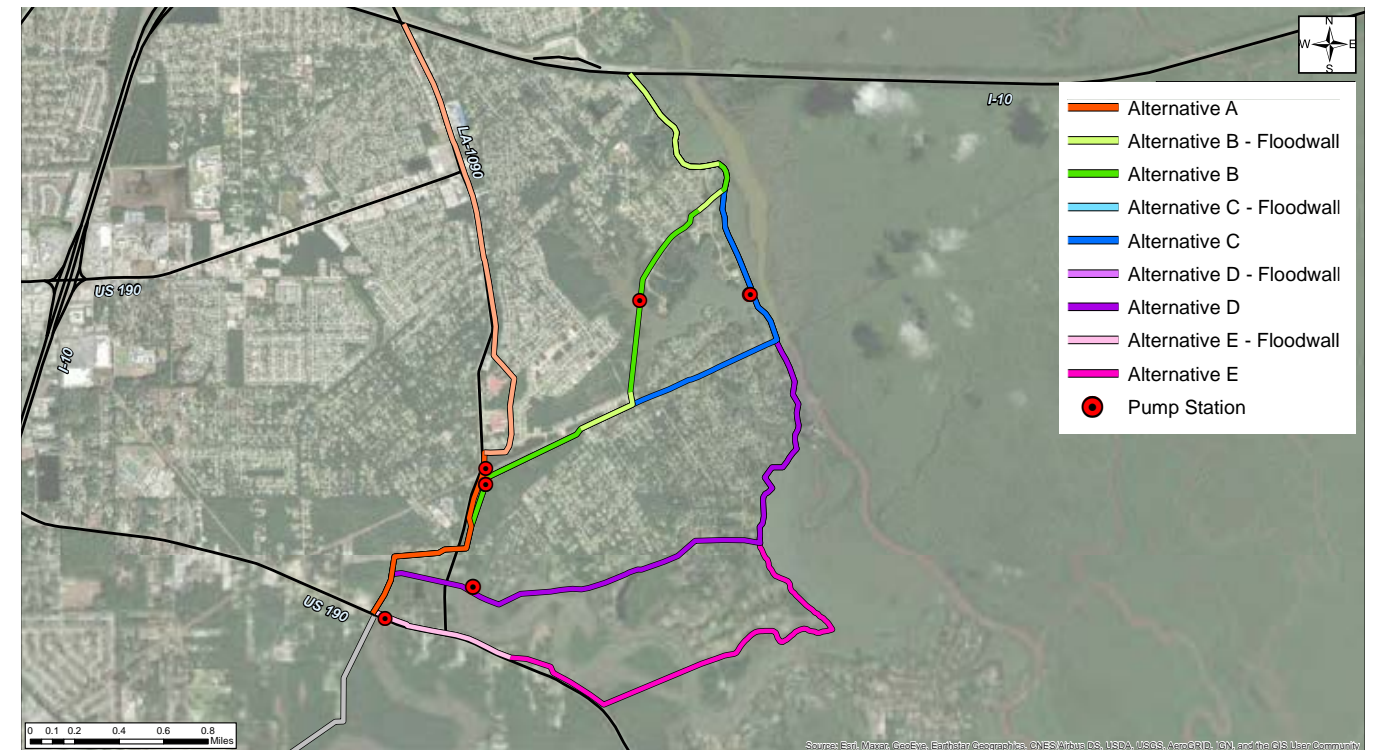


Figure 5-36 Military Road Project 100-Year Alternatives

Alternative A – Military Road Alignment

Alternative A continues north from Highway 190 with 1,500 feet of levee and a small drainage structure near Doubloon Bayou. The levee turns east for 1,700 feet where it crosses Military Road with a roadway gate. Once on the east side of Military Road, the levee turns north and continues 2,500 feet to a large structure and a pump station at French Bayou. Alternative A transitions to a floodwall along the east side of the Military Road with multiple roadway gates including single and double gates at the major roadways until it reaches Interstate 10. As the alignment nears Interstate 10, a 1,947-foot frontage or service road is needed to provide driveway access to Military Road through the narrow corridor.



Table 5-9 Alternative A - Structural Components

Alternative A: Military Road Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along Military Rd.
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at HWY 190 Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 5,559 LF Levee Width - 55 LF Floodwall Length – 11,268 LF Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station – Large Capacity (1) Roadway Roller Gate (8) Drainage Structure (2) Frontage Road – 1,947 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated that 35 landowners will be affected by this alignment.

Table 5-10 Military Road Alternative A Property Impacts

Alternative A: Military Road Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	2
		Total Acquisition without Structure	0
		Partial Impact with Structure	5
		Partial Impact without Structure	2
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	21
		Partial Impact without Structure	5
Pearl River Management Area Impact		No	
Total			35

Roadways Impacts

There will be roadway impacts on the following roads:

1. US Highway 190
2. Leaning Oak Dr
3. Cross Creek Dr
4. Turtle Creek Blvd
5. Cross Gates Blvd (South)
6. Herwig Bluff Rd
7. Steele Rd
8. Cross Gates Blvd (North)

The roadway impacts include floodgates that will be closed during a storm events and right-of-way encroachments. The number of floodgates can be reduced by re-routing roads to a common access point.

Environmental Concerns

Less than 10 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs

The estimated construction costs ranges from \$488,000,000 to \$660,000,000. There are \$163,000,000 in costs for property acquisition of 27 acres and two structural conflicts, environmental mitigation, utility relocation, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-11 Military Road 100-YR Alternative A - Estimated Total Capital Costs

Alternative A: Military Road Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$13,940,000	\$180,000	\$574,000,000	\$5,740,000	\$143,540,000	\$737,360,000

Alternative B – Bluffs Subdivision Alignment

Alternative B continues north with 1,500 feet of levee, a roadway gate and a drainage structure. The levee turns east crossing US Highway 190 with a roadway gate for 1,700 feet before turning north and continues along the east of US highway 190 for another 1,700 feet reaching a drainage structure and a pump station. The levee continues northeast along the south side of Cross Creek Dr. and transitions into a floodwall for 1,500 feet until it reaches Old River Rd. Alternative B continues north as a levee with a drainage structure and a pump station at the crossing at Arbor View Dr. with a roadway gate and another drainage structure at the end of the road. The Levee continues northeast until it reaches Old Pearl River. Alternative B continues northwest as a levee along the river towards Interstate 10 for 600 feet and transitions to floodwall with a drainage structure until it reaches Interstate 10.



Table 5-12 Alternative B - Bluffs Subdivision Alignment Structural Components

Alternative B: Bluffs Subdivision Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along Old River Rd. And Devil’s Elbow
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at Interstate 10 Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 12,704 LF Levee Width – 71 LF Floodwall Length – 5,936 LF Floodwall Width – 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Stations (2) Roadway Roller Gate (3) Drainage Structure (4) Frontage Road – 878 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated that 30 landowners will be affected by this alignment.

Table 5-13 Military Road Alternative B Property Impacts

Alternative B: Bluffs Subdivision Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	13
		Partial Impact without Structure	15
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	1
		Partial Impact without Structure	1
Pearl River Management Area Impact		No	
Total		30	

Roadway Impacts

There will major roadway impacts on the following roads:

1. Leaning Oak Dr
2. US HWY 190
3. Arbor View Dr

The roadway impacts include floodgates that will be closed during a storm events and right-of-way encroachments. Consideration of local service roads may provide consolidated access to the main access roadway of Arbor View Dr.







Environmental Concerns

It was estimated that up to 19 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs

The estimated construction costs ranges from \$301,000,000 to \$407,000,000 to construct both levee and floodwalls, along with two pump stations at French Branch and near Leeds Drive. There are \$103,000,000 in costs for property acquisition of 43 acres and 14 structural conflicts, environmental mitigation expenses, utility relocation costs, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-14 Military Road 100-YR Alternative B Estimated Total Capital Costs

Alternative B: Bluffs Subdivision Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$9,310,000	\$1,140,000	\$354,000,000	\$3,540,000	\$88,500,000	\$456,490,000

Alternative C – Old River Rd Alignment

Alternative C continues north 1,500 feet of levee and a drainage structure. The levee turns east crossing US Highway 190 with a gate for 1,700 feet before turning north along the east of US highway 190 for another 1,700 feet to a floodgate and a pump station. The levee continues northeast along Old River Rd. 2,000 feet and transitions to floodwall until it reaches Old Pearl River with a gate. Alternative C continues northwest as a levee along the river towards Interstate 10 for 4,600 feet and transitions to floodwall with a drainage structure until it reaches Interstate 10.



Table 5-15 Alternative C - Old River Road Alignment Structural Components

Alternative C: Old River Road Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> • Levee with 10-ft wide crown, 3H:1V Side slopes • T-Wall along Old River Rd. And Devil’s Elbow
Structure Tie-Ins	<ul style="list-style-type: none"> • Northern Tie-In at Interstate 10 • Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> • Levee Length – 15,449 LF • Levee Width - 85 LF • Floodwall Length – 8,511 LF • Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> • Pump Station (2) • Roadway Roller Gate (3) • Drainage Structure (4) • Frontage Road – 1,375 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated that 22 landowners will be affected by this alignment. Additionally, the alignment is proposed to follow between the Pearl River Management Area interface and private properties.

Table 5-16 Military Road Alternative C Property Impacts

Alternative C: Old River Road Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	17
		Partial Impact without Structure	3
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	1
		Partial Impact without Structure	1
Pearl River Management Area Impact		Yes	
Total		22	

Roadway Impacts

Based on the proposed alignment, it is anticipated that there will major roadway impacts on the following roads:

1. US HWY 190
2. White Stork Dr

The roadway impacts include floodgates that will be closed during a storm events and right-of-way encroachments. Consideration of local service roads may provide consolidated access to the main access roadway of Old River Road between Leeds Dr and Diamond Dove Road.

Environmental Concerns

25 acres of undeveloped wetland habitat will be affected by this alignment. Additionally, a portion of the alignment will follow between the Pearl River Management Area interface and private properties. This will require additional permitting efforts and review.

Estimate of Budgetary Construction Costs

The estimated construction costs ranged from \$345,000,000 to \$467,000,000 to construct both levee and floodwalls, along with 2 pump stations located at French Branch and near Highland Bluff. There are \$120,000,000 in costs for property acquisition of 58 acres and 18 structural conflicts, environmental mitigation, utility relocation costs, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-17 Military Road 100-YR Alternative C Estimated Total Capital Costs

Alternative C: Old River Road Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$12,790,000	\$1,440,000	\$406,000,000	\$4,060,000	\$101,500,000	\$525,790,000

Alternative D – Doubloon Bayou Alignment

Alternative D continues north with a roadway gate and a drainage structure 200 feet to the east of Leaning Oak Dr for 1,000 feet. The levee turns east crossing US Highway 190 with a roadway gate and continues along Doubloon Bayou with pump station and a drainage structure. Alternative D continues northeast until the western edge of the Pearl River near the marsh & land interface with gates at Douglas Dr. and Starling Dr. The levee continues northward towards Interstate 10 following the marsh & land interface with drainage structures at Paradise Point and near the north of Nighthawk Dr. The levee continues northwest along Devil’s Elbow as a floodwall and a drainage structure until it reaches Interstate 10.



Table 5-18 Alternative D - Doubloon Alignment Structural Components

Alternative D: Doubloon Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> • Levee with 10-ft wide crown, 3H:1V Side slopes • T-Wall along Devil’s Elbow
Structure Tie-Ins	<ul style="list-style-type: none"> • Northern Tie-In at Interstate 10 • Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> • Levee Length – 20,480 LF • Levee Width - 75 LF • Floodwall Length – 3,465 LF • Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> • Pump Station (2) • Roadway Roller Gate (4) • Drainage Structure (7)

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated that 45 landowners will be affected by this alignment. Additionally, the alignment is proposed to follow between the Pearl River Management Area interface and private properties.

Table 5-19 Military Road Alternative D Property Impacts

Alternative D: Doubloon Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	29
		Partial Impact without Structure	15
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	1
		Partial Impact without Structure	0
Pearl River Management Area Impact		Yes	
Total		45	

Roadway Impacts

There will major roadway impacts on the following roads:

1. Leaning Oak Dr
2. US HWY 190
3. Douglas Dr
4. Starling Dr

The roadway impacts include floodgates that will be closed during a storm events and right-of-way encroachments.







Environmental Concerns

64 acres of undeveloped wetland habitat will be affected by this alignment. Additionally, the alignment will follow between the Pearl River Management Area interface and private properties. This will require additional permitting efforts and review.

Estimate of Budgetary Construction Costs

The estimated construction costs ranges from \$292,000,000 to \$396,000,000 to construct both levee and floodwalls, along with 2 pump stations located at French Branch and near Highland Bluff. There are \$104,000,000 in costs for property acquisition of 64 acres and 30 structural conflicts, environmental mitigation, utility relocation costs, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-20 Military Road 100-YR Alternative D Estimated Total Capital Costs

Alternative D: Doubloon Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$11,090,000	\$3,840,000	\$344,000,000	\$3,440,000	\$86,000,000	\$448,370,000

Alternative E – Highway 190 Alignment

Alternative E continues east along Highway 190 with a floodwall and drainage structure then crosses Military Road with a roadway gate. After Military Road it transitions to a levee and continues along Highway 190. Approximately 1,500 feet before Indian Village Road, the levee turns northeast and crosses Doubloon Bayou with drainage structures and a roadway gate. Alternative E continues along the northern bank of Doubloon Bayou until the western edge of the Pearl River near the marsh & land interface with a small drainage structure near Jamestown Dr. and another small drainage structure near Little Gull Dr. The levee continues northward towards Interstate 10 following the marsh and land interface with a pump station and a drainage structure between the south of Highland Bluff Ct. and the north of Nighthawk Dr. The levee proceeds north along the West Pearl River edge as a floodwall and a drainage structure until Interstate 10.



Table 5-21 Military Road Alternative E Structure Components

Alternative E: Highway 190 Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along US Highway 190E
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at Interstate 10 Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 21,759 LF Levee Width - 84 LF Floodwall Length – 6,915 LF Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station (2) Roadway Roller Gate (2) Drainage Structure (9) Frontage Road – 2,674 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it is estimated that 58 parcels are impacted by this levee alignment.

Table 5-22 Military Road Alternative E Property Impacts

Alternative E: Highway 190 Alignment		
Property Impacts		
 Residential	Total Acquisition with Structure	0
	Total Acquisition without Structure	0
	Partial Impact with Structure	36
	Partial Impact without Structure	21
 Commercial	Total Acquisition with Structure	0
	Total Acquisition without Structure	0
	Partial Impact with Structure	0
	Partial Impact without Structure	1
Pearl River Management Area Impact		Yes
Total		58

Roadway Impact

This alignment impacts the following roads:

1. US HWY 190
2. Yorktown Dr

The impacts include floodgates that close during storms events and right-of-way encroachments.



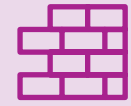



Environmental Concerns

66 acres of wetland habitat will be impacted by this alignment. Additionally, the alignment will follow between the Pearl River Management Area interface and private properties. This will require additional permitting efforts and review.

Highway 190 Estimate of Budgetary Construction Costs

The estimated construction costs ranged from \$343,000,000 to \$463,000,000 to construct both levee and floodwalls, along with 2 pump stations located at French Branch and near Highland Bluff. There are \$122,000,000 in costs for property acquisition of 75 acres and an 36 structural conflicts, environmental mitigation, utility relocation costs, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-23 Military Road 100-YR Alternative E Estimated Total Capital Costs

Alternative E: Highway 190 Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$14,820,000	\$3,960,000	\$403,000,000	\$2,015,000	\$100,750,000	\$524,545,000

Interim Level of Protection for Military Road

Five alternative alignments are considered for the Military Road corridor.

- Alternative A – Military Road Alignment
- Alternative B – Bluffs Subdivision Alignment
- Alternative C – Old River Road Alignment
- Alternative D – Doubloon Bayou Alignment
- Alternative E – US Highway 190 Alignment

These five alternative alignments start at the termination of the Slidell East Levee alignments on the south side of US Highway 190, cross Hwy 190 with a roadway gate structure then four continue north while Alternative E travels east. Figure 5-46 shows the alternative alignments as well as the Hurricane Katrina inundation line. This inundation line is considered the limits for the Interim Level of Protection for the Military Road Corridor. Details of the alignments can be found in **Appendix C** along with an enlarged map, the components, and cost analysis.

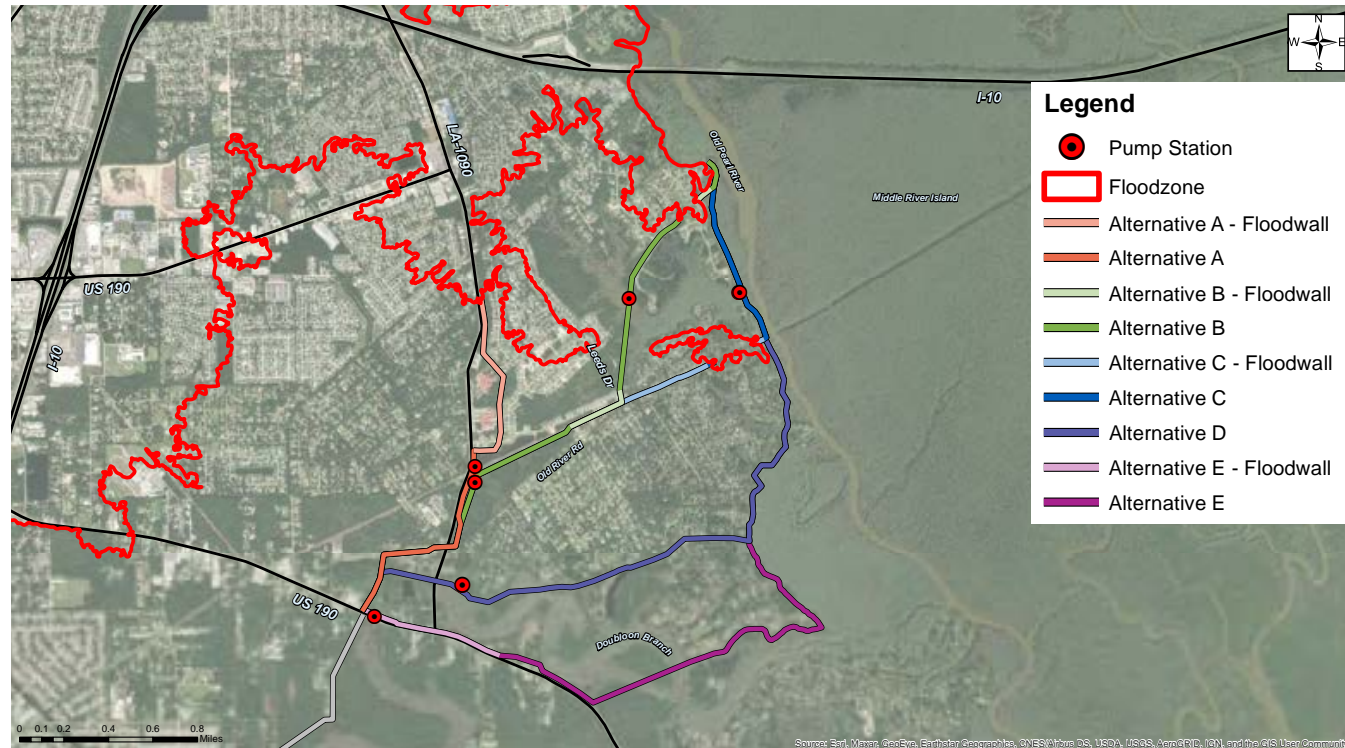


Figure 5-37 Military Road Project Alternatives

Alternative A – Military Road Alignment

Alternative A continues north from Highway 190 with 1,500 feet with levee and a drainage structure near Doubloon Bayou. The levee turns east for 1,700 feet where it crosses Military Road with a roadway gate. From the east side of Military Road, the levee turns north and continues 2,500 feet to a floodgate structure, a four-barrel drainage structure and a pump station at French Bayou. Alternative A transitions to a floodwall along the east side of the Military Road with multiple roadway gates including single and double gates at the major roadways until it reaches D’Evereux Dr.

Table 5-24 Alternative A - Structural Components Interim Level

Alternative A: Military Road Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along Military Rd.
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at D’Evereux Dr. Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 5,558 LF Levee Width - 16 LF Floodwall Length – 4,338 LF Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station – (1) Roadway Roller Gate (3) Drainage Structure (2)

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated 13 landowners will be affected by this alignment.

Table 5-25 Military Road Alternative A Property Impacts

Alternative A: Military Road Alignment			
Property Impacts			
Residential		Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	4
		Partial Impact without Structure	2
Commercial		Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	3
		Partial Impact without Structure	4
Pearl River Management Area Impact			No
Total			13

Roadways Impacts

There will be roadway impacts on the following roads:

1. US Highway 190
2. Leaning Oak Dr
3. Cross Creek Dr

The roadway impacts include floodgates that will be closed during a storm events and right-of-way encroachments. Consideration of local service roads or frontage roads may provide consolidated access to the main access roadway of Military Road.


Environmental Concerns

5 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs – Interim Level

The estimated construction costs ranges from \$245,000,000 to \$331,000,000 to construct a levee, floodwall, and a pump station located at French Branch. An additional \$82,000,000 in costs for property acquisition of 13 acres and 13 structural conflicts, environmental mitigation, utility relocation costs, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-26 Military Road Interim Level Alternative A - Estimated Total Capital Costs

Alternative A: Military Road Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$6,510,000	\$131,000	\$288,000,000	\$2,880,000	\$72,000,000	\$369,521,000

Alternative B – Bluffs Subdivision Alignment

Alternative B continues north with 1,500 feet of levee with a gate and a drainage structure. The levee turns east crossing US Highway 190 with a gate for 1,700 feet before it turns north and continues along the east side of US highway 190 for another 1,700 feet to a four-barrel drainage structure and a pump station at French Bayou. The levee continues northeast along the south of Cross Creek Dr. and transitions into a floodwall 1,500 feet until it reaches Old River Rd. Alternative B continues north as a levee with a drainage structure and a pump station crossing Arbor View Dr. with a gate and a drainage structure at the end of the road. The Levee continues northeast until it reaches high ground near the Bluffs Subdivisions.



Table 5-27 Alternative B - Bluffs Subdivision Alignment Structural Components – Interim Level

Alternative B: Bluffs Subdivision Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along Old River Rd.
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at the Bluffs Subdivisions Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 12,452 LF Levee Width - 32 LF Floodwall Length – 2,391 LF Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station (2) Roadway Roller Gate (3) Drainage Structure (4) Frontage Road – 878 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated that 19 landowners will be affected by this alignment.

Table 5-28 Military Road Alternative B Property Impacts

Alternative B: Bluffs Subdivision Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	4
		Partial Impact without Structure	13
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	1
		Partial Impact without Structure	1
Pearl River Management Area Impact		Yes	
Total		19	

Roadway Impacts

There will major roadway impacts on the following roads:

1. Leaning Oak Dr
2. US HWY 190
3. Arbor View Dr

The roadway impacts include floodgates that will be closed during a storm events and right-of-way encroachments. Consideration of local service roads may provide consolidated access to the main access to Military Road or other local neighborhood roadways.







Environmental Concerns

15 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs – Interim Level

The estimated construction costs ranges from \$222,000,000 to \$300,000,000 to construct both levee and floodwalls, along with 2 pump stations located at French Branch and near Leeds Drive. There are \$78,000,000 in costs for property acquisition of 27 acres and 19 structural conflicts, environmental mitigation, utility relocation, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs

Table 5-29 Military Road Interim Level Alternative B Estimated Total Capital Costs

Alternative B: Bluffs Subdivision Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$8,800,000	\$880,000	\$261,000,000	\$2,261,000	\$65,250,000	\$338,540,000

Alternative C – Old River Rd Alignment

Alternative C levee continues north 1,500 ft with a drainage structure. The levee turns east crossing US Highway 190 with a roadway gate for 1,700 feet before it turns north along the east side of US highway 190 for another 1,700 feet to a floodgate structure, a four-barrel drainage structure and a pump station at French Bayou. The levee continues northeast along Old River Rd. until it reaches a frontage road from Nighthawk Dr. to White Stork Dr. Alternative C continues with a gate structure northwest as a levee along the river towards Interstate 10 for 5,000 feet until it reaches high ground near the Bluffs Subdivision.



Table 5-30 Alternative C - Old River Road Alignment Structural Components – Interim Level

Alternative C: Old River Road Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along Old River Rd.
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at the Bluffs Subdivisions Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 12,123 LF Levee Width - 36 LF Floodwall Length – 4,113 LF Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station (2) Roadway Roller Gate (2) Drainage Structure (3) Frontage Road – 1,375 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated 14 landowners will be affected by this alignment.

Table 5-31 Military Road Alternative C Property Impacts

Alternative C: Old River Road Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	9
		Partial Impact without Structure	3
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	1
		Partial Impact without Structure	1
Pearl River Management Area Impact		Yes	
Total		14	

Roadway Impacts

There will major roadway impacts on the following roads:

1. US HWY 190
2. White Stork Dr.

The roadway impacts include floodgates that would be closed during a storm events and right-of-way encroachments. Consideration of local service roads may provide consolidated access to the main access roadway of Military Road or within the local neighborhood roadways.



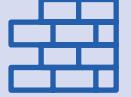



Environmental Concerns

19 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs - Interim

The estimated construction costs ranges from \$237,000,000 to \$321,000,000 to construct a levee and 2 pump stations located at French Branch and east of Leeds Drive. An additional \$81,000,000 in costs for property acquisition of 32 acres and 14 structural conflicts, environmental mitigations, utility relocation, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-32 Military Road Interim Level Alternative C Estimated Total Capital Costs

Alternative C: Old River Road Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$7,340,000	\$1,140,000	\$279,000,000	\$2,790,000	\$69,750,000	\$360,020,000

Alternative D – Doubloon Bayou Alignment

Alternative D levee continues north with a roadway gate and a drainage structure approximately 200 feet to the east of Leaning Oak Dr for about 1,000 feet. The levee turns east crossing US Highway 190 with a roadway gate and continues along the Doubloon Bayou with pump station and a drainage structure. Alternative D continues northeast until it reaches the western edge of the Pearl River near the marsh & land interface with a gate at Douglas Dr. and Starling Dr. The levee continues northward towards Interstate 10 following the marsh & land interface with drainage structures at Paradise Point and near the north of Nighthawk Dr. The levee continues northwest along the west side of Old Pearl River until it reaches high ground near the Bluffs Subdivision.



Table 5-33 Alternative D - Doubloon Alignment Structural Components

Alternative D: Doubloon Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at the Bluffs Subdivisions Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 20,510 LF Levee Width - 46 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station (2) Roadway Roller Gate (4) Drainage Structure (6)

Property Impacts

Based on information from the St. Tammany Assessor’s website, it was estimated 37 landowners will be affected by this alignment.

Table 5-34 Military Road Alternative D Property Impacts

Alternative D: Doubloon Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	21
		Partial Impact without Structure	15
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	1
		Partial Impact without Structure	0
Pearl River Management Area Impact		Yes	
Total		37	

Roadway Impacts

There will major roadway impacts on the following roads:

1. Leaning Oak Dr.
2. US HWY 190
3. Douglas Dr.
4. Starling Dr.

The roadway impacts include floodgates that will be closed during a storm events or right-of-way encroachments. Consideration of local service roads may provide consolidated access to the main access roadway of Military Road or within the local neighborhood roadways.



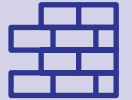



Environmental Concerns

It was estimated that 41 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs – Interim Level

The estimated construction costs ranges from \$203,000,000 to \$275,000,000 to construct a levee and 2 pump stations located at French Branch and Highland Bluff as well as the multiple drainage structures. An additional \$78,000,000 in costs for property acquisition of 41 acres and 37 structural conflicts, environmental mitigation, and utility relocation, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-35 Military Road Interim Alternative D Estimated Total Capital Costs

Alternative D: Doubloon Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$13,100,000	\$2,440,000	\$239,000,000	\$2,390,000	\$59,750,000	\$316,680,000

Alternative E – Highway 190 Alignment

Alternative E levee continues east along Highway 190 as a floodwall and drainage structure then crosses Military Road with a gate. After Military Road, it transitions to levee and continues along Highway 190. The levee turns northeast 1,500 feet before Indian Village Road and crosses Doubloon Bayou with drainage structures and a gate. Alternative E continues along the northern bank of Doubloon Bayou until it reaches the western edge of the Pearl River near the marsh & land interface with a small drainage structure near Jamestown Dr. and near Little Gull Dr. The levee continues northward towards Interstate 10 following the marsh and land interface with a pump station and a drainage structure between the south of Highland Bluff Ct. and the north of Nighthawk Dr. The levee proceeds north along the West Pearl River edge with a drainage structure until high ground near the Bluffs Subdivisions.



Table 5-36 Military Road Alternative E Structure Components

Alternative E: Highway 190 Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes T-Wall along US Highway 190E
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at the Bluffs Subdivisions Southern Tie-in at PO-0184
Footprint	<ul style="list-style-type: none"> Levee Length – 21,768 LF Levee Width - 45 LF Floodwall Length – 3,450 LF Floodwall Width - 50 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station (2) Roadway Roller Gate (2) Drainage Structure (8) Frontage Road – 2,674 LF

Property Impacts

Based on information from the St. Tammany Assessor’s website, it is estimated that 50 parcels are impacted by this levee alignment.

Table 5-37 Military Road Alternative E Property Impacts

Alternative E: Highway 190 Alignment			
Property Impacts			
	Residential	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	28
		Partial Impact without Structure	21
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	0
		Partial Impact without Structure	1
Pearl River Management Area Impact		Yes	
Total		50	

Roadway Impact

This alignment impacts the following roads:

1. US HWY 190
2. Yorktown Dr.

The impacts include floodgates that close during storms events and right-of-way encroachments. Consideration of local service roads may provide consolidated access to the main access roadway of Military Road or within the local neighborhood roadways.






Alignment Specific Environmental Impacts

It is estimated that 44 acres of wetland habitat will be impacted by this alignment.

Highway 190 Estimate of Budgetary Construction Costs

The estimated construction costs ranges from \$237,000,000 to \$321,000,000 to construct both levee and floodwalls, along with 2 pump stations located at French Branch and near Highland Bluff. An additional \$93,000,000 in costs for property acquisition of 52 acres and 50 structural conflicts, environmental mitigation, and utility relocation, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.

Table 5-38 Military Road Interim Level Alternative E Estimated Total Capital Costs

Alternative E: Highway 190 Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$18,900,000	\$2,650,000	\$279,000,000	\$1,395,000	\$69,750,000	\$371,695,000

Military Road Area Next Steps

The Military Road area is included in the federal non-structural program for structure raising and floodproofing opportunities. Many of the structures in the Military Road area are near or above the interim flood risk reduction elevation, therefore do not offset the extensive environmental impacts and mitigation costs associated with a structural levee feature. Additionally, economic benefits associated with the large-scale structural projects suggested within this chapter may not sufficiently offset the costs associated with the alignments.

The area could consider the following resiliency options to address localized flooding concerns.

Resiliency Considerations for the Military Road Corridor

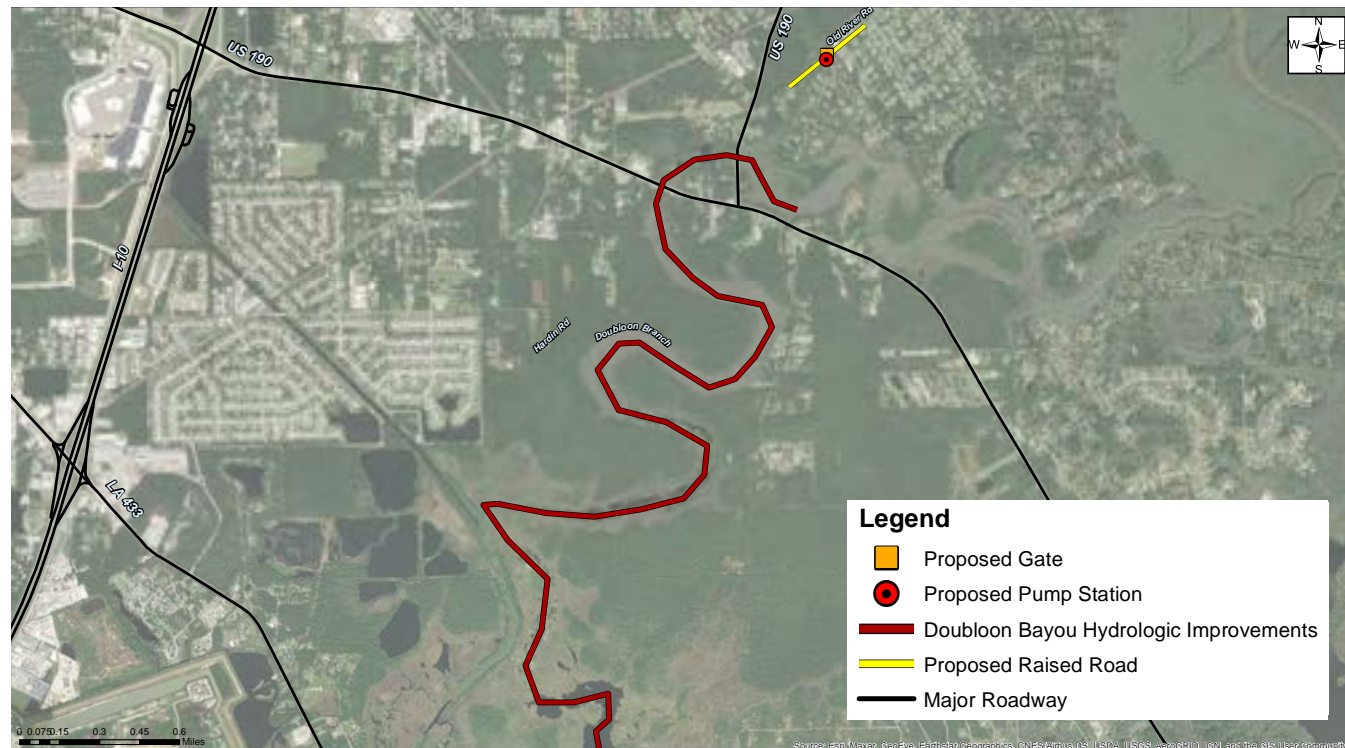




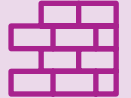



Figure 5-38 Resiliency Options for the Military Road Corridor

Resiliency Option 1 – French Branch Control Structure

Due to the high costs associated with the structural flood protection, consideration is given to targeted areas that provide benefit to the community with limited impacts while also lower in cost.

French Branch and the surrounding residential properties flood during heavy rainfall and high river stages. These are repetitive loss areas for Slidell and could benefit from a control structure on French Branch near Old River Road. This drainage structure, normally open for flow of water, would be closed during high water events. A pump station would provide drainage during the closed events minimizing the impacts of rainfall events. The cost range for this structure and pump station is estimated to be \$111,000,000 to 151,000,000 with an additional \$34,500,000 in costs for real estate, environmental, utility relocations, and engineering, planning, and construction management. Refer to **Appendix C** for the summary of estimated costs.



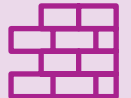



Table 5-39 Military Road Resiliency Option 1 Estimated Total Capital Costs

French Branch Closure					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$190,000	\$60,000	\$131,000,000	\$1,310,000	\$32,750,000	\$165,310,000

Resiliency Option 2 – Elevation of Old River Rd.

Within the same area of Old River Road described in Resiliency Option 1, during rainfall events and/or high river stage events. There is a 2,000 foot segment of Old River Road, on the east side of Military Road that drops below +7.0 to +3.5ft NAVD88. This area would benefit from an increase in elevation to maintain a consistent road elevation from Military Rd to the end of Old River Road. An additional \$1,560,000 is anticipated for utility relocations and engineering, planning and construction management.



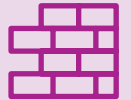



Table 5-40 Military Road Resiliency Option 2 Estimated Total Capital Costs

French Branch Closure					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$0	\$0	\$6,000,000	\$60,000	\$1,500,000	\$7,560,000

Resiliency Option 3 – Hydrologic Improvements to Doubloon Bayou.

Residents in the area of Doubloon Bayou noted that the frequency and amount of flooding is increasing along Military Road where it intersects Doubloon Bayou just north of US Hwy 190. There are two 36" reinforced concrete pipes providing water flow through Doubloon Bayou towards the Pearl River or Fritchie Marsh depending on river conditions. This area, along with many other portions of Doubloon Bayou, is overgrown with vegetation, collects debris, and has deposits of sediment in the channel. The result is reduced flow capacity within the Bayou and increased flooding of the area, including Military Road. This resiliency option would replace the culvert pipes with box culverts, clear and de-snags, Doubloon Bayou surrounding Military Road. The project would then clear, de-snag, and dredge Doubloon Bayou to Fritchie Marsh and repair the bank breach of Doubloon Bayou at the W-14 canal. These improvements have been previously considered by state and local entities however, they have not to the Military Road corridor.

Table 5-41 Military Road Resiliency Option 3 Estimated Total Capital Costs

Hydraulic Improvements					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$2,610,000	\$10,440,000	\$59,000,000	\$590,000	\$14,750,000	\$87,390,000

5.2.3 Lacombe Levee

Project Location

Lacombe is a small unincorporated area in St. Tammany Parish; however, has enough population to be considered a census-designated place (CDP). Lacombe is located between Mandeville to the west and Slidell to the east and bisected by Bayou Lacombe as seen in Figure 5-46. It covers 26.5 square miles and has approximately 2,757 households with 8,657 residents .



Figure 5-39 Location Map of Lacombe Area

Historic Flooding

Most of the population within the Bayou Lacombe watershed is in the southern portion of the basin. Flooding is primarily due to storm surge from Lake Pontchartrain but, flood events have ranged from rainfall to hurricanes spanning multiple decades. Lacombe is low-lying and some properties have flooded multiple times.

Alternatives Considered

The St. Tammany Coastal Study considered one alignment for structural flood control for Lacombe. This alignment consisted of levees, floodwalls, floodgates, pump stations, and structural tie-ins. The alignment was developed considering constructability, cost, and impacts to property, roadways, and environment. The alignment for the interim and 100-year level of protection are in the same footprint, with the 100-year levels reaching beyond the termination of the interim protection to existing natural ground elevations matching the 100-year level of protection elevation.

Existing Conditions

Hydraulics, Hydrology and Watersheds

Bayou Lacombe and its watershed is the largest drainage basin completely contained within St. Tammany Parish. It is made up of two smaller tributary areas, Lacombe Bayou and Big Branch Bayou-Lacombe Bayou as seen in Figure 5-40. The watershed drains over 70,000 acres and stretches 20 miles from Talisheek to Lake Pontchartrain. The elevation at the northern end of the watershed is +60.0 feet NAVD88 and falls to +1.0 feet NAVD88 at its discharge point in Lake Pontchartrain.

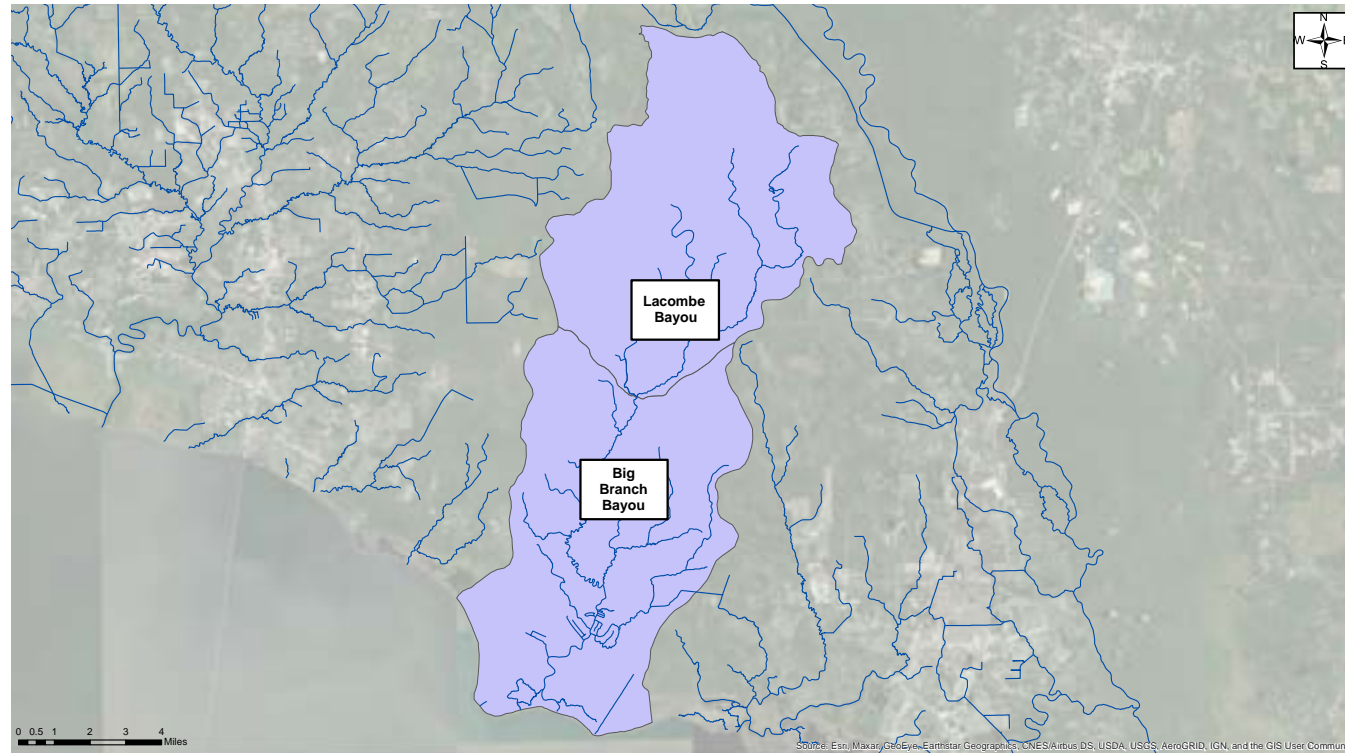


Figure 5-40 Bayou Lacombe Watersheds

The last 3 miles of Bayou Lacombe wind through the Big Branch National Wildlife Refuge which is a natural, brackish marsh between Lake Pontchartrain and Lacombe. This marsh area provides a small amount of protection from storm surge and flood water storage.



Figure 5-41 Big Branch Wildlife Refuge at Bayou Lacombe

Existing Soil Conditions

Based on soil borings nearby CPRA project PO-0033 Goose Point/Point Platte, the top 10 feet of soil consists of very soft peats, silts, and silty sands and clays. The soil transitions to medium to stiff clay with increasing strength to a depth of 60 feet. This stiff material is expected to be the Pleistocene clay deposits found within St. Tammany Parish. Seams of silts and shells vary throughout the borings below the 10-foot depth.

Design Considerations

Storm Surge Level of Protection – Lacombe

Using CPRA's 2017 Master Plan ADCIRC model, Lacombe's flood risk reduction elevations range from +8.5 feet NAVD88 to +12 feet NAVD88 depending on location and level of protection.

Geotechnical Considerations

Previous geotechnical explorations and USACE geology maps show the Lacombe Levee is within the marsh (towards the east of the alignment), but generally transitions to stiffer Pleistocene Age foundation soils as the alignment progresses westerly. Limited data exists along these alignments, and the settlement of the levee will be governed by the thickness of marsh deposits within the levee footprint. Additional data is required for the LFPDG or HSSDRS guidelines. The geotechnical findings and results are conceptual and could change based on future site-specific geotechnical explorations.

Levee and/or wall construction within a marsh area will require special adaptive equipment such as marsh buggies and may require geotextile fabric or local dewatering strategies to facilitate construction.

Levee Construction Overbuild and Settlement

The estimated vertical overbuild required for levee flood protection is estimated to be 1.5 feet to address settlement. The estimated overbuild is based on a single levee overbuild without future levee raises. Lateral spreading and mud-wave actions will likely induce settlement of the levee during and immediately after construction. The estimates overbuild estimate does not incorporate potential lateral spreading or mud-wave action caused by marsh construction. Additional analyses will be required to evaluate lateral spread and settlement within the marsh.

Lacombe Levee Alignment

The Lacombe Levee consists of 12.8 miles of earthen levee including flood gates for roadways and a Bayou Lacombe Floodgate with a pumping station.

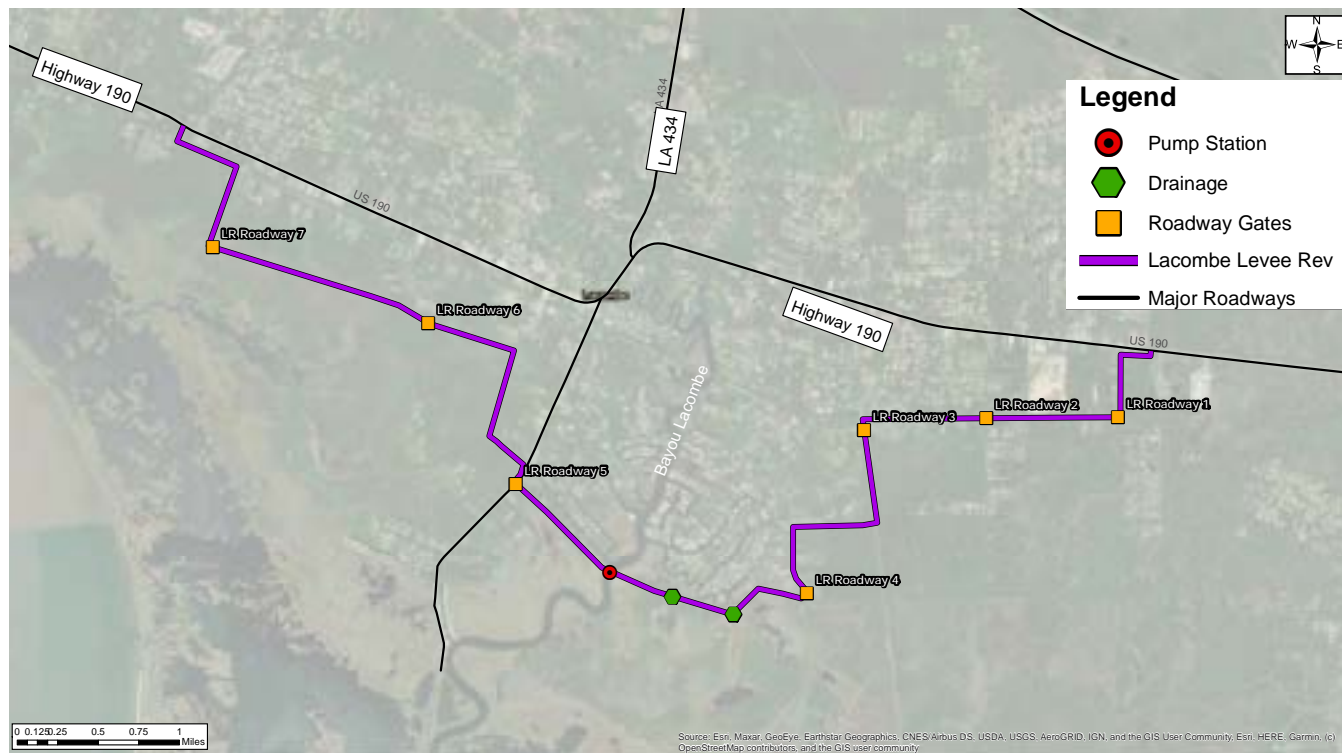


Figure 5-42 Lacombe Levee

The alignment starts at Highway 190 on the east side of Lacombe and heads west and then south towards S. Tranquility Rd. It follows along S. Tranquility Rd., crosses the Tammany Trace Bike Path, then turns westward to Durnin Dr. with a roadway gate. The alignment continues southward following along Chene Dr., crossing the Southern Natural Gas Pipeline, and proceeding towards Paquet Rd. with a roadway gate. The alignment proceeds to and crosses Bayou Lacombe with a 40-foot floodgate and a 3,200-cfs pump station and other small drainage structures. The alignment continues westward crossing Highway 434 with a 50-foot-wide roadway gate. The alignment shifts north northwest Barringer Rd. with a roadway gate. The alignment crosses S. Pontchartrain Dr., the Tammany Trace, and reaches Highway 190 again.

Table 5-42 Alternative A - Structural Components

Bayou Lacombe Alignment	
Structure Components	
Structure Type	<ul style="list-style-type: none"> Levee with 10-ft wide crown, 3H:1V Side slopes
Structure Tie-Ins	<ul style="list-style-type: none"> Northern Tie-In at HWY 190 East of Bayou Lacombe Southern Tie-in at HWY 190 West of Bayou Lacombe
Footprint	<ul style="list-style-type: none"> Levee Length – 52,415 LF Levee Width - 86 LF
Other Structural Components	<ul style="list-style-type: none"> Pump Station – Large Capacity (1) Navigable Floodgate (1) Pipeline Protection Structure (1) Roadway Roller Gate (50FT) (1) Roadway Roller Gate (30FT) (8) Roadway Gate at Bike Path (2) Drainage Structure (2)

Property Impacts

Based on information from St. Tammany Assessor’s website, 41 landowners will be affected by this alignment.

Table 5-43 Bayou Lacombe Levee Alternative A Property Impacts

Bayou Lacombe Alignment		Property Impacts	
	Residential	Total Acquisition with Structure	3
		Total Acquisition without Structure	2
		Partial Impact with Structure	2
		Partial Impact without Structure	34
	Commercial	Total Acquisition with Structure	0
		Total Acquisition without Structure	0
		Partial Impact with Structure	0
		Partial Impact without Structure	0
Pearl River Management Area Impact			No
Total			41

Roadways Impacts

The following roadways are impacted by this alignment.

- S. Tranquility Rd.
- Transmitter Rd.
- Dinkins Dr.
- Pacquet Rd. Access Rd.
- Pacquet Rd.
- Hwy 434 (Lake Dr.)
- Barringer Rd.
- S. Pontchartrain Dr.

The impacts include roadway floodgates that close during a storm events and right-of-way encroachments. In cases where the alignment crosses multiple roads, roads can be re-routed to a common access point to minimize the number of floodgates. Additionally, the Tammany Trace may require closure gates at each connection to the levee system.

Environmental Concerns







Approximately 111 acres of undeveloped wetland habitat will be affected by this alignment.

Estimate of Budgetary Construction Costs

100-Year Level of Protection Budgetary Costs

The levee, drainage structures, and a pump station construction costs ranges from \$360,000,000 to \$486,000,000. An additional \$123,000,000 in costs is estimated for the 141 acres of property acquisition, 4 structural conflicts, environmental mitigations expenses, utility relocation, and engineering, planning, and construction management efforts. Refer to **Appendix C** for the summary of estimated costs.



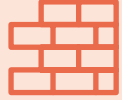



Table 5-44 Bayou Lacombe Levee 100-YR - Estimated Total Capital Costs

Bayou Lacombe Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$8,657,000	\$6,300,000	\$423,000,000	\$2,115,000	\$105,750,000	\$545,822,000

50-Year Level of Protection Budgetary Costs

A levee, drainage structures, and a pump station construction costs ranges from \$349,000,000 to \$472,000,000. An additional \$119,000,000 in costs is estimated for the 130 acres of property acquisition, 4 structural conflicts, environmental mitigations expenses, utility relocation, and engineering, planning, and construction management efforts. Refer to **Appendix C** for the summary of estimated costs.



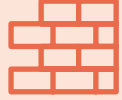



Table 5-45 Bayou Lacombe Levee 50-YR - Estimated Total Capital Costs

Bayou Lacombe Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$8,095,000	\$6,124,000	\$410,000,000	\$2,050,000	\$102,500,000	\$528,769,000

25-Year Level of Protection Budgetary Costs

A levee, drainage structures, and a pump station construction costs ranges from \$320,000,000 to \$432,000,000. An additional \$108,000,000 in costs is estimated for the 112 acres of property acquisition, 4 structural conflicts, environmental mitigations expenses, utility relocation, and engineering, planning, and construction management efforts. Refer to **Appendix C** for the summary of estimated costs.

Table 5-46 Bayou Lacombe Levee 25-YR - Estimated Total Capital Costs

Bayou Lacombe Alignment					
Item Description					
					
Real Estate	Environmental Cost	Construction Costs	Utility Relocation Costs	Engineering, Planning & Construction Management	Total
\$7,157,000	\$5,273,000	\$376,000,000	\$1,880,000	\$94,000,000	\$484,310,000

Lacombe Levee Next Steps

A Lacombe Structural Flood Risk Reduction System was also evaluated in the USACE St. Tammany Parish, LA Feasibility Study.

It should be noted that the project has high costs associated with low-lying terrain and poor soil conditions. Additionally, there are limited benefits from the limited population and there are extensive environmental impacts and mitigation costs. For these reasons, it was not selected in the USACE Feasibility Study because of the low Benefits to Costs Ratio (BCR). However, this area is included in the Non-Structural protection program of the USACE Feasibility Study. It is recommend this levee alignment be re-evaluated in the future if conditions change

5.3 Nonstructural Risk Reduction Strategies

Nonstructural Risk Reduction strategies include renovating or acquiring structures in flood prone areas to reduce the impacts of flooding. Nonstructural renovations and acquisitions include residential and non-residential floodproofing, residential, and residential voluntary acquisition.

Floodproofing strategies are elevating “any combination of structural and nonstructural additions, changes, or adjustments to structures” to reduce or eliminate flood damage per the Code of Federal Regulations (44CFR Chapter 1, Part 59). This includes applying watertight paints on membranes and using closures for windows and doors for structures that cannot be elevated out of the floodplain.

Residential elevations raise the house above the floodplain and often requires specialized equipment. It can range from a foot to multiple feet of increased elevation.

Real-property acquisitions are also a nonstructural flood risk reduction strategy. Severe repetitive loss structures are purchased and removed from the floodplain restoring the floodplain to natural conditions, which allows for flood water storage where previous structural flooding occurred. Acquisitions are generally on a voluntary basis and are for select areas which have flooded in multiple events.

Nonstructural measures have been proposed by several programs at the State and Federal level over the last few years.

5.3.1 USACE St. Tammany Parish Feasibility Study

The USACE St. Tammany Parish, Louisiana Feasibility Study (study) developed nonstructural plans for the areas of St. Tammany Parish that does not directly benefitting from the structural features of the project plan. The plan was developed to reduce coastal, riverine, and rainfall flood risk through floodproofing raisings, or acquisitions. The Parish was divided into 20 watersheds, see Figure 5-47, and the flood risk was evaluated for the 25-year, 50-year, or the 100-year floodplain respective to the individual watersheds. Structures were selected based on the watershed with which their flood risk was associated. Additional Preconstruction Engineering and Design (PED) is necessary to confirm final eligibility and determine the most cost-effective strategy for each potential structure.



Above: An example of floodproofing measures
Below: Elevating a home to reduce flood risk



Preliminary Eligibility and Costs

The USACE determined that approximately 6,410 structures in the National Structure Inventory are potentially eligible for the Nonstructural Plan. In Figure 5-43, the tentatively selected structures eligible for the nonstructural plan are represented by the purple dots throughout St. Tammany Parish. This includes:

- 5,583 residential structures
- 827 non-residential structures

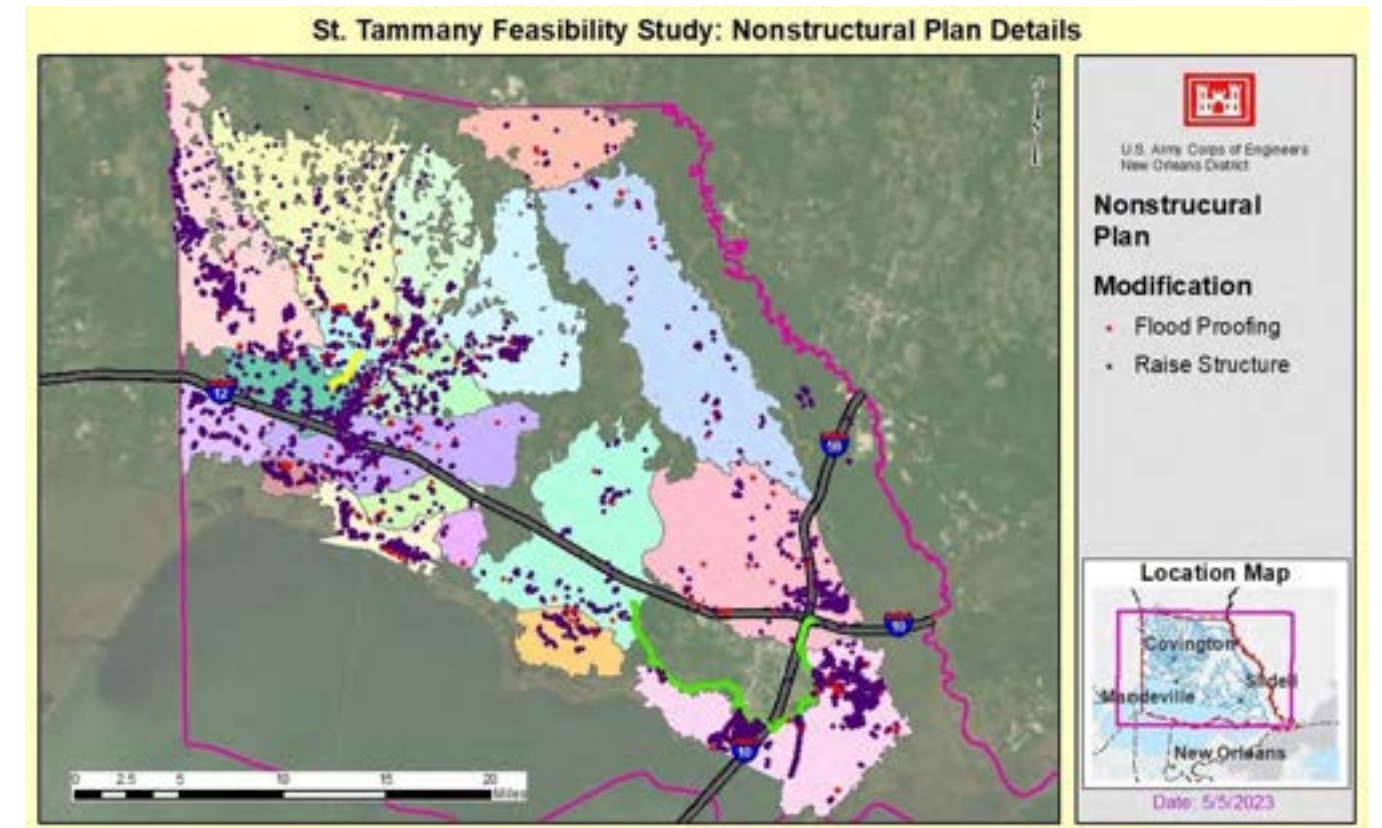


Figure 5-43 USACE Nonstructural Risk Reduction Tentatively Selected Plan with Watersheds

Participation would be voluntary through an application process that determines the final eligibility determination specific to the structure and includes environmental assessments, valuations, and inspections.

Preliminary estimates of the Nonstructural Plan for St. Tammany Parish exceed \$2,000,000,000.

Final Eligibility and Costs

For the USACE to determine final eligibility, the applicant must:

1. have a first-floor elevation at or below the floodplain based on hydrologic conditions predicted to occur in 2032. The floodplain (25, 50, or 100 year) is dependent on the structure’s watershed.
2. provide access for inspections, ownership documentation with no encumbrances to the property title such as tax liens, or other third-party interests;
3. be willing to enter into a floodproofing agreement with restrictions to limit new structural features below the lowest habitable finished floor as determined by the USACE;
4. be cleared through Environmental Site Assessment (ESA) and Hazardous, Toxic, & Radioactive Waste (HTRW) investigations;

5. be in good condition to structurally withstand the floodproofing strategy such as house raising;
6. require less than 13ft of additional elevation.

Once eligible, the costs for the floodproofing strategy will be borne by USACE. These costs include design, permitting, surveying, and costs for raising the structure including the associated mechanical systems and utilities. Costs associated with temporary relocation for residents is also be a covered expense within the Plan. Ineligible expenses include repair work not directly associated with the raising effort, modifications to structures detached from the primary residence, and costs to raise a structure above the Base Flood Elevation (BFE) by more than 1 foot.

5.3.2 Louisiana’s Comprehensive Plan for a Sustainable Coast (CPRA Master Plan)

The CPRA Master Plan adopts a regional approach for local variabilities in land loss rates, mechanisms, and effectiveness of different project strategies. Under this regional approach, St. Tammany Parish lies within the Pontchartrain / Breton region. This region includes Lake Pontchartrain, Lake Borgne, the Mississippi River, and the Pearl River. This area includes some of the largest population densities in the state and is susceptible to some of the largest storm surges in the state, resulting in unique challenges from a flood control standpoint.

2023 Master Plan Projects

For the 2023 Master Plan, specific nonstructural projects are not identified, but deemed generally consistent with the Master Plan. The decision not to identify nonstructural projects is based on the fact that most are carried out at the locally through State and Federal programs.

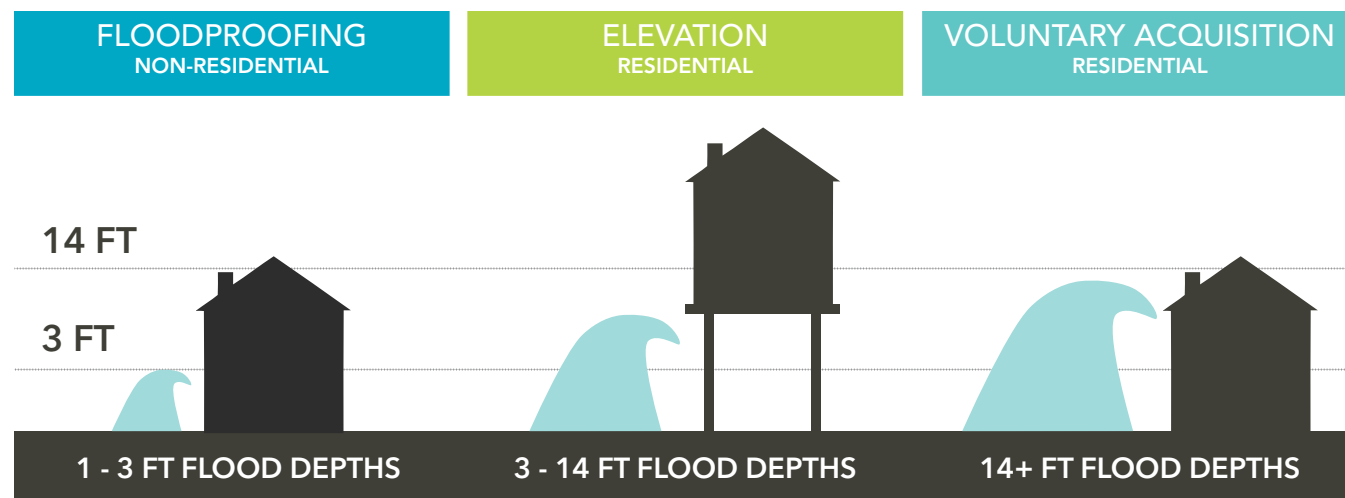


Figure 5-44 2023 CPRA Nonstructural Risk Reduction Strategies (Source: CPRA 2023)

Nonstructural measures identified in the Master Plan include floodproofing non-residential properties where 100-year flood depths are 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet. A total of \$11.2 billion for nonstructural projects statewide is estimated.

2017 Master Plan Projects

The 2017 CPRA Masterplan included a project to mitigate flood risk in St. Tammany Parish through nonstructural strategies. This plan provided more define values for acquisition and flood proofing in St. Tammany Parish summarized in the 2023 CPRA Masterplan. These include floodproofing non-residential properties where 100-year flood depths are projected 1-3 feet, elevating residential properties where 100-year flood depths are 3-14 feet, and acquiring residential properties where 100-year flood depths are greater than 14 feet.

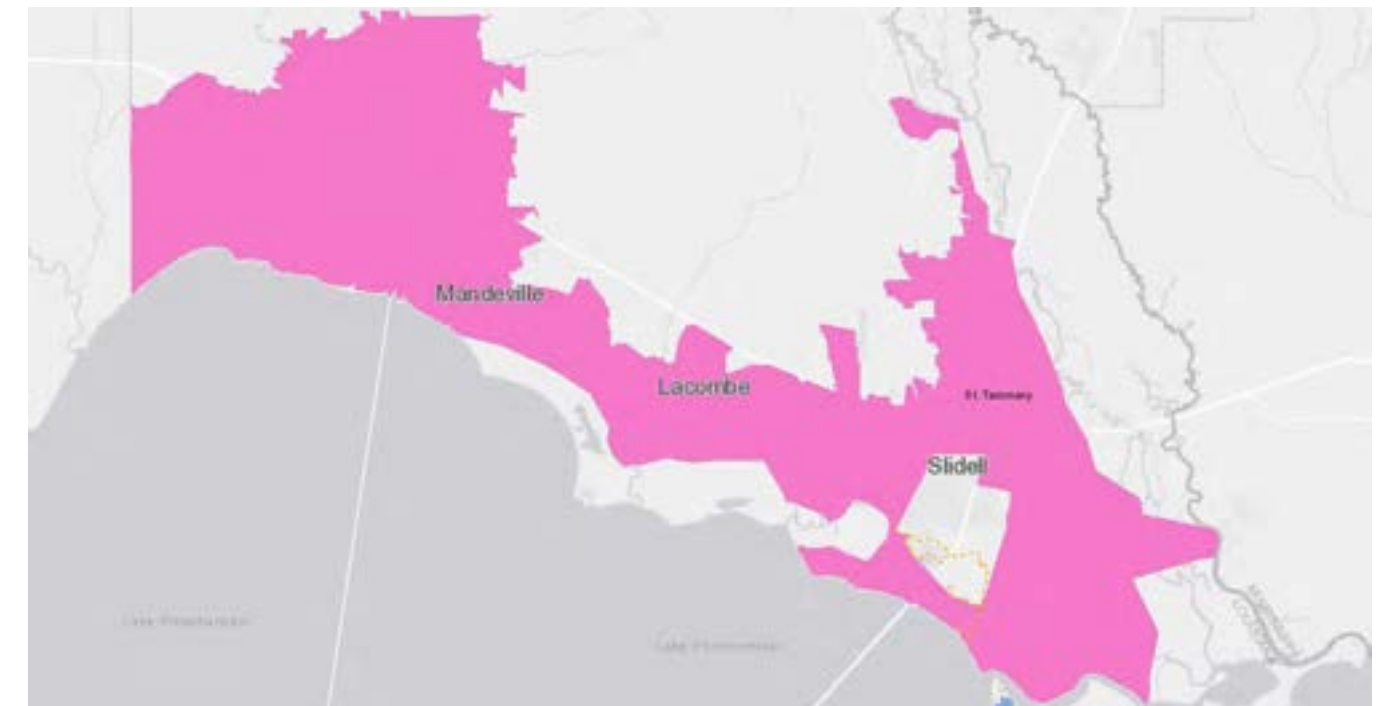


Figure 5-45 2017 CPRA Master Plan Nonstructural Project Area for St. Tammany Parish (Source: CPRA 2023)

For St. Tammany Parish, the 2017 Masterplan estimated:

- Floodproofing of 375 non-residential structures
- Elevation of 4,605 residential structures
- Voluntary acquisitions of 889 structures

This resulted in an estimated 5,869 properties participating over a 7-year time period. The total cost of the project was estimated at \$1,611,300,000. The cost estimate does not represent specific residential or commercial structures to be mitigated but is based on the National Structure Inventory Database.

Louisiana Watershed Initiative

The Louisiana Watershed Initiative, a statewide, watershed-based floodplain management program, was established following two historic rainfall events in 2016.

As part of the LWI program, the state will conduct large-area buyouts (on a block or neighborhood scale) for families within repetitive loss areas; areas subject to moderate or high flood risk; areas within FEMA designated floodways. Such buyout programs include provisions for community-oriented assistance to homeowners to facilitate a successful transition to a lower flood risk outside Special Flood Hazard Areas (SFHA). Property acquired through program buyouts will be restored to natural floodplain conditions and may be further enhanced through the use of blue and green infrastructure.

To preserve communities that cannot relocate from flood prone areas due to geography or natural resource dependence, and maintain important social and cultural standards, the state may also administer residential elevations or other traditional nonstructural flood risk mitigation activities. The state will administer residential elevations justified by cost-benefit and cost reasonable analyses relative to other mitigation measures. This program will prioritize project funding that benefits low-to moderate- income residents and uses predictive watershed modeling to produce measurable reductions in residents' exposure to flood risk.

In 2021, as part of the first phase of this program, \$230 million was awarded for 20 projects state-wide. Of these, St. Tammany Parish was awarded \$10 million for voluntary residential buyouts, elevations, or reconstructions. The program offers residents a capped amount of \$250,000 per residence. Seventy-five homes have been identified for the program – 68 in the Avery Estates Subdivision, six in Covington, and one in Slidell. This program is being administered by the Office of Community Development within the Division of Administration. Like other nonstructural programs, the homeowner must provide documentation of ownership and clear titles. Additional details can be found at watershed.la.gov/ buyouts.

5.3.3 2020 St. Tammany Parish Hazard Mitigation Plan

St. Tammany Parish administers hazard mitigation funds from FEMA, through the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), to assist residents in reducing risk and reducing reliance on federal disaster funds.

In 2000, the Federal Disaster Mitigation Act (42 USC 5165) required a mitigation plan for the "best use of mitigation funding and meeting the prerequisite for obtaining such funds from the Federal Emergency Management Agency (FEMA)". This plan requires communities such as cities, counties/ parishes, and states to develop methods to reduce hazards within their respective areas. St. Tammany Parish initially developed a Hazard Mitigation plan in 2004 and revised the plan again in 2010, 2015 and 2020. The goal of the plan is to identify natural hazards and risks within the Parish and identify the Parish's hazard mitigation strategy to make St. Tammany Parish less vulnerable and more disaster resilient. The plan covers a variety of potential hazards, refer to Table 5-47, but it focuses on water inundation (flooding) and wind events.

Table 5-47 Hazard Risk Summary from St. Tammany Parish Hazard Mitigation Plan 2010

Hazard Risk Summary				
Hazard	Areas Exposed	Annual Chance	Threat to People	Property Damage
2.1 Tropical Storms/Hurricanes	Entire Parish	0.83	High	High
2.2 Flooding	Floodplains	1.00	Medium	High
2.2.A Repetitive Flooding	Entire Parish	0.20	Medium	High
2.3 Tornadoes	Entire Parish	1.00	High	High
2.4 Wildfires	Forests	1.00	Low	Medium
2.5 Drought	Entire Parish	0.05	Low	Low
2.6 Fog	Roads and Airport	1.00	High	Low
2.7 Earthquake	Entire Parish	0.01	Low	Low
2.8 Hailstorm	Entire Parish	0.16	Low	Medium
2.9 Land Failure	Shoreline	1.00	Low	Low
2.10 Severe Winter	Entire Parish	0.05	Medium	Low
2.11 Dam Failure	Downstream of Dams	1.01	Low	Medium
2.12 Levee Failure	Leveed Areas	0.02	Medium	High
2.13 Termites	Entire Parish	1.00	Low	Medium

Multiple strategies are in the plan for mitigation of flooding, including the nonstructural measure of elevating severe repetitive loss and repetitive loss (SRL/RL) structures.

Repetitive loss structures are structures covered by a contract for flood insurance made available under the NFIP that:

1. have incurred flood-related damage on two occasions, in which the cost of the repair, on average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and
2. at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

Severe repetitive loss (SRL) is defined by the Flood Insurance Reform Act of 2004 and updated in the Biggert-Waters Flood Insurance Reform Act of 2012. For a property to be designated SRL, the following criteria must be met:

1. it is covered under a contract for flood insurance made available under the NFIP; and
2. it has incurred flood related damage –
 - a. for which four or more separate claims payments have been made under flood insurance coverage with the amount of each claim exceeding \$5,000 and with the cumulative amount of such claims payments exceeding \$20,000; or
 - b. for which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

In the plan, 3,508 structures are identified Parish-wide as repetitive loss structures. Although structures in the coastal zone are not identified, it was noted that the primary concentration of these structures are in the southern portion of the Parish.

5.3.4 St. Tammany Coastal Master Plan

St. Tammany Parish published its Coastal Master Plan for the years 2016-2020. The Plan detailed nine (9) projects to mitigate against further damage to the coast, wetlands, and watersheds of the Parish. The Home Elevation Project included nonstructural measures, to elevate 903 homes in the coastal surge zone. The estimated cost was \$180,600,000, which equates to \$276,300,000 in 2023 dollars.

5.3.5 Next Steps

Nonstructural measures are widely accepted as an alternative to structural flood protection for cases where population density or home values do not justify the cost of a full structural protection, or in situations where no funding is identified for a structural system. Multiple programs at the State and Federal level are pursuing nonstructural measures of flood risk reduction in St. Tammany Parish. It is recommended that the Parish continue to support these measures, promote equitable distribution of funds, and seek new funding opportunities for residences and structures that lie outside existing and proposed structural protection systems.



Chapter 6 Environmental/ Ecosystem Projects

6.1 Marsh Creation & Restoration Strategies

Marsh land loss is common throughout Louisiana and St. Tammany Parish. Damage to marshes occurs through natural and human induced processes. Increasing salinity and oil exploration are some of the more well-known triggers for marsh loss. With the loss of marsh, there is loss of vegetation and habitat; a reduction in storm surge protection; and, increases in erosion exacerbating the marsh loss. Marsh creation and nourishment projects are designed to restore the marsh platform to its historic location and elevation. Projects often utilize nearby sediment, through mechanical or hydraulic means, and place the sediment into areas where loss is occurring.



Figure 6-1 Fritchie Marsh (GEC 2019)

With the Coastal Wetlands Planning, Protection, and Restoration act in 1990, the State of Louisiana proposed and developed marsh creation projects throughout Coastal Zone of Louisiana including in St. Tammany Parish. These projects are designed to reestablish the natural processes within the marsh and to last for 20-years. They have been successful and continue to be pursued by local, state, and federal agencies.

6.1.1 Parish Restoration Projects

An integral part of a robust Coastal Master Plan for St. Tammany Parish includes Restoration projects in addition to Structural and Non-Structural projects. Restoration projects are projects that restore degraded components of St. Tammany Parish’s coastal ecosystem by re-establishing natural processes, or through mechanical means such as the placement of dredged material or rock. Restoration projects include the following general categories:

- Marsh Creation
- Shoreline Protection
- Hydrologic Restoration
- Living Shorelines
- Ridge Restoration
- Terracing
- Vegetative planting
- Bank Stabilization

6.1.2 Previously Proposed Projects

Chapter 3 of this report describes previous and ongoing studies that include restoration projects. The projects recommended by these studies includes:

- 2023 CPRA MASTER PLAN
 - Fritchie North Marsh Creation
- 2017 CPRA MASTER PLAN
 - Guste Island Marsh Creation Project
 - St. Tammany Marsh Creation
 - New Orleans East Landbridge Restoration
- 2016-2020 ST. TAMMANY COASTAL MASTER PLAN
 - West Shoreline Protection Project
 - Cane Bayou Marsh Creation Project
 - Bayou Lacombe Marsh Creation Project
 - Faciane Canal Marsh Creation Project
 - Fritchie North Marsh Creation Project
 - Fritchie Hydrologic Restoration
 - Guste Island Marsh Creation

The Guste Island and St. Tammany Marsh Creation Projects are included in the 2017 CPRA Master Plan but were not in the 2023 Master Plan due to a revised method to calculate project benefit cost ratios.

The listed projects change nomenclature and projects overlap between the different Master Plans. In several cases, the same projects or portions of the projects have different names. The St. Tammany Marsh Creation Project from the 2017 CPRA Master Plan includes several smaller projects that are listed individually in the 2016-2020 St. Tammany Coastal Master Plan: Cane Bayou Marsh Creation, Bayou Lacombe Marsh Creation, and Faciane Canal Marsh Creation. Also, the New Orleans East Landbridge Restoration Project from the 2017 CPRA Master Plan includes a portion of the Fritchie Marsh Creation Project that is in the 2023 CPRA Master Plan and the St. Tammany 2016-2020 Master Plan.

A 2019 data gap analysis identified vulnerable areas of the Coastal Zone and conceptual projects were developed to address the gap areas. These projects are listed below and include the projects from the 2017 and 2023 CPRA Master Plans and the 2016-2020 St. Tammany Coastal Master Plan. These projects are recommended to be carried forward for further analysis, engineering, and design as funding allows.

2019 NSI GAP Analysis Recommended Projects

- Big Branch Living Shoreline
- Fritchie Hydrologic Restoration
- Fritchie North Marsh Creation
- Guste Island Living Shoreline
- Guste Island Marsh Creation
- Mandeville Lakefront Living Shoreline and Marsh Creation
- Mandeville Lakefront Wetlands Restoration
- New Orleans East Landbridge Restoration
- Northshore/Eden Isles Breakwater
- Pearl River Island Shoreline Protection and Restoration
- St. Tammany Marsh Creation
- Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement, and Marsh Restoration
- Vegetative Tree Planting Program
- West Mandeville Living Shoreline

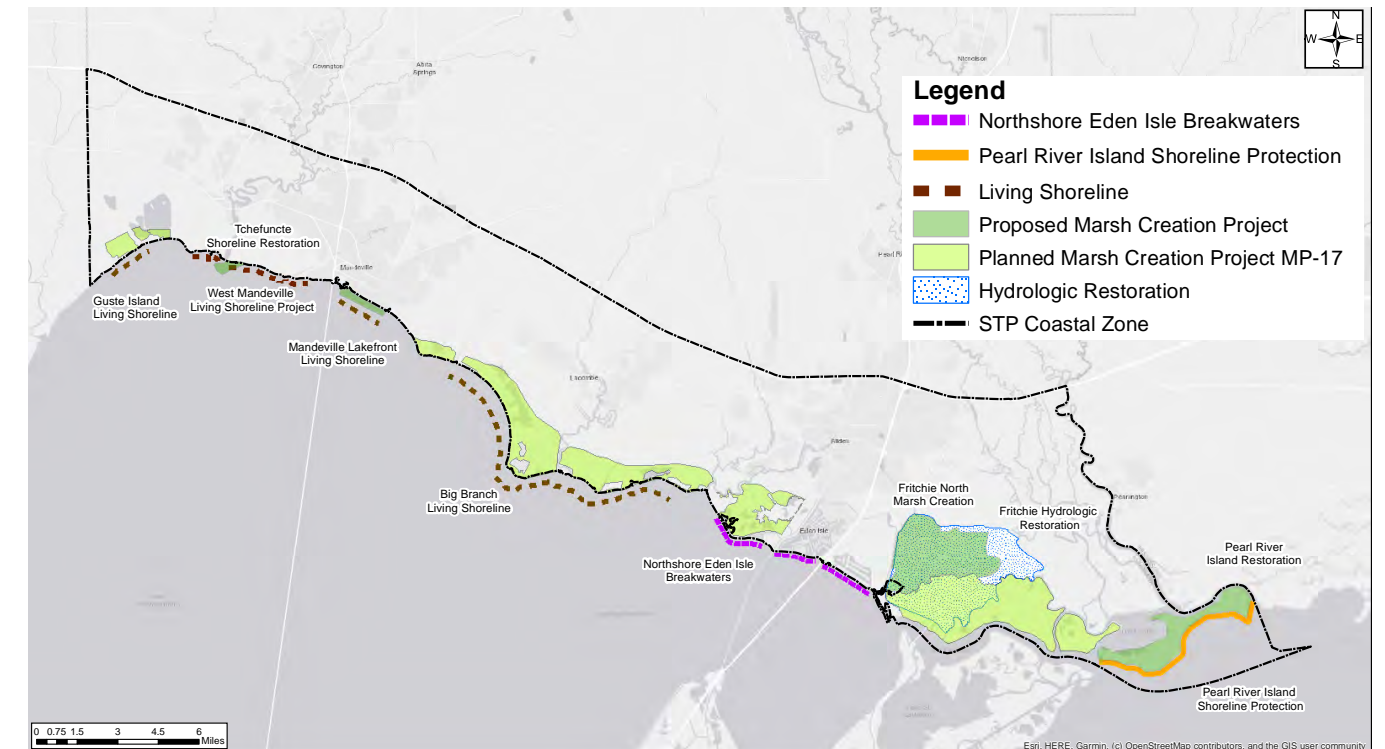


Figure 6-2 St. Tammany Parish Restoration Projects

6.1.3 Projects Proposed for Further Analysis

The restoration projects below are recommended for further engineering, analysis, and design. In many cases, the areas are large, with varying degrees of restoration needed within the project areas. In some cases, projects have been constructed or are being designed within the larger overall area. In these cases, a summary of the projects is also included.

Big Branch Living Shoreline

The project is an 11-mile living shoreline south of Lacombe protecting the proposed St. Tammany Marsh Creation. The existing shoreline is deteriorating and breaches exist. These breaches provide connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. This project provides protection from the continued wave erosion along this shoreline by repairing breaches and installing wave attenuating living shoreline devices. The estimated construction cost is \$144 million.

Fritchie Hydrologic Restoration

The project is a 4,395-acre hydrologic restoration project near Salt Bayou within the Fritchie Marsh area. Over the last 20 years this area has lost a significant amount of marsh, due in part to changes in drainage patterns after the construction of Highway 90. This project will improve water discharge from the west from W-14 Canal into the Fritchie Marsh. The construction cost inflated from the 2016-2020 St. Tammany Parish Coastal Master Plan is \$7.4 million.

Previously Constructed: PO-06 Fritchie Marsh Hydrologic Restoration

The project was completed as part of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program in 2001. The Salt Bayou culvert under Highway 90 was enlarged to increase the flow of freshwater and nutrients from east to west from the Pearl River into the marsh.

Fritchie North Marsh Creation

The project is a 4,395 acre marsh creation near Salt Bayou within the Fritchie Marsh area. Over the last decade the open water in this area nearly doubled. This project restores approximately 2,417 acres of low salinity marsh and nourished an additional 1,997 acres of stressed marsh by using hydraulically dredged sediment from Lake Pontchartrain. Existing tidal creeks will be maintained in the project to facilitate hydrologic exchange and fisheries access. The 2023 CPRA Master Plan construction cost for this project is \$110 million. A portion of this project area is being pursued further for design and construction by St. Tammany Parish Government as well as the USACE for additional Lake Pontchartrain & Vicinity (LPV) mitigation efforts.

Constructed: PO-121 HSDRRS LPV Mitigation Project – New Zydeco Ridge

Approximately 379 acres within the Fritchie Marsh Creation Area was constructed in 2023 to mitigate impacts from the construction of the Lake Pontchartrain and Vicinity Hurricane and Storm Damage Risk Reduction System levee. Three cells were constructed: 60 acres of bottomland hardwood habitat, 159 acres of bottomland hardwood, and 160 acres of intermediate/brackish marsh habitat.



Figure 6-3 USACE New Zydeco Ridge Mitigation Project for Lake Pontchartrain & Vicinity Projects - Fritchie Marsh (Google Earth 2020)

Guste Island Living Shoreline

The project is a 1.5-mile living shoreline west of Madisonville, on Lake Pontchartrain, protecting the proposed Guste Island Marsh Creation Project. The shoreline in this area is deteriorating and several breaches exist.

These breaches provide direct connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. This project provides protection from the continued wave erosion along this shoreline by repairing breaches and installing wave attenuating living shoreline devices. The total estimated construction cost of approximately \$16 million.

Guste Island Marsh Creation

The project includes the creation and/or nourishment of approximately 700 acres of marsh in St. Tammany Parish along the northwest shoreline of Lake Pontchartrain within and adjacent to the area of Guste Island. Construction costs developed as part of the 2017 CPRA Master Plan and the 2016-2020 St. Tammany Master Plan are inflated to 2023 dollars and range from \$42 million to \$93 million.

Constructed: PO-121 HSDRRS LPV Mitigation Project

Approximately 143 acres of the Guste Island Marsh Creation Area was constructed in 2016 to mitigate impacts from the construction of the Lake Pontchartrain and Vicinity Hurricane and Storm Damage Risk Reduction System levee.

Mandeville Lakefront Living Shoreline

The project is a 1.75-mile living shoreline and 125-acre marsh creation protecting Mandeville Lakefront. Over the last decade, this Mandeville Lakefront area has been subjected to severe wave energy from tropical and subtropical storms. This project protects the Mandeville Seawall and provides natural coastal resilience to the community of Old Mandeville. The living shoreline component's construction cost is \$11 million and the marsh creation component's construction cost is \$14 million. The City of Mandeville is pursuing funding for feasibility efforts associated with this project.

Mandeville Lakefront Wetlands Restoration

A proposed berm for shoreline protection, two pedestrian bridges, fill sediment for wetlands creation, and ready conditions for a future wetland planting project. The project restores deteriorated wetlands, protects existing wetlands, reduces storm surge, and increases lakefront recreational use. Design was completed in March 2022 and is estimated to cost of \$4.8 million. The city is considering changes to reduce the estimated construction cost.



Figure 6-4 Mandeville Wetland Project (NSI)

New Orleans East Landbridge Restoration

The project includes the creation and nourishment of 8,000 acres of marsh in St. Tammany Parish along the historic New Orleans East Landbridge. This is a part of the larger 33,400-acre New Orleans East Landbridge Project in the 2017 CPRA Master Plan that also includes restoration of marsh in Orleans Parish. The cost for the full 33,400-acre project in the 2017 Master Plan is \$1.5 billion. Approximately 24% of the project lies in St. Tammany Parish and the cost is estimated at \$522 million.

Northshore/Eden Isles Breakwater (Slidell Breakwaters)

The project is a segmented offshore rock breakwater from east of the I-10 Twinspan Bridge to the mouth of Bayou Liberty. The breakwater is 5.5 miles long and provides shoreline protection for the community of Eden Isle. It also provides future protection from wave erosion for the St. Tammany Marsh Creation project. The estimated construction cost is \$41 million. ST. Tammany Parish Government is pursuing additional design effort for this project.



Figure 6-5 Slidell Breakwaters Rendering (NSI)

Pearl River Island Shoreline Protection and Restoration

The project includes shoreline protection, restoration, and marsh creation project is located on Pearl River Island. This project protects approximately 5.5-miles of shoreline and facilitates 2,400 acres of the restoration and marsh creation and nourishment on Pearl River Island. The shoreline protection component estimated construction cost is \$31 million and the marsh creation component cost is \$100 million.

St. Tammany Marsh Creation

The project consists of three marsh creation and nourishment projects along the northern shore of Lake Pontchartrain within and adjacent to the Big Branch National Wildlife Refuge, making up over 10,000 acres. The three cells and their costs are as follows:

Cane Bayou Marsh Creation (4,117 acres - \$102 million)

Previously Constructed: PO-33 Goose Point / Point Platte Marsh Creation

The project consisted of five cells totaling 566 acres of marsh creation and nourishment, completed as part of the CWPPRA program in 2009. Two of the cells, totaling 289 acres, were constructed within the overall Cane Bayou Marsh Creation project footprint.

Soon to be Constructed: PO-181 Bayou Cane Marsh Creation Project

630 acres within the overall project area is slated to be constructed in 2024. Design was recently completed on the PO-181 Bayou Cane Marsh Creation Project as part of the CWPPRA program. Once permitting is complete, the project will be bid for construction.

Bayou Lacombe Marsh Creation (3,114 acres - \$79 million)

Previously Constructed: PO-33 Goose Point / Point Platte Marsh Creation

The project consisted of five cells totaling 566 acres of marsh creation and nourishment, completed as part of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program in 2009. Three of the cells, totaling 277 acres, were constructed within the overall Bayou Lacombe Marsh Creation project footprint.

Previously Constructed: PO-104 Bayou Bonnfuca Marsh Creation

The project consisted of four cells totaling 608 acres of marsh creation and nourishment, completed as part of the CWPPRA program in 2018. Two of the cells, totaling 121 acres, were constructed within the overall Bayou Lacombe Marsh Creation project footprint.

Faciane Canal Marsh Creation (2,853 acres - \$114 million)

Previously Constructed: PO-104 Bayou Bonnfuca Marsh Creation

The project consisted of four cells totaling 608 acres of marsh creation and nourishment, completed as part of the CWPPRA program. Construction was completed in 2018. Two of the cells, totaling 487 acres, and an additional 851 acres of unconfined marsh creation and nourishment, were constructed within the overall Faciane Canal Marsh Creation project footprint.

Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement, and Marsh Restoration

This is a phased project to restore the mouth of the Tchefuncte River at Lake Pontchartrain to its historic hydrologic condition. When fully implemented, the project creates or nourishes 266 acres of degraded marsh habitat and reduces tidal storm surge entering the mouth of the Tchefuncte River. The phases and their associated costs are as follows:

Phase 1 – Wooded Island Protection (\$2.1 million).

Phase 2a – Emergency Breakwater (\$4.2 million).

Phase 2b – Living Shoreline Protection (\$7.0 million).

Phase 3 – Marsh Restoration Spray (\$1.7 million).

Phase 4 – Marsh Restoration West Shoreline (\$1.4 million).

St. Tammany Parish is pursuing additional design efforts for the Living Shoreline Protection, Emergency Breakwater, and Marsh Restoration West Shoreline projects.

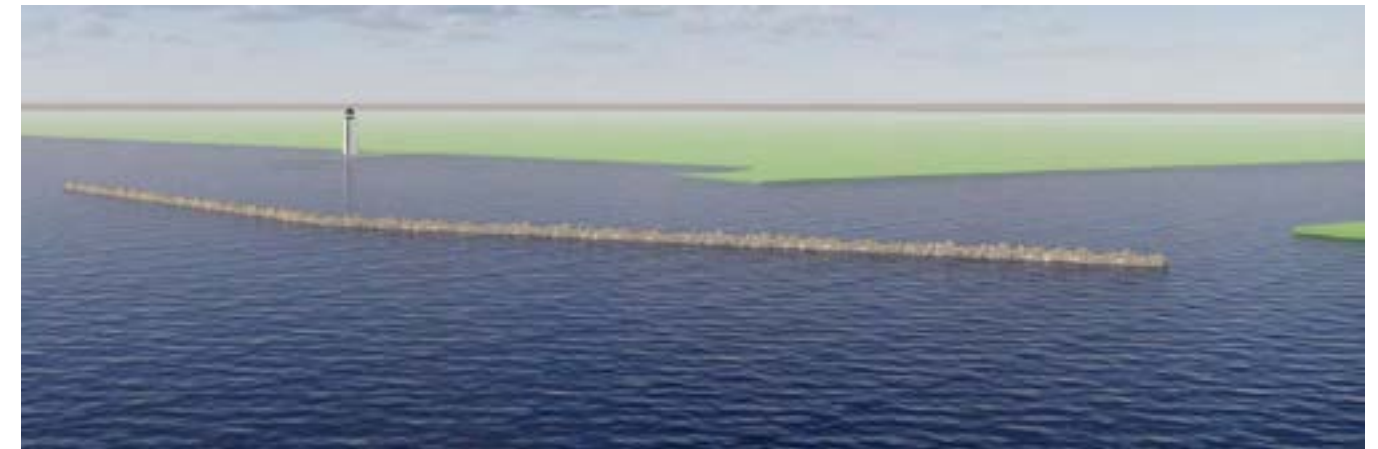


Figure 6-6 Lower Tchefuncte Breakwater Restoration (Courtesy: St. Tammany Parish Government)

Vegetative Planting Programs

St. Tammany Parish has several active planting programs parish wide. One program engages local students to plant trees and other indigenous species in dry stormwater detention ponds to reduce maintenance and provide habitat. Another program completed plantings of native wetland trees and plants on the St. Tammany coastline to increase habitat and provide water quality and storm surge benefits. Aerial planting of wetland species has also been performed and shows promising results.

The Lake Pontchartrain Conservancy (formerly the Lake Pontchartrain Basin Foundation) conducted various swamp tree plantings on the Maurepas Landbridge since 2013 in partnership with the Restore the Earth Foundation (REF) and with the help of community volunteers. In addition to volunteer plantings, there have also been commercial plantings supported by REF.



Figure 6-7 Fritchie Marsh Marsh Grasses

West Shoreline Protection

The project is a 4.7-mile rock dike shoreline protection located west of Mandeville and south of Madisonville. The shoreline is deteriorating and several breaches exist. These breaches provide connection between the fresher interior marshes and higher salinity waters of Lake Pontchartrain. This project provides protection from the continued wave erosion along this shoreline by repairing breaches and installing a rock dike for shoreline protection. Construction costs developed for the project as part of the 2017 CPRA Master Plan and the 2016-2020 St. Tammany Master Plan, inflated to 2023 dollars, range from \$18 to 28 million.

6.1.4 Marsh Creation & Restoration Next Steps

Marsh creation and restoration projects include multiple approaches to restore the function of natural ecosystems, which can improve or curb land loss rates and reestablish natural buffers for coastal areas. These projects are widely accepted as a method to address future flood concerns. Multiple programs at the State and Federal level are currently evaluating marsh creation and restoration projects to improve flood risk reduction in St. Tammany Parish. St. Tammany Parish should continue to pursue restoration projects across the Coastal Zone to provide recreational and environmental benefits to the community.

6.1.5 References

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6.2 Watershed Management

Watershed management is a nonstructural method providing flood risk reduction to communities through the restoration of watersheds, floodplains, and historic channels. Watersheds are areas of land that focus overland flow of water towards waterbodies such as creeks, rivers, bayous, lakes and oceans, as shown in Figure 6-8. Watersheds include features, such as ponds and small tributaries that are temporary depending on the rainfall event. Additionally, watersheds can facilitate ground infiltration of rainwater through differing habitats and soil conditions.



Figure 6-8 Louisiana Watershed Initiative Watershed (LWI) Illustration

Development within watersheds can impact the movement of stormwater throughout the basin to its final discharge point. Changes to historic drainage locations or re-routing of stormwater flows can alter where water is stored, how fast it reaches its discharge, and how much infiltrates the ground. Adding impervious surfaces prevents water from being absorbed, which increases the amount of water that travels overland to the watershed outlet. These changes can affect both downstream and upstream conditions within the area.

Identification of watersheds and the impacts development can have on the watershed are critical steps in improving and managing stormwater. Examples of watershed management include providing stormwater storage to regulate water volume and speed, relocating high flood risk structures to minimize impediments to flow, and implementing development standards to reduce development within flood prone areas.

6.2.1 2020 St. Tammany Parish Hazard Mitigation Plan

The Hazard Mitigation Plan developed goals and preventive measures implemented to reduce the impact of the hazards to the community. On a watershed basis, some of these measures include adopting the International Building Code (IBC), updating and maintaining the Community Rating System (CRS) standards for reduced insurance premiums, and assisting residents in raising or relocating repetitive loss structures out of the floodplain.

6.2.2 St. Tammany Parish Critical Drainage Areas

St. Tammany identified Critical Drainages Areas within the Parish (see Figure 6-9) which generally corresponds to the 100-year floodplain identified by FEMA through the Flood Insurance Study (FIS) program. Developments within these areas must follow stringent guidelines in order to reduce or eliminate developments in these Critical Drainage Areas. The regulations provide definitions for fill material, excavation, and drainage standards within these identified areas. Some areas are considered Areas of Special Concern and have requirements that limit fill volumes and require specialized approval for development.

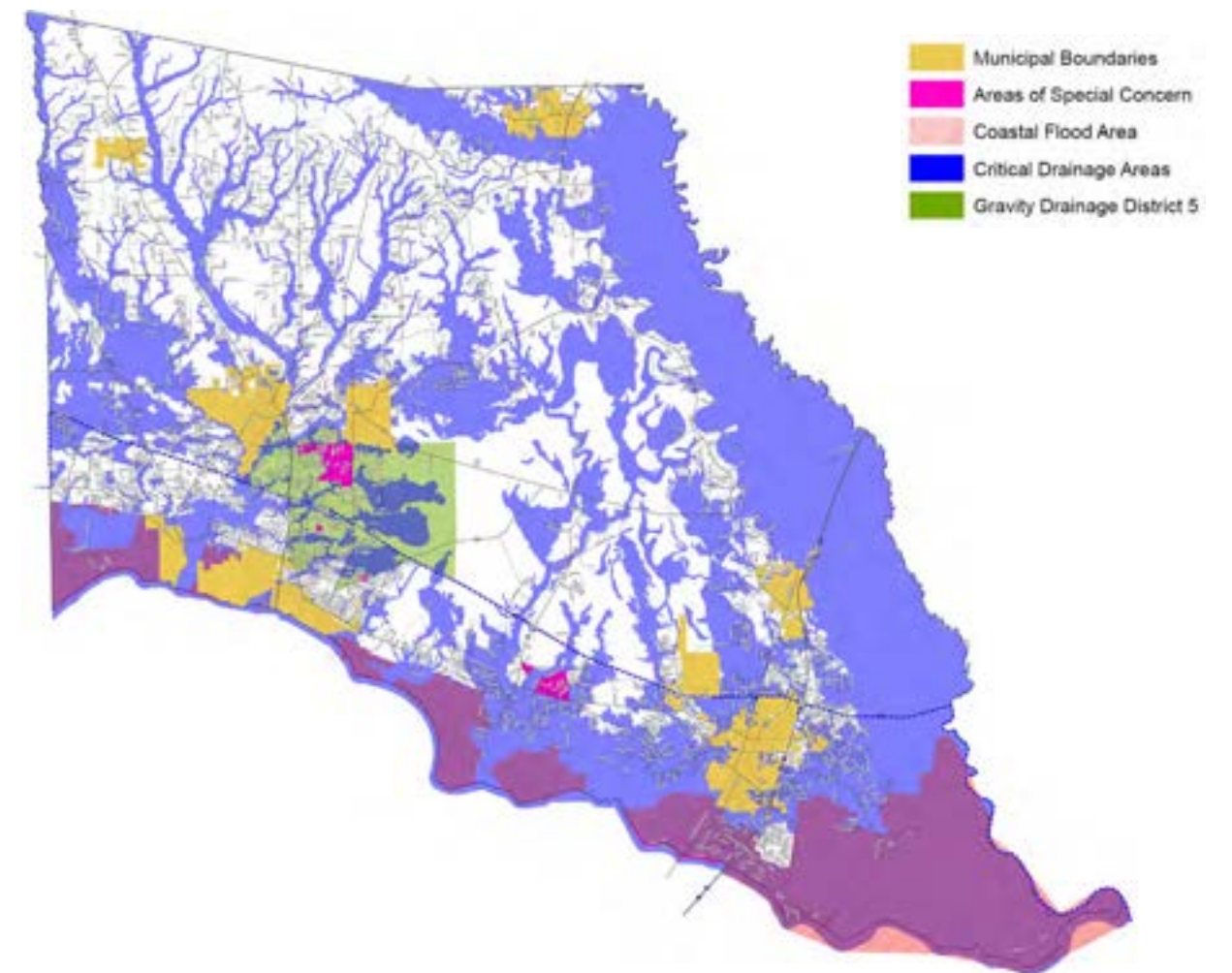


Figure 6-9 St. Tammany Parish Government Critical Drainage Map (Courtesy of St. Tammany Parish Government)

Additionally, developers, both inside and outside of Critical Drainage Areas, are required to perform hydraulic and hydrologic modeling and demonstrate that stormwater discharge rates will be lower after construction of the developments. Through this process, future developments and their impacts to the watersheds are minimized for the entire community.

6.2.3 St. Tammany Comprehensive Drainage Plan

In 2022 St. Tammany initiated a Comprehensive Drainage Plan study to assess stormwater runoff across the entirety of St. Tammany Parish and its associated watersheds. This plan is the first parish-wide drainage plan to assess stormwater runoff and is focused on assessing the state of drainage (including flood risk), water quality, and development guidelines. The plan will recommend capital projects and potential policy changes to reduce flood risk and increase public safety and welfare.

The Plan is in Phase 1 data collection of the effort. Public meetings were held in Fall 2022 and public comments were accepted for consideration via an interactive map. Phase 2 is expected to begin in late 2023 and will involve more detailed analyses.

6.2.4 2021 St. Tammany Sustainable Growth Pilot Study

The St. Tammany Parish Sustainable Growth Pilot Study provides guidance to St. Tammany Parish Government as ways to provide sustainable growth within the Parish while minimizing flood risk impacts to the existing communities. St. Tammany Parish is seeing a growing concern from the public regarding commercial and residential developments and their impacts on drainage and flood risk.

The study showcases the benefits of developing high-resolution regional hydraulic models to understand the existing hydrologic conditions of St. Tammany Parish and better predict impacts from proposed developments and community growth. The study also provides a template for evaluating potential regulatory and engineered solutions to better manage flood risk, and provide for sustainable growth and regulatory conditions for commercial and residential development.

Regional hydraulic modeling is proposed to provide consistency between St. Tammany Parish Government and developers for updated water surfaces, tailwater conditions, and boundary conditions for use when designing development specific drainage and stormwater management plans. Additionally, it allows the Parish to incorporate new developments into the regional model to facilitate future flood risk studies. This pilot study aligns future development with the Parish's intended goal of promoting suitable growth as outlined in the New Direction 2040 planning process.

6.2.5 Louisiana Watershed Initiative (LWI)

The Louisiana Watershed Initiative (LWI) is a program to address flood risk in the State of Louisiana based on improved watershed management. This initiative was established after extensive flood damage occurred in March and August of 2016. These 2016 extreme rainfall events caused extensive damage in St. Tammany Parish. Transportation routes, residential homes, and commercial facilities were impacted. This flooding exposed the vulnerability of communities along rivers and bayous within the State and prompted the need for improved watershed management.

St. Tammany Parish in Region 7 area for the LWI program. As part of the program, \$10 million in funding is earmarked to buy high risk, repetitive loss structures. These are voluntary programs that remove structures from flood prone areas and return the floodplain to a more historic state. As discussed in the Nonstructural chapter, areas in the Parish have been identified for these buyouts. Additionally, this program provided funding for pump station hardening for the Dellwood and Lee St. Pump Stations in Slidell, LA. The program is also promoting nature-based solutions to reduce flood risk and improve water quality.

6.2.6 Watershed Management Next Steps

Watershed management is widely accepted as a method to address flood concerns. Multiple programs at the state and federal level are currently evaluating improvements to existing watershed to provide flood risk reduction in St. Tammany Parish. It is recommended that the Parish continue to support these measures, promote equitable distribution of funds, and seek new funding opportunities for residences and other structures that lie outside existing and proposed structural protection systems. These actions provide an additional benefit of increased natural habitat and a restoration of historic ecosystems.

Chapter 7 Summary

This Coastal Master Plan presents multiple projects and strategies to provide flood risk reduction for the St. Tammany Parish Coastal Zone. These include both structural and nonstructural methods. For structural measures, multiple alignments are considered with 100-year, 50-year, and 25-year levels of protection, as well as coastal resilience. Conceptual designs and projections of structure footprint, capacity, and capital expenditures were evaluated and included. Additional survey, geotechnical data collection and analysis, hydraulic modeling, real estate impacts, and engineering and design effort will be necessary to move these projects from the concepts presented in this plan through to construction.

7.1 Flood Risk Reduction and Coastal Resilience

Ongoing studies such as the St. Tammany Parish Feasibility Study will impact and steer the direction of the 100-year level of protection for St. Tammany Parish. With the approval of the Tentatively Selected Plan by the USACE, St. Tammany Parish Government can continue to refine the proposed alignments and work towards the Non-Federal Sponsor requirements. Projects consistent with the USACE Tentatively Selected Plan include:

1. West and South Slidell
2. Slidell Levee – East Segment
3. Nonstructural Risk Reduction Strategies

Additionally, for those areas that are no longer considered within the federal level of protection (100-year), St. Tammany Parish Government can pursue independent efforts at levels as described in the 50-year, 25-year, and resilience scenarios as funding allows. Through other Federal, State, or Local programs, the following projects are currently in engineering and design:

1. Eden Isles Flood Risk Reduction and Resilience Project
2. City of Mandeville Seawall and Resilience Project
3. Northshore Eden Isles Breakwaters

Reevaluating the St. Tammany Parish Coastal Master Plan should occur frequently to consider community changes in both composition and support. Future storms could have impacts on the community and shift benefits, resources, or priorities for St. Tammany Parish as well as the residents. Should these changes occur in favor of structural protection, or if additional funding is allocated for additional studies, the following communities could benefit from the additional efforts:

1. Lake Pontchartrain Barrier
2. Military Road Flood Risk Reduction
3. Lacombe Flood Risk Reduction and Levee System

Furthermore, the STPG and STLDCD should continue to review, support, and participate in state and federal evaluations. As studies by the USACE, CPRA, LWI, and other state or local agencies continue, maintaining consistency across the alignments in future design efforts will be necessary to avoid duplication of efforts. Leaders should review projects that are developed at the local level for consistency with the goals of larger state and federal programs. Maintaining the flow of information between different agencies and at all levels of government is critical to securing project funding.

As flood risk reduction projects evolve in St. Tammany Parish, identification of sustainable funding mechanisms to operate and maintain the proposed projects is critical to securing federal and state funding. Additionally, cost sharing agreements are required between local, state, and federal agencies including STPG, STLDCD, CPRA, and the USACE. These cost sharing agreements may vary depending on the funding source and agencies involved and will impact construction priorities.

Finally, stakeholder engagement should be maintained throughout project development. Involving communities impacted by flood protection features during project development helps generate community support. Also, flood tolerance versus flood risk reduction should be considered for communities which prefer lower levels of protection that align with their quality of life.

7.2 Restoration and Nature-Based Projects

Several communities within St. Tammany Parish have expressed a preference for nature-based projects. The Coastal Master Plan includes multiple ecological restoration project that will also provide the secondary benefit of flood resilience and multiple lines of defense for flood prone communities. Projects in engineering and design or moving to construction include :

1. Mandeville Lakefront Wetland Restoration
2. Tchefuncte River Area, Wooded Island Protection, Peninsula Replacement and Marsh Restoration
3. Fritchie North Marsh Creation
4. Big Branch Living Shoreline

Projects awaiting funding for in engineering and design include :

1. Guste Island Living Shoreline
2. Guste Island Marsh Creation
3. West Mandeville Living Shoreline
4. Mandeville Lakefront Living Shoreline
5. Fritchie Hydrologic Restoration
6. Pearl River Island Shoreline Protection and Restoration
7. St. Tammany Marsh Creation
8. New Orleans East Landbridge Restoration

With continued growth and the ever-present flood risk within St. Tammany Parish, the proactive efforts outlined in this report provide St. Tammany Parish Government and St. Tammany Levee, Drainage and Conservation District officials a holistic approach for development of coastal resilience and flood risk reduction. The approach provides increased habitats, stronger communities, and a more sustainable future.





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COASTAL MASTER PLAN

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Appendix A:

Modeling Reports



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Appendix B:

Geotechnical Data & Reports



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Appendix C:

Construction Cost Estimates



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Appendix D:

Survey & Levee Ownership Report



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Appendix E:

Environmental Summary Report



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DECEMBER **2023**

DRAFT

Prepared by

