Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Revised Draft Integrated Feasibility Report and Environmental Impact Statement

July 2023

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Cover Page

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Revised Draft Integrated Feasibility Report and Environmental Impact Statement

Counties/Parishes:	St. Tammany Parish, Louisiana
Lead Agency:	U.S. Army Corps of Engineers, New Orleans District
Cooperating Agencies:	U.S. Fish and Wildlife Service; National Marine Fisheries Service; Louisiana State Historic Preservation Office; Louisiana Department of Wildlife and Fisheries; City of Mandeville, LA; City of Slidell, LA; Choctaw Nation of Oklahoma.

Abstract: The St. Tammany Parish, Louisiana Feasibility Study (study) for flood damage reduction in St. Tammany Parish, Louisiana (study area), is authorized by Subtitle B, Section 1201 (14) of the Water Resources Development Act of 2016, as included in the Water Infrastructure Improvements for the Nation Act (P.L. 114-322). The study was authorized in accordance with the annual reports submitted to the Congress in 2015 and 2016, pursuant to Section 7001 of the Water Resources Reform and Development Act of 2014 (33 U.S.C. 2282d). The study was funded by the Bipartisan Budget Act of 2018 (P.L. 115-123), Division B, Subdivision 1, Title IV. The study area includes all of St. Tammany Parish in southeastern Louisiana. The revised Draft Integrated Feasibility Report and Environmental Impact Statement contains, among other things, sections on plan formulation, analysis of potential environmental impacts and consequences, alternatives analysis, mitigation, and a description of the Optimized Tentatively Selected Plan (TSP or proposed action). The Optimized TSP includes the construction (and operation) of approximately 18.5 miles of a levee and floodwall system from West Slidell to South Slidell, to include 8 pump stations, 13 culverts/sluice gates/lift gates, 18 vehicular floodgates, 1 pedestrian floodgate, 1 railroad floodgate, 6 road ramps, and the I-10 road surface would be raised to construction elevation 22.0 to ramp over the new levee section to stay above the hydraulic design elevation for year 2082, to ensure the entire pavement section remains above the hydraulic design elevation across the interstate by constructing ramps to the preliminary design elevation of 15 feet. The Optimized TSP also includes 2.15 miles of channel improvements to Mile Branch in Covington and nonstructural home elevations for 5,583 preliminarily eligible residences, and floodproofing for 827 eligible non-residential structures in St. Tammany Parish. The Optimized TSP would reduce flood risk to approximately 26,600 structures in the study area and approximately 70,000 residents. The Optimized TSP is estimated to produce nearly $237,803,000 in net benefits with a BCR of 2.4 (greatest net economic benefits) and is consistent with USACE policies for protecting the environment and applicable environmental laws and regulations.

The Optimized TSP decreases expected annual damages from $547,701,000 under the without-out project condition to $162,887,000 under the with project condition.

For further Information, please visit the study website at:
https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/St-Tammany/ or contact:

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Executive Summary

The United States Army Corps of Engineers (USACE), Mississippi Valley Division (MVD), New Orleans District (CEMVN), Regional Planning and Environment Division South (RPEDS), prepared this revised draft Integrated Feasibility Report and Environmental Impact Statement (RDIFR-EIS). The RDIFR-EIS (the “report”) reflects the collective efforts and input of the state of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB) as the Non-Federal Sponsor (NFS), cooperating agencies, stakeholders, and members of the public. The Optimized Tentatively Selected Plan (Optimized TSP or proposed action) is supported by the NFS.

The purpose of the St. Tammany Parish, Louisiana Feasibility Study (study) is to investigate flood risk management (FRM) and coastal storm risk management (CSRM) solutions to reduce flood damages caused by riverine, rainfall, and coastal storm flooding in St. Tammany Parish (study area). A Feasibility Cost Share Agreement (FCSA) was executed between the Department of the Army and the NFS on 14 January 2020. The study is funded through the Bipartisan Budget Act of 2018 (P.L. 115-123), Division B, Subdivision 1, Title IV, and is 100 percent federally funded up to $3,000,000.

An exemption to the Section 1001 of WRRDA 2014 requirements that established a 3-year study duration and a $3 million federal study cost was approved by the Assistant Secretary of the Army for Civil Works ASA(CW) in April 2022 in order to complete the complex feasibility study and to further reduce risk and address policy and legal, public, Agency Technical Review (ATR) and Independent External Peer Review (IEPR) comments received on an earlier version of the draft report. An additional $1.77M and 16 months was allocated to complete critical tasks to inform the decision on the Recommended Plan. As part of the Exemption approval, the study was designated as a “Mega Study” and is required to follow the requirements in the Interim Guidance for Civil Works Mega Studies dated 15 October 2021.

Study Area: The study area encompasses all of St. Tammany Parish, which is approximately 1,124 square miles and located in southeastern Louisiana (see Figure ES-1). St. Tammany Parish is home to over approximately 258,110 residents and 2,500 businesses. The parish is uniquely located at the

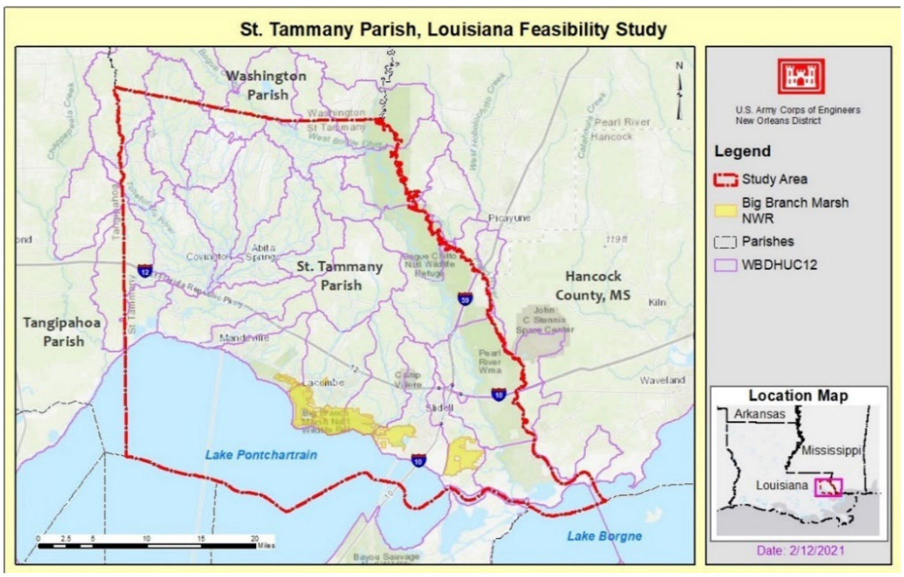

Figure ES-1. St. Tammany Parish, Louisiana Study Area crossroads of three interstates, I-10, I-12, and I-59, and transportation waterways to the Gulf of Mexico. The hydrology is complex, and communities experience repeated damages from flooding, including, but not limited to storm surge from coastal events, localized heavy rainfall, and riverine flooding.

The Pearl River runs along the Mississippi-Louisiana state line and is the eastern boundary of the study area. Lake Pontchartrain, one of the largest estuaries in the United States, serves as the southern border. Tangipahoa Parish is located along the western boundary, and Washington Parish is located along the northern boundary. There are 36 hydrologic sub-basins, as defined by the United States Geological Survey (USGS) 12- digit hydrologic unit delineations (WBDHUC12) within the study area. See Figure ES-1.

Problems and Opportunities (Need): St. Tammany Parish has experienced repeated, widespread flooding from both riverine, rainfall and coastal storm flood events (i.e., riverine bank overtopping, drainage, and storm surge) including historic flood impacts during Hurricane Katrina (August 2005) and the flood August 2016. The flood events caused major disruptions, damages, and adverse economic impacts to the parish. *Opportunities* to address the problems include:

- 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 for, mitigate, and recover from flood events;
- Transportation and Evacuation - Increase the reliability of the national transportation corridors (I-10, I-12, and I-59) by providing alternatives that could potentially lessen damages to roads and interstates; reduce flooding to evacuation routes used for flood events;
- Natural Resources - Protect the function and increase the resiliency of the ecosystem to reduce flood damages.

Planning Objectives/ Constraints: *Planning objectives* represent desired positive changes to future conditions within the study area during the 50-year period of analysis from 2032 to 2082.The 50-year period of analysis begins once the project has been implemented.

- Reduce the risk to public health and safety by reducing flood impacts to structures, evacuation routes, and critical infrastructure in St. Tammany Parish.
- Reduce flood damage to structures (i.e., businesses, residential, commercial, and public structures) from flooding in St. Tammany Parish.
- Reduce interruption, to the maximum extent practicable, to the national transportation corridor, e.g., the I-10, I-12, and the I-59 interchange in St. Tammany Parish.
- Increase community resiliency, which is the sustained ability of a community to use available resources before, during, and after significant rainfall and/or coastal storm events.

A *planning constraint* is a limitation or restriction that limits plan formulation or that requires a work around and are things to be avoided during plan formulation. The planning constraints for this study include the following:

- Proposed projects must meet minimum flow (800 cubic feet per second for a 10 percent chance flood) and drainage area (1.5 square miles) requirements (USACE Engineer Regulation (ER) 1165-2-21);
- Avoid direct or indirect support of floodplain development (in accordance with EO 11988), wherever there is a practicable alternative;
- Avoid locating project features on lands known to have hazardous, toxic, and radioactive waste (HTRW) and/or related concerns.

Additional considerations in the plan formulation process included:

- Avoid and minimize impacts to threatened and endangered (T&E) species and their critical habitats;
- Avoid and minimize impacts to managed habitats, i.e., essential fish habitat (EFH);
- Avoid and minimize impacts to established recreational areas;
- Avoid and minimize impacts to viewshed;
- Avoid and minimize impacts to cultural resources.

Planning Process and Alternatives Considered: The USACE's planning process was followed, which included identifying problems and opportunities, inventorying, and forecasting conditions, identifying measures, creating alternatives and continually reevaluating the measures within the alternatives and screening measures through the selection of the Final Array of Alternatives (Final Array) and the Tentatively Selected Plan (TSP).

Initially, a total of 195 site-specific management measures were identified and compiled from previous reports, NFS, stakeholders, the public, and recommendations from the PDT. These measures were based on the inventory of resources and forecasting of significant resources that are relevant to the problems and opportunities under consideration. At the request of the NFS and the St. Tammany Parish Government (STPG), additional FRM measures were developed specifically for the Eden Isle community in the city of Slidell, Louisiana. As a result of this iterative process, an additional 13 management measures were added for the Eden Isle community, resulting in a total of 208 measures for the entire study area. These 208 measures were evaluated using a screening process which was based on the planning objectives, opportunities, and constraints listed above; together with existing information and data and the exercise of professional judgment. A detailed description of the screening process is contained in Appendix B: Plan Formulation. See also: Figure 4-1 in Section 4.

Following the first screening of the initial 195 site specific management measures, an Initial Array of 13 alternatives were formulated consisting of 62 site-specific management measures. The Initial Array of Alternatives was developed by grouping measures based on hydrologic sub-basins in different geographic locations within the study area. Next, the Project Delivery Team (PDT) evaluated, screened, and compared the site-specific management measures within the Initial Array of Alternatives, including the No Action Alternative. Further screening by the PDT resulted in the development of the Focused Array of Alternatives which consisted of 11 alternatives and 43 site-specific management measures. The screening of the Focused Array of Alternatives was informed by preliminary hydraulic (H&H) modeling (Advanced CIRCulation (ADCIRC) and Hydrologic Engineering Center – River Analysis System (HEC-RAS)), updated cost estimates and economic modeling (Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA)). Next, the PDT identified the Final Array of Alternatives consisting of 8 alternatives and 27 site-specific management measures. The screening, evaluation, and comparison of the Final Array of Alternatives was informed by H&H modeling (ADCIRC) and (HEC-RAS), USACE Class 4 cost estimates, engineering, design, environmental impacts and compensatory mitigation, risk assessments and potential life safety concerns, and economic modeling (HEC-FDA). In the final iteration of the screening process, the PDT selected a Draft TSP, which was set forth in an earlier draft report, which was released for concurrent public, ATR, IEPR, and policy review in June 2021. At the conclusion of the 45-day review period, the Draft TSP was refined and optimized based on additional modeling and design efforts by the PDT, and to address the comments received in the review process.

Throughout the planning process, the geographic based alternatives were evaluated separately to determine which measures within an alternative that were incrementally justified. In locations where multiple causes of flooding were documented, justified measures to reduce the risk from the multiple flooding sources were included in an alternative. After the evaluation of the Final Array of Alternatives, the justified measures within the alternatives were combined into a comprehensive parish-wide alternative to reduce flood risk to multiple subbasins within the study area. The levee and floodwall features in all of the alternatives in the Final Array follow the Hurricane and Storm Damage Risk Reduction System (HSDRRS) design standards which were developed for the greater New Orleans levees and floodwalls but have since, have been incorporated into updated USACE-wide engineering manuals and using engineering judgment. St. Tammany Parish is on the Northshore of the Lake Pontchartrain and part of the New Orleans Metropolitan area. Levees in St. Tammany Parish were proposed as part of the New Orleans levee system were proposed as far back as the 1960s in Lake Pontchartrain and Vicinity (LPV), LA Hurricane Protection Project.

The Final Array of Alternatives, including the evaluation and comparison and measures included in the TSP is summarized below. See Section 4 and Appendix B: Plan Formulation, for more information regarding the alternatives and measures.

Final Array of Alternatives:

Alternative 1. No Action - Future without project condition (FWOP): The No Action Alternative assumes the future conditions in the absence of taking Federal action to address the identified problems. Consideration of a No Action Alternative is a requirement of the National Environmental Policy Act (NEPA) and forms the basis against which all other alternatives plans are measured. Under the No Action Alternative, current flooding problems and concerns in the study area would persist. The area would continue to experience damages from riverine, rainfall, surge, and coastal storm related flooding. Neither the TSP nor any of the other alternatives would be implemented. During analysis of the Final Array, the

PDT determined that Alternative 1 does not address the planning objectives. Consequently, Alternative 1 was screened out based on completeness since it would not alleviate problems or provide flood risk reduction benefits.

Alternative 2. Nonstructural: Alternative 2 included the standalone comprehensive nonstructural measures which reduce flood damages without significantly altering the cause or extent of flooding. Nonstructural measures and plans were evaluated using a logical aggregation method (e.g., grouping by structures' main floor elevation; census block or tract boundaries; neighborhoods or communities sharing common infrastructure; neighborhoods or communities sharing common floodplains; and structures within other geophysical boundaries or sharing other flood characteristics).

Nonstructural measures (i.e., elevation, floodproofing etc.) focus on reducing the consequence of flooding for a specific structure rather than constructing hard infrastructure measures (i.e., levees, floodwalls, culverts, pump stations, etc.) which are physical modifications designed to reduce the frequency of damaging levels of flood inundation. Flood damage reduction from nonstructural measures is accomplished by changing the use of the floodplains, or by accommodating existing uses to the flood hazard. The nonstructural measures that were considered for the study area included floodproofing, elevations, buyouts, and relocations.

For the Final Array, the logical aggregation method used to evaluate the nonstructural measures were the AEP floodplains. The study area was assessed and structures that incurred damages in the 10, 20, 50 and 100 year floodplains were grouped together for evaluation.

During analysis of the Final Array, the PDT screened out the standalone comprehensive nonstructural alternative in favor of the combined structural and nonstructural alternative, which would provide more net benefits. The combined structural and nonstructural measure was retained and is included in the Draft TSP. The draft nonstructural plan was optimized during feasibility of design.

[Note: Alternative 3: Lake Pontchartrain Surge Reduction was eliminated during an earlier screening stage in the planning process. See Appendix B: Plan Formulation for additional details.]

Alternative 4. Lacombe: Alternative 4 included variations of a levee system to reduce coastal storm flooding in Lacombe, Louisiana (Variations 4a and 4a.1). A longer levee, extending from Lacombe to the West Slidell area, was also considered (Variation 4b). Although the PDT determined that Alternative 4 met the planning objectives and was complete and effective, none of the levee variations (Variations 4a, 4a.1 and 4b) had a positive benefit-cost ratio (BCR) and therefore, Alternative 4 was screened out based on lack of efficiency. Alternative 4 was not included in the Draft TSP.

Alternative 5. Bayou Liberty/ Bayou Vincent/Bayou Bonfouca: Alternative 5 included measures to address riverine, rainfall, and coastal storm flooding in the areas of Bayou Liberty, Bayou Vincent, and Bayou Bonfouca. To address riverine flooding, the Bayou Bonfouca

Regional Detention Pond and channels improvements on Bayou Liberty and Bayou Patassat were considered. A West Slidell levee with floodgates and pump stations was also considered to reduce coastal storm surge impacts to the area. During analysis of the Final Array, the Bayou Bonfouca Detention Pond and Bayou Liberty Channel improvements were screened out based on lack of efficiency due to a negative BCR. It should be noted that ultimately the West Slidell Levee was incorporated into Alternative 6c as part of the Draft TSP. Bayou Patassat was initially retained and included in the Draft TSP, but was ultimately screened out and removed from the Optimized TSP.

Alternative 6. South Slidell Storm Surge: Alternative 6 included a combination of levees and pump stations to reduce damages from coastal storm events, including a levee and floodwall system in South Slidell (6a). Variation (6b) incorporated the Eden Isle community into the South Slidell levee system. A combination of the measures in Variation 6a and the West Slidell levee from Alternative 5, was created to form Variation 6c. During analysis of the Final Array, Variation 6b was screened out due to the combined South Slidell and West Slidell combination providing the greatest net benefits. Variation 6b, which incorporated the Eden Isle community into the levee alignment, was screened based on lack of efficiency due to a negative BCR. Variation 6c was moved forward into the Draft TSP and was optimized during feasibility level of design.

Alternative 7. Eastern Slidell: Alternative 7 included measures to address riverine, rainfall, and coastal storm flooding to eastern Slidell. Measures included a diversion at Gum Bayou, Poor Boy Canal Improvements, channel improvements on Doubloon Bayou, and a levee to prevent riverine flooding from the Pearl River. During analysis of the Final Array, the Pearl River Levee, Doubloon Bayou channel improvements, Gum Bayou Diversion, and Poor Boy Canal improvements were all screened out based on lack of efficiency due to a negative BCR. Alternative 7 was not included in the Draft TSP.

Alternative 8. Upper Tchefuncte/Covington: Alternative 8 includes channel modifications to Mile Branch in Covington to reduce riverine flooding. The evaluation also included enlarging the lower 2 miles of Mile Branch and enlargement of Lateral "A." During analysis of the Final Array, the Lateral A channel improvements were screened out based on lack of efficiency resulting in a negative BCR, and because the improvements would not be effective in reducing flooding (the H&H modeling only showed minor reductions in water surface elevations). The Mile Branch Channel Improvement measure of Alternative 8 was moved forward into the Draft TSP and was optimized during feasibility level of design.

Alternative 9. Mandeville Lakefront: Alternative 9 considered three variations of replacing and raising the existing Lake Pontchartrain seawall and providing additional improvements, such as floodwalls, floodgates and or pumps to address tidal and storm surge flooding in Mandeville, Louisiana. This Alternative investigated both variations with forced drainage and pump stations and passive (gravity) drainage systems at Little Bayou Castine and Ravine aux Coquille. During analysis of the Final Array, all structural measures that made up Alternative 9 were screened out based on lack of efficiency due to a negative BCR. Alternative 9 was not included in the Draft TSP.

Evaluation and Comparison Summary - Draft Tentatively Selection Plan: Each Alternative in the Final Array was evaluated to determine its effects, benefits, costs, and impacts. Existing data was used to model the physical, economic, and environmental conditions in the study area, along with measuring how well each Alternative performed in meeting the study objectives and avoiding the study constraints. Each Alternative and measures within the Alternatives were compared to the No Action Alternative.

Per USACE Guidance, the PDT evaluated the Final Array measures and alternatives across multiple benefit and impact categories, which included economic (national and regional), environmental (national and regional), and social considerations, which were captured under the following accounts: National Economic Development (NED), Regional Economic Development (RED), Other Social Effects (OSE), and Environmental Quality (EQ). The PDT analyzed, evaluated, and compared all of the measures independently across the benefit categories. The measures had to be incrementally justified from the Final Array of Alternatives and then the PDT selected the specific justified measures from the Alternatives in the Final Array to form the Draft TSP, which includes a combination of structural and nonstructural measures for both FRM and CSRM.

Final Feasibility Design and Optimization of the Tentatively Selected Plan:

Subsequent to the release of the Draft IFR-EIS, the PDT conducted additional engineering, economic, and environmental investigations on the individual features of the Draft TSP. Based on information gathered by the PDT, together with the consideration of comments received from the public, stakeholders, and the resource agencies, the PDT further refined the Draft TSP to form the Optimized TSP. Sections 4.5 and 6 describe the updates made by the PDT for the Optimized TSP. See Appendix D: Engineering for full description of optimized structural plan, and Appendix F: Economics and Appendix H: Nonstructural Implementation Plan for full description of the optimized nonstructural plan.

Table ES-1. Summary of Measures in the Optimized TSP

	South Slidell and West Slidell Levee and Floodwall System	Mile Branch Channel Improvements	Rest of Parish Nonstructural Plan	Combined Plan-Structural & NS Plan
First Cost	2,440,973,000	77,002,000	1,934,084,000	4,452,059,000
Benefits	162,588,000	3,472,000	236,702,000	402,762,000
Average Annual Cost	94,173,000	3,104,000	68,403,000	165,680,000
Net Benefits	68,415,000	368,000	168,300,000	237,083,000

B/C Ratio	1.7	1.1	3.5	2.4
Approx. # structures with flood risk reduction	20,000	250	6,410	26,600

*Bayou Patassat was previously included in the Draft TSP released for review and comment in 2021. Updated analysis indicated that the measure was not cost effective and it was removed from the Optimized TSP.

Table ES-1 provides a breakdown of the average annual benefits, average annual cost, net benefits, and the BCR for the measures of the Optimized TSP. The Optimized TSP is a comprehensive plan to address flooding parish-wide. The Optimized TSP includes both FRM and CSRM measures, with approximately 18.5 miles of a levee and floodwall alignment from west Slidell to south Slidell, channel improvements in Mile Branch in Covington, and nonstructural home elevations and floodproofing for eligible structures in the parish. The combined structural and nonstructural Optimized TSP would reduce flood risk to approximately 26,600 structures in the study area and approximately 70,000 residents. The Optimized TSP is also the NED Plan.

The Optimized TSP is estimated to produce nearly $237,803,000 in net benefits with a BCR of 2.4 (greatest net economic benefits) and is consistent with USACE policies for protecting the environment (e.g., EC 1165-2-220, ER 200-2-3, etc.) and the environmental laws and regulations further described in Section 8. The Optimized TSP decreases expected annual damages from $547,701,000 under the without-out project condition to $162,887,000 under the with project condition.

The following is a discussion of the measures that form the Optimized TSP:

Nonstructural Elevations and Floodproofing (from Alternative 2)

Approximately 5,583 eligible residential structures would be elevated and 827 eligible nonresidential structures would be floodproofed. The floodproofing of eligible nonresidential structures would protect structures that are not included in the areas benefitted from the structural measures of the Optimized TSP. These structure counts are preliminary and are not absolute at this time; they will continue to be evaluated and refined by the PDT. To be considered preliminarily eligible for participation, a structure must meet the following criteria:

- The structure must have a first-floor elevation at or below the applicable floodplain (which may be either a 25, 50 or 100 year floodplain depending on the location of the structure), based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis) at a specific location.

- The structure must be outside of the area of influence of the structural features recommended in the Optimized Tentatively Selected Plan and not be receiving flood risk reduction benefits from the structural features (i.e., outside of the areas of influence (defined as the area that benefits from a given structural measure in the form of lowering stages) of the Optimized TSP.

- The elevation or floodproofing measures proposed for the structure must be economically justified, meaning that the cost to implement the nonstructural measure of a certain structure does not exceed the total monetary cost of the flood damages that are anticipated to be avoided over the 50-year period of analysis (years 2032-2082).

- The structure must have a permanent foundation and be permanently immobilized and affixed or anchored to the ground as required by applicable law and must be legally classified as immoveable real property under state law. Notwithstanding the provisions of La. R.S. 9:1149.6, a manufactured, modular or mobile homeowner and any subsequent owner of an immobilized manufactured, modular or mobile home, may not deimmobilize the manufactured, modular or mobile home in the future, by detachment, removal, act of deimmobilization, or any other method. Manufactured, modular and mobile homes that do not meet these requirements are not eligible for elevation. This criteria only applies to residential uses of manufactured, modular, and mobile homes.

The nonstructural elevations and floodproofing are voluntary; property owners who have preliminarily eligible structures that wish to participate in the flood proofing measures would be required to submit an application and provide a right-of- entry to their structure to undergo site assessment, appraisal, and other inspections and evaluations to determine the final eligibility of the structure.

South Slidell and West Slidell Levee and Floodwall System (from Alternative 6- Variation 6c)

The system is comprised of approximately 18.5 miles (97,700 feet) of alignment with a combination of 15 miles of levees (79,500 feet) and 3.5 miles (18,200 feet) of floodwall. The I-10 road surface would be raised to a final construction elevation of 22.0 feet in order to ramp over the new levee section, to remain above the hydraulic design elevation for year 2082. The construction of the levee and floodwall system would temporarily impact approximately 102 acres staging areas for construction of the levee and floodwall system. The levee alignment would require approximately 7,239,000 cubic yards of fill for the 50-year period of analysis (includes 30 percent contingency). This component of the Optimized TSP includes 8 pump stations, 13 culvert/sluice gates/lift gates, 18 vehicular floodgates, 1 pedestrian floodgate, 1 railroad floodgate, and 6 road ramps.

Mile Branch Channel Improvements (from Alternative 8)

This measure consists of channel improvements on the lower 2.15 miles (11,341 foot channel) of Mile Branch in Covington, Louisiana. The Mile Branch channel improvements would start at the intersection of the Mile Branch Channel and U.S. Highway 190, crossing U.S. Highway 190 Business, and ending at the confluence of the Mile Branch Channel and the Tchefuncte River. The work would consist of clearing and grubbing approximately 21 acres of the Mile Branch Channel prior to mechanical dredging. A maximum of 130,000 cubic yards of fill will be mechanically dredged from the Mile Branch Channel.

Approximately 38.8 acres of permanent ROW would be needed for the work and will include 25 feet on each side of the Mile Branch Channel, 5.1 acres for a temporary ROW for clearing and grubbing and mechanical dredging, and approximately 2.2 acres for bridge replacements would be required as temporary ROW for staging along the various areas of the bridge replacements. The 4.8 acres for staging area would become a backwater area after construction is complete. The Mile Branch Channel improvements would include seven bridge replacements.

Subsequent to the Draft TSP selection, it was discovered that the clearing and snagging of Bayou Patassat would not be as effective as the H&H modeling originally estimated. An updated analysis of the measure yielded a BCR of 0.5. As a result, the measure was not carried forward as part of the Optimized TSP.

The RDIFR-EIS fully describes flood risk to structures and life safety associated with riverine, rainfall, and coastal storm flood events. The measures of the Optimized TSP were formulated to reduce the risk of flood damages to key infrastructure and structures. The Optimized TSP would greatly reduce, but not eliminate future damages and residual risk would remain. The structural measures of the Optimized TSP reduces expected annual damages by approximately 30 percent relative to the without project conditions. The nonstructural plan of the Optimized TSP reduces annual damages by approximately 40 percent relative to the without project condition. The residual risk, along with the potential consequences, has been communicated to the Non-federal Sponsor and will become a requirement of any communication and evacuation plan.

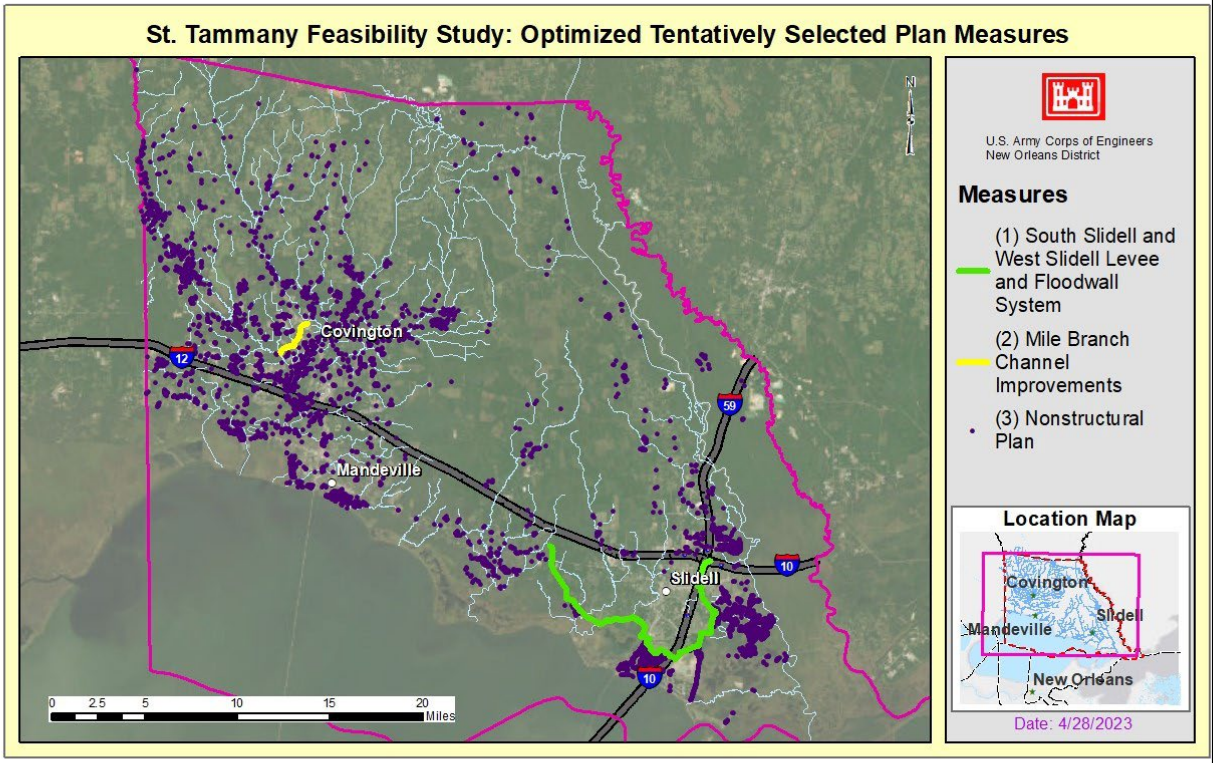

Figure ES-2. Optimized TSP/NED Plan

Environmental Summary: A Notice of Intent (NOI) to prepare a DEIS for the study was published in the Federal Register (Vol. 85, No. 119) on 19 June 2020 and included a 45-day scoping public comment period. Two virtual public scoping meetings were held on 14 and 15 July 2020. Approximately 85 comments were received as a result of the public scoping. Input received from the public meetings assisted the PDT in identifying and refining the problems within the study area and developing opportunities to address those problems. Input from the public and resource agencies during initial scoping helped to further refine study goals, objectives, potential measures to address the problem and develop alternative plans.

The U.S. Fish and Wildlife Service (USFWS); National Marine Fisheries Service (NMFS); Louisiana State Historic Preservation Office (LA SHPO); Louisiana Department of Wildlife and Fisheries (LDWF); city of Mandeville, Louisiana; and city of Slidell, Louisiana are cooperating agencies and participants in the PDT meetings. See Appendix C: Environmental.

A Notice of Availability was published in the Federal Register (Vol. 86, No. 111) on Friday, 11 June 2021, announcing the release of the initial draft IFR-EIS for a 45-day public comment period. One hundred fifty-nine comments from 88 individuals and 11 agencies were received. The top reoccurring themes were regarding modeling (20 percent), plan formulation (30 percent), non-structural plan (16 percent), potential impacts or insufficient discussion of impacts (14 percent) and induced flooding (8 percent). Nine percent of the comments expressed opposition to the proposed plan. Comments received and the Public Involvement Plan are included in Appendix C: Environmental.

Important resources identified, but not limited to include: migratory birds, threatened and endangered species (T&E) and protected species, wetlands, aquatic resources, essential fish habitat, water quality, air quality, cultural resources, socioeconomics, environmental justice (EJ), agricultural lands, Hazardous, Toxic, and Radioactive Waste (HTRW), recreation, aesthetics, and noise. Detailed descriptions of these resources and associated impact analyses are included respectively in Section 3 and Section 5 of the report and Appendix C: Environmental.

Direct, indirect, and cumulative effects of the Final Array of Alternatives are addressed in the evaluation of the measures and alternatives. A Wetland Value Assessment (WVA) and Habitat Evaluation Procedures (HEP) was conducted in coordination with USFWS to assess habitat impacts and determine the required compensatory mitigation. Table ES-2 identifies the habitat types impacted, acres of impact, the net acres impacted over the 50-year period of analysis and the average annual habitat units lost.

Table ES-2. Environmental Impacts

	Direct *			Indirect					
Refuge Impacts	**Acre Impact**	**Net Acres**	**AAHU**	**Acre Impact**	**Net Acre**	**AAHU**	**Total Net Acres**	**Total Net AAHU**	**Total Impact Acres**
Fresh/ Intermediate Marsh	-77	-29	33	0	0	0	-29	33	-77
Pine Savanna/ flatwood	-21	-1.19	RCW 10 PW 3	-36	-0.25	RCW 7 PW 2	-1.44	RCW 17 PW 5	-57
	Direct			**Indirect**					
Private Impacts	**Acre Impact**	**Net Acres**	**AAHU**	**Acre Impact**	**Net Acre**	**AAHU**	**Total Net Acres**	**Total Net AAHU**	**Total Impact Acres**
Fresh/ Intermediate Marsh	-45.5	-11	14	0	0	0	-11	14	-46
Pine Savanna/ flatwood	-171	-145	PS RCW 0 RCW 0 PW 43	-201	0 -3	PS RCW 0 PS PW 11 RCW 0 PW 2	-148	PS RCW 0 RCW 0 PS PW 11 PW 45	-373
Riparian Habitat	-35	-35	22.9	0	0	0	-35	0	-35
Stream Habitat	-3	-3	na	na	na	na	-3	na	-3

*Notes:

-PS = protected side impacts

-Net acres are the difference between FWP (year 50 with the project) and FWOP (year 50 without the project) or FWP-FWOP at the end of the project life. AAHUs represent changes in habitat quality and/or quantity which are annualized over the 50-year period of analysis.

-Direct impacts on current refuge land require a land exchange prior to construction. The NFS would then own the direct project impact areas and would be required to mitigate habitat impacts in those areas as off refuge impacts. See section 5.2.

Consultation and coordination with resource agencies is on-going and would be concluded prior to the approval of the Record of Decision.

Timeline: This RDIFR-EIS is available for a 45-day public review and comment beginning 21 July 2023. The official closing date for comments is 45 days from the date on which the Notice of Availability appears in the Federal Register. Comments should be mailed or emailed to:

U.S. Army Corps of Engineers
Attention: Ch, Environmental Branch
CEMVN–PDS, Room 331,
7400 Leake Avenue New Orleans, LA 70118
Email: sttammanyfs@usace.army.mil

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Section 1
Introduction

The United States Army Corps of Engineers (USACE), Mississippi Valley Division (MVD), New Orleans District (CEMVN), Regional Planning and Environment Division South (RPEDS), prepared this revised draft Integrated Feasibility Report and Environmental Impact Statement (RDIFR-EIS) (collectively, the “report”) for the St. Tammany Parish, Louisiana Feasibility Study. This RDIFR-EIS documents the analysis conducted by CEMVN to identify and evaluate Flood Risk Management (FRM) and Coastal Risk Management (CSRM) solutions to flooding in St. Tammany Parish, Louisiana. CEMVN undertook this study and analyses to confirm a Federal interest in the project, identify and evaluate an array of alternative plans, and make a recommendation for action or inaction. This RDIFR-EIS includes input from the Non-Federal Sponsor (NFS), agencies, and the public. The NFS is the State of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB). The RDIFR-EIS also documents the plan formulation process and recommends an Optimized Tentatively Selected Plan (TSP) for implementation. The selection of the TSP as described herein, is based on consideration of the associated economic benefits, environmental outputs, environmental and social impacts, costs, and residual risk. A Draft TSP was released for concurrent public, agency technical review, and policy review in June 2021. Subsequent to receipt of the comments on the Draft TSP, additional engineering design and analysis was conducted, and the Draft TSP was refined and optimized (Optimized TSP). The Optimized TSP is considered “tentatively selected” unless and until a Recommended Plan in the FIFR-EIS is approved by Headquarters USACE (HQUSACE). Plan approval follows several USACE internal peer, external peer, legal, policy, state, other federal agency, and public review processes.

1.1 STUDY SCOPE

The study is authorized to investigate both FRM and CSRM problems and solutions. CEMVN considered past, current, and future management and flood resilience studies and projects by USACE, and other Federal, state, and local agencies and identified and evaluated a full range of reasonable alternatives, including the No Action Alternative, to reduce flood damages from rainfall and storm surge events in St. Tammany Parish. Both structural and nonstructural measures were considered in the study process. The CEMVN performed these overarching efforts:

- Assess the study area’s problems, opportunities, and future without project condition (FWOP) for a 50-year time period called the period of analysis. The period of analysis for this study is 2032-2082, which is the time period used to consider the benefits and impacts of an action. The time it takes to conduct the study and implement the plan is not part of the period of analysis. For this study, it was assumed that the study and design and initial construction activities would not be completed until 2032.

- Evaluate the feasibility of implementing site-specific solutions, including structural, nonstructural, and natural and nature-based measures, or possibly a combination thereof.

The RDIFR-EIS was prepared in accordance with the USACE Planning Guidance Notebook (1105-2-100); Engineering Regulation (ER) 1105-2-101 "Risk Assessment for Flood Risk Management Studies" dated 15 July 2019; NEPA and Council on Environmental Quality (CEQ) and Corps NEPA regulations, and all other applicable laws, regulations, and policies. CEMVN uses a standard format for the Integrated Feasibility Report and EIS to be consistent with the CEQ NEPA regulations. In the table of contents, the specific sections for the following bulleted list are located:

- the purpose and need for the proposed action (Section 2);
- the affected environment and relevant resources in the study area where the proposed action would occur (Section 5);
- alternatives and the proposed action (Section 4 and Section 6);
- environmental consequences of implementing an alternative (Section 5);
- public involvement including scoping, establishing cooperating agencies and public review and input during preparation of the RDIFR-EIS (Section 9).

The study followed the specific, measurable, attainable, risk-informed, timely (SMART) planning process. The outcome of the planning process, as performed up to the date of the RDIFR-EIS, is the identification of the NED plan, and designation of the TSP.

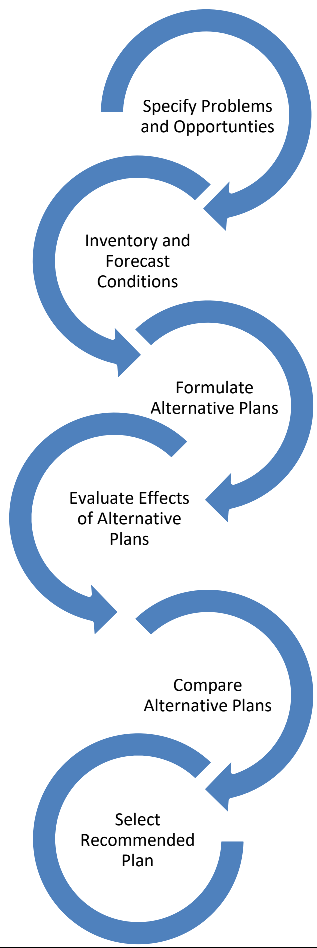

Figure 1-1. Six Step USACE Planning Process adapted from ER 1105-2-100

The study was conducted by a multi-disciplinary PDT comprised of professionals with expertise to identify the water resource problems, develop alternatives to address the problems, and recommend a plan that addresses the need to reduce flooding in St. Tammany Parish. The NFS and cooperating agencies were an integral part of the PDT. Throughout the feasibility process, the PDT also coordinated with, and integrated input from, the USACE vertical team, which includes MVD, or the Major Subordinate Command (MSC), and USACE Headquarters (HQUSACE). The PDT followed ER 1105-2-100, which describes the USACE planning process (Figure 1-1) and is also detailed in Appendix B: Plan Formulation.

1.2 STUDY AUTHORITY

This study is authorized by Subtitle B, Section 1201 (14) of the Water Resources Development Act (WRDA) of 2016, as included in the Water Infrastructure Improvements for the Nation Act (P.L. 114-322). The study is authorized in accordance with the annual reports submitted to the Congress in 2015 and 2016, pursuant to Section 7001 of the Water Resources Reform and Development Act (WRDDA) of 2014 (33 U.S.C. 2282d). The study is funded by the Bipartisan Budget Act (BBA) of 2018 (P.L. 115-123), Division B, Subdivision 1, Title IV, which appropriated supplemental funds in the Supplemental Investigations Funds for Long Term Disaster Recovery Investment Plans (LDRIPs) related to the completion, or initiation and completion, of authorized flood and storm damage risk reduction studies, including shore protection. See also 14 February 2017 MEMORANDUM FOR DISTRIBUTION; SUBJECT: Implementation Guidance for Sections 1201 and 1207 of the WRDA of 2016. The study is authorized for inclusion as a BBA 2018 study in September 2019. The 5 September 2019 Memorandum for the Deputy Commanding General for Civil and Emergency Operations; Subject: Supplemental Appropriations BBA of 2018 - LDRIP - Investigations Account. This Memorandum reflects the determination of the Office of the Deputy Commanding General for Civil and Emergency Operations, that the feasibility study for St. Tammany Parish, Louisiana, should be included as a BBA 2018 funded study in the Investigations Account LDRIP.

Notwithstanding Section 105(a) of the WRDA of 1986 (33 U.S.C. 22 I 5(a)), which specifies the cost-sharing requirements generally applicable to feasibility studies, BBA 2018 authorizes the Government to conduct the study at full Federal expense, to the extent that appropriations provided under the Investigations heading of the BBA 2018 are available and used for such purpose. The Policy Guidance Memorandum on Implementation of Supplemental Appropriations of the BBA of 2018 dated 9 August 2018, states that a new FCSA or an amendment to the existing FCSA is required to address use of Supplemental Investigations funds at 100 percent Federal expense. Further, HQUSACE is authorized to develop and approve FCSAs, and amendments to existing FCSAs, for studies in the LDRIP and to delegate to the Division Commander authority to approve use of such FCSAs and amendments. In addition, authority to execute a FCSA or amendment, once approved, may be delegated to the District Commander. HQUSACE developed and approved a model FCSA as set forth in the MEMORANDUM FOR DISTRIBUTION, SUBJECT: Bipartisan Budget Act of 2018 (BBA 2018) - Model Agreement for New Feasibility Studies dated 10 August 2018.

On 26 November 2019, the CEMVN submitted the (model) FCSA package (with no deviations) for review and approval to the MVD Commander, together with a request that the signature authority for the FCSA be delegated to the CEMVN Commander. Pursuant to the MEMORANDUM FOR Commander, New Orleans District, SUBJECT: Request for Review and Approval to Execute the Model FCSA between the Department of the Army and the State of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana for the St. Tammany Parish, Louisiana Feasibility Study, dated 6 January 2020, the MVD Commander approved the draft FCSA and directed the CEMVN to proceed as scheduled with processing the FCSA. The FCSA was fully executed by all parties on 14 January 2020.

Generally, feasibility studies funded by BBA 2018 are conducted for not more than $3 million and are completed within 36 months, consistent with Section 1001 of WRRDA 2014. If a cost exemption is approved for a study, those additional costs may be funded from remaining supplemental investigations funds. However, if available remaining supplemental investigations funds are exhausted, then the additional costs are cost shared and the Federal portion of those remaining costs compete for funding from annual investigations funding. If additional cost sharing is required, the FCSA is amended.

An exemption to the Section 1001 of WRRDA 2014, requirements was approved by the Assistant Secretary of the Army for Civil Works ASA(CW) in April 2022 in order to complete the complex feasibility study and to further reduce risk and address policy and legal, public, ATR, and IEPR comments received. An additional $1.77M and 16 months was allocated to complete critical tasks to inform the decision on the Recommended Plan. As part of the Exemption approval, the study was designated as a Mega Study and is required to follow the requirements in the Interim Guidance for Civil Works Mega Studies dated 15 October 2021.

Except as otherwise noted, studies funded by BBA 2018 are undertaken in accordance with existing civil works policies and guidance and incorporate Specific Measurable Attainable Risk-Informed Timely (SMART) planning principles. This study has been undertaken in accordance with Sections 1001 and 1002 of WRRDA 2014, applicable existing USACE civil works regulations, policies, and guidance, and has incorporated SMART planning principles. See MEMORANDUM FOR COMMANDING GENERAL, U.S. ARMY CORPS OF ENGINEERS, SUBJECT: Revised Implementation Guidance for Section 1001 of the Water Resources Reform and Development Act of 2014, Vertical Integration and Acceleration of Studies as amended by Section 1330(b) of the WRDA of 2018, dated 25 March 2019.

1.3 NON-FEDERAL SPONSOR

CPRAB is the NFS pursuant to the FCSA executed on 14 January 2020.

1.4 STUDY AREA

The study area encompasses all of St. Tammany Parish, which is approximately 1,124 square miles and located in southeastern Louisiana (see Figure 1-2). St. Tammany Parish is located on the northeast shore of Lake Pontchartrain and is home to over approximately 258,110 residents and 2,500 businesses. The hydrology is complex, and communities experience repeated damages from flood events, including, but not limited to, coastal rainfall, high tide, wave action and storm surge from coastal storms, and riverine flooding from localized rainfall events. The term “study area” and “St. Tammany Parish” are used interchangeably throughout this document.

The State of Mississippi, with the Pearl River, creates the eastern boundary. Lake Pontchartrain serves as the southern boundary. Tangipahoa Parish is located along the western boundary and Washington Parish is located along the northern boundary. The study area includes 36 hydrologic sub-basins, as defined by the United States Geological Survey (USGS) 12- digit hydrologic unit delineations (WBDHUC12).

Most of the population resides along the northern edge of Lake Pontchartrain, and many residents commute into New Orleans from Mandeville, Slidell, Covington, Abita Springs, Pearl River, and Madisonville. St. Tammany Parish is the fastest-growing parish in Louisiana and is one of the fastest-growing areas in the nation. Major industries include health care and social assistance, retail trade, professional, scientific, and technical services, construction, finance, and insurance.

The Big Branch Marsh National Wildlife Refuge (BBMNWR), the Bogue Chitto National Wildlife Refuge, and the St. Tammany Wildlife Refuge are located within St. Tammany Parish. The Fontainebleau State Park is also located within the parish.

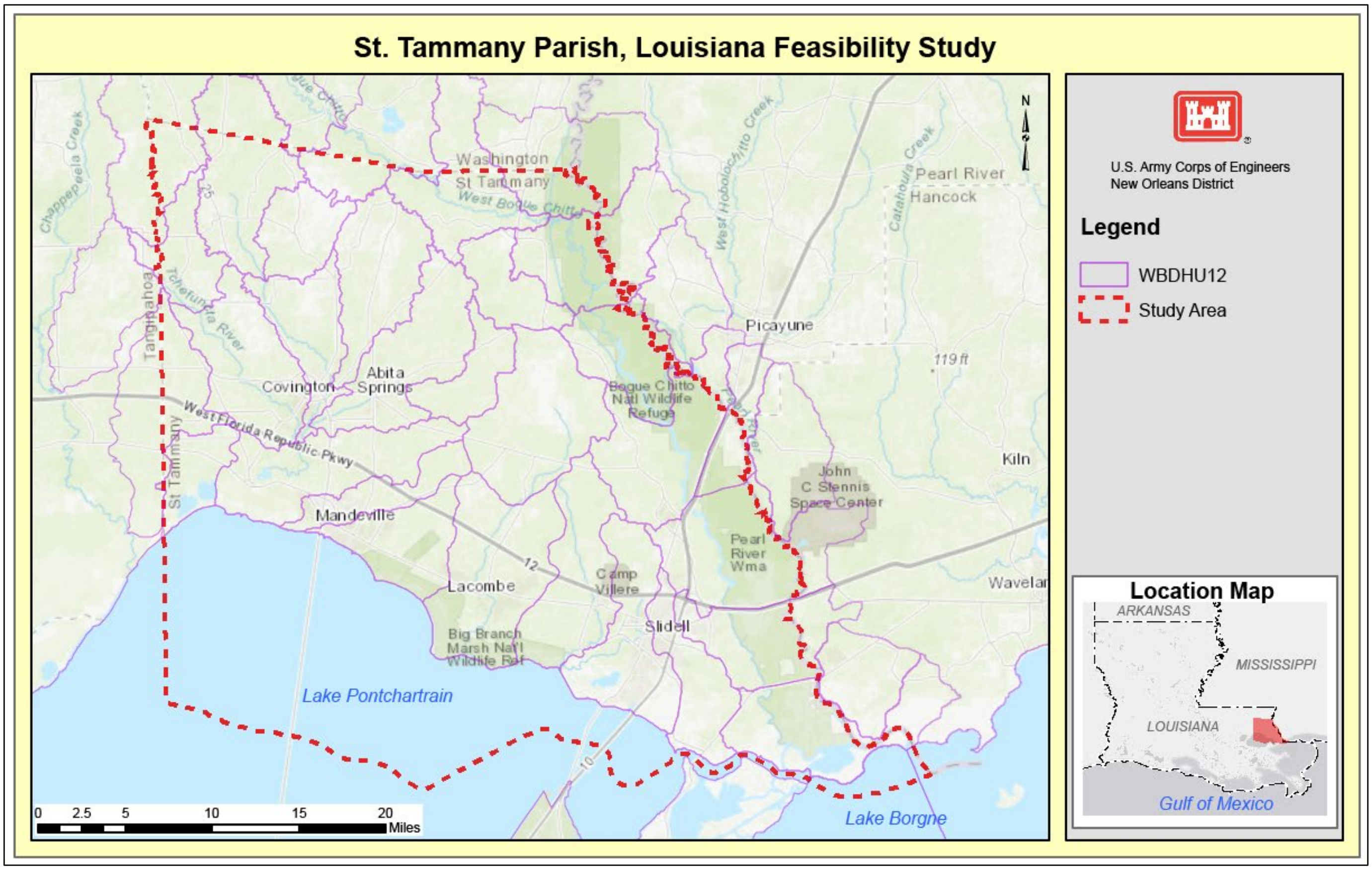

Figure 1-2. Study Area

Note: The U.S. Geological Survey Watershed Boundary Dataset (WBDHU12) was used to delineate the hydrologic sub basins with study area.

1.5 PROJECT AREA

Within the 36 sub-basins, 18 sub-basins have documented flooding, whether from coastal or riverine flooding and repetitive flood loss damages. These 18 sub-basins comprise the project area and are listed and bolded in Table 1-1 and shown on Figure 1-3. The project area was examined to determine measures and alternatives that would address the needs of the area and provide opportunities to reduce risk from flooding.

Table 1-1. Hydrologic Subbasins

Sub-Basin		Type of Flooding
1	**Bayou Vincent-Bayou Bonfouca**	**Coastal (storm surge)/Rainfall**
2	**Ponchitolawa Creek-Tchefuncte River**	**Coastal (storm surge)/Rainfall (headwater Flooding)**
3	West Pearl River-Pearl River	Rainfall (headwater and backwater)
4	Talisheek Creek	Rainfall
5	**Savannah Branch-Tchefuncte River**	**Rainfall**
6	**Talleys Creek-Bogue Chitto**	**Rainfall**
7	Upper Bogue Falaya River	Rainfall (headwater and backwater)
8	**Bayou Castine-Cane Bayou**	**Coastal/Rainfall (headwater flooding)**
9	Washley Creek	Rainfall
10	**Soap and Tallow Branch-Tchefuncte River**	**Coastal/Rainfall (headwater flooding)**
12	English Branch	Rainfall
13	**Pearlington-Pearl River**	**Costal/Rainfall**
15	Warner Creek-Bogue Chitto	Rainfall
16	Lacombe Bayou	Rainfall (headwater flooding)
17	**Middle River-Pearl River**	**Costal/Rainfall**
18	**Big Branch Bayou-Lacombe Bayou**	**Costal (storm surge)/Rainfall**
19	Simalusa Creek	Rainfall
20	Bull Branch-Tchefuncte River	Rainfall
21	Pearl River Canal-Pearl River	Rainfall
22	**Black River**	**Costal/Rainfall**
23	**Salt Bayou**	**Costal/Rainfall**
24	**Abita River**	**Rainfall (Headwater Flooding)**
25	**Rigolets-Pearl River**	**Costal/Rainfall**
26	**Old Channel-Pearl River**	**Rainfall**
27	Bedico Creek	Rainfall
28	Berrys Creek-Bogue Chitto	Rainfall
30	**Bayou Chinchuba**	**Costal/Rainfall (headwater flooding)**
31	**Lower Bogue Falaya River**	**Costal/Rainfall**
32	Second Alligator Branch-Pearl River	Rainfall
34	Wilson Slough-Pearl River	Rainfall
35	**Liberty Bayou-Bayou Bonfouca**	**Costal/Rainfall, (headwater and backwater flooding)**
36	**Little Bogue Falaya River**	**Rainfall**

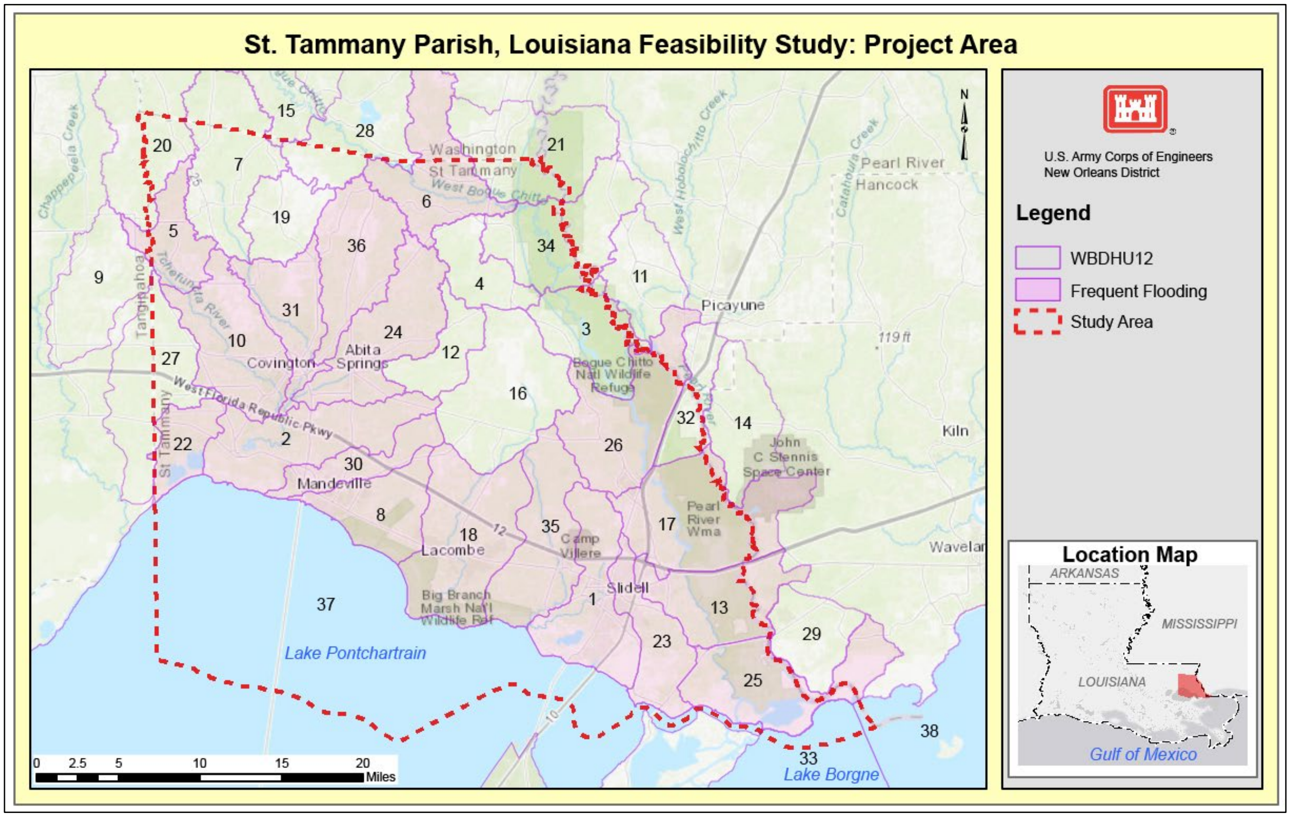

Figure 1-3. Project Area

Note: The U.S. Geological Survey Watershed Boundary Dataset (WBDHU12) (November 2019) is included to delineate the hydrologic sub basins. The highlighted WBDHU 12 sub-basins are documented areas of frequent flooding and repetitive loss.

1.6 PRIOR REPORTS, EXISTING WATER PROJECTS, AND ONGOING PROGRAMS

A number of studies and reports on water resources development have been prepared by USACE, and other Federal, state, parish, and local agencies. Existing information and data collected during the plan formulation process was used in the development of problems, opportunities, management measures, and alternatives for the study.

1.6.1 Prior Reports and Existing Water Resource Development Projects

Information from existing documents listed in Table 1-2 were considered the most significant to identifying problems and formulating plans. Listed in Table 1-2 below, is the title of the document, date, and how the information was utilized in the study, including whether the information was used as a source of data for analysis, modeling, establishing future without project (FWOP) conditions, or included recommendations to inform the development of management measures in the study area. Existing studies and reports were reviewed to ensure consistency between the plan formulation under this study and other existing plans and reports for the area.

Table1-2. Relevant Prior Reports and Studies

Year	Study/Report/Environmental Document Title	Data Source	Consistency	Structural Measures	Nonstructural Measures	FWOP Conditions
1958	USACE Tchefuncte River & Bogue Falaya Operations and Maintenance	×				
1986	USACE Pearl River Basin Interim Report on Flood Control	×		×		
1990	USACE Schneider Canal, Slidell, LA Hurricane Protection Reconnaissance Report	×	×	×		
1991	USACE Tangipahoa, Tchefuncte and Tickfaw Rivers Reconnaissance Report			×		
1992	St. Tammany Local Coastal Program	×				
1994	City of Slidell Master Drainage Plan		×			
1996	USACE Southeast Louisiana Flood Control Project (SELA) Includes 7 projects in St. Tammany: Schneider Canal Hurricane Levee; Mandeville Hurricane Protection; Lacombe Area Plan; Mile Branch Plan; Bayou Chinchuba Plan; and Slidell Area Plan (W-13, W-14, and W-15 Canals)		×	×	×	
1996	St. Tammany Parish, Louisiana Reconnaissance Study			×	×	
1996	USACE Southeast Louisiana Project St. Tammany Parish Technical Report	×	×	×		
1998	Coast 2050 Region 1 Strategy		×			
2003	St. Tammany Bayou Liberty Watershed Management Plan	×		×		
2004	St. Tammany Bayou Lacombe Watershed Management Plan	×				
2004	St. Tammany Bayou Tete L'Ours Watershed Management Plan	×				
2006	Comprehensive Habitat Management Plan for the Lake Pontchartrain Basin	×				
2006	St. Tammany Bayou Chinchuba Watershed Management Plan *	×				
2006	Bayou Liberty St. Tammany Parish LA	×				
2007	Louisiana Speaks Regional Plan LA		×			
2007	St. Tammany Parish Tchefuncte and Bogue Falaya Study	×				
2008	St. Tammany Analysis and Recommendations for Drainage Improvements	×				
2009	USACE Louisiana Coastal Protection and Restoration (LACPR) Final Technical Report			×		
2009	Update Natural Hazards Mitigation Plan St. Tammany Parish	×				
2010	St. Tammany Parish Hydrologic and Hydraulic Analysis of Bayou Lacombe Drainage Basin	×				
2011	Lake Pontchartrain Basin Foundation Northshore: Recommendations for Restoration and Conservation Report				×	

Year	Study/Report/Environmental Document Title	Data Source	Consistency	Structural Measures	Nonstructural Measures	FWOP Conditions
2012	Northshore Hurricane/Food Protection/Restoration Plan by G.E.C. Inc for St. Tammany and Tangipahoa Parish, CPRA Sponsor (PO-0074)	×	×	×	×	×
2012	Draft Southeast Louisiana Urban Flood Control Project W-14 Canal Improvements Section 533(D) Report Vol. 1 Vol. 2 Appendices	×	×			
2013	French Branch (W-15) and Doubloon Bayou Drainage Study for St. Tammany Parish	×		×		
2014	CPRA-St. Tammany Parish Watershed Management Study (PO-0151)	×		×	×	×
2015	Drainage Study and Cost Benefit Analysis for the Little Bayou Castine Drainage Project	×				
2015	City of Mandeville Hazard Mitigation Plan		×			
2015	St. Tammany Parish Hazard Mitigation Plan Final		×			
2015	FEMA Little Bayou Castine Drainage Improvements Study St. Tammany Parish	×				
2016	Flood Loss Outreach & Awareness Taskforce (FLOAT) Lake Pontchartrain, Louisiana Area Floodplain and Stormwater Management Program	×				
2016	Reducing Coastal Risk with a Lake Pontchartrain Surge Barrier	×		×		×
2016	USGS FEMA Characterization of Peak Streamflows and Flood Inundation of Selected Areas in Louisiana, Texas, Arkansas, and Mississippi from Flood of March 2016	×				×
2016	St. Tammany Parish Coastal Master Plan	×	×	×	×	×
2017	CPRA- Louisiana's Comprehensive Master Plan for a Sustainable Coast	×	×	×	×	×
2017	1077/1085 Regional Drainage Report St. Tammany Parish	×		×		×
2017	St. Tammany Parish Stormwater Management Plan (SWMP)			×		
2018	City of Covington Flood Response Plan		×			×
2018	Integrated Draft Feasibility and Environmental Impact Statement Pearl River Basin, Mississippi; Hinds and Rankin Counties, MS	×	×			
2019	St. Tammany Parish Watershed Management: Water Quality Impact Modeling Program	×				
2019	St. Tammany Parish Code of Ordinances		×			
2019	Coastal Wetlands Planning, Protection and Restoration Act	×			×	×
2020	St. Tammany Parish Coastal Protection (PO-167)	×	×	×	×	×
2020	St. Tammany Parish Multi-Jurisdictional Hazard Mitigation Plan Update 2020	×	×			
2023	CPRA- Louisiana's Comprehensive Master Plan for a Sustainable Coast	×	×	×	×	×

1.6.2 Existing Structural Flood Risk Reduction Features

The structural flood risk reduction features that are considered in the FWOP conditions are listed below and illustrated in Figure 1-4. All levees in Slidell are identified as existing Slidell levees. (Note: The only levee that is currently accredited by Federal Emergency Management Agency (FEMA) is the Lakeshore Levee, Slidell, Louisiana.) An accredited levee system is a system that FEMA has determined to meet the design, data, and documentation requirements of 44 CFR 65.10; it therefore can be shown on a Flood Insurance Rate Map as reducing the base flood hazard.

- Seawall, Mandeville, Louisiana
- Oak Harbor Levee, Slidell, Louisiana
- Kings Point East Levee, Slidell, Louisiana
- Kings Point West Levee, Slidell, Louisiana
- Lakeshore Levee Slidell, Louisiana (federally certified levee)

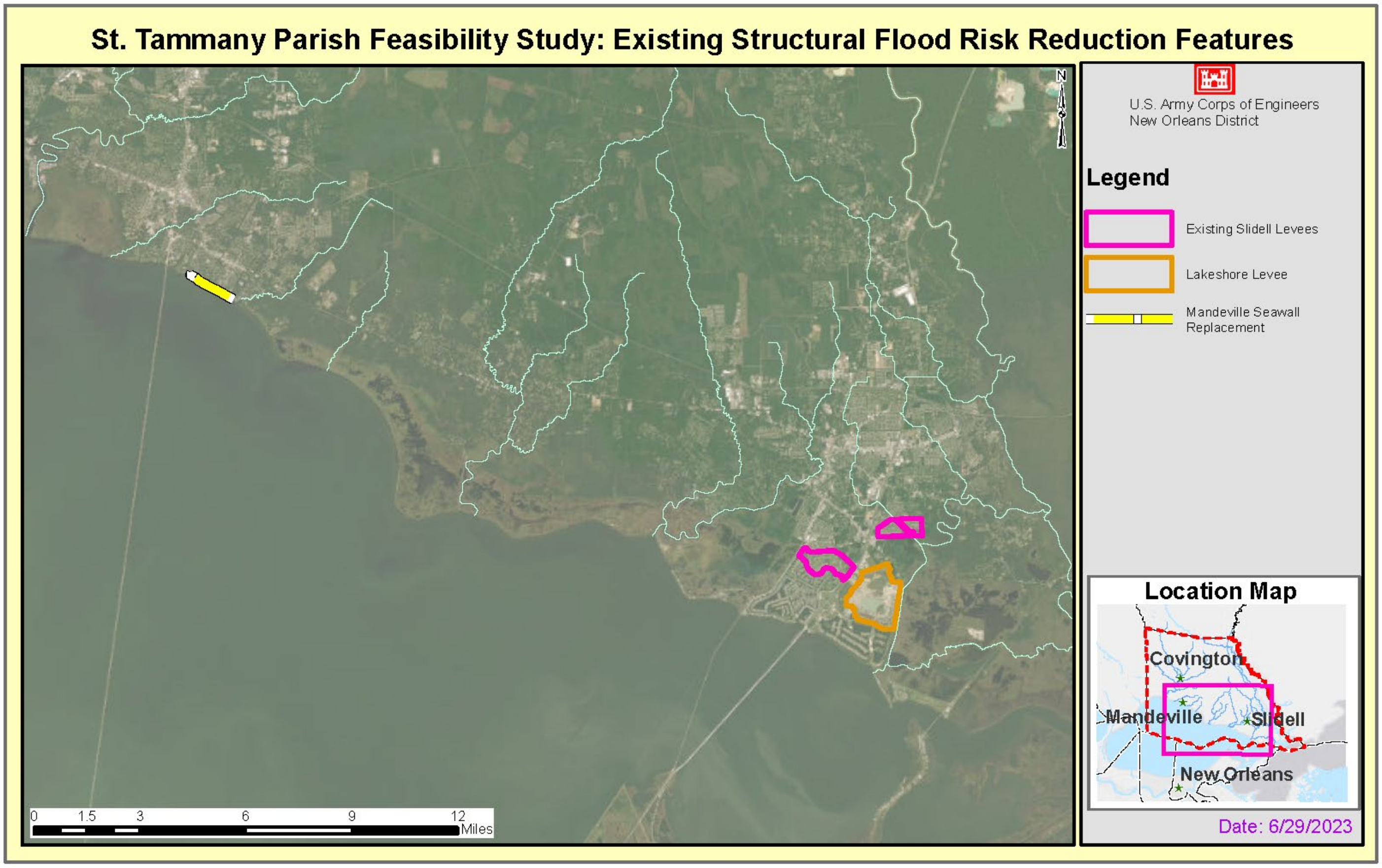

Figure 1-4. St. Tammany Parish Existing Structural Features

The STPG has identified the following projects as ones that have the potential to further reduce flood risk in the study area:

- River Glen Drainage-in progress
- Abita River Regional Detention Pond
- Riverwood and Country Club Estates Drainage Improvements-completed
- Magnolia Drive Drainage
- Orleans Avenue Drainage
- Trinity Lane Drainage
- Lamarque St Drainage
- Little Bayou Castine Drainage Improvements
- Labarre St. Detention Pond and Channel Improvements-completed
- Chevreuil St Drainage
- Frenchmen Dr. & Lafitte Ct Drainage Improvements
- N. Pontchartrain Dr. Drainage
- Erindale Drainage
- Cypress Park Drainage Improvements-completed
- Ozone Woods Drainage Improvements-ongoing
- Oak Manor Drainage Feasibility-ongoing
- Ben Thomas Road Detention Pond
- Ben Thomas Rd. Subsurface & Sidewalk
- Robert Road Detention Pond Expansion
- Forest Brook and Quail Creek storage facilities and channel Improvements-completed
- Whisperwood pond excavation- complete
- Alton Drainage Improvement
- Graci Drive and Brier Lakes Culvert Improvements-completed
- Northwood Village, Whisperwood & Eddins Canal
- Lake Village Drainage-completed
- Lower W-15 Area Detention Pond-complete
- Lower W-15 Widening
- Bayou Bonfouca Marsh Creation (PO-0104)-completed
- Goose Point/Point Platte Marsh Creation (PO-0033)-completed
- PO-51 Mandeville Aquatic Ecosystem Restoration-complete
- Tchefuncte Marsh Acquisition- Complete
- Guste Island Aquatic Ecosystem Restoration-complete
- PO-87, Madisonville Bulkhead
- West Pearl River Vegetative Plantings-complete
- Clearing and Snagging of the W-14 Canal from I-12 to Fremaux
- Canal Improvements from the downstream side of Fremaux to the upstream side of the Daney Street Bridge
- Improvements to the existing canal from the downstream side of the Daney Street Bridge to the upstream side of the I-10 Bridge.
- West Diversion Pond located on the west side of U.S. Route 11 near North Boulevard
- Louisiana Watershed Initiative project - city of Covington and Avery Estates Buyout Program

It should be noted that not all of the above-listed local drainage projects are sizable enough to be captured in the engineering hydrology and hydraulic (H&H) modeling conducted for the study. Additional information regarding what was included in the H&H modeling is located in Appendix E: Hydrologic & Hydraulics.

1.6.3 Ongoing Programs and Projects

Major ongoing programs and/or projects are described below.

Louisiana Watershed Initiative (LWI): Floodplain issues in Louisiana have historically been managed within political jurisdictions, often without the mechanisms to consider the effects on other jurisdictions or the surrounding watershed. Furthermore, agencies often operate with numerous mandates and responsibilities related to floodplain management that are outlined in codes, statutes or Federal laws. In 2018, Executive Order JBE18-16 was issued in Louisiana, creating 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 (LaDOTD), and the LDWF.

The State of Louisiana is developing the statewide Louisiana Watershed Initiative to address FRM with a coordinated, coherent and long-term vision for sustainability and resilience. The Louisiana Watershed Initiative is developing computer models to better understand flood risk and help with the selection of projects best suited for investment in each watershed region as well as ongoing efforts to address compound flooding (surge and rain). The USACE has been engaged in the ongoing efforts to address compound flooding.

(https://www.watershed.la.gov/)

The CEMVN and Vicksburg Districts have been in coordination with the State of Louisiana Council on Watershed Management and entered into a Memorandum of Understanding between USACE and the State of Louisiana, Council on Watershed Management on 3 December 2020, to allow for USACE collaboration and technical assistance as part of the local, state, and Federal agency and stakeholder effort to create a Comprehensive Statewide Watershed-Based Floodplain Management Plan. Additionally, the PDT coordinated with the Louisiana Watershed Initiative (LWI) through the NFS to ensure coordination regarding the Watershed Initiative activities in St. Tammany Parish. To date, there have been no products developed from the initiative that could be incorporated into this study, but the PDT will continue coordination efforts as the study and the LWI progress. If new data becomes timely available, it would be incorporated into the FIFR-EIS. On 23 March 2021, Governor Edwards announced that $10 million in Community Development Block Grant Mitigation funding from the LWI would be allocated toward nonstructural projects in St. Tammany Parish. The PDT is in coordination with the NFS regarding allocation and implementation of these nonstructural projects and how this work supplements the efforts of this study.

USACE Southeast Louisiana Urban Flood Control Project (SELA): As a result of the extensive flooding in May 1995, Congress authorized SELA with enactment of Section 108 of the Energy and Water Development Appropriations Act for Fiscal Year 1996 (EWDAA 1996) and Section 533 of the Water Resources Development Act of 1996 (WRDA 1996), as amended, to provide for flood control and improvements to rainfall drainage systems in Jefferson, Orleans, and St. Tammany Parishes, Louisiana. Seven projects were authorized under the SELA program in St. Tammany Parish in 1996, pending a study (known as a 533d report) to confirm they are technically sound, environmentally acceptable, and economically justifiable (BCR greater than 1.0). Those projects include Schneider Canal Hurricane Protection; Mandeville Hurricane Protection; Lacombe Area Plan; Abita Area Plan; Mile Branch Plan; Bayou Chinchuba Plan; and Slidell Area Plan (W-13, W-14, and W-15 Canals). Figure 1-5 shows the seven SELA authorized projects within St. Tammany Parish.

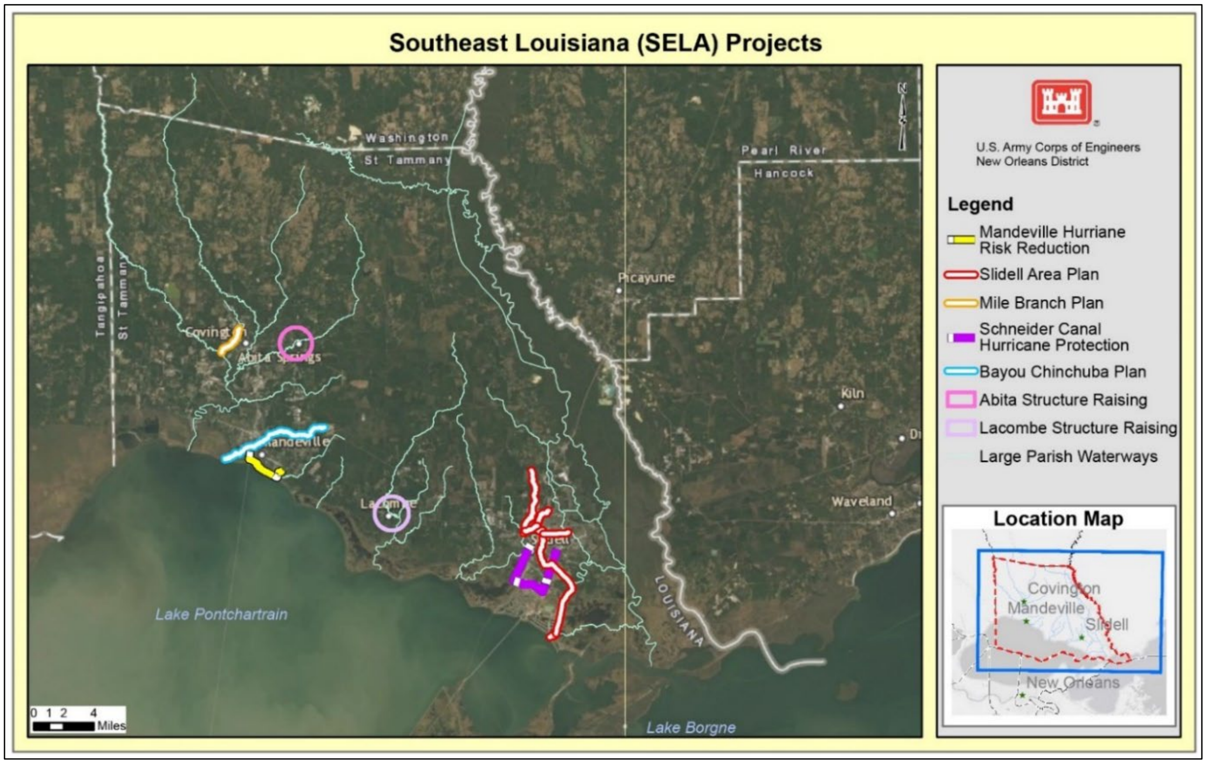

Figure 1-5- SELA Projects Map

Of the seven potentially authorized SELA Projects in St. Tammany Parish, only the W-14 SELA Project in Slidell has an approved 533(d) report from March 2012 with a recommended plan that has been found to be technically sound, environmentally acceptable, and economically justifiable. Because the W-14 project has an approved 533d report, it was excluded from plan formulation under this study. Analysis of the other six projects were included as part of plan formulation and included as potential measures and alternatives because the original SELA projects were over 30 years old, and it was expected that conditions in the study area might have changed.

After this study was underway, efforts to develop a 533d report for the SELA Schneider Canal hurricane protection project were initiated but is currently without funding to proceed. There is significant overlap in the larger St. Tammany study area with the smaller SELA Schneider Canal study area. This study evaluated a comprehensive plan for the parish, whereas, the SELA Schneider Canal 533d study is much more limited in scope and study area. If funding is received, the SELA Schneider Canal study PDT would evaluate the recommended alignment included in the Schneider Canal Hurricane Protection Reconnaissance Report dated May 1990. Coordination between the two study PDTs, Office of Counsel, and leadership would continue to determine the linkages between the two studies if the SELA Schneider Canal 533d study moves forward.

Coastal Protection and Restoration Authority: Following Hurricanes Katrina and Rita in 2005, the Louisiana legislature created the Coastal Protection and Restoration Authority (CPRA) and tasked it with coordinating the local, state, and Federal efforts to achieve comprehensive coastal protection and restoration. To accomplish these goals, CPRA was charged with developing a coastal master plan. http://coastal.la.gov/ Louisiana's Comprehensive Master Plan for a Sustainable Coast (Master Plan), updated in 2023. The 2023 Master Plan sets forth a path to create a more sustainable coastal Louisiana landscape. The Master Plan includes protection and restoration goals for reducing coastal flood risk, promoting sustainable ecosystems by providing habitats for a variety of commercial and recreational activities, and support for regional and national business and industry. The 2023 Master Plan recommends a diversity of projects to build land and reduce flood risk to balance short-term needs with long-term goals. The PDT has been in contact with the CPRA Master Plan team to better ensure coordination and consistency between this study and the 2023 Master Plan.

Structural and nonstructural projects contained in the 2023 Master Plan that are in the study area and were included in the development of management measures and alternatives are:

- Lake Pontchartrain barrier (Project No. 001. HP.08)
    - Construction of closure gates and weirs to an elevation of 2 feet North American Vertical Datum of 1988 (NAVD 88) across the passes at Chef Menteur and the Rigolets for storm surge risk reduction within the Lake Pontchartrain Basin.
- Slidell ring levees (Project No. 001. HP.13)
    - Construction and improvement of a levee to an elevation between 13 to 17 feet NAVD88 around the city of Slidell. Project features approximately 76,000 feet of earthen levee, approximately 11,000 feet of T-wall, a 30-foot barge gate, a 180-foot barge gate, a 220-foot barge gate, a 20-foot stop log gate, and a 30-foot stop log gate.
- St. Tammany nonstructural risk reduction (Project No. STT.01N)
    - Project includes flood proofing 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.

- Tchefuncte River Reduction Restoration (ID# 318)
    - Restoration of approximately 3,600 feet of historic ridge at the mouth of the Tchefuncte River to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.

- Fritchie Marsh Restoration (ID# 249)
    - Creation of marsh within a footprint of approximately 4,400 acres in St. Tammany Parish along the eastern Lake Pontchartrain shoreline to create new wetland habitat, restore degraded marsh, and reduce wave erosion.

The PDT is also coordinating with other governmental entities on flood risk reduction studies in the Parish. (See e.g., Table 1-2, PO-167 St. Tammany Parish Coastal Protection).

1.6.4 ATR/IEPR Comments Received on draft IFR-EIS Release (June 2021)

At the time of the first IFR-EIS release in 2021, there was insufficient information on some environmental resources and a thorough impact assessment utilizing the wetland value assessment model had not yet been conducted. The level of analysis at the time the initial IFR-EIS was released led to the identification of several data gaps during public and agency reviews. Subsequent to the June 2021 release of the IFR-EIS, additional engineering, economic, and environmental investigations were conducted on the individual measures of the Optimized TSP, which is comprised of a structural plan and a nonstructural plan. Information gathered through these additional investigations, together with the consideration of comments received from the public, stakeholders, the USFWS and the NMFS assisted the PDT in further refining the design of the Draft TSP, which developed into the Optimized TSP. Sections 4.5 and 6 of this RDIFR-EIS describe the updates for the Optimized TSP.

Comments received and how they were addressed are listed below:

- 2021 draft IFR-EIS does not analyze the environmental effects of the potential bottomland hardwood (BLH) and marsh, or USACE-constructed compensatory mitigation sites. BASIS OF CONCERN: NEPA; Compensatory mitigation is an integral component of the TSP that would have environmental effects both during construction and in the long term. Since construction of compensatory mitigation is being considered, in compliance with NEPA, the environmental effects should be evaluated and disclosed.
    - _Response:_ Further assessments were conducted and the impacted habitat is fresh/intermediate marsh, pine flatwood/savanna, and riparian habitat comprised of mixed BLH and Pine. Mitigation sites were identified and assessed. Refer to Section 7 and Appendix I: Mitigation Plan for details on the Mitigation Plan.

The 404(b)1 Evaluation was not included in the 2021 draft IFR/EIS. Section 8.7 of draft IFR/EIS states that the 404(b)1 notice would be mailed later for concurrent public/agency review with final IFR-EIS.

- *Response*: A draft 404(b)(1) evaluation has been conducted on the Optimized TSP and will be released at the same time as the public review of this RDIFR-EIS. The evaluation is available in Appendix C: Environmental.

- Inconsistencies with the magnitude of impacts to Environmental Justice communities between Sections 5.13.1.7 and 8.12.
  - *Response:* Additional EJ analysis has been conducted and appropriate sections have been updated. The EJ report is available in Appendix C: Environmental.

- Description of potential mitigation measures to minimize/reduce or compensate for adverse effects to EJ communities resulting from nonstructural solutions is lacking in the 2021 draft IFR-EIS.
  - *Response:* Additional EJ analysis has been conducted and appropriate sections have been updated. The EJ report is available in Appendix C: Environmental.

- Monitoring Costs not included in the 2021 draft IFR-EIS.
  - *Response:* Monitoring costs have been developed and are available in Appendix I: Mitigation Plan.

- The 2021 draft IFR-EIS and appendices are not compliant with the letter and spirit of the National Environmental Policy Act (NEPA).
  - *Response:* The analysis has been updated to include a complete impact assessment on the Optimized TSP including modeling of the impacts and development of a compensatory mitigation plan. Section 5 and 7 include these updates as well as Appendix I: Mitigation Plan.

- The methodology used to evaluate cumulative effects in the draft IFR-EIS is not currently NEPA-compliant considering the recent change in regulatory guidance, the incompleteness of many studies in the documentation, and the significant data gaps.
  - *Response:* The cumulative impact analysis has been updated and is included in Section 5 and Appendix C: Environmental.

- There is no draft mitigation plan in the 2021 draft IFR-EIS. A mitigation plan must be prepared, according to guidance, and included in the draft IFR-EIS for public review.
  - *Response*: A draft mitigation plan has been developed. A summary of the plan is located in Section 7 and the full plan is available in Appendix I: Mitigation Plan.

Section 2

Problems and Opportunities (Purpose and Need)

2.1 SPECIFIC PROBLEMS AND OPPORTUNITIES

Step 1 of the Planning Process: Identifying Problems and Opportunities.

The planning process begins with identifying the problems and opportunities in the study area. It was important for the PDT to understand the flooding issues and what was driving those issues. Once there was an understanding of the problems in the watershed, study objectives were defined describing the potential results that a federal project could achieve and the constraints that could limit achieving potential solutions.

St. Tammany Parish has experienced repeated, widespread flooding (Figure 2-1) from rainfall and riverine bank overtopping, and storm surge, including historic impacts during Hurricane Katrina in August of 2005 and recently with the flood of August 2016. Hurricane Katrina damaged over 48,000 residential structures, causing $1.45 billion in damages (U.S. Department of Housing and Urban Development 2006). The flood of August 2016, in St. Tammany Parish, caused flood damage to approximately 900 businesses and 8,000 employees, together with impacts to transportation along both I-10 and I-12. (Louisiana Economic Development 2016), and caused major disruptions, damages, and economic impacts to the parish.

Figure 2-1. Flooding in St. Tammany Parish
Source: St. Tammany Parish Government

Flood damages from riverine flooding, rainfall, and coastal storm surge are experienced in the study area. FRM seeks to reduce flood risks by managing the floodwaters to reduce the probability of flooding and by managing the floodplains to reduce the consequences of flooding. CSRM would account for different sources of flood damage, including inundation, waves, and erosion.

Table 2-1 provides a summary of the disaster declaration events in St. Tammany Parish (St. Tammany Parish Hazard Mitigation Plan 2020). The flooding disasters were caused by flooding from rainfall and/or coastal storm events. Tropical cyclones (hurricanes) were determined to be the most hazardous type of flooding event to the parish primarily due to storm surge. Flooding also frequently occurs from non-hurricane events, such as flash floods, which can cause heavy rainfall flooding (St. Tammany Parish 2020). Section 3.2.2.1.4 provides information regarding the Federal Emergency Management Agency (FEMA) flood statistics for the study area.

Table 2-1. St. Tammany Parish Flood Events and Major Disaster Declarations (Amended from the 2020 St. Tammany Parish Hazard Mitigation Plan)

Date	Event	Date	Event
Aug-65	Hurricane Betsy	Aug-02	Tropical Storm Bertha
Aug-69	Hurricane Camille	Sep-02	Hurricane Isidore
Apr-73	Severe Storms and Flooding	Oct-02	Hurricane Lili
Apr-77	Drought and Freezing	Sep-04	Hurricane Ivan
Apr-79	Heavy Rainfall	Aug-05	Hurricane Cindy
Apr-80	Heavy Rainfall	Aug-05	Hurricane Katrina
Dec-82	Heavy Rainfall	Sept-05	Hurricane Rita
Jan-83	Heavy Rainfall	Jan-06	Heavy Rainfall
Mar-83	Heavy Rainfall	Oct-07	Heavy Rainfall
Apr-83	Heavy Rainfall	May-08	Heavy Rainfall
Aug-85	Hurricane Danny	Aug-08	Tropical Storm Fay
Nov-85	Hurricane Juan	Sep-08	Hurricane Gustav
Feb-88	Heavy Rainfall	Sep-08	Hurricane Ike
Apr-88	Heavy Rainfall	Apr-09	Heavy Rainfall
Jun-89	Heavy Rainfall	Oct-09	Heavy Rainfall
May-91	Heavy Rainfall	Nov-09	Heavy Rainfall
Aug-92	Hurricane Andrew	Nov-09	Hurricane Ida
Feb-93	Severe Storm, Flood	Dec-09	Heavy Rainfall
Apr-95	Heavy Rainfall	Sept-11	Tropical Storm Lee
May-95	Heavy Rainfall	Aug-12	Hurricane Isaac
Oct-95	Hurricane Opal	Mar-16	Heavy Rainfall
Aug-96	Heavy Rainfall	Oct-17	Hurricane Nate
Oct-96	Coastal Flooding	Aug-19	Hurricane Barry
Jan-98	Heavy Rainfall	May-20	Heavy Rainfall
Mar-98	Heavy Rainfall	Jun - 20	Tropical Storm Cristobal
Sep-98	Tropical Storm Frances	Oct-20	Hurricane Zeta
Sep-98	Hurricane Georges	July-21	Heavy Rainfall
Jun-01	Heavy Rainfall	Sept-21	Hurricane Ida
Jun-01	Tropical Storm Allison		

2.1.1 Problems

The study area has experienced repeated, widespread flooding from both rainfall and coastal storm flood events (i.e., riverine bank overtopping, drainage, and storm surge) including historic flood impacts during Hurricane Katrina (August 2005) and the flood of August 2016. The flood events caused major disruptions, damages, and adverse economic impacts to the parish.

Different locations throughout the study area experienced different flood damages since the sources of flooding vary across the parish and drainage subbasins. Figure 2-2 shows repetitive loss areas, flood zones, and frequently flooded roads and also the areas that experience coastal flooding and/or riverine flooding. The flooding within the study area has been described in prior studies, such as the 2012 Northshore Flood Protection Plan, as excerpted and set forth below.

> *Tropical storms and hurricanes produce coastal and inland flooding. Within five miles of Lake Pontchartrain, flooding occurs as a result of intense rainfall, abnormally high tides in the lake, hurricanes or lesser tropical storms, or any combination of these events. Coastal flooding is produced by storm surges from the lake, with the capacity to produce waves greater than 15 feet that inundate the extensive low-lying coastal area in the parish and the lower portions of the Pearl River floodplain.*
>
> *In the areas not adjacent to the lake, flooding occurs from periodic intense rainfall causing overflow of rivers and streams. Flooding occurs when the drainage system is unable to adequately convey the water produced by rainfall events. Flooding occurs on the floodplains of the streams that comprise the major drainage basins in the parish (Tchefuncte, Bayou Chinchuba, Little Bayou Castine, Bayou Castine, Cane Bayou, Bayou Lacombe, Bayou Bonfouca, W/14/W15 and Gum Bayou Basin). Smaller watersheds flood more quickly. The larger Pearl River watershed responds more slowly to runoff, and the duration of flooding tends to be much longer. Water tends to pond in the flat areas of the parish and to run off slowly, resulting in localized flooding conditions.*
>
> *Natural drainageways have been disrupted in developed areas, and impervious surfaces increase the runoff. All of these conditions are aggravated by channel obstructions. These watershed conditions mean that the parish is faced by longer-lasting overbank flooding from the larger rivers and quick or "flash" stormwater flooding in areas where the runoff overloads the drainage system. The first occurs primarily because of rain falling upstream in the watershed, and the second occurs by rain falling in the affected area. Because overbank flooding takes longer to occur, there may be advance warning time; but there is very little warning of local stormwater flooding.* 2012 Northshore Flood Protection Plan

Additional flood risk information is contained in the 2014 St Tammany Parish Watershed Management Plan.

The problems identified within the study area include:

- Increasing risk to people from catastrophic flooding events;
- Increasing risk of damage to residential and commercial property;
- Critical infrastructure is expected to become more at risk of damage from potential floods; critical infrastructure throughout the study area includes the I-10, I-12, and I-59 transportation system and evacuation routes, Government facilities, hospitals, critical infrastructure, and schools;
- Economic losses from flooding to industrial and commercial structures and businesses;
- Increasing risk to historically significant structures in the study area;
- Development has led to increased flooding;
- Degradation of local channels and banks stability contribute to upstream and downstream flooding;
- Degrading natural flood protection:
    - Diverse ecologically and important habitat within the study area is being lost and degraded due to saltwater intrusion, waves, subsidence, storm surge, and development.
    - Sea level rise and subsidence are expected to increase in the future, causing more frequent storm surge inundation and flood events.

2.1.2 Opportunities

The opportunities identified to address the recognized problems include:

- Public Safety - Decrease risk to public safety during flood events;
- Flood Damages - Reduce the flood risks and damage to public, commercial, and residential property, real estate, and infrastructure;
- Community Resilience - Improve the communities' ability to prepare for, mitigate, and recover from flood events;
- Transportation and Evacuation - Increase the reliability of the national transportation corridors (I-10, I-12, and I-59) by providing alternatives that would potentially lessen damages to roads and interstates; reduce flooding on roadways used as evacuation routes during flood events;
- Natural Resources - Protect the function and increase the resiliency of the ecosystem to reduce flood damages.

2.2 PLANNING GOALS AND OBJECTIVES

Based on the documented problems, the overall goal of the 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 Federal objective of water and related land resources project planning is to contribute to the National Economic Development (NED) in a manner that is consistent with protecting the Nation's environment, and in compliance with environmental laws and regulations, applicable Executive Orders, and other Federal planning requirements. Planning objectives represent desired positive changes to future conditions.

See Appendix B: Plan Formulation for additional information regarding the linkages between the documented problems, opportunities, and identified planning objectives.

Planning Objectives:

- Objective 1: Reduce the risk to public health and safety by reducing flood impacts to structures and critical infrastructure in St. Tammany Parish.
    - Metric(s) to evaluate objective: water surface elevation (WSE), structure impacts, impacts to population.

- Objective 2: Reduce flood damage to structures (i.e. businesses, residential, commercial, and public structures) from flooding in St. Tammany Parish.
    - Metric(s) to evaluate objective: WSE, annualized damages, structure impacts.

- Objective 3: Reduce interruption, to the maximum extent practicable, to the Nation's transportation corridor and evacuation routes e.g. the I-10, I-12, and the I-59 interchange in St. Tammany Parish.
    - Metric(s) to evaluate objective: road inundation.

- Objective 4: Increase community resiliency, the sustained ability of a community to use available resources, before, during, and after significant rainfall and or coastal events.
    - Metric(s) to evaluate objective: reduce or adapt risk to known flooding hazards.

Figure 2-2 shows the areas with repetitive loss from both coastal and riverine sources. The various flood zones are shaded and include the areas with a 0.2 percent change of annual flooding, those in a designated A zone with hazards from erosion and waves >3 feet without a Base Flood Elevation (BFE), those designated to be in an AE zone with a BFE; those designed to be in a floodway and those in a VE zone which has additional hazards from storms and waves >3 feet. For additional information on the elevation of surface water and the flood zones please see www.FEMA.gov.

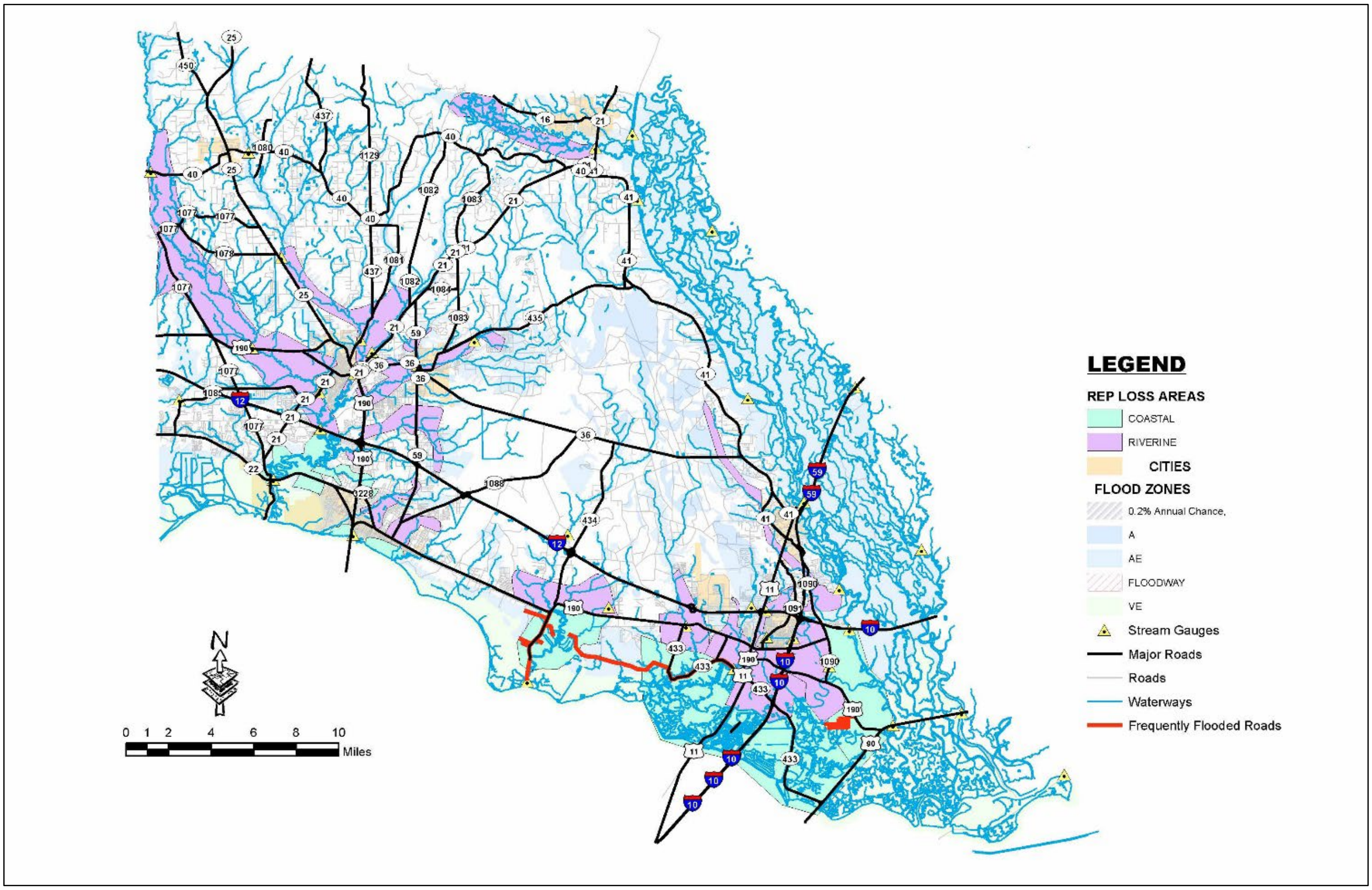

Figure 2-2. St. Tammany Parish- Repetitive Loss Areas, Flood Zones, and Frequently Flooded Roads. (Source STPG 2020)

2.3 PLANNING CONSTRAINTS

A planning constraint is a restriction that limits plan formulation or that formulation must work around. It is a statement of things that the alternative plans should avoid. The planning constraints identified in the study area include the following:

- Proposed projects must meet minimum flow (800 cubic feet per second for a 10 percent chance flood) and drainage area (1.5 square. miles) requirements (ER 1165-2-21).
- Avoid direct or indirect support of floodplain development (in accordance with EO 11988), wherever there is a practicable alternative.
- Avoid locating project features on lands known to have hazardous, toxic, and radioactive waste (HTRW) and/or related concerns.

Additional considerations in the plan formulation process included:

- Avoid and minimize impacts to threatened and endangered species and their critical habitats;
- Avoid and minimize impacts to managed habitats i.e. essential fish habitat (EFH);
- Avoid and minimize impacts to established recreational areas;
- Avoid and minimize impacts to viewshed;
- Avoid and minimize impacts to cultural resources.

2.4 PUBLIC, STAKEHOLDER AND RESOURCE AGENCY INPUT INTO THE PLANNING PROCESS

Early and continued coordination with the public, stakeholders, and other agencies is an essential part of the study development and planning process (process is further described in Section 4). This coordination helps in determining the appropriate level of documentation and analysis necessary, developing and refining the study purpose, goals, objectives, and constraints, the range of alternatives to consider, impacts to resources, possible mitigation measures, and opportunities for environmental enhancement as well as identifying the NEPA and permit requirements of other agencies.

Scoping was conducted in accordance with the CEQ guidelines. The USACE, cooperating agencies and other interested groups were brought together early in the project development process to determine the scope of the issues to address, and identify important issues to consider in the study. By taking advantage of early coordination, conflicts arising later in the study could be avoided and the full input from the various interests are considered. Refer to Section 9 for a summary discussion of the scoping conducted as well as a list of the cooperating and participating agencies. Appendix C: Environmental contains the complete Scoping Report.

The points at which public, stakeholder, and agency input was gained to inform the study process are summarized below and detailed further in Section 9, Public Scoping, Involvement and Agency Coordination.

- During the early phases of project planning, CEMVN held two public information meetings within 90 days after the commencement of the study, which was on 14 January 2020 when the FCSA was signed with the NFS: (1) 11 February 2020, at the Mandeville Community Center, and (2) 12 February 2020, at the Slidell Civic Auditorium.

- Two public NEPA scoping meetings were conducted virtually via Facebook Live due to COVID-19 gathering restrictions on 14 July and 15 July 2020, with live feeds to provide interaction with members of the public. The purpose was to present the alternative plans under consideration and obtain feedback to ensure the proposed alternatives were addressing the study area problems. Both meetings were recorded and shared on the study website, https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/St-Tammany/.

- Public comments were due by 3 August 2020 to be considered in the plan formulation and development. Input received helped to refine the study problems and opportunities, goals, objectives, potential measures, and alternative plans for consideration in the planning process. The Public Scoping Report is contained in Appendix C: Environmental.

- There is ongoing coordination between the CEMVN, NFS and key stakeholders, such as the STPG, the St. Tammany Levee, Drainage, and Conservation District (STLDCD), cities of Slidell, Covington, and Mandeville, towns of Madisonville, Pearl River, Abita Springs, villages of Folsom and Sun, the community of Lacombe, other local municipalities, and the State of Louisiana Congressional Delegation. Quarterly meetings with key stakeholders will continue to ensure that they are informed of the study progress. Select meetings held with key stakeholders during plan development and after the release of the draft IFS-EIS in 2021 are shown in Table 2-2.

Table 2-2. List of Meetings Held with Key Stakeholders

Date of Meeting	Purpose of Meeting
14MAY21	NFS meeting to discuss levee alignment and potential changes during feasibility level design
24MAY21	Stakeholder meeting to discuss investigation into structural protection around the Eden Isle area
26AUG22	Meeting with landowners for West Slidell Levee to discuss
26OCT22	Phone call Levee District President and Exec Office to update study process
07NOV23	Stakeholder updates with Executive Office and PDT on study progress and optimized levee
12JAN23	Col. Jones personal meeting Levee District President
19JAN23	Stakeholder, NFS and Exec Office brief on efforts for Military Rd. optimization
24JAN23	Stakeholder, NFS and Exec Office discussion of Economics for STPFS
27MAR23	Stakeholder, Project Management and Landowner site visit in West Slidell area
02MAY23	PDT and Stakeholder working meeting for Mile Branch measure
05MAY23	Exec Office and Stakeholder engagement with landowners in West Slidell area
17MAY23	PM outreach and attendance to the St. Tammany Levee, Drainage and Conservation District monthly meeting
23MAY23	PM phone conference with board members to discuss Eden Isle Nonstructural Plan

- Bi-weekly meetings are held between the PDT, NFS, cooperating agencies and resource agencies.

- On 16 July 2020 the CEMVN sent out letters to tribal, Federal, state, and local government entities inviting them to become a cooperating agency with USACE in preparation of the environmental compliance documentation.

- Environmental Justice (EJ) Outreach meetings were performed to inform residents in areas of EJ concern (refer to EJ Existing Conditions Section 3 for Areas of EJ Concern within the study area and potential impacts. Feedback from residents is critical to the process. These EJ Outreach meetings were held on 4 April 2023 in the Slidell Civic Auditorium and 5 April 2023 in the Covington Firehouse Event Center. Refer to Section 9.2.3 for more information about EJ outreach and engagement.

Section 3

Inventory and Forecast Conditions Affected Environment

The President's Council on Environmental Quality (CEQ) regulations (40 CFR Part 1500 *et seq*.), promulgated to implement NEPA; provides guidance for the preparation of NEPA documents. Section 1502.15 of the CEQ regulations provides direction for preparing the Affected Environment section and states that it shall contain data and analysis "commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced."

This section describes the existing conditions of the affected environment within the study area as well as project area. Described are the relevant resources that may be affected by the project such as wetlands, fisheries, essential fish habitat, threatened and endangered species, social-economic environment, and environmental justice among others.

3.1 EXISTING CONDITIONS

3.1.1 Geography

St. Tammany Parish (study area) is located in the southeast portion of Louisiana, on the northern shore of Lake Pontchartrain. It is bordered to the north by Washington Parish, to the west by Tangipahoa Parish, to the south by Jefferson and Orleans Parishes, and to the east by the Pearl River, which forms the natural border between southeastern Louisiana and southern Mississippi. St. Tammany Parish has a surface area of approximately 715,652 acres, of which approximately 52 percent (373,226 acres) is water or wetlands (STPS HMP, 2020).

St Tammany Parish contains eight incorporated communities: the Villages of Folsom and Sun, the towns of Abita Springs, Madisonville, and Pearl River, and the cities of Covington, Mandeville, and Slidell. Covington, the parish seat, is located in the central-eastern part of the parish and is the second most populous municipality in the parish behind the City of Slidell.

Critical infrastructure includes numerous hospitals, schools, and local government facilities. Interstates I-10 and I-12 connect the parish with the State of Mississippi and the cities of Baton Rouge and New Orleans, serving as a major transportation corridor through Louisiana. The Lake Pontchartrain Causeway (Causeway) connects the town of Mandeville directly with the greater New Orleans area in Metairie (Jefferson Parish).

3.1.2 Topography

The topography of St. Tammany Parish varies from gently rolling to low lying wetlands, with the highest elevation of 262 feet found in the northwestern portion of the parish and steadily decreases moving to the south and to the east. The lowest elevations are found along the Northshore of Lake Pontchartrain as well as south and east of Slidell, LA at a low of -22 feet.

3.1.3 Land Use

The land use of the Lake Pontchartrain Basin is both rural and urban and is the most densely populated region in Louisiana and includes metro New Orleans and the state capital, Baton Rouge. It is one of the largest estuarine systems in the Gulf of Mexico containing over 22 essential habitats. St. Tammany Parish is one of 16 parishes within the Lake Pontchartrain Basin.

3.1.4 Land Cover

Land cover within the parish varies widely based on elevation. The areas of higher elevation generally to the north contain upland habitats consisting of mixed scrub-shrub, mixed upland forests, evergreens, open fields/agricultural lands and the lower lying areas of the parish to the south and east consist of wetlands, bottomland hardwoods, pine savanna/flatwoods. Reference Figure 3-1 for Habitat data within the parish.

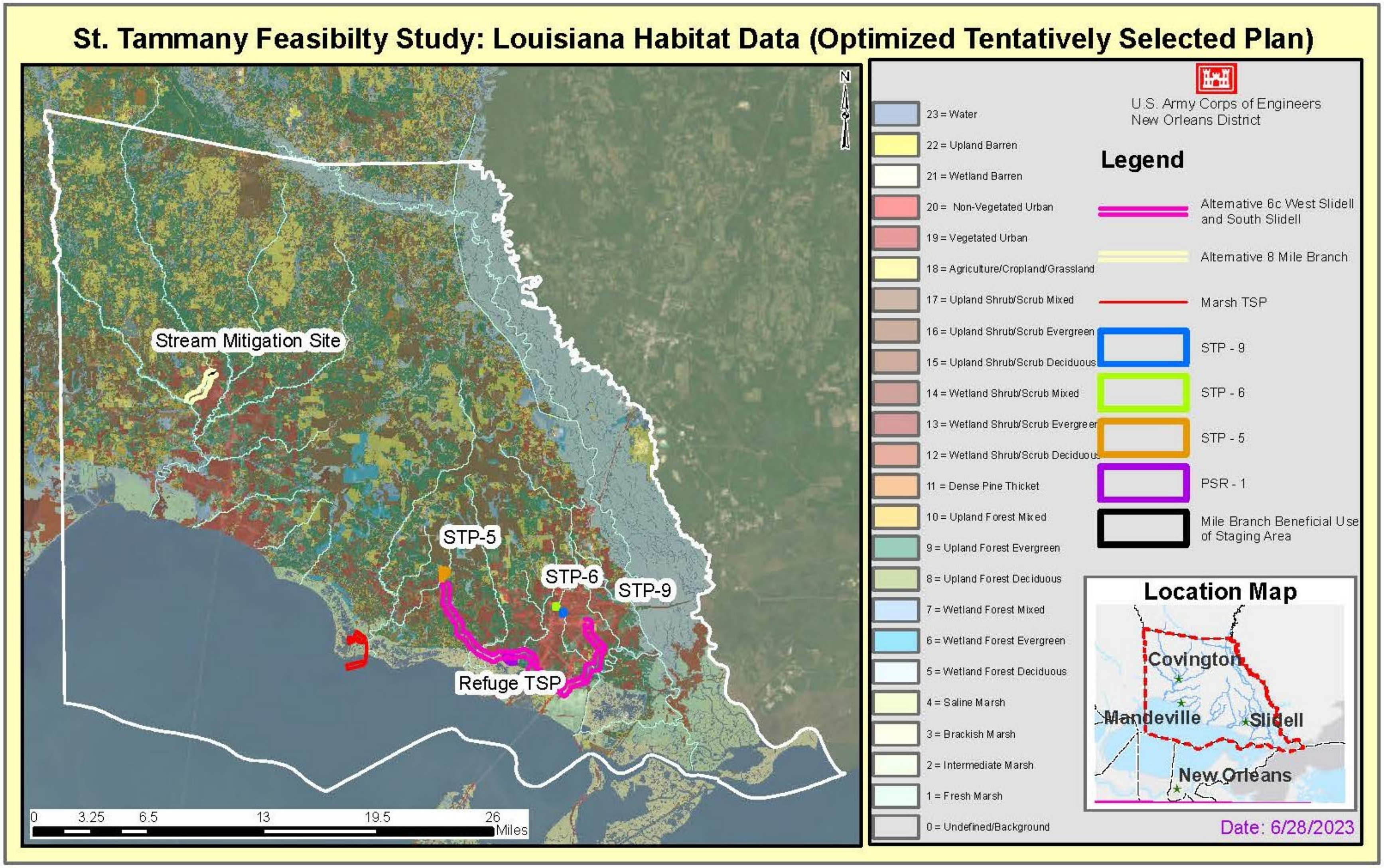

Figure 3-1. TSP Habitat Data within St. Tammany Parish
*** Borrow site MS-1 and MS-2 are located in Mississippi just outside of the state line*

3.1.5 Geomorphic and Physiographic Setting

Louisiana and the study area fall within the Mississippi Alluvial Plain of the Mississippi Alluvial and Southwest USA Coastal Plains ecoregion as defined by Omernik (1987,1995, 2004, 2014). This riverine ecoregion extends from southern Illinois at the confluence of the Ohio River with the Mississippi River, south to the Gulf of Mexico. The study area consists of four physiographic areas: the forested terrace uplands, used mainly for woodland and pastureland; the broad terraces or Gulf Coast Flatwoods, used mainly for woodland; the narrow flood plains of major streams, used for woodland and wildlife habitat; and the marshes and swamps, used mainly as habitat for wetland wildlife and for recreation.

3.1.6 Climate

The Mississippi Alluvial Plain ecoregion has a mild mid-latitude humid subtropical climate. Winters are generally mild and summers are hot and humid reflecting the subtropical nature typical for the region. Variations in daily temperature are fairly consistent throughout the parish, although small differences can be attributed to the proximity to Lake Pontchartrain, and to a much lesser degree, the differences in elevation between the northern and southern portions of the parish. The average annual temperature for the state as a whole is 68ºF. January is typically the coldest month for Louisiana, averaging approximately 51ºF, while July is typically the warmest at an average of 82ºF. Winter months are usually mild with cold spells of short duration. For St. Tammany Parish in particular, the summer months are usually quite warm, with an average daily maximum temperature in July and August of 92°F. Winters are typically mild, with snowfall averages less than one inch per year. Average annual rainfall for the area is 55.45 inches. St. Tammany Parish is susceptible to the normal weather dangers, but due to its location within the state and its proximity to Lake Pontchartrain and the Gulf of Mexico, the parish is extremely susceptible to tropical cyclones and storm surge inundation (National Climatic Data Center).

Projections of storm frequencies from the 2017 Master Plan anticipate increased frequencies for hurricanes and decreased frequencies for tropical storms. Table 3-1 presents the average annual number of North Atlantic Basin tropical storms and major hurricanes (CPRA 2017).

Table 3-1. North Atlantic Basin Tropical Storms and Major Hurricanes based on the Plausible Range of Future Tropical Storm Frequency

	1981-2010 Average	**Projected Average for 2015-2065**	**Range of Frequency change (2015-2065)**
All tropical storms	12.1	8.8 to 12.6	-28%
Major Hurricanes	2.7	3.1 to 8.6	+13% and +83%

The 2014 USACE Climate and Resiliency Policy Statement states, “USACE shall continue to consider potential climate change impacts when undertaking long-term planning, setting priorities, and making decisions affecting its resources, programs, policies, and operations.”

The USACE June 2015 Climate Adaptation Plan Update to 2014 Plan, reflects climate preparedness and resilience actions in the Climate and Natural Resources Priority Agenda and recommendations from the State, Local, and Tribal Leaders Task Force for Climate Preparedness and Resilience. The Climate Adaptation Plan is designed to evaluate the most significant climate change related risks to, and vulnerabilities in, agency operations and mission in both the short and long term, while also addressing how USACE would address vulnerabilities.

The PDT complied with EO 13990 issued 20 January 2021 to “bolster resilience to the impacts of climate change” through consideration of climate change in the plan formulation process and in the engineering analysis. As an example, the rainfall and coastal flood risk analyses incorporated projected sea level rise. The rainfall flood risk analysis included a higher downstream boundary water level (representative of higher future sea levels in Lake Pontchartrain and the Gulf of Mexico); the coastal flood risk data used a higher starting water level that represents future sea level rise, which results in higher storm surge values in the future. For more detailed information on the Hydrologic and Hydraulic modeling see Appendix E: Hydrologic & Hydraulics.

Engineering regulation (ER) 1100-2-8162 provides guidance for incorporating direct and indirect physical effects of projected future sea level change (SLC) across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. Potential relative sea level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. Relative sea level change (RSLC) was considered. The intermediate scenario was used in the quantitative analysis of the Final Array alternatives. Changes in storm surge and wave values from higher sea levels (in the form of starting water levels in the coastal model) are included. Higher starting water levels resulted in higher surge values for a given frequency.

USACE policy in ER 1100-2-8162, requires that sea level change be considered in project formulation. In particular, the policy requires that alternatives be evaluated such that an alternative that performs best across the full range of plausible future conditions should generally be selected over an alternative that only performs well under one of the scenarios. For alternative section, the PDT should demonstrate that uncertainty over future sea level conditions does not constitute uncertainty over which alternative would perform the best in the future. Further discussion on the TSP and how climate change was considered can be found in Section 6.3.

Temperatures in Southeast Louisiana have increased approximately 0.5 degrees Fahrenheit over the past century (EPA, 2016). Climate patterns in Louisiana are forecasted to see continued warming of temperature, and a corresponding increase in severe flooding events and droughts. Increasing sea temperatures are expected to result in the increased likelihood of more intense tropical storm events, as well as accelerating land loss and decline of coastal marsh (EPA 2016).

3.1.7 Hydrology

The study area is located within the Lake Pontchartrain Basin (LPB) of southeast Louisiana (Figure 3-2). Lakes Maurepas, Pontchartrain, and Borgne form a shallow brackish receiving basin for fresh water from the Amite, Tickfaw, Blind, Tangipahoa, Tchefuncte, and Pearl Rivers, as well as Bayous Lacombe and Bonfouca. Fresh water is also introduced through regional drainage canals while salt water enters these lakes from the Gulf of Mexico via Mississippi and Chandeleur Sounds and Chef and Rigolets Passes

Figure 3-2. Lake Pontchartrain Basin

St. Tammany Parish is comprised of 10 major watersheds and 36 hydrologic subbasins as defined by the USGS 12-digit hydrologic unit delineations. Figure 3-3 illustrates the subbasins. The area has complex hydrology and experiences repeated damages from various types of flood events, including, but not limited to storm surge, wave action, rainfall, riverine, and high tide.

The watersheds include the Pearl River, Gum Bayou, W-14/W-15 basin, Bayou Bonfouca, Bayou Lacombe, Bayou Cane, Bayou Castine, Little Bayou Castine, Bayou Chinchuba and the Tchefuncte River. Figure 3-3 depicts the hydrologic units and highlights the project areas receiving major flooding. Table 3-2 lists the subbasins and the types of flooding experienced.

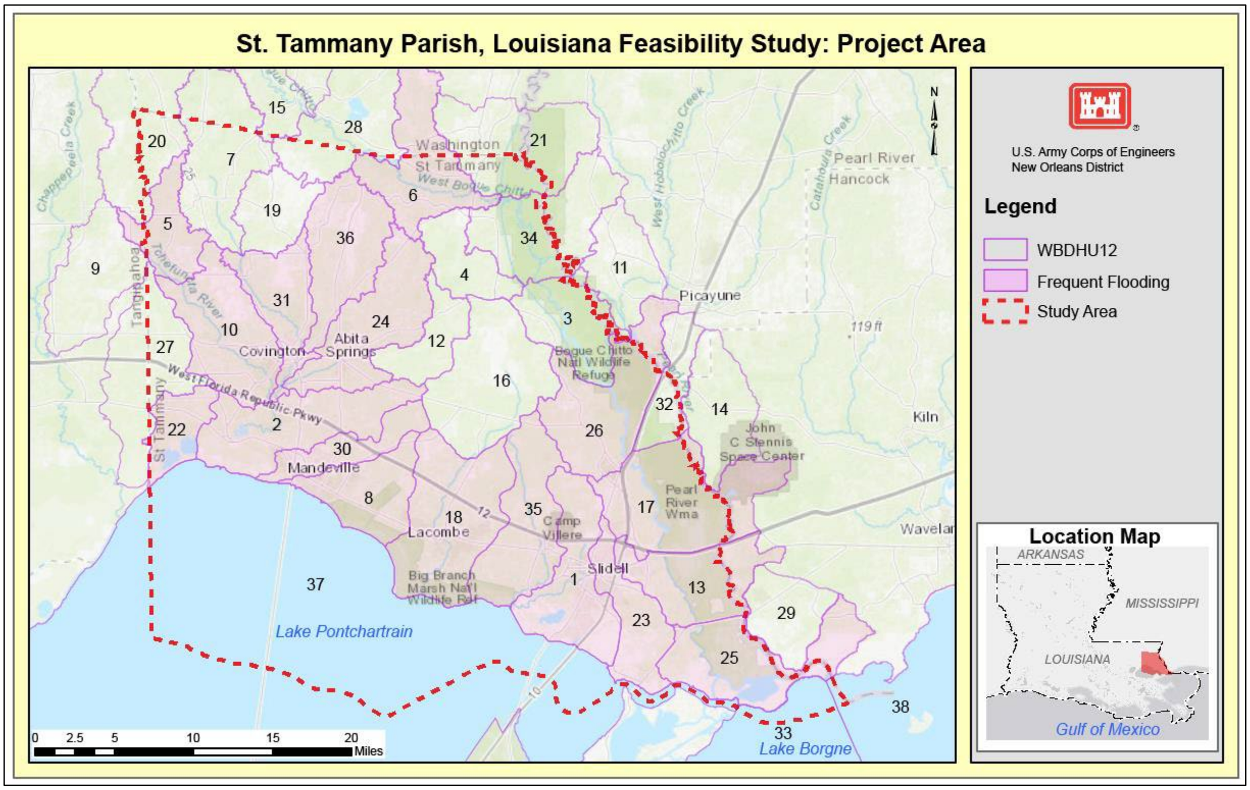

Figure 3-3. St. Tammany Parish Hydrologic Units

Table 3-2. Lists the Project Area Sub-Basins with frequent flooding and the Types of Flooding Occurring

Sub-basin		Type of Flooding
1	Bayou Vincent-Bayou Bonfouca	Coastal (storm surge)/Rainfall
2	Ponchitolawa Creek-Tchefuncte River	Coastal (storm surge)/Rainfall (headwater flooding)
5	Savannah Branch-Tchefuncte River	Rainfall
6	Talleys Creek-Bogue Chitto	Rainfall
8	Bayou Castine-Cane Bayou	Coastal/Rainfall (headwater flooding)
10	Soap and Tallow Branch-Tchefuncte River	Coastal/Rainfall (headwater flooding)
13	Pearlington-Pearl River	Coastal/Rainfall
17	Middle River-Pearl River	Coastal/Rainfall
18	Big Branch Bayou-Lacombe Bayou	Coastal (storm surge)/Rainfall
22	Black River	Coastal/Rainfall
23	Salt Bayou	Coastal/Rainfall
24	Abita River	Rainfall (Headwater Flooding)
25	Rigolets-Pearl River	Coastal/Rainfall
26	Old Channel-Pearl River	Rainfall
30	Bayou Chinchuba	Coastal/Rainfall (headwater flooding)
31	Lower Bogue Falaya River	Coastal/Rainfall
35	Liberty Bayou-Bayou Bonfouca	Coastal/Rainfall, (headwater and backwater flooding)
36	Little Bogue Falaya River	Rainfall

There are a number of rivers and bayous that traverse the parish, generally in a north-south direction: the Tchefuncte River, found in the western portion of the parish, is used for a number of recreational activities, including the Wooden Boat festival in Madisonville; the Bogue Falaya River, which is a tributary of the Tchefuncte River, is another river that hosts a number of recreation activities, including kayaking, tubing, and swimming; the Bayou Lacombe, part of the Big Branch Marsh National Wildlife Refuge, is known for its fishing and wildlife viewing and lastly, the Pearl River is the largest river in the parish and forms the eastern border with the State of Mississippi. The Bogue Chitto and Pearl River have the biggest flooding impacts to communities in the eastern and northeastern portion of the parish.

The operation of the Bonnet Carré spillway in times of emergency can also result in impacts to portions of the Lake Pontchartrain basin as freshwater enters the lake. More information regarding the Bonnet Carre spillway operations can be found in the “1976 Final Environmental Impact Statement EIS for the Mississippi River and Tributaries Mississippi River Levees and Channel Improvement.”

The study area experiences flood risk from three primary sources: costal storm surge and waves, local rainfall on and around the study area, and the Pearl River Basin that outlets to the Gulf of Mexico along the eastern boundary of St. Tammany Parish.

3.1.7.1 Lake Pontchartrain Watershed

The Lake Pontchartrain Basin is a 700 square mile watershed encompassing 16 Louisiana parishes. Three large lakes, Maurepas, Pontchartain, and Borgne cover 55 percent of the basin. It is one of the largest estuarine systems in the Gulf of Mexico, containing over 22 important habitat types. Portions of nine parishes lie within the basin of which St. Tammany is one.

Bayou Bonfouca is a subbasin within this larger watershed and has a drainage area of approximately 53,242 acres.

The Bayou Lacombe subbasin drains approximately 41,600 acres within this larger watershed. Bayou Lacombe flows 20 miles through St. Tammany Parish. It originates in Talisheek, Louisiana, near the junction of LA Highway 41 and LA Highway 435 and flows southward to Lake Pontchartrain. The entire length is designated as a Louisiana Natural and Scenic Stream (Louisiana RS 56:1847) (It is not designated as a National Wild and Scenic River.)).   This subbasin includes connecting bayous, canals, swamps, and marshes that are also associated with the Big Branch Marsh National Wildlife Refuge (BBMNWR), terminating in the northeastern portion of Lake Pontchartrain. The Bayou Lacombe complex is bordered on the west by Bayou Cane, on the east by Bayou Liberty and Bayou Bonfouca, and on the south by Lake Pontchartrain.

3.1.7.2 Pearl River Watershed

The Pearl River watershed drains an area of 8,760 square miles in 23 counties in Central and Southern Mississippi and 3 parishes in Louisiana. The Pearl River originates in Neshoba County, Mississippi, runs through the 33,000-acre Ross Barnett Reservoir, passes by the state capital of Jackson, flows along the border of Louisiana and eventually drains to the MS Sound, Lake Borgne, and the Gulf of Mexico. The river is approximately 490 miles in length and its major tributaries include the Yockanookany, Strong, and Bogue Chitto Rivers. About 50 miles north of its mouth, the Pearl River forks into two, the East fork forming the border of Mississippi and Louisiana and the West Pearl River situated entirely in Louisiana (MSDEQ, 2007).

3.1.7.3 Tchefuncte River Watershed

The upper Tchefuncte initially flows southward and forms the eastern boundary of the Tangipahoa Parish and parts of the western boundary of Washington Parish before turning southeastward into St. Tammany Parish. The Tchefuncte watershed has a drainage area of 168.9 sq mi, of which about half lies within St. Tammany Parish. Below the confluence with the Bogue Falaya, the Tchefuncte drains an additional 70.5 sq mi before flowing into the lake, including the Ponchitolawa Creek subwatershed, giving a total of 436 sq mi for the entire watershed.

3.1.7.4 Sea Level Rise

The impacts of SLR with coincident frequency inflows on the Eastern side of the parish are exhibited from the coastline of Lake Pontchartrain inland approximately 4-6 miles, and varies along the extent of the coastline. In general, the impact zone of SLR remains south of I-12 along the eastern side of the parish coastline for the 10-year and 100-year model runs. See Appendix E: Hydrologic & Hydraulics, H&H modeling report.

3.2 RELEVANT RESOURCES

This section contains a description of relevant resources that exist within the study area. The relevant resources described are those recognized by laws, executive orders, regulations, and other standards of national, state, or regional agencies and organizations; technical or scientific agencies, groups, or individuals; and the general public. Relevance based on institutional recognition means that the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, federally recognized tribes, and private groups. Relevance based on public recognition means that some segment of the general public recognizes the importance of an environmental resource. Relevance based on technical recognition means that the importance of an environmental resource is based on scientific or technical knowledge or judgment of critical resource characteristics. See Appendix C: Environmental, for a summary of the institutional, technical, and public importance of these resources.

3.2.1 Natural Environment

The natural environment includes areas that have not been developed to support human uses and includes terrestrial and aquatic wildlife, their habitats, and the ecological quality of the current systems. Louisiana’s coastal wetlands provide habitat for the largest concentration of over-wintering waterfowl in the U.S., as well as habitat for wildlife, finfish, shellfish, and other aquatic organisms, including threatened or endangered species.

The population of St. Tammany Parish is currently approaching 200,000. The increasing numbers are creating tremendous development pressure, suburban sprawl, increased traffic congestion, and environmental degradation. Recognizing the need for planned and sustainable growth, the STPG initiated the New Directions 2025 - St. Tammany Parish Comprehensive Plan. As part of this planning initiative, the LDWF, Wildlife Diversity Program, identified 22 habitat types occurring within St. Tammany Parish and analyzed the status of those habitat types (Tables 3-4 through 3-6). Of the 22 vegetative habitat types identified, 15 are classified as wetlands, of which all are in a state of decline.

Table 3-4. Status of Wetland Vegetative Types in St. Tammany Parish

Wetland Vegetative Type	Abundance/Status	Trend
Fresh Marsh	**Rare**	**Stable/Very Slowly Declining**
Intermediate Marsh	**Common**	**Stable/Very Slowly Declining**
Brackish Marsh	Uncommon	Stable/Very Slowly Declining
Hillside Seepage Bog	Exceedingly Rare	Declining
Bald Cypress/Bald Cypress-Tupelo Swamp	Common	Slowly Declining
Pond Cypress/Blackgum Swamp	Rare (old growth very rare)	Slowly Declining
Bottomland Hardwood Forest	Common (old growth very rare)	Slowly Declining
Small Stream Forest	Common (old growth very rare)	Declining
Bayhead Swamp	Common (poor quality)	Declining
Slash Pine-Pond Cypress/Hardwood Forest	Critically Imperiled	Declining
Slash Pine/Wiregrass	Rare	Probably Declining
Gum Pond	Uncommon (old growth very rare)	Slowly Declining
Shrub Swamp	Uncommon	Slowly Declining
Forested Seep	Rare	Declining
Longleaf Pine Flatwood Savanna	**Rare**	**Declining**

Source: Louisiana Department of Wildlife and Fisheries, 1999 and St. Tammany New Directions 2025 web site

Bold text represents habitat impacted by the TSP

Table 3-5. Status of Aquatic Vegetative Types in St. Tammany Parish

Aquatic Vegetative Type	Abundance/Status	Trend
Submersed Estuarine Grassbeds	Very Rare	May Be Slowly Increasing
Fresh Floating/Submersed Vegetation	Common	Stable

Source: Louisiana Department of Wildlife and Fisheries, 1999 and St. Tammany New Directions 2025 web site

Table 3-6. Status of Upland Vegetative Types in St. Tammany Parish

Upland Vegetative Type	Abundance/Status	Trend
Hardwood Slope Forest	Very Rare	Declining
Mixed Hardwood-Loblolly Forest	Uncommon	Declining
Shortleaf Pine/Oak-Hickory Forest	Critically Imperiled	Declining
Longleaf Pine Flatwoods	Critically Imperiled	Rapidly Declining
Upland Longleaf Pine Forest	Critically Imperiled	Rapidly Declining

Source: Louisiana Department of Wildlife and Fisheries, 1999 and St. Tammany New Directions 2025 web site

3.2.1.1 Wetlands Resources

Louisiana's coastal wetlands provide protection from wave action, erosion, and storm damage and offer various consumptive and non-consumptive recreational opportunities. Coastal wetland types within the planning area include bottomland forests, fresh, intermediate, and brackish emergent wetland, swamps, and pine savannah flatwoods.

The major factors that influence the type of wetland community defined by elements such as plant community and spatial relation to bodies of water are elevation, hydrology, salinity, and soil type. Elevation is critical to the type of wetland occurring in an area, and small elevation changes can result in major shifts in community type (Connor et al, 1981). Freshwater habitats generally have salinities less than 0.5 parts per thousand (ppt), salinities in intermediate marsh range between 0.5-5.0 ppt, brackish marsh has salinities of 5-18 ppt, and saline marsh salinities vary between 18-30 ppt.

The Louisiana coastal plain accounts for 90 percent of the total coastal marsh loss in the nation (USACE 2004). Couvillion et al. (2011) analyses shows coastal Louisiana has undergone a net change in land area of about -1,883 square miles of wetlands from 1932 to 2010. The USGS uses historical surveys, aerial imagery and satellite data to track landscape changes in coastal Louisiana over time. For the latest study, "Land Area Change in Coastal Louisiana (1932 – 2016)," Couvillion and other scientists at the compiled and analyzed data from a variety of historical and modern sources. The USGS researchers found that over the 84 years studied, Louisiana's rates of loss ranged from a high of 83.5 square kilometers (32.0 square miles) per year to a more moderate 28.0 square kilometers (10.8 square miles) per year. While land loss rate is not a constant, this equates to losing an average of an American football field's worth of coastal wetlands in 34 minutes when losses were rapid, or in 100 minutes at more recent rates. Analyses show that coastal Louisiana has experienced a net change in land area of approximately -4,833 square kilometers (modeled estimate: -5,197 +/- 443 square kilometers) from 1932 to 2016. This net change in land area amounts to a decrease of approximately 25 percent of the 1932 land area in the state of Louisiana. However, the long-term rate of land loss has slowed since its peak in the 1970s, and USGS scientists have recently found a further slowing since 2010 (USGS, 2017).

St. Tammany Parish has more than 12,000 acres of wetlands in 17 mitigation banks, and 11,320 acres of that are pine flatwood savanna (USACE Regulatory 2020). The STPG recently established the Cane Bayou Mitigation Preserve in 2019, a 12,000-acre wetland preserve near Mandeville that would be utilized to offset impacts from public-work projects.

3.2.1.1.1 Bottomland Hardwoods

Bottomland hardwoods (BLH) are alluvial-forested wetlands typically found throughout southern Louisiana in the deltaic plain of the Mississippi River (Hodges, 1997). A variety of plant species, including oak, hickory, sugarberry, and maple occur in this habitat. Between the forested wetlands and marsh lies a thin band of scrub shrub habitat, and typical vegetation includes elderberry, wax myrtle, buttonbush, and red maple (Connor et al, 1976). In coastal BLH forests stressed by prolonged inundation, the less water tolerant tree species gradually die out leaving the more water tolerant bald cypress and water tupelo present (Kiem et al. 2013)

3.2.1.1.2 Swamps

Swamps are defined by their higher proportional representation of bald cypress and tupelo and a repetitive wet-dry cycle. The Louisiana swamps generally lack a mature tree canopy because of historic logging, and have lower productivity where isolated from riverine influences (Shaffer et al., 2003). Bald cypress, as an important indicator species of the health of a swamp, is a large deciduous conifer and has long been recognized for its decay resistant wood. It can grow to a height of 100 to 120 feet with a diameter of 3 to 5 feet. In the original, old grove forests of the south, virgin bald cypress averaged over 500 years old and could reach a diameter of 6 to 8 feet. Young bald cypress tree trunks are considerably tapered and support an open, narrowly pyramidal crown. As the tree ages, the trunk becomes more cylindrical and the crown irregularly fattened. Older trunks often are ashy-gray with swollen, fluted bases, and branches bearded with Spanish moss. Older bald cypress trees also have a very distinctive root system that consists of several descending roots, providing anchorage, and many wide-spreading roots commonly known as "knees." This type of root system makes the bald cypress exceptionally stable, even on the most unstable sites. Permanent inundation results in a loss of regeneration and eventually conversion to marsh (Hodges, 1997).

3.2.1.1.3 Marsh

Freshwater marsh is found surrounding bodies of open water and is located in the study area along the shoreline of Lake Pontchartrain and along the mouth of the Pearl River. It forms in accreting, sediment rich, high energy environments typical for this region and is dominated by rush and reed plant species like cattails and arrowhead. These marshes can form detached mats of vegetation, known as flotant, which encourage colonization by other plant species. Historically, wax myrtle trees would colonize the mat, which results in the entire mat sinking, allowing for more open water plants to infiltrate thick marshes. Freshwater marsh that does not float is more dramatically impacted by flood events and can be less productive.

Fresh marshes provide nursery habitat for estuarine-dependent species important to recreational and commercial fisheries such as blue crab, white shrimp, Gulf menhaden, Atlantic croaker, red drum, southern flounder, bay anchovy, striped mullet, and others. Fresh marshes also provide habitat for largemouth bass, warmouth, black crappie, blue catfish, bowfin, and gar.

Intermediate marsh is a unique type of wetland marsh found in the study area whose vegetative community reflects the shifts in salinity associated with proximity to marine environments. This type of marsh is the middle part of the gradient found in vegetative communities shifting from fresh to saline waters, and the marsh species that are found in this type like saltmeadow grass are capable of withstanding spikes of salinity that are associated with tropical storm surge events. It is commonly a fairly narrow band of vegetation when compared with other marsh types due to the large differences between freshwater and brackish salinities. Wildlife found within an intermediate marsh is less diverse than found in freshwater marshes, but more individuals may be present.

Brackish marsh is the last type of marsh found in the study area. The vegetation within a brackish marsh consists of wire grass, smooth cord grass (*Spartina alterniflora*) and black needle rush (*Juncus roemerianus*); however, without many variety in plant species, and often times the habitat is almost entirely composed of saltmeadow cord grass. Waterfowl thrive in this habitat, as well as many invertebrate and fish. This type is more prevalent in the study area around the mouth of the Pearl River, as well as around the Rigolets, which lies between Lake Pontchartrain and the Gulf of Mexico. Exchange between the two bodies of water has a compounding effect on countless species.

3.2.1.1.4 Longleaf Pine Flatwood Savanna

Longleaf pine flatwood savannas (pine savannas) are floristically rich, herb-dominated wetlands, that are naturally sparsely stocked with longleaf pine. They historically dominated the Gulf coastal plain flatwood regions of southeast and southwest Louisiana. The term "savanna" is classically used to describe expansive herb-dominated areas with scattered trees.

Pine savannas are scattered within the study area and are a managed habitat type within the Bayou Bonfouca National Wildlife Refuge. They are found naturally on broad "flats" in an interdigitated mosaic with mesic to dry-mesic (non-wetland) longleaf pine flatwoods, savannas occupying the poorly drained and seasonally saturated/flooded depressional areas and low flats, while the non-wetland flatwoods occupy the better drained slight rises and low ridges. They are subject to a highly fluctuating water table, from surface saturation/shallow flooding in late fall/winter/early spring to growing-season droughtiness. (LNHP 1988).

3.2.1.2 Uplands

Uplands scattered throughout the parish are dry and generally consist of a mixed hardwoods and loblolly pine forest as well as dry-mesic pine flatwoods. Mixed hardwood-loblolly pine forests are distributed in a variety of ecological settings statewide on broad ridgetops and gentle side slopes in terrace uplands; on middle and lower slopes between uplands and stream bottoms; and at the heads of drainages along small, intermittent streams. Loblolly pine forests comprise approximately 20 percent of the overstory associated with various hardwood species. Mixed hardwood-loblolly pine forest is estimated to have occupied 500,000 to 1,000,000 acres historically with the same amount thought to remain today. However, older, more natural examples of this habitat are threatened by conversion to pine plantations, agriculture or other land uses. Other threats include construction of roads, pipelines and utilities, invasive and exotic species, fire suppression, physical damage from timber harvesting, and contamination by chemicals (herbicides, fertilizers).

Pine flatwood habitat is found primarily in the northern portion of the parish. An ideal pine flatwood forest would lack a mid-story; however, due to fire suppression and lack of prescribed burns, much of this habitat is in less than ideal conditions.

Riparian corridors similar to the habitat found along Mile Branch are a combination of mixed hardwoods and pine habitat. Wildlife species found utilizing this habitat rely on streams, bayous and other bodies of water as transportation corridors, breeding habitat, and for hunting as they serve as a nexus point for biodiversity within the community. Impacts to waterways can have a compounding effect to species located up the trophic chain. This can result in upland species being affected by water resource management projects that cumulatively result in shifts in community composition of flora and fauna.

3.2.1.3 Soils

St. Tammany Parish has a total area of 721,830 acres of which 562,749 acres is land and 159,081 acres is large water areas (streams, small lakes, and Lake Pontchartrain).

3.2.1.4 Prime and Unique Farmlands

Prime and unique (P&U) farmlands are designated by the U.S. Department of Agriculture (USDA) based on an identification of soil types. The identification of these soil types often has a correlation with the economic value of a given piece of property due to its potential for agricultural use. Within the parish, agricultural lands are found primarily further inland from the coastal communities along Lake Pontchartrain, though there are tracts identified as prime and unique farmlands within each of the major coastal communities in the study area. This reflects the fact that farmlands that are closer to the coast generally have been developed for residential and commercial purposes.

P&U farmland soils are listed in Table 3-7. The predominant P&U farmland soils are Stough fine sandy loam at 12.4 percent and Savannah fine sandy loam at 6.7 percent.

There are approximately 211,246 acres of P&U farmlands within the study area reference Figure 3-4 and Table 3-7. A review of the P&U farmland located within the study area and potential borrow sources was conducted using the web soil survey service provided by the Natural Resource Conservation Service (NRCS). See Appendix C: Environmental.

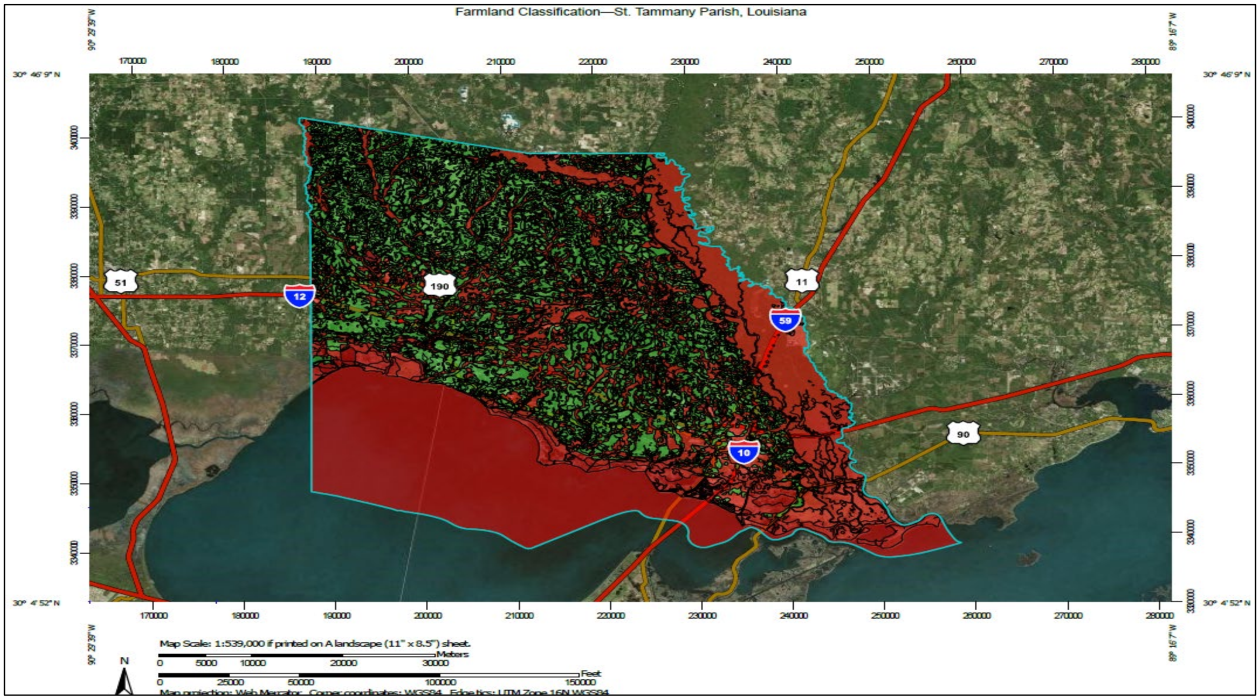

Figure 3-4. Prime and Unique Farmlands in St. Tammany Parish

(Note: Red indicates no prime farmland and Green indicates all areas prime farmland)

Table 3-7. Farmland Classification for St. Tammany Parish, Louisiana

Soil Type	Rating	Acres	Percent (%)
Maurepas muck, drained	Not prime farmland	510.4	0.1
Myatt fine sandy loam, 0 to 1 percent slopes	Not prime farmland	59,183.7	8.2
Myatt fine sandy loam, frequently flooded	Not prime farmland	37,325.2	5.2
Ouachita and Bibb soils, frequently flooded	Not prime farmland	33,216.0	4.6
Pits	Not prime farmland	1,058.8	0.1
Prentiss fine sandy loam, 0 to 1 percent slopes	All areas are prime farmland	39,183.0	5.4
Prentiss fine sandy loam, 1 to 3 percent slopes	All areas are prime farmland	3,071.5	0.4
Ruston fine sandy loam, 1 to 3 percent slopes	All areas are prime farmland	118.5	0.2
Ruston fine sandy loam, 3 to 6 percent slopes	All areas are prime farmland	5,423.5	0.8
Savannah fine sandy loam, 1 to 3 percent slopes	All areas are prime farmland	48,022.4	6.7
Savannah fine sandy loam, 3 to 6 percent slopes	All areas are prime farmland	25,982.7	3.6
Smithdale fine sandy loam, 8 to 12 percent slopes	Not prime farmland	1,902.1	0.3
Stough fine sandy loam, 0 to 1 percent slopes	All areas are prime farmland	89,444.6	12.4
Water	Not prime farmland	175,820.5	24.4

Total for St. Tammany Parish	719,375.3	100.0

3.2.1.5 Water Quality

The Louisiana Department of Environmental Quality (LDEQ) has designated numerous streams and rivers within St. Tammany Parish as impaired. The source of impairment is predominantly excessive nutrients and bacteria, which are partially attributable to discharges from failing sewer systems; and sediment-related pollutants from construction runoff. In many cases, contact recreation (fishing and swimming) is not recommended due to this pollution.

As a result of surface water pollution, the LDEQ has instituted the Total Maximum Daily Load (TMDL) program to quantify water quality and set limits on discharges of pollutants. This program establishes discharge limits from point sources (such as wastewater plants) and nonpoint sources such as stormwater runoff.

Water quality in the watershed is influenced by the emergency operations of the Bonnet Carre Spillway (BCS) during periods of high water along the Mississippi River that threaten the city of New Orleans and other communities along the River. Impacts to water quality also occur from rivers like the Tchefuncte and Pearl, as well as smaller water bodies and bayous that drain into Lake Pontchartrain and the Gulf of Mexico. Sediment transport from the uplands of the parish brings agricultural runoff into Lake Pontchartrain and fuels algal blooms and deposits of large amounts of fine sediment.

Section 305(b) of the Clean Water Act requires each state to monitor and report on surface and groundwater quality, which the Environmental Protection Agency (EPA) synthesizes into a report to Congress. The LDEQ produces a Section 305(b) Water Quality Report that provides monitoring data and water quality summaries for hydrologic units (subsegments) throughout the state. Water quality criteria are elements of state water quality standards that represent the quality of water that would support a particular designated use. These criteria are expressed as constituent concentrations, levels, or narrative statements. There are currently eight designated uses adopted for Louisiana’s surface waters: primary contact recreation, secondary contact recreation, fish, and wildlife propagation (”subcategory” for limited aquatic life and wildlife), drinking water supply, oyster propagation, agriculture, and outstanding natural resource waters. None of the sub-basins in this part of the Lake Pontchartrain Basin fully meets EPA's designated use standards, and Bayou Liberty has a fish-consumption advisory for mercury.

3.2.1.5.1 Bayou Liberty

The 2022 LDEQ report states that Bayou Liberty is not supporting Fish and Wildlife Propagation; however, it is supporting its designated uses of Primary Contact Recreation and Secondary Contact Recreation. LDEQ's 2011 Bayou Liberty and Bayou Bonfouca Watershed Total Maximum Daily Load (TMDL) report states that suspected causes of impairment are low dissolved oxygen, mercury, chlorides, sulfates, and total dissolved solids. The suspected source is on-site treatment systems (septic systems and similar decentralized systems), package plant or other permitted small flows discharges, and unknown source. LDEQ is utilizing a phased TMDL approach for Bayou Liberty. This approach provides LDEQ with the opportunity to revise the DO criteria and at the same time, allows LDEQ to develop a meaningful and implementable DO TMDL based upon the appropriate DO criteria and in accordance with EPA's Consent Decree (E. D. La. 2002) deadlines. These efforts should lead to improved water quality while providing local governments and businesses the opportunity to prepare and adjust to the new permit requirements that would be implemented as a result of the TMDL developed in Phases I and IL One of LDWF's goals in managing Bayou Liberty is to improve the waterbody's ability to support recreation and wildlife propagation (Scenic River Management Plan for Bayou Liberty, 2015, LDWF).

3.2.1.5.2 Bayou Bonfouca

The 2022 LDEQ report indicates that Bayou Bonfouca is not supporting fish and wildlife propagation and primary contact recreation. It is supporting secondary contract recreation. The 2022 LDEQ report states that suspected causes of impairment are low dissolved oxygen and enterococcus.

3.2.1.5.3 Bayou Lacombe

LDEQ has Bayou Lacombe broken into two subsegments. LDEQ sub-segment 040901 does not support fish and wildlife propagation. However, outstanding natural resource and primary and secondary contact recreation uses are fully supported. Fish in this sub segment have been tested for mercury but levels were not found to be a cause for concern. LDEQ sub segment 040902 does not support fish and wildlife propagation and primary contact recreation uses. Outstanding natural resource and secondary contact recreation uses are fully supported. Fish in this sub segment have been tested for mercury contamination and results indicate further testing is needed.

3.2.1.6 Aquatic Resources

Primary fresh and intermediate water bodies of importance include: Lake Pontchartrain, Pearl River, Bayou Bonfouca, Bayou Patassat, Bayou Lacombe, Bayou Liberty, Bayou Cane, Bayou Castine, Bayou Chinchuba, and the Tchefuncte River. Average water depths of the lakes and bayous are relatively shallow, with Lake Pontchartrain extending to 15 feet (NOAA Chart 11639). In addition, there are many miles of manmade canals and unnamed waterways used for recreation, irrigation, and drainage.

The Pearl River watershed supports a biodiverse assemblage of fauna with over 40 species of mussel and 130 species of native fish. It supports eight federally listed species including the ringed map turtle, Gulf sturgeon, inflated heelsplitter mussel, Bald Eagle, dusky gopher frog, gopher tortoise, Pearl darter and Louisiana black bear. The ringed map turtle is an endemic, threatened species found only in the Pearl River watershed in Louisiana and Mississippi. The USFWS has designated the Pearl River as a critical habitat for the Gulf sturgeon, which migrates up the river to breed.

Wetlands throughout the area abound with numerous aquatic species: least killifish, threadfin shad, rainwater killifish, sheepshead minnow, American eel, mosquitofish, sailfin molly, and grass shrimp. These species rely upon submerged aquatic vegetation and marsh and provide forage for a variety of fish and wildlife.

Freshwater and estuarine marshes with lower salinities provide habitat for commercially and recreationally important freshwater fish species, including but not limited to: largemouth bass, yellow bass, black crappie, green sunfish, bluegill, redear sunfish, warmouth, blue catfish, channel catfish, walleye, freshwater, bowfin, and gar. Water bodies where there is minimal water exchange may exhibit low dissolved oxygen conditions that result in higher amounts of algal blooms, and this can lead to a reduced fisheries abundance.

Benthic communities throughout Lake Pontchartrain are directly impacted by geochemical changes that are associated with nutrient exchange between the marshes of the Rigolets that separate Lake Pontchartrain from the Gulf of Mexico.

3.2.1.7 Essential Fish Habitat

All marine and estuarine waters of the northern Gulf of Mexico, including the eastern portion of Lake Pontchartrain, have been designated as Essential Fish Habitat (EFH) through regulations promulgated by the NMFS and the Gulf of Mexico Fishery Management Council, as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). EFH is described as waters and substrates necessary for federally-managed species to spawn, breed, feed, and grow to maturity. In the northern Gulf of Mexico, EFH has generally been defined as areas where individual life-stages of specific Federally-managed species are common, abundant, or highly abundant. In estuarine areas, EFH is defined as all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities), including the subtidal vegetation (submerged aquatic vegetation and algae) and adjacent intertidal vegetation (marshes and mangroves).

To assist in meeting consultation requirements, the NMFS local field office reviewed the study area and provided comments to CEMVN that identified the following species as being of concern for this study: brown shrimp, white shrimp, red drum, and bull sharks. Table 3-8 lists the life stages of EFH for federally managed fishery species in the study area. See Appendix C: Environmental for more information.

Table 3-8. Essential Fish Habitat for Life Stages of Federally Managed Species in the Project Area, St. Tammany, Louisiana.

Species	Life Stage	Essential Fish Habitat
Brown Shrimp	Adult	Gulf of Mexico <110 m, silt sand, muddy sand
	Juvenile	Marsh edge, submerged aquatic vegetation (SAV), tidal creeks, inner marsh
	Larvae/Postlarvae	0 to 82 m; pelagic
White Shrimp	Adult	Gulf of Mexico <33 m, Silt, soft mud
	Juvenile	Marsh edge, SAV, marsh ponds, inner marsh, oyster reefs
	Larvae/Postlarvae	Planktonic, soft bottom, emergent marsh
Red Drum	Adult	Gulf of Mexico & estuarine mud bottoms, oyster reef
	Juvenile	SAV, estuarine mud bottoms, marsh/water interface
	Larvae/Postlarvae	All estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
Bull Shark	Adult	Gulf of Mexico <25m, bays
	Juvenile	Marsh edge, estuarine mud bottoms, oyster reefs

Brown shrimp (*Farfantepenaeus aztecus*) and white shrimp (*Litopenaeus setiferus*) are two species of shrimp found in the study area and serve as an important commercial resource. Brown shrimp spawn on the Gulf of Mexico continental shelf, and then drift toward the shore, before eventually returning to the continental shelf to reproduce (Li and Clarke, 2005). The white shrimp lifecycle follows a similar pattern, with the primary difference being their seasonal occurrence, with white shrimp found in the fall and brown shrimp found in the spring (Baker et al, 2014). Marshes in and adjacent to the study area serve as a nursery for both species of shrimp and harvests are regulated by the LDWF. EFH for shrimp includes waters of the Gulf of Mexico and substrates extending from the US/Mexico border to Fort Walton Beach, Florida from estuarine waters out to depths of 100 fathoms; waters and substrates extending from Grand Isle, Louisiana to Pensacola Bay, Florida between depths of 100 and 325 fathoms; waters and substrates extending from Pensacola Bay, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida to Naples, Florida between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms (Habitat Conservation Division, 2015).

Red drum (*Sciaenops ocellatus*) is an important recreational gamefish found in coastal waters throughout the Gulf of Mexico (Matlock, 1987; Exec. Order No. 13449, 2007). Adults inhabit nearshore waters, particularly areas within the surf zone or in the vicinity of inlets (Matlock, 1987). Spawning occurs in nearshore areas, and eggs and larvae are transported by tides and wind currents into estuaries (Matlock, 1987; Brown et al, 2004). Larvae and juveniles typically occupy estuarine environments until maturation (Matlock, 1987). Red drum are predatory in all stages of life; however, the type of prey consumed varies with life stage. Early juvenile red drum primarily consume small marine invertebrates, including mysids and copepods, while adults feed on large marine invertebrates, including shrimp, crabs, and small fishes (Bass and Avault Jr., 1975). EFH for red drum consists of all Gulf of Mexico estuaries; waters and substrates extending from Vermilion Bay, Louisiana to the eastern edge of Mobile Bay, Alabama out to depths of 25 fathoms; waters and substrates extending from Crystal River, Florida to Naples, Florida between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms (Habitat Conservation Division, 2015).

Bull sharks (*Carcharhinus leucas)* are common in coastal waters and use Lake Pontchartrain as a nursery. While they are able to survive in fresh water as a euryhaline species, they do not live there exclusively, and typically prefer to use estuarine conditions as a survival strategy for their young before moving into the marine environment as adults. This reflects their ability to osmoregulate in managing their internal body's chemistry as they move across a wide range of habitat salinities through their lifecycle. EFH for reef fish, including bull sharks, includes waters of the Gulf of Mexico and substrates extending from the US/Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms (Habitat Conservation Division, 2015).

3.2.1.8 Wildlife

There are a variety of habitats in the study area for wildlife species, including: uplands, forested wetlands, fresh marsh, open fields used for foraging, lines of trees, and shrubs along drainage ditches and denser tree growth along waterways that provide cover and connectivity. The study area has undergone extensive artificial modifications in the historic period, resulting in common fauna within the study area primarily being species that can tolerate a wide range of disturbed habitats. Forested wetlands and riparian zones provide important breeding and wintering habitats for a variety of migratory birds. Because the study area is located within the Mississippi Flyway, it is an area that experiences significant seasonal migrations of waterfowl species, which are of particular interest to recreational hunters. Crop fields are seasonally flooded because of inadequate interior drainage in the upper basin, and they provide important feeding areas for wintering waterfowl. Flooded fields are especially valuable to wildlife when they are located adjacent to flooded BLH forests because they provide nocturnal roosting sites for many species.

Two national wildlife refuges (Big Branch and Bogue Chitto) and three state Wildlife Management Areas (WMA) (Lake Ramsey Savannah WMA, Pearl River WMA, and St. Tammany Wildlife Refuge) whose primary purpose is the conservation of wildlife and fisheries resources are located in St. Tammany Parish.

3.2.1.9 Threatened, Endangered, and Protected Species

Within the project area there are six documented animal species, one plant species, and one Critical Habitat designation under the jurisdiction of the USFWS and/or the NMFS, presently classified as threatened or endangered (Table 3-9). The USFWS and NMFS share jurisdictional responsibility for Gulf Sturgeon. The Alligator Snapping Turtle (*Macrochelys temminckii)* and Monarch Butterfly (*Danaus* plexippus) are also listed on the Endangered Species List as Proposed Threatened and Candidate, respectively. However, they are not subject to ESA Section 7 consultation requirements.

Table 3-9. Threatened and Endangered Species in St. Tammany Parish, Louisiana that may be Present in the Project Area

Species	Status	Potentially Present in Project Areas	Jurisdiction	
			USFWS	NMFS
West Indian Manatee (*Trichechus manatus)*	Threatened	X	X	
Red-Cockaded Woodpecker (*Picoides borealis)*	Endangered	X	X	
Gopher Tortoise (*Gopherus polyphemus)*	Threatened		X	
Ringed Map Turtle (*Graptemys oculifera*)	Threatened		X	
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	Threatened	X	X	X
Gulf Sturgeon Critical Habitat	Final	X	X	X
Louisiana Quillwort (*Isoetes louisianensis*)	Endangered	X	X	

3.2.1.9.1 West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is Federally and state listed as threatened and is also protected under the Marine Mammal Protection Act of 1972, under which it is considered depleted (USFWS 2001). The West Indian manatee is known to regularly occur in Lakes Pontchartrain and Maurepas and their associated coastal waters and streams. It also can be found less regularly in other Louisiana coastal areas, most likely while the average water temperature is warm. Based on data maintained by the LDWF, Wildlife Diversity Program, over 80 percent of reported manatee sightings (1999-2011) in Louisiana have occurred from the months of June through December. Manatee occurrences in Louisiana appear to be increasing and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of southeastern Louisiana. Manatees may also infrequently be observed in the Mississippi River and coastal areas of southwestern Louisiana. Cold weather and outbreaks of red tide may adversely affect these animals. However, human activity is the primary cause for declines in species number due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution.

3.2.1.9.2 Red-Cockaded Woodpecker

The red-cockaded woodpecker (RCW, *Picoides borealis*) is a federally listed endangered bird species that prefers open longleaf pine uplands throughout the southeast. RCWs roost and forage year-round and nest seasonally (i.e., April through July) in open, park-like stands of mature pine trees containing little hardwood component, a sparse midstory, and a well-developed herbaceous understory. RCWs can tolerate small numbers of overstory and midstory hardwoods at low densities found naturally in many southern pine forests, but they are not tolerant of dense midstories resulting from fire suppression or from overstocking of pine. Trees selected for cavity excavation are generally at least 60 years old, although the average stand age can be younger. The collection of one or more cavity trees plus a surrounding 200-feet wide buffer of continuous forest is known as a RCW cluster. RCW foraging habitat is located within one-half mile of the cluster and is comprised of pine and pine-hardwood stands (i.e., 50 percent or more of the dominant trees are pines) that are at least 30 years of age and have a moderately low average basal area (i.e., 40 – 80 square feet per acre is preferred. The proposed project would be located in a parish known to be inhabited by RCWs; however, it is anticipated that this species is more of a concern toward the northern border of the parish, where uplands are more common and there is less development.

3.2.1.9.3 Gopher Tortoise

The gopher tortoise is an upland species that is federally listed as threatened. The range of protection for this population extends to Alabama; east of Alabama it is listed as a candidate for Federal protection under the ESA. It is the only tortoise that is native to the southeastern United States and is known to live up to 60 years in the wild. Despite being an ectotherm that spends much of its time basking in the sun, the gopher tortoise builds elaborate underground burrows in dry, sandy soil where it nests, which can be used by other species.

Gopher tortoises prefer “open” longleaf pine-scrub oak communities that are thinned and burned every few years. Habitat degradation (lack of thinning or burning on pine plantations), predation, and conversion to agriculture or urbanization have contributed to the decline of this species. That habitat decline has concentrated many remaining gopher tortoise populations along pipeline and power line rights-of-way (ROW) within their range. Tortoise burrows also can be found along road ROWs, and other marginal habitats, including fence rows, orchard edges, golf course roughs and edges, old fields, and pasturelands. Tortoises are often pushed into these areas due to adjacent habitat becoming unsuitable.

On June 14, 2022, LDWF along with CEMVN and USFWS personnel, conducted gopher tortoise surveys within the project area. Half of the areas assessed appeared to be uninhabitable for gopher tortoises due to the dense forests completely covering these areas. No evidence of gopher tortoises or their burrows were observed within the project area.

3.2.1.9.4 Ringed Map Turtle

Federally listed as threatened, the ringed map turtle is a riverine species that occurs in the Pearl and Bogue Chitto Rivers. It spends much of its day basking on submerged logs and prefers open channels where the water column experiences a high degree of light penetration. Declines in population for this species are attributed to changes in hydrologic regime, channel modifications, and activities that impact water quality and turbidity. The decline of the ringed map turtle has been attributed to habitat modification (i.e., loss of exposed sandbars, basking areas) and water quality deterioration, reservoir construction, channelization, desnagging for navigation, siltation, and the subsequent loss of invertebrate food sources. The proposed action is not expected to impact the Pearl or Bogue Chitto Rivers where the Ringed Map Turtle is known to occur. Therefore, the proposed action would have no effect on the species.

3.2.1.9.5 Gulf sturgeon

The Gulf sturgeon was federally listed as threatened throughout its range on September 30, 1991. The Gulf sturgeon is an anadromous fish that migrates from salt water into coastal rivers to spawn and spend the warm summer months. Subadults and adults typically spend the three to four coolest months of the year in estuaries or Gulf of Mexico waters foraging before migrating into the rivers. This migration typically occurs from mid-February through April. Most adults arrive in the rivers when temperatures reach 70 degrees Fahrenheit and spend 8 to 9 months each year in the rivers before returning to estuaries or the Gulf of Mexico by the beginning of October.

Prior to the listing of the species, Davis et al. (1970) reported the collection of Gulf sturgeon from Lake Pontchartrain during a LDWF anadromous fish survey from 1966 to 1969. From 1988 to 1999, LDWF, through various means and studies, captured and recorded at least 60 Gulf sturgeon throughout Lake Pontchartrain, Lake Catherine, the Rigolets, and Lake Borgne. A LDWF trammel net study conducted by Inland Fisheries Division in the spring of 2001 resulted in the capture of three young of the year juvenile sturgeon at the intersection of the East Pearl River and Little Lake. In 2002, LDWF Seafood Division reported the capture of a Gulf sturgeon in one of their gill nets while sampling in a cove west of Alligator Point, Lake Borgne. By-catch of Gulf sturgeon has been reported by several recreational and commercial fishermen within these waters. A total of 177 Gulf sturgeon, measuring up to 7.2 feet in length and weighing from 2 to 152 lbs., were captured in these lakes and in the Rigolets from October 1991 to September 1992 (Rogillio, 1993). Reynolds (1993) reported that sturgeon measuring up to 7.2 feet in length and weighing up to 258 lbs. were incidentally caught by shrimp trawlers, netters, and recreational anglers from 1889 to 1993 in Lake Pontchartrain.

3.2.1.9.6 Louisiana Quillwort

Federally listed as an endangered plant species, the Louisiana quillwort (*Isoetes louisianensis*) is a small, semi-aquatic, facultative evergreen plant with spirally arranged leaves (sporophylls) arising from a globose, two-lobed corm. The hollow leaves are transversely septate, and measure approximately 0.12 inches wide and up to 16 inches long. This species grows on sand and gravel bars on the accreting sides of streams and moist overflow channels within riparian forest and bay head swamp communities in Washington and St. Tammany Parishes, Louisiana. The Louisiana quillwort is believed to be dependent on a special hydrologic regime resulting from the presence of small springs scattered at the base of banks or bluffs. Major threats to this species are habitat loss through hydrologic modifications of stream habitat, and land use practices that significantly alter stream water quality and hydrology.

3.2.1.10 Critical Habitat Present

Critical habitat identifies specific areas that have been designated as essential to the conservation of a listed species. The project area, specifically the borrow area in Lake Pontchartrain) is located within the boundary of critical habitat Unit 8. In 2003, Unit 8 was designated as critical habitat for Gulf sturgeon. Unit 8 encompasses Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, the Rigolets, Lake St. Catherine, Lake Borgne, including Heron Bay, and the Mississippi Sound in Jefferson, Orleans, St. Tammany, and St. Bernard Parishes, Louisiana, Hancock, Jackson, and Harrison Counties in Mississippi, and in Mobile County, Alabama.

Unit 8 includes approximately 1,377 square miles of critical habitat with 277 square miles in Lake Borgne, 3 in Little Lake, 295 in Lake Pontchartrain, 10 in Lake St. Catherine, 5 in the Rigolets, 725 in Mississippi Sound, and 62 along the Mississippi near shore Gulf (68 FR 13369-13495). Critical habitat follows the shorelines around the perimeters of each included lake. The Mississippi Sound includes adjacent open bays, including Pascagoula Bay, Point aux Chenes Bay, Grand Bay, Sandy Bay, and barrier island passes, including Ship Island Pass, Dog Keys Pass, Horn Island Pass, and Petit Bois Pass. Critical habitat excludes St. Louis Bay, north of the railroad bridge across its mouth; Biloxi Bay, north of the U.S. Highway 90 bridge; and Back Bay of Biloxi.

3.2.1.10.1Protected Species

<u>Bald Eagle</u>

The bald eagle was officially removed from the List of Endangered and Threatened Species as of 8 August 2007. However, the bald eagle remains protected under the Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act (BGEPA). Comprehensive bald eagle survey data have not been collected by the LDWF since 2008 and new active, inactive, or alternate nests may have been constructed in the study area since that time.

Bald eagles typically nest in large trees located near coastlines, rivers, or lakes that support adequate foraging from October through mid-May. In southeastern Louisiana parishes, eagles typically nest in mature trees (e.g., bald cypress, sycamore, wouldow, etc.) near fresh to intermediate marshes or open water. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants. Furthermore, bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during these periods may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival.

On 11 September 2009, Federal regulations 50 CFR 22.80 and 50 CFR 22.85 were established the authority of USFWS to issue permits for non-purposeful bald eagle take (typically disturbance) and eagle nest take when recommendations of the NBEM Guidelines cannot be achieved. In 2016, the USFWS finalized a rule (81 FR 91494) revising the 2009 Eagle Rule. Permits may be issued for nest take only under the following circumstances where: 1) necessary to alleviate a safety emergency to people or eagles, 2) necessary to ensure public health and safety, 3) the nest prevents the use of a human-engineered structure, or 4) the activity or mitigation for the activity would provide a net benefit to eagles. Except in emergencies, only inactive nests may be permitted to be taken.

Coastal Forest and Neotropical Migrating Songbirds

The MBTA is the primary legislation in the United States established to conserve migratory birds. In Louisiana, the primary nesting period for forest-breeding migratory birds occurs between 15 April and 1 August. Some species or individuals may begin nesting prior to 15 April or complete their nesting cycle after 1 August, but the vast majority nest during this period. The TSP may directly impact migratory birds of conservation concern because habitat clearing that occurs during the aforementioned primary nesting period may result in unintentional take of active nests (i.e., eggs and young) despite all reasonable efforts to avoid such take. The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing incidental take, USFWS recognizes that some birds may be taken during project construction/operation, even if all reasonable measures to avoid take are implemented.

The Mississippi Alluvial Valley (MAV) is critically important as a major migration corridor for many bird species with more than 40 percent of the waterfowl that breed in North America using the MAV as migratory stopover, wintering or breeding habitat; the alluvial land located between the river at low-water stage and the levees (i.e., batture) is an important corridor for songbird migration. In addition, at least 107 species of land birds breed in the MAV, with 70 of those depending upon bottomland hardwood forests for most or all of their life cycle. Over the last few decades, documented long-term population declines of migratory bird species have spurred significant concern over the persistence of many species and has contributed to widespread investigations into the causes of these declines, including habitat loss, feral and free-ranging domestic cats, pesticides, and a variety of other stressors. To determine potential occurrences of priority birds occurring within the study area, the USFWS

Information for Planning and Consultation (IPaC; USFWS 2019c) was used by CEMVN as a primary source.

Wading Bird Colonies

The study area includes habitats that are commonly inhabited by colonial nesting waterbirds and/or seabirds that are recorded in the 2003 Louisiana Statewide Wading Bird and Seabird Nesting Inventory and it is likely that there are additional colonies that are not listed in that database. A site inspection of all of the TSP footprints would be conducted by a qualified biologist before construction for the presence of undocumented nesting colonies during the nesting season in coordination with the USFWS and NOAA because some waterbird colonies change locations year-to-year.

Atlantic Bottlenose Dolphin

Bottlenose dolphins are protected under the Marine Mammal Protection Act and can potentially be found in the coastal waters of the parish. They often venture very close to shore and are naturally curious, so it can be anticipated that they may be drawn to coastal construction activities.

3.2.1.10.2“At-Risk” Species

USFWS’s Southeast Region has defined “at-risk species” as those that are: 1) proposed for listing under the ESA by USFWS; 2) candidates for listing under the ESA, which means the species has a "warranted but precluded 12-month finding;" or 3) petitioned for listing under the ESA, which means a citizen or group has requested that the USFWS add them to the list of protected species. USFWS’s goal is to work with private and public entities on proactive measures to conserve species with low or declining populations, thereby precluding the need to federally list as many at-risk species as possible. While not all species identified as at-risk would become ESA listed species, their potentially reduced populations warrant additional consideration during plan formulation and design to avoid and minimize impacts. See Appendix C: Environmental for a list of “At-Risk” Species from USFWS.

3.2.1.11 Scenic Rivers

There are no federally designated Wild and Scenic Rivers as defined by the federal Wild and Scenic Rivers Act, 16 U.S.C. §1271, *et seq* within the study area.

However, there are natural and scenic streams designated by the Louisiana Scenic Rivers Act of 1988 within the parish. The LDWF is the lead State agency in the Scenic Rivers Program. There are approximately 3,000 miles of water that are currently designated as Scenic Rivers in Louisiana. Designated state scenic streams within St. Tammany Parish include: Abita River, Bayou Cane, Bayou Chinchuba, Bayou LaCombe, Bayou Liberty, Bogue Chitto River, Bogue Falaya River, Bradley Slough, Holmes Bayou, Morgan River, Tchefuncte River and its tributaries, West Pearl River, and Wilson Slough. Bayou Liberty and Mile Branch as a tributary to the Tchefuncte River are designed state scenic streams that would be impacted by the Optimized TSP.

3.2.1.11.1Bayou Liberty

The headwaters of Bayou Liberty are found in St. Tammany Parish, approximately 1.5 miles southeast of St. Tammany Comer. The bayou flows from this point, generally southward to its confluence with Bayou Bonfouca near Lake Pontchartrain. Bayou Liberty, from its headwaters, just north of Horseshoe Island road, to its confluence with Bayou Bonfouca, is designated a Louisiana Natural and Scenic River in an amendment to the Scenic Rivers Act passed in 2010 by Act 406.

Bayou Liberty is approximately 15.3 miles long. The bed of the bayou is privately owned from its headwaters to a point approximately one-half mile north of Interstate 12. From that point southward to its entrance into Bayou Bonfouca the State claims ownership of the water bottom of Bayou Liberty (Office of State Lands). The bayou which is part of the Lake Pontchartrain Basin drains approximately 26,963 acres of land (USDA GIS) and empties into Bayou Bonfouca which then empties into Lake Pontchartrain. The bayou has not been channelized, cleared, snagged, or otherwise altered in the last 25 years (conversations with St. Tammany Parish gov). The primary land uses immediately adjacent to the bayou are silva-culture and residential development; however, a large portion of the watershed, especially within the southern reaches, remains undeveloped floodplain.

Bayou Liberty supports a wide range of recreational opportunities such as boating, paddling, fishing, hunting, birding, etc. There are several boat launches providing direct access, and the bayou benefits from the lower reach of Bayou Bonfouca providing connection from Bayou Liberty to Lake Pontchartrain. Fishermen take common freshwater species (e.g., bass, bream, catfish, etc.) regularly and saltwater species (e.g., speckled trout, red drum, etc.) can be had in the lower reaches seasonally, beginning in fall.

3.2.1.11.2Mile Branch

Mile Branch is a tributary to the Tchefuncte River and therefore is designated as a Louisiana Natural and Scenic River in an amendment to the Scenic Rivers Act. The channel is narrow and cut-off from its floodplain. It represents the characteristics of a high gradient ephemeral stream flowing during and after a period of rainfall. When it flows, the flows are faster flowing. The Mile Branch flows through an urban area with housing development directly on the stream banks. The Mile Branch has been channelized through the neighborhood. It is highly incised and subject to high erosive forces during large storm events. There is a narrow broken riparian corridor adjacent to the stream considered highly disturbed given the development on its banks.

3.2.1.12 Hazardous, Toxic, and Radioactive Waste

Under Engineer Regulation (ER) 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance For Civil Works Projects (26 June 1992), CEMVN undertakes reasonable identification and evaluation of Hazardous, Toxic, and Radioactive Waste (HTRW) contamination within the vicinity of the footprints of the TSP in order to avoid construction in HTRW-contaminated areas where practicable. USACE HTRW policy is to avoid the use of project funds for HTRW removal and remediation activities. USACE conducts a Phase I

Environmental Site Assessment (ESA) for the footprints of the TSP (including the proposed borrow sites) in accordance with ER 1165-2-132 and the American Society for Testing and Materials (ASTM) E 1527-13, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (ASTM, 1997).

A preliminary Phase I site investigation was conducted on 18 February 2020 for the study area generally and 8 March 2023 for the Optimized TSP. Two superfund sites, three brownfield sites, eight Resource Conservation and Recovery Act (RCRA) large quantity generator sites, 26 RCRA small quantity generator sites, several crude oil pipelines natural gas pipelines, and several plugged and abandoned oil/gas wells were found within the boundaries of the study area. The two superfund sites and the brownfield sites should be considered as potential recognized environmental conditions (RECs), and the pipelines and wells may be considered as RECs. Three RECs were identified in the regulatory database within the standard 1-mile search radius of the proposed ROW for Mile Branch and South and West Slidell. The EPA and LDEQ's EDMS both revealed no records of enforcement or compliance for the two brownfield sites. The TSCA facility had one reported violation in the 4th quarter of 2020. The issue has been corrected.

Two containment booms and a rusted 55-gallon drum were found within the Mile Branch (Appendix C: Environmental, Photos 15-22). Per LDEQ, the containment booms were placed by the city of Covington to prevent trash from traveling into the waterway. The 55-gallon drum was found to contain no products of concern per LDEQ.

It should be noted that some areas in the project area have been extensively utilized for oil and natural gas exploration and production activities. This includes the presence of oil and gas wells, tank batteries, and petroleum and natural gas transmission pipelines. Oil and gas wells, tank batteries, and petroleum and natural gas transmission pipelines may have a moderate, potential impact on the soil and water resources within or adjacent to the proposed levee ROW.

Further investigation in the proposed levee ROW is necessary due to lack of Right Of Entry for the entire St. Tammany Parish Feasibility Study footprint.

3.2.1.13 Air Quality

The Clean Air Act Amendment of 1990 directed the EPA to establish National Ambient Air Quality Standards (NAAQS) for the following six criteria pollutants considered harmful to public health and the environment:

- carbon monoxide (CO),
- nitrogen dioxide (NO2),
- ozone (O3),
- sulfur oxides (commonly measured as sulfur dioxide [SO_2]),
- lead (Pb),
- particulate matter no greater than 2.5 micrometers (µm) in diameter (PM2.5),
- particulate matter no greater than 10 µm in diameter (PM10).

The EPA classifies air quality by air quality control region (AQCR) according to whether the region meets primary and secondary air quality standards. An AQCR or portion of an AQCR may be classified as attainment, nonattainment, or unclassified. A classification of attainment indicates that air quality for one or more criteria air pollutants within the region is within NAAQS values. A nonattainment classification indicates that regional air quality for one or more criteria air pollutants is not within NAAQS values. A classification of unclassified indicates that air quality within the region cannot be classified (generally because of lack of data). A region designated as unclassified is treated as an attainment region. The study area is located in the southern Louisiana AQCR.

The EPA Green Book Nonattainment Areas for Criteria Pollutants (Green Book) maintains a list of all areas within the United States that are currently designated nonattainment areas with respect to one or more criteria air pollutants. Nonattainment areas are discussed by county or metropolitan statistical area (MSA). MSAs are geographic locations, characterized by a large population nucleus, that are comprised of adjacent communities with a high degree of social and economic integration. MSAs are generally composed of multiple counties. Based on review of the Green Book, the parish is currently designated as being in attainment for all NAAQS.

3.2.2 Human Environment

Historically, damages from storm surge and riverine flooding events have adversely impacted business and industrial activity, agricultural activity, local employment and income, which then led to commensurate negative impacts to property values and the tax base, upon which government revenues rely. Public facilities and services have historically grown to meet population demands. The area includes a mixture of community centers, schools, hospitals, airports, colleges, and fire protection.

The transportation infrastructure includes major roads, highways, railroads, and navigable waterways that have developed historically to meet the needs of the public. Interstate 12 (I-12) is an east-west thoroughfare that branches off from Interstate 10 (I-10) and is a primary route for hurricane evacuation and post-storm emergency response. Rail and aviation facilities are spread throughout the parish.

Community cohesion is based on the characteristics that keep the members of the group together long enough to establish meaningful interactions, common institutions, and agreed upon ways of behavior. These characteristics include race, education, income, ethnicity, religion, language, and mutual economic and social benefits. The study area is comprised of communities with a long history and long-established public and social institutions, including places of worship and schools.

3.2.2.1 Socioeconomics

The socioeconomics can be characterized by inventory of structures, trends in population, number of households, employment, and income. Historically, damages from storm surge and riverine flood events have adversely impacted business and industrial activity, agricultural activity, and local employment and income, which then led to commensurate negative impacts to property values and the tax base upon which state and municipal government revenues rely.

3.2.2.1.1 Structures

An inventory of residential and nonresidential structures was developed by CEMVN in 2019 using the National Structure Inventory (NSI) version 2 for the study area. The inventory consists of approximately 94,000 structures with 90 percent categorized as residential and 10 percent categorized as commercial. Figure 3-5 shows the NSI and the study area boundary. Table 3-10 shows the structures damaged by coastal and riverine combined probability events, which is a specific event that will occur in any given year (specific events listed in the Table 3-10) under existing conditions.

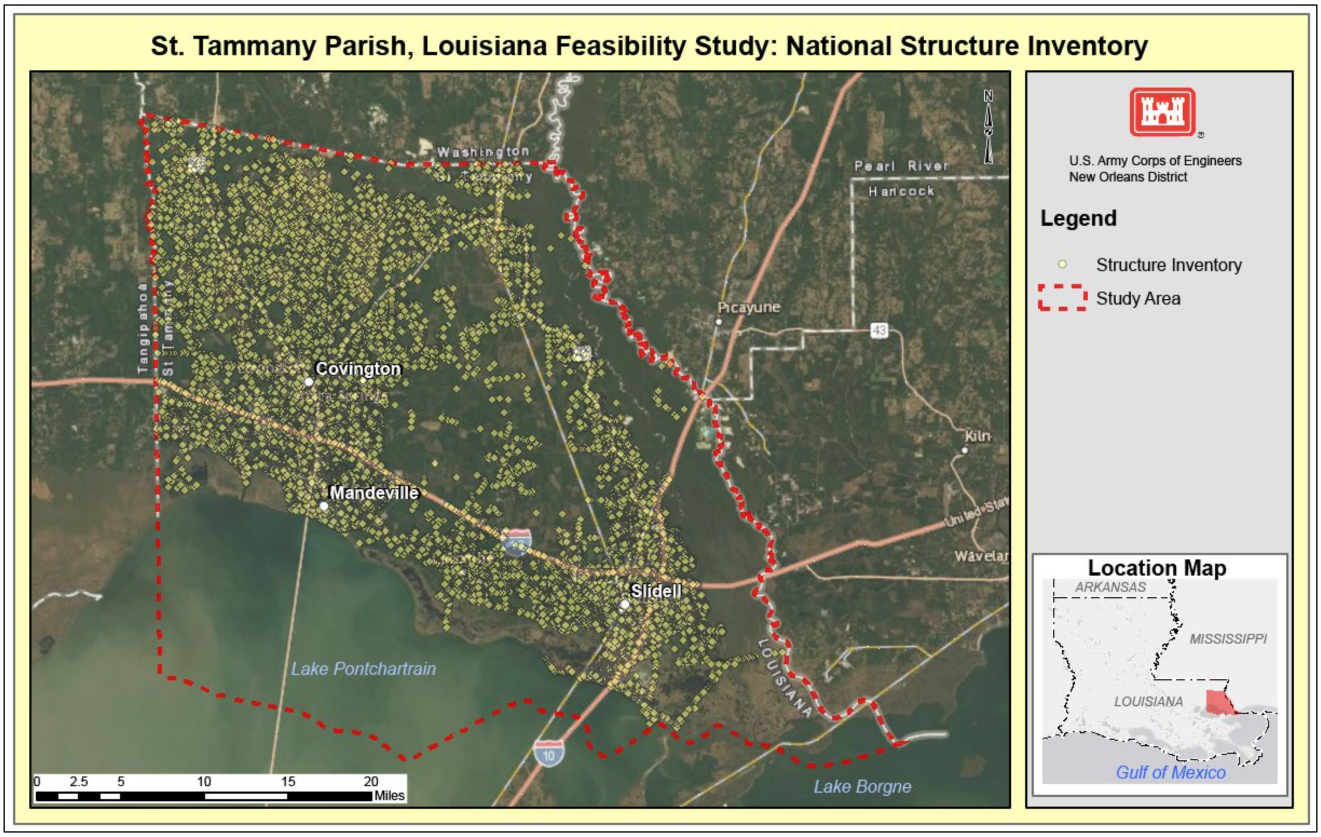

Figure 3-5. Study Area Boundary and National Structure Inventory (2019)

Table 3-10. Structures Damaged by Probability Event under Existing Conditions

Structures Damaged by Probability Event in Existing Conditions	
0.10 (10 year)	6,150
0.04 (25 year)	9,650
0.02 (50 year)	13,800
0.01 (100 year)	17,850
0.005 (200 year)	22,800
0.002 (500 year)	25,600

3.2.2.1.2 Population, Number of Households, and Employment

Tables 3-11, 3-12, and 3-13 display the population, number of households, and the employment (number of jobs) for the years 2000, 2010, 2020, and projections for 2025 and 2045 for St. Tammany Parish.

Table 3-11. Historical and Projected Population

Parish	2000	2010	2020	2025	2045
St. Tammany	192,131	234,567	258,447	262,054	275,133
Sources: 2000 and 2010, and 2020 from U.S. Census Bureau; 2019, 2025, 2045 from Moody's Analytics (ECCA) Forecast					

Table 3-12. Historical and Projected Households

Parish	2000	2010	2020	2025	2045
St. Tammany	69,714	87,915	95,054	105,906	119,757

Sources: 2000 and 2010, and 2020 from U.S. Census Bureau; 2019, 2025, 2045 from Moody's Analytics (ECCA) Forecast

Table 3-13. Historical and Projected Employment

Parish	2000	2010	2020	2025	2045
St. Tammany	59,560	78,379	89,294	96,699	110,549

Sources: 2000 and 2010, and 2020 from U.S. Bureau of Labor Statistics; 2019, 2025, 2045 from Moody's Analytics (ECCA) Forecast

3.2.2.1.3 Income

Table 3-14 shows the actual and projected per capita personal income levels for St. Tammany Parish from 2000 to 2025.

Table 3-14. Actual and Projected Per Capita Personal Income Levels from 2000 to 2025

Parish	2000	2010	2020	2025
St. Tammany	29,945	46,995	70,190	96,474

Sources: 2000, 2010, and 2020 from U.S. Bureau of Economic Analysis; 2019, 2025 from Moody's Analytics (ECCA) Forecast

3.2.2.1.4 FEMA Flood Claims

The FEMA flood loss statistics for St. Tammany Parish from July 2018-July 2019 are shown in Table 3-15. The table includes the total number of insured losses and total dollars paid. According to the Flood Loss Outreach and Awareness Taskforce (FLOAT), approximately 37 percent of the properties in St. Tammany Parish have flood insurance. The table does not account for uninsured losses or unincorporated areas of the parish. Recent disasters and predicted future events would continue to negatively impact the region without some form of flood risk management solution. The PDT developed FRM, CSRM, and combined FRM and CSRM management measures to reduce the risk of flood damages for residential and commercial structures, vehicles, and major transportation routes and activities vital to the economy of the region and nation.

Table 3-15. FEMA Loss Statistics for St. Tammany Parish, Louisiana from 11/1970 through 3/2022

Location	Number of Claims	Total Payments
ABITA SPRINGS, TOWN OF	247	$2,283,799
COVINGTON, CITY OF	2,731	$56,600,007
FOLSOM, VILLAGE OF	333	$10,890,845
MADISONVILLE, TOWN OF	1,298	$32,209,102
MANDEVILLE, CITY OF	4,708	$80,767,614
PEARL RIVER, TOWN OF	566	$8,719,945
SLIDELL, CITY OF	25,992	$1,504,274,888
ST. TAMMANY PARISH*	38,642	$1,773,746,121

Source: Federal Emergency Management Agency (FEMA). *Incorporated St. Tammany Parish includes but is not limited to Lacombe and Bush.

3.2.2.1.5 Social Vulnerability Index

The devastation from Hurricane Katrina brought nation-wide attention to the salience of the related concepts of social vulnerability and resiliency when evaluating water resources projects (USACE, 2008). Social vulnerability is a characteristic of groups or communities that limits or prevents their ability to withstand adverse impacts from hazards to which they are exposed. Resiliency, in turn, refers to the ability of groups or communities to cope with and recover from adverse events. The factors that contribute to vulnerability often reduce the ability of groups or communities to recover from a disaster; therefore, more socially vulnerable groups or communities are typically less resilient.

Several factors have been shown to contribute to an area's vulnerability/resiliency, including poverty, racial/ethnic composition, educational attainment, and proportion of the population over the age of 65. The social vulnerability index used in this study was developed by the Center for Disease Control (CDC) which utilized 2018 American Community Survey data. The CDC's Social Vulnerability Index (SVI) measures the relative vulnerability of every U.S. Census tract. The SVI ranks 15 social factors including unemployment, minority status, and disability and then further groups these factors into four related themes. Each census tract receives a rating for each theme as well as an overall theme. The four themes include socioeconomic status, household composition and disability, minority status and language, and housing type and transportation. Tracts are rated as percentile ranking values ranging from 0 to 1, with higher values representing greater vulnerability. The CDC flags census tracts with an overall SVI rating greater than or equal to 0.9 as high vulnerability to hazards.

Of the 43 census tracts in the study area, one census tract was flagged as "high vulnerability". Located in Slidell, Louisiana, census tract 409 has an overall SVI score of 0.95. There are a few other census tracts with somewhat high SVI scores ranging between 0.8165 and 0.8927; most of these census tracts located in the southeast portion of the study area in the North Slidell/McClane area. Overall, the majority of SVI scores in the area are less than 0.9, meaning there is not an especially high vulnerability to natural disasters in these locations.

3.2.2.1.6 Environmental Justice

Environmental Justice (EJ) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin or income regarding the development, implementation and enforcement of environmental laws, regulations, and policies, with no group bearing a disproportionate burden of environmental harm, and risks. Executive Order (EO) 12898 directs federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Areas of EJ concern are identified to help inform planners as to the location of those areas needing a particular focus and attention when determining the impacts of the federal action, as described in EO 12898. Federal agencies should assess the effects of their projects on communities with Environmental Justice concerns in accordance with EO 12898: Environmental Justice, 1994 and EO 14008, Tackling the Climate Crisis at Home and Abroad, 2021. For USACE, compliance with these Executive Orders is mandatory pursuant to Section 112(b)(1) of WRDA 2020 (Public Law 116-260). ("In the formulation of water development resources projects, the Secretary shall comply with any existing Executive Order regarding environmental justice . . . to address any disproportionate and adverse human health or environmental effects on minority communities, low-income communities, and Indian Tribes."). For purposes of consistency with EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, the terms "minority populations" and low-income populations" are used in this document.

The PDT used U.S Census Data to identify areas of EJ concern (minority and low income communities) within the study area, St. Tammany Parish. For purposes of the EJ analysis, "environmental justice communities" were defined as communities that meet established thresholds for identifying low-income area residents who identify as a person of color, or minority. Methods for determining thresholds are explained in EPA's EJ Promising Practices document and are presented below.

1. Census Data. The PDT used the NHGIS tool to obtain the most recent U.S. Census Bureau 5-year survey data, 2016-2020, herein referred to as 2020 data. Similar data is available through the EJSCREEN tool. Data for cities and towns and for U.S. Census Block Groups are presented which helps highlight areas of EJ concern for different geographic areas. Cities and towns are identified by the U.S. Census bureau. The U.S. Census block is a geographic area consisting of several smaller U.S. Census Blocks which are combined to form Block Groups. Each of these groups represent geographic areas and people living in communities. There are 160 census block groups in the study area, St. Tammany Parish.

   A. Low income threshold criteria. A reference area's percentage of residents living below poverty was used as the threshold for identifying areas of EJ concern based upon poverty status. The state of Louisiana is the reference area for the study. The 2020 percentage of Louisiana residents living below the poverty level is 19.6 percent. Any area in the study area that consists of 19.6 percent or more of residents living below poverty is considered an area of EJ concern. The state poverty income level for year 2020 was $26,200 for a family of four.

B. Minority population threshold criteria. If 50 percent of residents in an area identify as a person of color (minority), then the area is considered an area of EJ concern. Additionally, if the percentage of minority residents in an area is meaningfully greater (15 percent) than the percentage minority in the state of Louisiana, that area is also considered an area of EJ concern. The threshold used to identify minority areas of EJ concern is the lower of the two. In this case, the minority threshold used to identify areas of EJ concern is 48.4 percent or greater.

Data for Places and CDPs gives a broad- brush overview of the parish's minority and low-income status. Table 3-16 shows the racial composition for the Parish and its cities and towns. A majority of the Parish is white with 83 percent identifying as white and 17 percent identifying as minority. The largest municipality in the study area is Slidell, home to about 11 percent of the Parish population, is also majority white. All of the other locations shown in Table 3-16, including Lacombe, Mandeville, Covington and Abita Springs are majority white. The largest minority in the parish is Black/African American. None of the locations shown in Table 3-16 meet or exceed the minority threshold of 48.4 percent to be considered an area of EJ concern.

Table 3-16. 2020 U. S. Census Bureau Information

Location	Total Population	White	Black	Native American	Asian	Native Hawaiian	Two or more Races	Minority	Hispanic
St. Tammany	264,570	82%	13.9%	0.6%	1.5%	0.1%	2.0%	18.0%	6%
Slidell (city)	28,781	71.5%	17.7%	0.9%	2.9%	0	6.0%	28.5%	7%
Lacombe CDP*	8,519	70.1%	24.9%	0.2%	0.2%	0	3.2%	29.9%	3%
Mandeville (city)	13,192	94.9%	0.8%	0.2%	2.3%	0	1.8%	5.1%	4%
Covington (city)	11,565	78.2%	14.7%	0.2%	0.7%	0	4.0%	21.8%	4%
Abita Springs town	2,605	83.6%	5.5%	0.3%	0.4%	0	10%	16.4%	7%

*Census Designated Place

Source: U.S. Census Bureau, American Fact Finder, ACS 2016-2020.

Table 3-17 shows the percentage of people living below poverty for the Parish and its cities and towns.

The EPA recommends using the state's low-income percentage to identify areas of EJ concern, which is 19.6 percent for year 2020. None of the places shown in Table 3-17 meet or exceed this EJ threshold.

Table 3-17. Places within Study Area Percent of Population Living Below Poverty

Place	Percent of Population Below Poverty
St. Tammany Parish	12.7%
Slidell (city)	14.1%
Lacombe CDP	16.4%
Mandeville (city)	7.6%
Covington (city)	13%
Abita Springs (town)	8%

Source: U.S. Census Bureau ACS 2016-20201

However, there may be neighborhoods within these large Places, cities and towns that meet the criteria for an area of EJ concern.

A more refined and zoomed in approach uses U.S. Census Block Groups which are much smaller geographic areas compared to cities and towns. Census Block Groups are smaller geographic areas made up of Census Blocks (the smallest geographic area for which U.S. Census data is available).

A closer look at the study area reveals pockets of neighborhoods with EJ concerns located in Census Block Groups within these larger communities, which are identified in Figure 3-6. The colored polygons in Figure 3-6 depict the U.S. Census Block Groups in the study area that meet or exceed minority or low-income thresholds (or both) used to identify areas of EJ concern. Figure 3-7 shows the minority population percentages and Figure 3-8 shows the low-income population percentages of the block groups that are areas of EJ concern in the study area.

Of the 160 U.S. Census Block Groups in St. Tammany Parish, 22 block groups are low-income while 7 more are low-income and minority for a total of 29 block groups that are considered areas of EJ concern and noted on Figure 3-6 as blue and green polygons, respectively.

Out of the 160 block groups in St. Tammany, 12 are minority block groups and five more are minority and poverty. Figure 3-6 shows the minority block groups in the study area.

All of the minority and low-income areas identified on Figure 3-6 are the focus of the EJ assessment in Chapter 5.

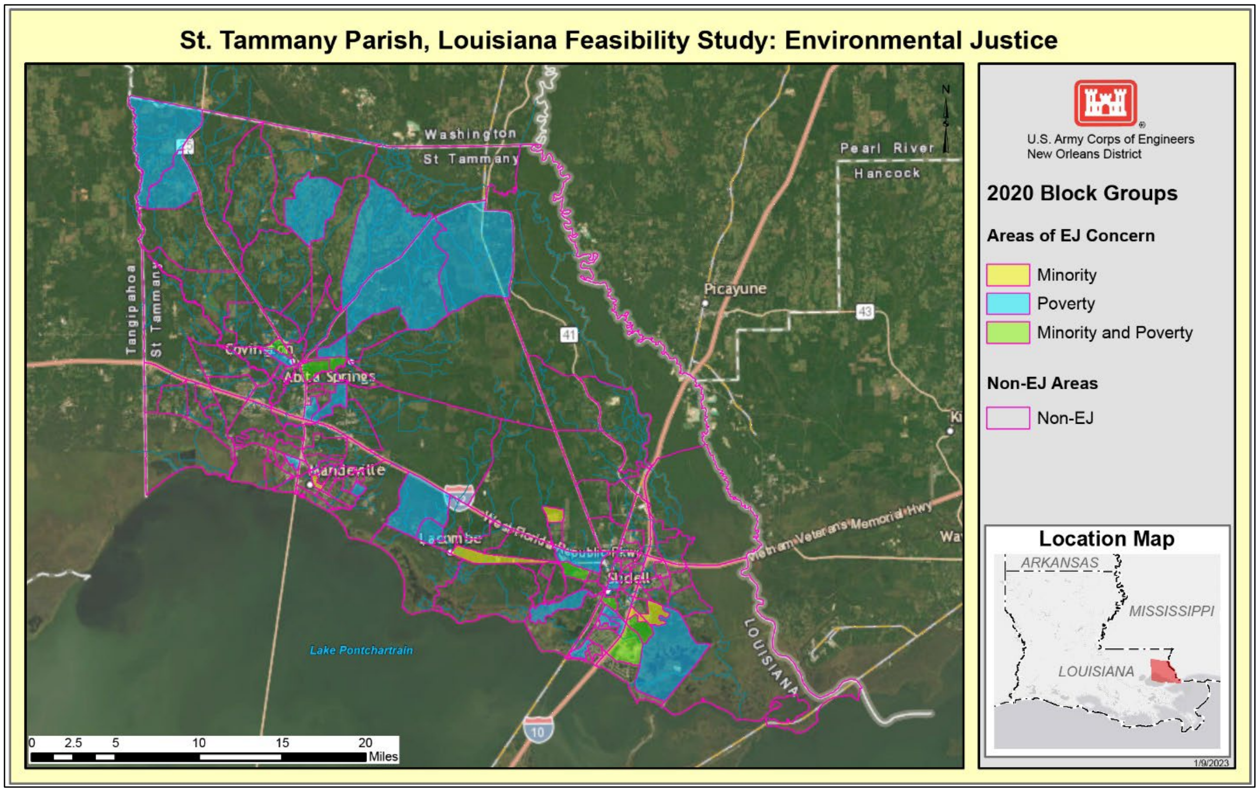

Figure 3-6. Areas of EJ concern at the Block Group Level, Study Area

Source: Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 16.0 [dataset]. Minneapolis, MN: IPUMS. 2021. http://doi.org/10.18128/D050.V16.0

Census Tract/Block Group Number	Total Population	White	Black	Native American	Asian	Hawaiian	Other	Two or More Races	Percent Minority
405013	1772	741	935	7	0	0	0	89	58.2%
406081	1121	458	353	0	0	0	247	63	59.1%
406083	1423	531	360	28	39	0	0	465	62.7%
407111	1976	848	1128	0	0	0	0	0	57.1%
408062	2177	787	912	0	260	0	0	218	63.8%
408063	1096	506	578	0	0	0	0	12	53.8%
408064	1625	587	1017	0	0	0	0	21	63.9%
408072	2882	831	1308	0	38	0	230	475	71.2%
409002	1242	461	606	126	0	0	49	0	62.9%
411051	1743	855	347	0	2	0	293	246	50.9%
412093	1805	740	795	0	0	0	0	270	59.0%
412133	1544	726	815	0	0	0	0	3	53.0%

Figure 3-7. Tract/Block Group, Areas of EJ Concern Minority Percentages

Source: U.S. Census ACS 2016-2020

Census Tract/Block Group Number	Total Population*	Population Living Below Poverty	% of Population Living Below Poverty
401032	2284	837	36.6%
401071	1202	297	24.7%
401072	3038	1096	36.1%
401081	1465	436	29.8%
402031	1016	265	26.1%
402033	898	371	41.3%
403061	1401	376	26.8%
405012	1388	375	27.0%
405013	655	279	42.6%
405021	2353	609	25.9%
406062	1389	474	34.1%
406081	1121	580	51.7%
406083	1423	339	23.8%
406091	2721	507	18.6%
408011	1625	303	18.6%
408012	1058	240	22.7%
408013	1355	350	25.8%
408052	1593	339	21.3%
408064	1625	628	38.6%
408072	2882	912	31.6%
408073	988	343	34.7%
409002	1242	357	28.7%
410021	764	182	23.8%
411032	2267	576	25.4%
411051	1743	392	22.5%
411061	1681	448	26.7%
412112	1713	383	22.4%
412131	1801	613	34.0%
412134	1082	452	41.8%

*Population for Whom Poverty Status is Determined

Source: U.S. Census ACS 2016-2020

Figure 3-8. Tract/Block Group, Group, Areas of EJ Concern Poverty Percentages

3.2.2.2 Navigation

The Abita River, Bayou Cane, Bayou Chinchuba, Bayou, LaCombe, Bayou Liberty, Bogue Chitto River, Bogue Falaya River, Morgan River, Tchefuncte River and its Tributaries, and the West Pearl River are navigable waterways that empty into Lake Pontchartrain and the Gulf of Mexico. All are of importance to recreational and commercial interests in the parish. Maintenance of access to these waterways is vital to the continued growth and health of industries and commerce they serve.

3.2.2.3 Cultural, Historic, and Tribal Trust Resources

Cultural resources include historic properties, archaeological resources, and Native American resources, including sacred sites and traditional cultural properties (TCPs). Historic properties have a narrower meaning and are defined in National Historic Preservation Act (NHPA) regulations at 36 CFR 800.16(l); they include prehistoric or historic districts, sites (archaeological and religious/cultural), buildings, structures, or objects listed in or eligible for listing in the National Register of Historic Places (NRHP). Historic properties are identified by qualified agency representatives in consultation with State Historic Preservation Officers (LA SHPO), federally recognized tribes, and other consulting parties. Common cultural resources include prehistoric Native American archeological sites, historic archeological sites, individually NRHP listed buildings, and National Register Historic Districts (NRHDs).

The cultural prehistory and history of parish is very rich. The generalized cultural chronology for Louisiana has five primary archaeological components, or “periods,” as follows: Paleoindian (11,500-8000 B.C.), Archaic (8000-800 B.C.), Woodland (800 B.C.-1200 A.D.), Mississippian (1200-1700 A.D.), and Historic (1700 A.D.-present). The PDT identified historic properties based on a review of the NRHP database, the Louisiana Division of Archaeology (LDOA) Louisiana Cultural Resources Map (LDOA website), historic maps, pertinent regional and local cultural resources investigations, historic aerial photography, and other appropriate sources. This review revealed a total of 45 historic properties listed in the NRHP are located within St. Tammany Parish. These include 6 historic districts, 36 individual buildings, and 3 sites.

Three historic districts are located in Covington and include the Division of St. John Historic District (Covington Historic District), Bogue Falaya Park (Wayside Park), the St. Scholastica Priory and Cemetery. The Division of St. John Historic District (Covington Historic District), listed in 1982 under Criteria A in the area of Community Planning and Development and Criteria C in the area of Architecture, is comprised of largely late-19th and early-20th century residential and commercial buildings. The Bogue Falaya Park (Wayside Park), listed in 2017, includes four contributing resources significant under Criterion A for Entertainment/Recreation. The St. Scholastica Priory and Cemetery, listed in 2018, is a rural 16-acre site comprised of four resources significant under Criteria A in the area of Religion and Education for its association with the Benedictine Sisters of the St. Scholastica in St. Tammany Parish.

Two other NRHDs located in western St. Tammany Parish include Fontainebleau State Park (Tchefuncte State Park) in Mandeville and the Abita Springs Historic District in Abita Springs. The Fontainebleau State Park (Tchefuncte State Park), listed in 1999, is located on Lake Pontchartrain. The park is significant in the area of Entertainment/Recreation and Politics/Government as it represents the early development of the state parks movement in Louisiana and the critical role of the Civilian Conservation Corps in the establishment of state parks in Louisiana. The Abita Springs Historic District, listed in 1982, is comprised of mostly late-19th and early-20th century resources that served Abita Springs, a former vacation resort for New Orleans residents.

The remaining historic district is the Teddy Avenue Residential Historic District located northeast of downtown Slidell. Recently listed in the NRHP in July 2021, the Teddy Avenue NRHD includes 29 contributing early 20th century residential buildings and one public park, Brugier Addition. The district is significant under Criterion C in the area of Architecture as the most cohesive and intact collection of early twentieth century residential buildings in Slidell.

Three sites in St. Tammany Parish include the Wouldiams Cemetery in Lacombe, and the Pottery Hill and Tchefuncte sites in Mandeville. The Wouldiams Cemetery, listed in 2018, is a 1-acre Creole cemetery locally significant under Criteria A in the area of Ethnic Heritage. The Pottery Hill site (16ST48), listed in 2011, is an archaeological site that is significant at the state level for subsurface deposits of prehistoric Tchefuncte and Marksville cultures with a period of significance A.D. 1-250. The Tchefuncte site (16ST1) is located in Fontainebleau State Park. It was listed in the NRHP in 2000 for its extensive and well preserved shell middens associated with the prehistoric Tchefuncte culture.

3.2.2.3.1 Archaeological Site Potential

Approximately 187 cultural resources investigations have occurred within the parish. The LDOA NRHP Eligibility Database indicates that 92 prehistoric and historic archaeological sites have been previously recorded as a result of these investigations. To date, no comprehensive systematic archaeological survey has been conducted throughout the entire study area and the distribution of recorded archaeological sites is largely the result of project-specific Federal and state compliance activities (e.g., linear surveys of roads, pipelines, and power line rights-of-way). Therefore, in addition to considering the known sites within the parish, the TSP footprints must also be further assessed for archaeological site potential.

In lieu of additional survey data, Louisiana's Comprehensive Archaeological Plan (Girard, et al. 2018) provides a useful site distribution model that can be used for baseline planning purposes. To a great extent, the unique geomorphology and ecology of the study area has influenced site type and location. To examine how the physical landscape in Louisiana impacts the archaeological record, the LDOA divides the state into a series of regions that follow the ecoregions classification of the Western Ecology Division of the United States Environmental Protection Agency (https://www.epa.gov/eco-research/ecoregion-downloadfiles-state-region-6#pane-16). There are six regions at Level III, two of which fall within the present study area: Southeastern Plains and Southern Coastal Plain. Girard, et al., (2018:24-31) define how the unique environmental, biological, and physiological characteristics of each region cumulatively influenced cultural development in order to provide context to the distribution of where sites are likely or unlikely to occur. These characteristics are described below.

Southeastern Plains

This region lies in the northern portions of the Florida parishes in the state of Louisiana and consists of level to gently undulating plains formed in Pliocene and Pleistocene deposits that are covered by thin layers of loess in some areas. These deposits consist of sandy loams, silt loams, and clay loams with cherty gravels present. Cherty gravel bars are common due to north-south trending streams and rivers that drain the region. Long-leaf pine woodlands with mixed oak-pine forest are present within upland vegetation. Sites are typically situated on higher ridge crests and along stream margins. Sites would occur in surface contexts in higher elevations while occasional buried sites may be found in alluvial settings. Agricultural and timber harvesting activities within this region impact sites in surface contexts. Gravel-mining operations within the larger drainages also have destroyed sites within the limits of their activities. Additionally, oil and gas development of the Tuscaloosa shale may have a significant impact on sites in the future.

Southern Coastal Plain

The Southern Coastal Plain region consists of late Pleistocene terraces with Holocene-age alluvial and deltaic deposits along the coast. The uplands consist of gently rolling topography dissected by north-south trending streams and rivers. Cherty gravels that originated from the Pleistocene sediments accumulate in stream beds. Long-leaf pine forests with infrequent open savannas on level upland surfaces dominate upland vegetation. Holocene alluvial deposits are in floodplains and on low terraces along the major streams, especially the Pearl River. Sites within the upland areas are concentrated on higher ridge crests and overlooking streams. Most of these deposits are shallow with overlapping occupations and no opportunity for stratified sites. Buried and stratified sites may be present in the floodplains of the larger streams.

The coastal areas of this region are experiencing some of the fastest urban development of any area in the state. As a result, this growth is impacting many sites. Further, there is significant erosion along the north shore of Lake Pontchartrain that is impacting sites in that area. In upland areas, pine plantations and agriculture are the dominant ground-disturbing activities in areas where sites are generally at the modern ground surface. Additionally, oil and gas development of the Tuscaloosa shale may have a significant impact on sites in the future.

3.2.2.3.2 Tribal Trust Resources

There are six federally-recognized Tribes that have current and/or ancestral interest within the study area:

- Alabama-Coushatta Tribe of Texas (ACTT)

- Choctaw Nation of Oklahoma (CNO)
- Coushatta Tribe of Louisiana (CT)
- Jena Band of Choctaw Indians (JBCI)
- Mississippi Band of Choctaw Indians (MBCI)
- Tunica-Biloxi Tribe of Louisiana (TBTL)

Each Tribe has a Tribal Historic Preservation Officer (THPO) who assumes the responsibilities of the LA SHPO for cultural resources within their Tribal lands, and consults with Federal agencies on activities that may impact archaeological sites of interest on or off of Tribal lands [as defined in 36 CFR § 800.16(x)].

3.2.2.3.3 Borrow Sites

CEMVN completed a preliminary review of existing conditions regarding cultural resources within the Area of Potential Effects (APE) for each of the proposed borrow sites. Historic properties within the proposed APEs for each borrow site were identified based on CEMVN's review of the NRHP database, the *Louisiana Cultural Resources Map* provided by the LA SHPO, and historic map research. No archaeological sites or historic built resources were identified within the proposed borrow sites. CEMVN's preliminary review of the proposed borrow sites evaluated is summarized in Table 3-19.

Table 3-19. Summary of Cultural Resources and Surveys within the Proposed Borrow Sites

Borrow Site	Previously Recorded Cultural Resources	Previous Survey	Previous Survey Coverage	Other Notes:
ST5	None	22-3725	Full	Phase I cultural resources survey on behalf of St. Tammany Parish for a 156.41 acre (63.30 ha) tract on Cypress Bayou in St. Tammany Parish, Louisiana (22-3725; Kuttruff et al. 2011). No cultural resources were identified within the ST5 borrow site.
ST6	None	None	None	City of Slidell constructed the West Diversion Detention Pond in 1998 (USACE 2012).
ST9	None	22-3151	Full	Phase I cultural resources survey on behalf of USCAE for five proposed detention ponds along the north side of the existing W-14 drainage canal (22-3151; Moreno et al. 2012). The parcel surveyed included 30.28 acres (12.25 ha). No cultural resources were identified within the ST9 borrow site. A determination of No Historic Properties Affected was submitted to the LA SHPO on 9 Sept 2008 and 22 Sept 2011. LA SHPO concurred with CEMVN's determination on 7 Oct 2008 and 16 Nov 2011.
MS-1	None	07-395	Full	MS-1 was investigated for cultural resources for IER #19 and #23 for the HSDRRS projects. At that time, the Mississippi Division of Archives and History (MDAH) had no record of listed or eligible historic properties within MS-1. A Phase I survey of the proposed borrow area did not identify any cultural resources within the Pearlington site (07-395; Pumphrey 2007). The MS SHPO concurred with CEMVN's determination on 22 Nov 2006.
MS-2	None	09-0690	Full	MS-2 was investigated for cultural resources for IER #31 for the HSDRRS projects. A Phase I cultural resources assessment was performed for the Port Bienville contractor-furnished borrow area and no NRHP listed or eligible cultural resources were identified (09-0690; Thorne 2008). Concerns were raised by the Jena Band of Choctaws and the Mississippi Band of Choctaws about potential unrecorded burials within the proposed borrow area. At that time, a Memorandum of Agreement (MOA) was signed between the two tribes as well as by M. Matt Durand, L.L.C. of Port Bienville Clay Mine, L.L.C. outlining procedures to allow use of the borrow area and to care for unexpected discoveries should these occur. It is unknown if this MOA has expired pursuant to its duration provision. If the agreement expired before the undertaking or mitigation measures have been completed, CEMVN must reinitiate consultation to develop a new MOA to resolve the adverse effects from the proposed undertaking. The new agreement may acknowledge, incorporate, or continue already agreed upon measures.

3.2.2.4 Noise and Vibration

The Noise Control Act of 1972 (P.L. 92-574) directs Federal agencies to comply with applicable federal, state, interstate and local noise control regulations. In 1974, United States Environmental Protection Agency provided information suggesting that continuous and long-term noise levels in excess of day-night sound level 65 A-weighted decibels (dBA), are normally unacceptable for noise-sensitive land uses such as residences, schools, churches, and hospitals.

Ambient noise levels within the study area are influenced by land uses including industrial, commercial, residential and agricultural areas. Noise sources include primarily vehicular traffic, trains, and large transport vehicles travelling in the study area. Secondary noise sources include industrial activities and construction along parish and township roads.

3.2.2.5 Aesthetics

The visual resources assessment procedure (VRAP) for USACE (Smardon, et al., 1988) provides a method to evaluate visual resources affected by USACE water resources projects. These VRAP criteria identify significant visual resources in the study area such as:

- important urban landscapes, including visual corridors, monuments, sculptures, landscape plantings, and greenspace,
- study area is easily accessible by a major population center,
- project is highly visible and/or requires major changes in the existing landscape,
- areas with low scenic quality and limited visibility,
- historic or archeological sites designated as such by the NRHP or State Register of Historic Places,
- parkways, highways, or scenic overlooks and vistas designated as such by a Federal, state, or municipal government agency,
- visual resources that are institutionally recognized by Federal, state, or local policies,
- tourism is important in the study area's economy,
- study area contains parks, forest preserves, or municipal parks,
- wild, scenic, or recreational water bodies designated by government agencies,
- publicly or privately operated recreation areas.

Significant visual resources are primarily described in the Cultural/Historic and Recreation Resources sections of this document and the Appendices. Specific examples include:

- of Mandeville lakefront area,
- Lake Pontchartrain Causeway,
- National Registered Historic Districts located in the cities of Covington and Abita Springs,
- National Registered structures located in in the cities of Covington and Slidell and towns of Abita Springs and Madisonville,
- National Registered Fontainebleau Louisiana State Park,
- National Registered Bogue Falaya City Park,
- Abita, Bayou Chinchuba, Bayou Cane, Bayou Lacombe, Bayou Liberty, Bayou Liberty, Bogue Chitto, Bogue Falaya, Bradley Slough, Holmes Bayou, Morgan, Tchefuncte and its tributaries, West Pearl, and Wilson Slough Louisiana State Designated Natural and Scenic Rivers,
- Bogue Chitto and Big Branch National Wildlife Refuges,
- Pearl River, St. Tammany, and Lake Ramsey Savannah Louisiana State Designated Wildlife Refuges,
- Fairview-Riverside Louisiana State Park.

3.2.2.6 Recreation

There are two Federal and five state public areas, comprising 143 square miles, which are used for recreational opportunities and are centered on natural resources: Big Branch National Wildlife Refuge (to include Southeastern Louisiana National Wildlife Refuge Complex Headquarters and Visitor Center in Lacombe), Bogue Chitto National Wildlife Refuge, Fairview-Riverside State Park, Fontainebleau State Park, Lake Ramsey Savannah WMA, Pearl River WMA, and St. Tammany Wildlife Refuge. Many of the parks offer hiking/biking trails, camping, and wildlife observation. Additionally, there are nearly 100 parish and city public areas consisting of green spaces, ball fields, playgrounds, indoor recreation facilities, paths and trails *(*See Appendix C: Environmental Table C:3-1*).* See photo of the Tammany Trace in Figure 3-8.

Figure 3-8. Tammany Trace is 31 Miles of Louisiana's only Rails-to-Trails Conversion, which Links Five North Shore Communities with Green Space *Photo credit: Louisiana Northshore.com.*

Communities like Abita Springs, Covington, Madisonville, Mandeville, Lacombe, and Slidell provide walking and biking trails as an integral part of the recreation development along Tammany Trace and the lakefront. Communities along the I-12 corridor and the lakefront provide numerous opportunities for non-consumptive recreation activities. The majority of forested areas are predominantly BLH and are located north of the I-12 corridor. These forested lands promote consumptive recreation activities, including fishing and hunting, with hunting being predominantly big game hunting (deer and turkey), small game hunting (squirrel, rabbit, raccoon, dove, etc.), and waterfowl hunting. Numerous boat-launching sites along the network of waterways cater to boating activities and sport fishing deep within the parish and along the lakefront.

According to the United States Department of the Interior (USDOI), National Park Service (NPS) Land & Water Conservation Fund (LWCF), nearly $4 million in LWCF funds has supported 30 recreation projects within the study area between 1965 and 2011 (See Appendix C: Environmental Table C:3-2). Section 6(f)(3) of the LWCF Act assures that once an area has been funded with LWCF assistance, it is continually maintained in public recreation use, unless NPS approves substitution property of reasonably equivalent usefulness and location and of at least equal fair market value.

> ***SEC. 6(f)(3) Legal Protection for Grant-Assisted Recreation Sites:*** *No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location.*

3.3 FUTURE WITHOUT PROJECT CONDITIONS

The NEPA requires that, in analyzing alternatives to a proposed action, a Federal agency must consider an alternative of “no action.” The No Action Alternative or future without project (FWOP) conditions represent the anticipated conditions if the proposed action were not implemented and the predicted project benefits (e.g. flood risk reduction) would not be achieved. Below is a summary of the FWOP conditions. Section 1.6 discusses ongoing programs and potential projects in the study area for floodplain related activities such as the projects listed in the 2023 Master Plan. Section 3.2 discusses the Relevant Resources and Existing Conditions of the affected environment and project areas. The environmental consequences of taking “no action” is discussed by resource in Section 5. of the existing and future conditions within the study area. Appendix E: Hydrologic & Hydraulics discusses the future hydrologic conditions anticipated within the study area.

In the FWOP condition, communities would continue to be at risk from high water events induced by coastal storm surges and flooding without intervention. Due to the low existing elevation and anticipated sea level rise, it is reasonably foreseeable that the communities located adjacent to the main water bodies would continue to be plagued with challenges related to high water events. Continued flooding from the Pearl River, Tchefuncte, Mile Branch, Bogue Chitto, Liberty Bayou, Bayou Bonfouca, and other waterways would continue to negatively impact communities within the parish. Due to heavy development along streams such as Mile Branch and the coast, riparian corridors and wetland habitat have been reduced resulting in a reduction of flood storage capacity of the various habitat to absorb increasing water during storm events. Flooding from the Pearl River is commonplace in Slidell and would only worsen based on current conditions. These trends are expected to continue into the future. Wetlands are beneficial for wave attenuation to reduce the energy of storm surges, and with anticipated increased storm buffering as the result of climate change, these benefits would decline as wetlands are lost.

An increased threat and the resulting negative effects from sea level rise, subsidence, and climate change are anticipated to continue into the future. This would result in higher and more frequent storm damages and higher average annual damages which could negatively impact tax revenues as property values decline due to higher risk of damage from flooding events over time. However, it is reasonable to believe that without implementation of the proposed action, other Federal, state, local, and private efforts would attempt to address the needs of the area, which would burden the revenue and budget of the parish and local communities.

Hydrologic modeling for the 10 year and 100 year storm events document a gradient of expected flooding in the parish. The hydrologic gradients were overlayed on the habitat data layers to assess potential future impacts. Increases in precipitation and tropical storm events resulting from climate change and relative sea level rise would cause increases in water temperature. Increases in water temperature along with the trend in climate change correlates with lower dissolved oxygen levels and warmer air temperatures that would likely increase the length of the growing season for certain species of aquatic plants. Species of aquatic plants that can adjust to increasing temperatures and lower dissolved oxygen would become dominant and those species that cannot adapt would become scarce. The adapted aquatic species are often invasive and longer growing seasons would create conditions favorable for growth of invasive species. Concurrently, shifts in the species of aquatic plants would result in lower plant biodiversity which would impact wildlife species dependent on the vegetation. Wildlife that does not adapt would become scarce in the area. Management of those invasive plant species, as is currently practiced in Louisiana, may result in increases in nutrient-laden runoff fueling algal blooms in nearby waterways.

Section 4
Formulation of Alternative Plans

Plan formulation is the process of building alternative plans that meet planning objectives, address the identified problems while avoiding identified constraints. A systematic and repeatable planning approach is used to ensure that sound decisions are made in accordance with the processes laid out in the Planning Guidance Notebook (ER 1105-2-100). This RDIFR-EIS describes the iterative process of identifying measures continually reevaluating the measures screening of measures, developing alternative plans and screening alternatives through the identification of the Final Array of Alternatives and ultimately identifying the TSP. The plan formulation process is consistent with protecting the Nation's environment, pursuant to national environmental statues, applicable EOs, and other Federal planning requirements. The plan formulation process considers all effects, beneficial and adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (P&G) (1983), which are: NED, EQ, RED, and OSE.

The plan formulation process is a data driven process, building upon previous data and information and developing more detail as necessary, including refinement of the measures identified and alternatives developed. Each review and screening iteration identified informational needs necessary to inform planning decisions. In the early phases of the study, the PDT used existing information and professional judgment. As the study progressed, additional data and analyses were deemed necessary to identify the differences between the measures and alternatives. Risk-informed decisions were incorporated into the planning process to balance the level of study detail necessary to make informed decisions and uncertainty that was acceptable in accordance with USACE policy, such as ER 1105-2-101 "Risk Assessment for Flood Risk Management Studies."

Early iterations of measures were devoted to understanding the problems while identifying possible solutions (solutions to reduce flood risk) and critical uncertainties. In subsequent iterations, information was developed to reduce uncertainties that affected the choices at hand. While it was not possible to eliminate all uncertainty, priority was given to those that posed the greatest risk to inform decision making. As existing information was utilized to inform the comparison of alternatives, the risk of using existing information was also measured to determine if the risk was acceptable when compared to the cost and time required to collect new data or develop new analyses.

Where information was determined to be insufficient on a critical aspect of the alternatives, consideration was given to the level of analysis and cost required to inform the decision versus the risk of obtaining the critical information at a later stage of the planning process such as after selection of the TSP. By using these principles, the tolerance for risk was managed by balancing the level of uncertainty with the tolerance for risk. Figure 4-1 illustrates the planning process and summarizes the information utilized at the various stages of the planning process. See Appendix B: Plan Formulation for more details.

Step 2 of Planning Process: Identification of Existing Conditions of the Affected Environment. Section 3 describes the affected environment and the historic, existing and future conditions related to FRM and CSRM. Historic and existing trends were evaluated and projected into the future to assess anticipated changes in the future conditions if no Federal actions are taken. The data and trends identified were used to define the FWOP conditions, or the No Action Alternative.

Step 3 of Planning Process: Formulate Alternative Plans. This step of the planning process involves developing a wide range of potential actions or management measures (measures) to solve the problems while also meeting the planning objectives and avoiding study constraints. Individual measures are combined to create different alternatives to meet planning objectives. A measure is, potentially, a piece or part of the solution to resolve a problem, satisfy a need, or take advantage of an opportunity. A management measure, as defined by Yoe and Orth (IWR Report 96-R-21, November 1996, page 134), is "a means to an end; an act, step, or proceeding designed for the accomplishment of an objective. The definition of a measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Measures are the building blocks of which alternative plans are made…." Alternative plans are a set of one or more measures functioning together to address one or more planning objectives.

Based on the identified problems, opportunities, objectives, constraints, and inventory and forecasting of critical resources defined in Sections 1, 2, and 3 of this RDIFR-EIS, 30 management strategies (different types of structural, nonstructural, and engineering with nature-based actions) to reduce flood risk were identified. See Appendix B: Plan Formulation Section 1.2 for more details on the strategies and management measures considered; how measures were screened; how measures were combined into alternative plans. The PDT initially developed a total of 195 measures within the structural, nonstructural, and nature-based category. The initial 195 site-specific management measures were compiled from previous reports, NFS, stakeholders, the public, and recommendations from the PDT based on the identified inventory and forecasting of significant resources that are relevant. An additional 13 management measures were added for a total of 208 measures that were ultimately evaluated. The measures were subsequently evaluated and screened, and the remaining 62 measures were combined to form alternative plans. See Appendix B: Plan Formulation for more details on the measures considered, how measures were screened, and how measures were combined into the Initial Array of Alternatives.

The separate alternatives were developed by combining the remaining 62 measures related to a given area or source of flooding into a geographic based alternative based on hydrologic sub-basins. In areas where the hydrologic influence of the subbasins overlap, measures were looked at in combination with other alternatives in the same vicinity (e.g., measures under Alternative 5 were looked at in combination with Alternative 4 and Alternative 6).

In areas where multiple causes for flooding were documented, measures to reduce the risk from the multiple sources were included in an alternative. The plan formulation strategy included screening and evaluating each of these distinct geographic areas separately to determine the measures that were incrementally justified in each. The Initial Array of Alternatives was assembled by combining the remaining 62 management measures by geographic area/hydrologic sub-units and included the following 13 alternatives: Lacombe, Mandeville Lakefront, Bayou Chinchuba, Abita, Bogue Chitto, Lower Tchefuncte, Upper Tchefuncte, Eastern Slidell, South Slidell, Bayou Liberty, Bayou Bonfouca Bayou Vincent, and Lake Pontchartrain Surge.

Step 4 and 5 of Planning Process: Evaluate Effects of Alternative Plans and Measures and Compare Alternative Plans. In early iterations of the planning process, the PDT narrowed the focus from many alternatives and measures to a smaller array of alternatives and measures. See Appendix B: Plan Formulation for more details. The PDT looked at each potential measure at multiple points during the study as new information was developed to see what its effects, benefits, costs, and impacts might be. These steps involved using existing and new data to qualitatively determine and, in later iterations, model the physical, economic, and environmental conditions, along with measuring how well each alternative and measure performs at meeting the objectives and avoiding the constraints. The PDT screened the Initial Array of Alternatives and measures to reach a Focused Array of Alternatives (11 alternatives). The screening for the Initial Array of Alternatives was informed by preliminary H&H modeling (HEC-RAS and analysis of ADCIRC results), and cost estimates from previous studies in the area, and economic modeling (HEC-FDA). The screening led to a Focused Array of 11 alternatives and 43 measures, which was further informed by preliminary H&H modeling (HEC-RAS and analysis of ADCIRC results), updated cost estimates, and economic modeling (HEC-FDA). Based on the evaluations, the PDT was able to determine which alternatives and measures performed the best and warranted further investigation as the Final Array of Alternatives. The PDT identified the Final Array, consisting of 8 alternatives and 27 measures In Step 5, the PDT compared each alternative and measures within the alternatives, including the No Action Alternative.

Step 6 of Planning Process: Select TSP and then a Recommended Plan. Step 6 was an additional screening step, where the selection of a Draft TSP from the Final Array of Alternatives was informed by among other things H&H modeling (HEC-RAS), analysis of ADCIRC results, USACE Class 4 cost estimates, engineering construction costs, design, supervision and administration costs, environmental impacts and mitigation, risk assessments and potential life safety concerns, and economic modeling (HEC-FDA). Ultimately measures from the Final Array of Alternatives that were not screened through the plan formulation process were combined into a comprehensive alternative that reduced flood risk to multiple parts of the study area. The Draft TSP was released for public, agency, and policy review and underwent feasibility level of design leading to a revised, Optimized TSP.

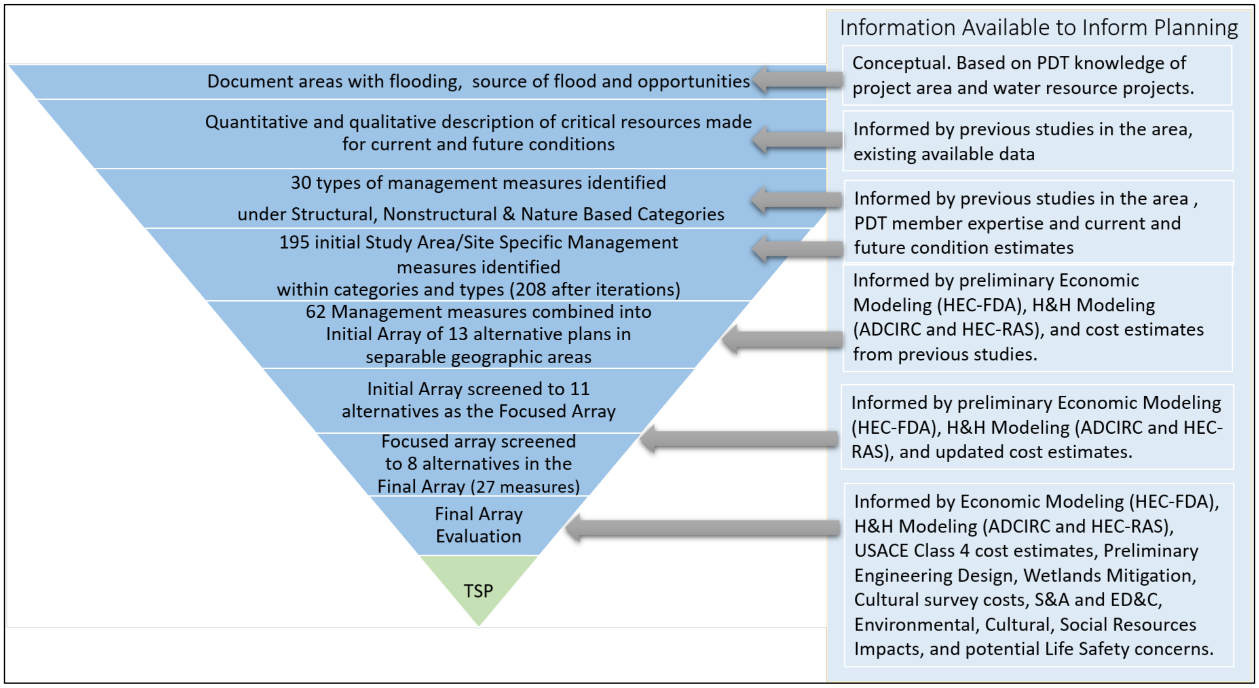

Figure 4-1. Summary of St. Tammany Parish, Louisiana Feasibility Study Plan Formulation Process

4.1 FINAL ARRAY OF ALTERNATIVES

The plan formulation process used the best available information at this phase of the study to identify the Final Array of Alternatives and then the Draft TSP. The measures, alternatives, and screening and evaluation process that led to the selection of the Final Array of Alternatives are further detailed in Appendix B: Plan Formulation. During the final phase of the feasibility study, called the feasibility level design phase, additional analyses was completed to refine and optimize the design and cost estimates of the measures included in the TSP. The revised design and costs were incorporated into the numerical modeling (Hydraulics and Economics) to develop refined assessments of the performance and cost-effectiveness of the Draft TSP, are included in the RDIFR-EIS as the Optimized TSP. The FIFR-EIS will fully describe the Recommended Action, as well as its costs, benefits, and consequences. Because uncertainty cannot be eliminated, the FIFR-EIS will further document the levels of uncertainty and the associated risks that are inherent in the assumptions and analyses. Further design (potential minor alignment shifts due to considerations such as real estate) on the Optimized TSP would occur during preconstruction engineering and design (PED).

During analysis of the Final Array, the measures within the Final Array of Alternatives (Table 4-1) underwent H&H modeling, preliminary engineering and design, development of full cost estimates, environmental resource analysis, and economic analysis. The Final Array of Alternatives included 8 alternatives and 27 measures (25 measures remaining from the alternatives in the Focused Array, plus two new CSRM structural measures (S-120 and S-

122). See Figure 4-2 for the structural measures. For each geographic based alternative listed below, the separable and combinable measures are also listed. These separate measures could all be implemented in concert if justified. For alternatives in which the measures in a given area were not separate and only one variation could be selected, the measures were denoted with a letter variation following the alternative number (e.g., 4a, 4b, 4c, 6a, 6b, 6c and 9a, 9b, and 9c). For example, in Alternative 6 the variations of levee systems are mutually exclusive and only one of the variations in 6a, 6b, or 6c could be selected if justified. The measures listed under Alternative 7 are separate and combinable and could all be implemented if they made it through the evaluation and screening process and be combined with justified measures from the other alternatives.

The Final Array of Alternatives and the measures were:

- Alternative 1: No Action Alternative
- Alternative 2: Nonstructural (NS-008, NS-009, NS-010, NS-011)
- Alternative 4: Lacombe
    - 4a Lacombe Levee (S-028)
    - 4a.1 Lacombe Levee Short (S-028)
    - 4b Lacombe Levee combined with West Slidell Levee (S-120)
- Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca
    - West Slidell Levee (S-081)
    - Bayou Bonfouca Detention Pond (S-004)
    - Bayou Liberty Channel Improvements (S-010)
    - Bayou Patassat Channel Improvements- Clearing and Snagging (S-080)
- Alternative 6: South Slidell
    - 6a South Slidell Levee and Floodwall System (S-074, S-075, S-076)
    - 6b South Slidell Levee and Floodwall System with Eden Isle (S-070, S-075, S-076)
    - 6c South Slidell and West Slidell Levee and Floodwall System (S-074, S-075, S-076, S-077, S-081) It should be noted that Alternative 6a and the West Slidell Levee from Alternative 5 (S-081) were combined to form Alternative 6c during evaluation of the Final Array as it was found the combined alternative provided the highest net benefits.
- Alternative 7: Eastern Slidell
    - Pearl River Levee (S-060)
    - Doubloon Bayou Channel Improvements-Dredging (S-069)
    - Poor Boy Canal Channel Improvements- Dredging (S-073)
    - Gum Bayou Diversion- Channel Improvements (S-072)
- Alternative 8: Upper Tchefuncte/Covington
    - Mile Branch Channel Improvements (S-057)
    - Lateral A Channel Improvements (S-121)
- Alternative 9: Mandeville Lakefront
    - 9a Mandeville Lakefront-Seawall Passive Drainage (S-046, S-047, S-118)
    - 9b Mandeville Lakefront-Seawall and Pump Stations (S-046, S-048, S-118, S-122)

- 9c Mandeville Lakefront-18 feet (S-046, S-048 S-118, S-122)

During the evaluation of the Final Array of Alternatives (as new information and modeling results became available) the PDT included two new measures to the Final Array as the opportunity to provide a higher level of flood risk reduction was identified. Measure S-120 Lacombe Levee was combined with West Slidell Levee and added as a potential variation to evaluate a complete levee and floodwall system from Slidell to Lacombe. Measure S-122 Mandeville Lakefront 18 feet was added to evaluate a 100-year level of protection in Mandeville after the 7.3 feet system proposed being evaluated was shown to have limited flood reduction benefits.

Additional information regarding the Final Array of Alternatives, the management measures, and identification codes can be found in Appendix B: Plan Formulation. Although not depicted in Figure 4-2, nonstructural measures were also considered across the study area (Alternative 2) throughout the study process. Alternative 3 was eliminated during an earlier screening stage in the planning process. See Appendix B: Plan Formulation for additional information.

The levee and floodwall features in all of the alternatives in the Final Array follow the Hurricane and Storm Damage Risk Reduction System (HSDRRS) design standards which were developed for the greater New Orleans levees and floodwalls but have since, have been incorporated into updated USACE-wide engineering manuals and using engineering judgment. St. Tammany Parish is on the Northshore of the Lake Pontchartrain and part of the New Orleans Metropolitan area. Levees in St. Tammany Parish were proposed as part of the New Orleans levee system were proposed as far back as the 1960s in Lake Pontchartrain and Vicinity (LPV), LA Hurricane Protection Project. Throughout this document, they are referred to as "levees." The HSDRRS Guidelines may be found at:

https://www.mvn.usace.army.mil/Missions/Engineering/Hurricane-Design-Guidelines/Hurricane-Design-Guidelines/

Throughout the RDIFR-EIS, flood events are referred to by their annual exceedance probability (AEP), which is the probability the level of flooding may be realized or exceeded in any given year. For example, a flood event with a 1 percent AEP would have a 1 percent probability of occurring every year.

Table 4-1. Measures included in the Final Array of Alternatives

Measure ID	Measure Name	Measure Category (structural, nonstructural, Nature Based)	Measure Type	Location	Type of Flooding Addressed (CSRM/FRM)
NS-08	Buyouts	Nonstructural	Buyouts	Parish wide	FRM or CSRM
NS-09	Flood proofing	Nonstructural	Flood proofing	Parish wide	FRM or CSRM
NS-10	Relocations	Nonstructural	Relocations	Parish wide	FRM or CSRM
NS-11	Structure Raising	Nonstructural	Structure Raising	Parish wide	FRM or CSRM
S-004	Bayou Bonfouca Detention Pond	Structural	Detention Ponds	Bayou Bonfouca	FRM
S-010	Bayou Liberty Channel Improvements	Structural	Channel Improvements	Bayou Liberty	FRM
S-028	Lacombe Levee	Structural	Levee, Flood Wall Pump Station, Flood Gates	Lacombe	CSRM
S-028	Lacombe Levee Short	Structural	Levee, Flood Wall Pump Station, Flood Gates	Lacombe	CSRM
S-046	Mandeville Seawall	Structural	Seawall Repair/Replacement	Mandeville	CSRM
S-047	Mandeville Seawall with Passive Drainage	Structural	Seawall with Passive Drainage	Mandeville	CSRM
S-048	Mandeville Seawall with Pump Stations	Structural	Seawall with Pump Stations	Mandeville	CSRM
S-057	Mile Branch Channel Improvements	Structural	Channel Improvements	Mile Branch, Covington	FRM
S-060	Pearl River Levee	Structural	Levee, Flood Wall	Pearl River	FRM
S-069	Doubloon Bayou Channel Improvements	Structural	Channel Improvements	Doubloon Bayou	FRM
S-070	Eden Isle Floodwall	Structural	Levee/Flood Wall S-70a. Western Segment; S-70-b Southern Segment; S-70c Eastern Segment	Slidell, Eden Isle	CSRM
S-072	Gum Bayou Diversions Channel Improvements	Structural	Channel Improvements	Slidell, Gum Bayou	FRM

Measure ID	Measure Name	Measure Category (structural, nonstructural, Nature Based)	Measure Type	Location	Type of Flooding Addressed (CSRM/FRM)
S-073	Poor Boy Canal Channel Improvements	Structural	Channel Improvements	Slidell, Poor Boy Canal	FRM
S-074	Pump Stations	Structural	Pump Stations	Slidell West of 1-10	CSRM
S-075	South Slidell Levee/Floodwall System-West of 1-10	Structural	Levee, Flood Wall	Slidell West of I-10	CSRM
S-076	South Slidell Levee/Floodwall System-East of 1-10	Structural	Levee, Flood Wall	Slidell East of 1-10	CSRM
S-077	Pump Stations	Structural	Pump Stations	Slidell East of 1-10	FRM
S-080	Bayou Patassat Channel Improvements	Structural	Channel Improvements	Slidell, Bayou Patassat	FRM
S-081	West Slidell Levee	Structural	Levee, Flood Wall, Pump Station, Flood Gates	West Slidell	CSRM
S-118	Mandeville Flood Barrier/Floodwall	Structural	Flood Barrier	Mandeville	FRM
S-120	West Slidell Combined with Lacombe Levee	Structural	Levee, Flood Wall Pump Station, Flood Gates	Lacombe to West Slidell	CSRM
S-121	Lateral A Channel Improvements	Structural	Channel Improvements	Lateral A, Covington	FRM
S-122	Mandeville 18feet Seawall with Pump Stations	Structural	Flood Wall 18 feet 100 year	Mandeville	CSRM

Individual maps depicting the locations of the alternatives in the Final Array of Alternatives are contained in Appendix B: Plan Formulation, and engineering details on the structural alternatives are contained in Appendix D: Engineering.

For the structural measures, CEMVN Engineering Division developed the estimated levee lengths, quantities, borrow quantities, etc. of the Final Array of Alternatives, using previous reports prepared by (or for) the NFS and stakeholders, H&H modeling performed for this study, similar measures from projects of the same type, and best engineering judgment. The cost estimates for the Final Array were developed using the Micro-Computer Aided Cost Estimating System (MCACES). Existing ground elevations were obtained from terrain raster dataset. Potential borrow sites and their anticipated impacts were investigated using the data that is currently available. (See Appendix B: Plan Formulation and Appendix D: Engineering for additional information on borrow).

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD 88 (Geoid 12B)) unless otherwise noted.

The nonstructural analysis was conducted concurrent with the development and evaluation of the Final Array of the structural measures. The nonstructural analysis is further described in Sections 4.2.4 and 4.2.5 and Appendix F: Economics.

The analysis for the measures in the Draft TSP was further refined during feasibility level of design and presented in Section 4.4.

Table 4-2. Final Array of Alternatives

Alternative		**Measure Name**	**Measure Type and Identification Code**					
	Final Array		Detention pond (FRM)	Channel improvements (FRM/ CSRM)	Pump stations (FRM/CSRM)	Levee, floodwall, seawall (FRM/ CSRM)	Flood gates (CSRM)	Nonstructural
1	No Action							
2	Nonstructural							NS-008, NS-009, NS-010, NS-011
4	Lacombe	4a Lacombe Levee			S-028	S-028	S-028	
		4a.1 Lacombe Levee Short			S-028	S-028	S-028	
		4.b Lacombe Levee Combined with West Slidell Levee			S-120	S-120	S-120	
5	Bayou Liberty/ Bayou Vincent/ Bayou Bonfouca							
		West Slidell Levee			S-81, S-	S-81	S-81	
		• Bayou Bonfouca Detention Pond	S-004					
		Bayou Liberty Channel Improvements		S-010				
		Bayou Patassat Channel Improvements		S-080				
6	6a South Slidell				S-074, S-075, S-077	S-075, S-076	S-075, S-076	
	6b South Slidell with Eden Isle				S-74, S-075, S-077	S-70, S-075, S-076	S-70, S-075,	

Alternative		Measure Name	Measure Type and Identification Code					
							S-076	
	6c South Slidell with West Slidell*				S-74, S-075, S-076, S-077, S-81	S-075, S-076, S-81	S-075, S-076, S-81	
7	Eastern Slidell	Pearl River Levee			S-060	S-060	S-060	
		Doubloon Bayou Channel Improvements		S-069,				
		Poor Boy Canal Channel Improvements		S-073				
		Gum Bayou Diversion- Channel Improvements		S-072				
8	Upper Tchefuncte/Covington	Mile Branch		S-057,				
		Lateral A		S-121				
9	Mandeville Lakefront	9a. Mandeville Lakefront-Seawall Passive Drainage				S-046, S-118,	S-047	
		9b. Mandeville Lakefront-Seawall and Pump Stations			S-048	S-046, S-118,		
		9c. Mandeville Lakefront-18 ft			S-048	S-046, S-118, S-122		

Note- Alternative 3 was screened out early in the screening process and was not included in the Final Array of alternatives. See Appendix B: Plan Formulation for additional details on screening prior to the Final Array.

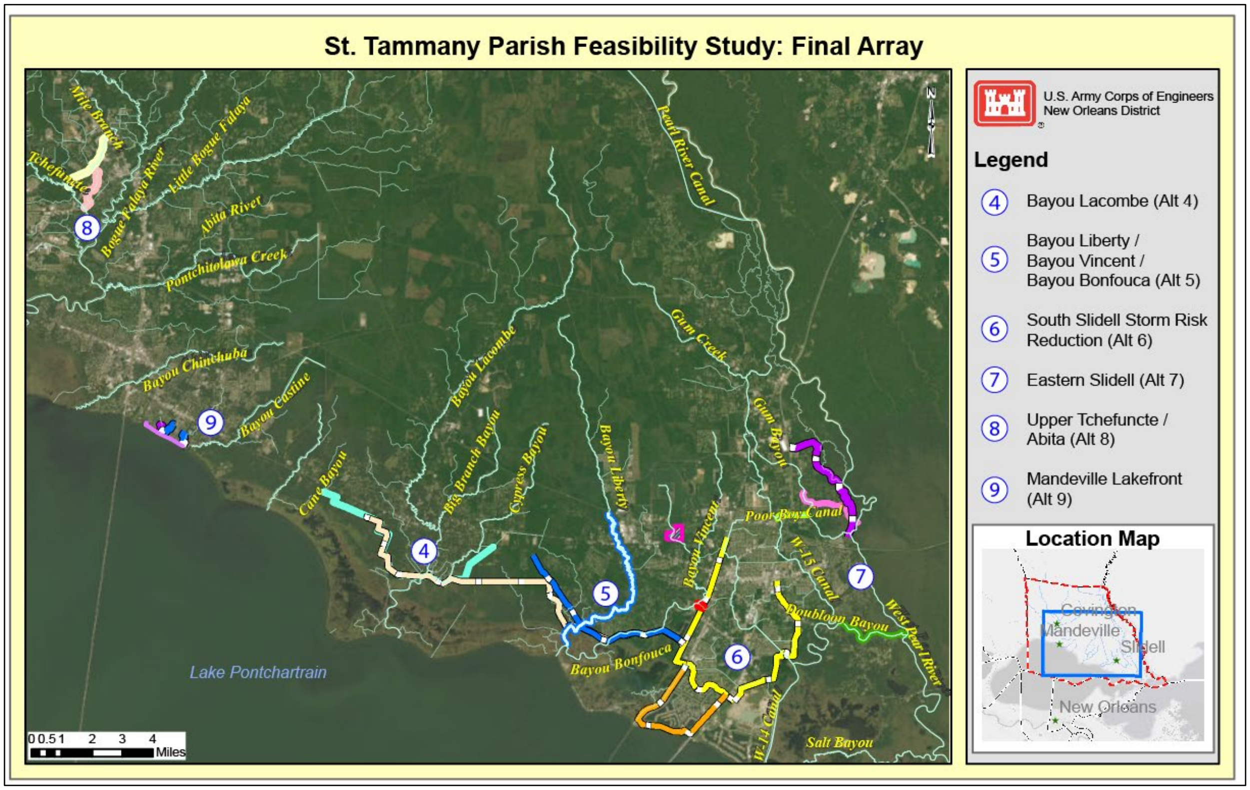

Figure 4-2. Structural Alternatives in the Final Array of Alternatives.

4.1.1 Alternative 1. No Action (FWOP condition)

Alternative 1 is the FWOP condition, if no plan is authorized. Under the No Action Alternative, no Federal FRM or CSRM measures would be implemented. The study area would continue to experience damages from riverine, rainfall, storm surge, and coastal storm related flooding. Wetland loss trends would be expected to continue into the future. See Section 5 for a more detailed description on the FWOP conditions for the significant resources.

4.1.2 Alternative 2. Nonstructural

The parish-wide nonstructural measure contained in Alternative 2 was aimed at reducing flood damages, without altering the nature or extent of the flooding by changing existing structures and/or structure usages. Nonstructural measures and plans were evaluated by the PDT using a logical aggregation method (e.g., grouping by structures' main floor elevation; census block or tract boundaries; neighborhoods or communities sharing common infrastructure; neighborhoods or communities sharing common floodplains; and structures within other geophysical boundaries or sharing other flood characteristics). The nonstructural measures (i.e., elevation, floodproofing etc.) focused on reducing the consequence of flooding for a specific structure rather than constructing hard infrastructure measures (i.e., levees, floodwalls, culverts, pump stations, etc.) which are physical modifications designed to reduce the frequency of damaging levels of flood inundation. The nonstructural measures that were considered for the study area included floodproofing, elevations, and relocations. During analysis of the Final Array, the PDT screened out the standalone comprehensive nonstructural alternative (Alternative 2) in favor of the combined structural and nonstructural alternative, which would provide more net benefits.

The parish-wide nonstructural Alternative 2 was developed for implementing nonstructural measures using structure elevations and flood proofing and anticipated to be voluntary. See Appendix F: Economics for additional information. The nonstructural analysis was based on an inventory of residential and non-residential structures using the National Structure Inventory (NSI) version 2.0 for the portions of the study area impacted by CSRM and FRM measures associated with the FWOP. For evaluation purposes, the cost of elevating and/or flood-proofing structures was used to determine the cost of the comprehensive nonstructural plan because the study area is most often receiving damages resulting from widespread, low-level flooding. Elevating and/or floodproofing structures was determined as being more cost effective than other nonstructural measures such as or relocations.

An initial assessment of all structures located in the 10, 20, 50, and 100-year (10 percent, 5 percent, 2 percent, and 1 percent AEP) floodplains was performed. During optimization of the TSP, the nonstructural analysis was refined and the study area was further subaggregated based on flooding source. Each subaggregate was analyzed independently. The nonstructural analysis was further refined to combine nonstructural measures with structural measures in various groupings by removing nonstructural home elevation and flooding proofing in areas that were addressed by structural measures. This allowed for an alternative with a nonstructural component combined with structural measures. See Section 4.4.2.7 for the description of the refinement and Section 6 and Appendix H: Nonstructural Implementation Plan for more information on the Nonstructural Plan.

The Measure IDs included in this Alternative are NS- 08, 09, 10, and 11.

See Section 4.2.4 and Appendix F: Economics for additional information regarding the nonstructural analysis. Appendix H: Nonstructural Implementation Plan includes the preliminary implementation plan for the nonstructural measures including the preliminary structure eligibility criteria.

[Note: Alternative 3: Lake Pontchartrain Surge Reduction was eliminated during an earlier screening stage in the planning process. See Appendix B: Plan Formulation for additional details.]

4.1.3 Alternative 4. Lacombe

Alternative 4 includes three variations of Alternative 4 (Alternative 4a, 4a.1, and 4b) of a levee system to reduce coastal flooding in the vicinity of the unincorporated community of Lacombe, Louisiana (Lacombe). These three alternatives (Alternative 4a.1, 4a, and 4b) are mutually exclusive alternatives and cannot be combined with one another but can be combined with other justified alternatives in the Final Array.

Alternative 4a consists of approximately 9 miles (47,700 feet) of levee, pump stations, floodgates, vehicular floodgates and ramps. The footprint includes 126 acres. This alignment is estimated to impact 110 acres of construction area and require approximately 595,000 cubic yards of fill. Alternative 4a includes a 3,200 cubic feet second (cfs) and a 300-feet long pump station complex across Bayou Lacombe. This complex includes a 20-feet navigable floodgate. Alternative 4a includes 14 vehicular road ramps over the levee and one vehicular floodgate to provide vehicular access through the levee. The Measure ID included in this Alternative is S-028.

Alternative 4a.1, is a shorter version of the Lacombe Levee and consists of approximately 7.5 miles (39,000 feet) of levee, floodwalls, floodgates, vehicular floodgates and ramps. The footprint includes 115 acres. This levee alignment is estimated to require 574,000 cubic yards of fill (borrow material) (includes 30 percent contingency). This variation includes a 3,200 cfs and 300-foot long pump station complex across Bayou Lacombe, a 20-foot navigable floodgate, 10 vehicular road ramps over the levee and 1 vehicular floodgate to provide vehicular access through the levee. The Measure ID included in this Alternative is S- 028.

Alternative 4b consists of the shorter version of the Lacombe Levee from Alternative 4a.1 and the West Slidell Levee from Alternative 5 (to evaluate a levee from Lacombe to Slidell). The combined levee and floodwall alignment is approximately 13.7 miles (72,000 feet) long and has a footprint of 2,133 acres. The levee alignment will require approximately 1,205,000 cubic yards of fill/ borrow (includes 30 percent contingency). The floodwall alignment includes 0.07 mile (350 feet) of floodwall. In addition, there are pump stations (4 with navigable gates) and three with sluicegates. There are also five road ramps and two vehicular floodgates. The Measure ID included in this Alternative is S-120.

Appendix D: Engineering contains additional engineering details for this Alternative.

4.1.4 Alternative 5. Bayou Liberty/ Bayou Vincent/Bayou Bonfouca

This Alternative includes measures to address riverine, rainfall, and coastal storm flooding to the areas of Bayou Liberty, Bayou Vincent, and Bayou Bonfouca. The features in this Alternative are all separate and combinable and could all be implemented, if environmentally sound and economically justified.

The *West Slidell Levee* measure includes 6.5 miles of levee and floodwall alignment. This alignment is a combination of approximately 6.5 miles (34,000 feet) of levees and 0.08 miles (450 feet) of floodwall. The footprint includes 111 acres. This levee alignment would require 611,000 cubic yards of fill. Within the levee alignment, there are three pump stations, three floodgates, and two sluicegates, one vehicular road ramp, and a 30-feet vehicular floodgate that are part of this Alternative. The Measure ID included in this Alternative is S-081.

The *Bayou Bonfouca Detention Pond* aims to reduce rainfall and riverine flooding and comprises of 109 acres and has a water detention capacity of 1,308 acre-feet. The footprint includes 110 acres. Approximately 125 acres would have to be cleared and grubbed prior to excavation. Approximately 2,500,000 cubic yards of excavated material is assumed. The detention pond also includes the construction of a weir. The Measure ID included in this Alternative is S-004.

Alternative 5 includes the *Bayou Patassat Channel Improvements* (channel improvements work) between Bayou Vincent Pump Station and U.S. Route 11. The Bayou Patassat channel improvements consist of approximately 0.17 miles (900 feet) of clearing and snagging that would occur in the channel. The footprint includes 1 acre. The Measure ID included in this Alternative is S-080.

Alternative 5 includes the *Bayou Liberty Channel Improvements* (channel improvements work to address rainfall and riverine flooding) which would begin from north-south, starting immediately south of the I-12, crossing U.S. Highway 190, the bridge that crosses the Tammany Trace, and LA Highway 433, and ending at the confluence with Bayou Bonfouca in the proximity of Lake Pontchartrain. The channel improvements include clearing and snagging of 8 miles (41,232 feet) of the channel and would be broken up into four reaches due to the length of this bayou. The footprint includes 103 acres. All trees and debris cleared would likely be chipped on site and then hauled to the nearest landfill. The Measure ID included in this Alternative is S-010.

Appendix D: Engineering contains additional engineering details for this Alternative.

4.1.5 Alternative 6. South Slidell

This Alternative includes 3 variations (Alternatives 6a, 6b, and 6c) which include a combination of levees, floodwalls, floodgates, pump stations, vehicular floodgates and ramps proposed to reduce damages from coastal storm events. These three alternatives (Alternatives 6a, 6b, and 6c) are stand-alone alternatives and cannot be combined with one another, but can be combined with other justified measures in the Final Array of Alternatives.

Alternative 6a consists of 13 miles of alignment with a combination of 7.3 miles of levees (38,500 feet) and 5.9 miles (30,000 feet) of floodwall in Slidell. The alignment would impact 88 acres of construction area. This alignment would require 851,000 cubic yards of fill. This variation would include 2 pump stations, 2 floodgates, 8 vehicular ramps over the levee, 14 vehicular floodgates, and the raising of the Interstate 10 roadway over the new levee section to 15 feet. The Measure IDs included in this Alternative 6a are S-074, 075, and 076.

Alternative 6b includes the *Slidell levee and floodwall system and incorporates an Eden Isle floodwall*. This Alternative comprises 17.1 miles of alignment with a combination of levee and floodwall. The alignment would have 5.2 miles of levee (27,400 feet). The alignment would also have approximately 6 miles (31,000 feet) of floodwall at Eden Isle and 5.9 miles (30,000 feet) of floodwall in the Slidell levee alignment. The floodwall alignment totals 11.9 miles (61,000 feet). The levee alignment would impact 63 acres of construction area. This levee alignment would require 742,000 cubic yards of fill. There would be 3 navigable floodgate structures, 2 pump stations, 5 vehicular floodgates, 4 vehicular ramps over the levee, 13 vehicular floodgates, and the Interstate 10 roadway would be raised to ramp over the new levee section. The Measure IDs included in this Alternative 6b are S-070, 075, and 076.

Alternative 6c consists of a combination of portions of the *West Slidell levee alignment* proposed in Alternative 5 and the *South Slidell levee and floodwall system* alignment proposed in Alternative 6a (except for the northwestern portion of that alignment), with the two alignments being connected by a new railroad gate across the existing Norfolk Southern railroad tracks. This Alternative was created based on the results of the economic analysis. The draft alignment for the levee and floodwall system was comprised of approximately 16.3 miles (85,900 feet) of alignment with a combination of 14 miles of levees (73,700 feet) and 2.3 miles (12,200 feet) of floodwall. The I-10 would be raised to ramp over the new levee section to the preliminary design elevation of 15 feet. The levee alignment would impact approximately 169 acres of construction area. The levee alignment would require approximately 1,528,000 cubic yards of fill. There would be five pump stations, and five floodgates associated with the pump stations. There would also be a total of three sluicegates, eight vehicular floodgates, one railroad floodgate across the Norfolk Southern, and seven ramps. It should be noted that the preliminary description presented for Alternative 6c above was later refined during further engineering and design described in Section 4.2.13. The Measure IDs included in this Alternative 6c are S-074, 075, 076, 077, and 081.

Additional details on the optimized levee and floodwall system are descried in Section 6. Appendix D: Engineering contains additional engineering details for this Alternative.

4.1.6 Alternative 7. Eastern Slidell

This Alternative includes measures to reduce risk to both riverine and rainfall flooding and coastal storm flooding to eastern Slidell. Measures include Gum Bayou Diversion, Poor Boy Canal improvements, channel improvements on Doubloon Bayou, and a levee to reduce riverine flooding from the Pearl River. The features in this Alternative are all separate and combinable and could all be implemented if justified.

The overall length of the *Pearl River levee* is approximately 4.8 miles (25,000 feet). This alignment was estimated to have approximately 57 acres of construction area. This levee alignment would require 350,000 cubic yards of fill. There are four floodwall sections for a total of 0.64 miles (3,400 feet) for this Alternative. There would also be one vehicular floodgate, a floodgate, a pump station, and a sluicegate. The Measure ID included in this Alternative is S-060.

The *Gum Bayou diversion* measure addresses rainfall and riverine flooding. The diversion channel would divert the existing Gum Bayou to the Pearl River through a new channel. The Gum Bayou diversion is 1.8 miles (9,300 feet) in length. The footprint includes 20 acres. A maximum of 100,000 cubic yards of material would be removed. The material requiring disposal would be trucked away from the site or sidecast along the bank line of the Gum Bayou channel. The Measure ID included in this Alternative is S-072.

Alternative 7 includes the *Poor Boy Canal channel improvements* measure to address rainfall and riverine flooding. The channel improvements in Poor Boy Canal would extend from LA Highway 1091, would cross LA Highway 59 and North Military Road, and would end into the Gum Bayou. The Poor Boy channel improvements consist of approximately 1 mile (5,288 feet) of clearing and snagging and mechanical dredging of the channel. The channel bottom would be lowered by 5 feet. The footprint includes 4 acres. Approximately 12 acres of channel would be cleared and grubbed prior to mechanical dredging. An assumed maximum of 80,000 cubic yards of material may be removed from the channel. The material requiring disposal would be trucked away from the site. The Measure ID included in this Alternative is S- 073.

This Alternative includes the *Doubloon Bayou channel improvements* to address rainfall and riverine flooding. The Doubloon Bayou channel improvements would extend from the intersection of Doubloon Bayou and W-15 Canal and end on West Pearl River. The Doubloon Bayou channel improvements consist of approximately 3 miles (13,500 feet) of clearing and snagging and mechanical dredging of the channel. The footprint includes 4 acres. Approximately 30 acres of channel would be cleared and grubbed prior to mechanical dredging. An assumed maximum of 190,000 cubic yards of material may be removed from the channel. The material would need to be pumped to a disposal area or pumped/placed into a barge for hauling away and disposed of downriver. The Measure ID included in this Alternative is S-069.

Appendix D: Engineering contains additional engineering details for this Alternative.

4.1.7 Alternative 8. Upper Tchefuncte/Covington

Alternative 8 includes measures to reduce rainfall and riverine flooding in the upper reaches of the Tchefuncte and Bogue Falaya Rivers. The measures in this Alternative are all separate. They are combinable within this Alternative or could also be combined with other alternatives. If justified, all of the measures in Alternative 8 could be implemented.

The Alternative includes channel modifications on Mile Branch in Covington to reduce risk from headwater flooding in the upper reaches of the Tchefuncte and Bogue Falaya Rivers. This includes enlarging the lower 2 miles of Mile Branch and enlargement of Lateral "A."

The Alternative includes channel improvements on the lower 2.15 miles (11,341 foot channel) of *Mile Branch* in Covington. The improvements include clearing and grubbing and mechanical dredging of the channel. The channel bottom would be lowered by 5 feet. The footprint includes 5 acres. Approximately 20 acres of channel would be cleared and grubbed prior to mechanical dredging. An assumed maximum of 130,000 cubic yards of material may be mechanically dredged from the channel and hauled away from the site. The Measure ID included in this Alternative is S- 057.

It should be noted that the preliminary description presented for the Mile Branch Channel improvements in Alternative 8, was later refined during further engineering and design and the optimized measure is described in Section 4.4.2.5 and in Section 6. Appendix D: Engineering contains additional engineering details for the optimized version of this measure.

Lateral A Mile Branch channel improvements were also evaluated to include clearing and snagging approximately 1.73 miles (9,129 feet channel) of Lateral A Mile Branch. The channel bottom would be lowered by 5 feet. The footprint includes 7 acres. Approximately 16 acres of channel would be cleared and grubbed prior to mechanical dredging. An assumed maximum of 104,000 cubic yards of material may be removed from the channel and hauled away from the site. Disposal of debris generated from clearing, snagging, and dredging would be trucked off-site and disposed at a facility licensed to handle the material. The Measure ID included in this Alternative is S-121.

Appendix D: Engineering contains additional engineering details for this Alternative.

4.1.8 Alternative 9. Mandeville Lakefront

Alternative 9 consists of variations for replacing and raising the existing seawall and constructing floodwalls, floodgates and or pumps to address tidal and storm surge flooding in Mandeville. Alternative 9 includes mutually exclusive variations (Alternatives 9a, 9b, and 9c), meaning that only one variation within Alternative 9 could be selected. This Alternative investigates both full pump options (forced drainage via pump stations) and passive drainage systems at Little Bayou Castine and Ravine aux Coquille.

Alternative 9a consists of replacing the existing seawall and constructing floodwalls, pump stations, floodgates, and passive flood barriers at the lakefront of Mandeville, Louisiana. The design elevation for the seawall is 7.3 feet. Elevation 7.3 feet is 2 feet higher than the existing seawall. The new seawall is approximately 1.5 miles long (7,703 feet). The floodwall at Galvez Canal is at elevation 7.3 feet and 0.3 miles (1,740 feet) long. The Ravine Aux Coquilles West and East Passive Barrier combined is approximately 1.1 miles (5,552 feet) of floodwall. The Little Bayou Castine West Passive Barrier is approximately 0.6 miles (3,000 feet) of floodwall. This variation would also include four pump stations along the lakefront seawall on West Beach Parkway (116 cfs), Lafayette Street (33 cfs), Coffee Street (106 cfs), and Girod Street (139 cfs), nine vehicular floodgates, and six pedestrian floodgates. The footprint includes 14 acres. The Measure IDs included in this Alternative are S- 046, 047, and 118.

Alternative 9b consists of replacing the existing seawall and constructing floodwalls, two pump stations, and floodgates. For elevation 7.3 feet, the new seawall is approximately 1.5 miles long (7,703 feet). The new floodwall in Galvez Canal would be at elevation 7.3 feet and 0.3 miles (1,740 feet) long. The new floodwall at Little Bayou Castine would be at elevation 7.3 feet and 0.64 miles (3,400 feet) long. One pump station would be constructed at the lakefront seawall on Girod Street (preliminary estimated capacity of 200 cfs) with a construction area of 0.009 acres. A second 500 cfs pump station and 20 foot floodgate would be constructed at Ravine Aux Coquilles at the lakefront (construction area is 2 acres). There would also be four vehicular floodgates. The footprint includes 14 acres. The Measure IDs included in this Alternative are S- 046, 048, 118, and 122.

Alternative 9c consists of elevating the Mandeville seawall to 18 feet with the construction of two pump stations, floodwalls, and floodgates. The elevation to provide 1 percent risk reduction (100-year) in future conditions in the year 2082 (planned project completion year 2032) was analyzed. For elevation 18 feet, the new seawall is approximately 1.8 miles long (9,600 feet). The new floodwall in Galvez Canal would be at elevation 18 feet and would be 0.5 miles (2,700 feet) long. The new floodwall at Little Bayou Castine would be at Elevation 18 feet and would be 1.7 miles (9,000 feet) long. The total seawall and floodwall length would be approximately 21,000 feet. One pump station would be constructed at the lakefront seawall on Girod Street (preliminary estimated capacity of 450 cfs) with a construction area of 0.009 acres. A second 500 cfs pump station and 20 feet sluicegate would be constructed at Ravine Aux Coquilles at the lakefront (construction area is 2 acres). There would also be six vehicular floodgates and 14 roller floodgates. The footprint includes 14 acres. The Measure IDs included in this Alternative are S- 046, 048, 118, and 122.

Measure S-122 was added during the analysis of the Final Array of Alternatives and was not evaluated in the Initial or Focused Array of Alternatives.

Appendix D: Engineering contains additional engineering details for the variations of this Alternative.

4.2 FINAL ARRAY ANALYSIS, EVALUATION, AND COMPARISON

The measures in the Final Array of Alternatives were evaluated, compared, and screened against the following criteria: physical performance, costs, economic benefits, impacts to life, impact to environmental resources, societal impacts, planning objectives and constraints, P&G alternative criteria, and contributions to Federal objectives and accounts. The analysis used for evaluation comparison and selection of the TSP are included in Sections 4.2.1 to 4.2.10. The environmental and social benefits and impacts for the Final Array of Alternatives were presented in Section 5 of the 2021 DIFR-EIS and the remainder of the analysis is presented within this Section 4.2 and Appendix B: Plan Formulation. This evaluation and screening informed the decisions in selecting the Draft TSP.

Subsequent to the release of the June 2021 Draft IFR-EIS, the PDT conducted additional engineering, economic, and environmental investigations on the separate measures of the Draft TSP. Information gathered by the PDT through these additional investigations, together with the consideration of comments received from the public, stakeholders, the USFWS and the NMFS assisted the PDT in further refining the design of the Draft TSP. Section 4.4 provides a summary of these additional investigations the PDT conducted to optimize the Draft TSP.

Where available, references are made to other sections of this RDIFR-EIS or the appendices for additional information.

4.2.1 Performance Analysis of Final Array Structural Measures

To assess the benefits of the structural measures of the Final Array of Alternatives, hydrologic and hydraulic (H&H) modeling was completed for the study. Additionally, a coastal modeling analysis was performed to quantitatively measure the reductions in Water Surface Elevations (WSEs) for the Final Array of Alternatives. This is referred to as the With Project modeling. H&H numerical modeling is a study of the movement of water as it moves through a watershed, basin, channel or man-made structure through numerical characterization of physical hydrologic and hydraulic features of a system in an effort to simulate real-world performance. See Appendix E: Hydrologic & Hydraulics for additional details.

Each FRM measure within an alternative was analyzed using Hydrologic Engineering Center-River Analysis System HEC-RAS modeling. Measures within an alternative were modeled together in a single geometry when they were not expected to hydraulically impact another measure. When one measure was expected to influence the H&H of another measure, they were modeled in distinct model geometries. Each model geometry was run for each frequency event (2, 5, 10, 25, 50, 100, 200, 500 year) for both base (2032) and future (2082) conditions. This totaled to 80 model simulations and results that were processed for analysis. Hydraulic model results were provided for analysis of flood damages in the form of geographic information system (GIS) rasters showing the maximum water surface elevation WSE during each frequency storm stimulation.

CSRM measure analysis was performed by delineating areas protected by proposed alternatives, estimating impacts on the exterior of the proposed alternatives, determining preliminary design elevations for alignments, and estimating capacities of interior drainage facilities where the proposed alignments cross large waterways. Areas that received risk reduction the proposed levees were determined using a terrain raster dataset. Design elevations, were continued to meet existing high ground. See Section 5.1 of Appendix E: Hydrologic & Hydraulics. Contour lines of that tie-in elevation form the remaining sides of the polygon that represents the area protected by each proposed alignment.

For the initial evaluation, the entire Final Array of Alternatives and Measures were not directly modeled in Advanced Circulation Model (ADCIRC) due to study constraints. Instead, prior coastal modeling for the 2009 Louisiana Coastal Protection and Restoration (LACPR) study, the USACE Morganza to the Gulf project, and the ongoing USACE West Shore Lake Pontchartrain project, were used to provide additional context for the analysis and estimates. The entire Final Array of Alternatives and measures were not directly modeled in Advanced Circulation Model (ADCIRC). Prior coastal modeling for the 2009 Louisiana Coastal Protection and Restoration (LACPR) study, the USACE Morganza to the Gulf project, and the ongoing USACE West Shore Lake Pontchartrain project were used to provide additional context for the analysis and estimates. However, because storm surge and wave response are highly dependent on the geometry of the area, ADCIRC modeling of the TSP was performed during the feasibility level of design phase on the Optimized TSP and is included in Appendix E: Hydrologic & Hydraulics.

HEC-RAS with-project modeling results and the CSRM analysis results and estimates were then compared to the modeling results without any alternatives in place (without project modeling). This comparison allowed the PDT to determine the potential flood reduction and ability of each alternative to reduce WSEs. A brief summary of model results for the structural measures is presented in Table 4-3 and difference grids displaying with-project vs. without project difference may be seen in Appendix E: Hydrologic & Hydraulics. The analysis of the nonstructural measures is included in Section 4.2.4.

Table 4-3. Summary Comparison Project Performance for the Structural Measures- with Project Compared to the without Project HH&C Results

Alternative	Measure	Qualitative Summary of Modeling Results
1	No Action	Continued flood damages for the Study Area.
4a, 4a.1	Lacombe Levee	Reduced coastal storm flood risk for Lacombe area.
4b	Combined Lacombe-West Slidell Levee	Reduced coastal storm flood risk for Lacombe and Western Slidell area.
5	West Slidell Levee	Reduced coastal storm food risk for Western Slidell area (west of Front St.).
5	Bayou Bonfouca Detention Pond	Reductions precipitate from pond location downstream to Lake Pontchartrain along the floodplain of bayou Bonfouca. Reductions range from 0-1 feet. Small inducements (i.e. increased water levels) are caused at the upstream end.
5	Bayou Liberty Channel Improvements	Reductions range from 0-1 feet along the Bayou Liberty floodplain.
5	Bayou Patassat Channel Improvements- Clearing and Snagging	Reductions range from 0-1 feet along the floodplain of Bayou Patassat and downstream of the confluence with Bayou Bonfouca.
6a	South Slidell Levee and Floodwall System	Reduced coastal storm flood risk for the South Slidell area.
6b	South Slidell Levee and Floodwall System with Eden Isle	Reduced coastal storm flood risk for the South Slidell and Eden Isle area.
6c	South Slidell and West Slidell Levee and Floodwall System	Reduced coastal storm flood risk for the West Slidell to South Slidell area
7	Doubloon Bayou Channel Improvements-Dredging	Inducements of 0-1 feet along the dredged channel. Lowerings, or reduction in the WSE with the project in place are seen in the Pearl River floodplain. This is because dredging Doubloon Bayou causes it to act as a conduit when Pearl River floods.
7	Poor Boy Canal Channel Improvements- Dredging	Minimal lowerings exhibited for the 10yr. frequency event.
7	Gum Bayou Channel Improvements- Diversion	Reductions of 0-0.1 feet for the 10yr. frequency event. Inducements are seen in lower frequency events along the floodplain of the proposed diversion.
7	Pearl River Levee	Reductions of more than 1 feet. on protected side of levee alignment for 200yr. frequency event. Inducements of up to 1feet. in certain areas outside the levee alignment.
8	Mile Branch Channel Improvements	Reductions of approximately 0-1feet for the 10yr. event upstream and in the floodplain of Mile Branch channel deepening location.
8	Lateral A Channel Improvements	Reductions of approximately 0-1feet. for the 10yr. event upstream and in the floodplain of Lateral A channel deepening location.

9a, 9b, 9c	Mandeville Lakefront	Reduced coastal storm flood risk for Mandeville area.

The model outputs and analysis results required conversion so that the results could be input into the HEC-FDA Economics Model described in Section 4.2.3. The hydraulic model results, provided in WSE for each event frequency (both ADCIRC and HEC-RAS models), were exported as Tag Image File Format (TIF) raster files. ArcGIS software was used to overlay structure inventory point sites with all eight frequency rasters, plus the elevation raster of combined topography and bathymetry data. A custom GIS python script was run against the structure inventory dataset to review the WSE results and output into an FDA-format American Standard Code for Information Exchange (ASCII) file. If the WSE for a structure inventory site is NO RESULT, then the GIS script outputs the terrain elevation minus 2.1 feet as the WSE for this location (this matches the FDA definition for no flooding at the site). The script reviews each frequency WSE result against the previous lower frequency results to ensure that WSE outputs increase for each increasing frequency. If the lowest frequency event has NO RESULT, and the next lowest frequency value has NO RESULT, then terrain elevation – 2.1 feet is output as the WSE for the lowest frequency, and terrain elevation – 2.1 feet + .01 feet is output as the WSE for the next lowest frequency. Additional information regarding the modeling is contained in Appendix E: Hydrologic & Hydraulics.

4.2.2 Final Array Cost Estimate-Structural Measures

To determine the cost estimates for evaluation and comparison of alternatives and TSP selection, the total cost and estimated annual costs for the structural alternatives and measures were developed to include planning, engineering and design, construction, construction management, real estate, and environmental and cultural mitigation costs, all of which include contingencies. See Tables 4-4 through 4-6. For the purposes of planning, construction was assumed to begin in 2027 and continue through 2032. This was the basis for the 50-year period of analysis that starts in 2032 and goes through 2082. For the levees, additional levee lifts (to maintain levee height notwithstanding expected sinking and subsidence) were assumed to occur at three times post initial construction at 5-7 years, 15-20 years, and 30 years. The first levee lifts would be overbuilt and allowed to settle for several years before the latter levee lift is added for each alternative. The current assumptions for the proposed levees are based on typical sections, which do not include berms. Future analyses (during PED) will include site specific data collection. Information gathered from data collection could result in the need for additional geotechnical analyses for individual levee features in PED. The lack of subsurface information and the consequential number of assumptions required are noted in the study risk register.

The design life of hydraulic steel structures is 100 years which applies to the pump stations and gates included in the TSP. The design of hydraulic steel structures will be in accordance with the requirements of ETL 1110-2-584. See also: ER 1110-2-8155; ECB 2021-6; and ECB 2019-10.

Preliminary mitigation costs for unavoidable habitat impacts were also calculated for each alternative and measure in the Final Array of Alternatives. Preliminary mitigation costs for proposed structural measures were developed based on visual inspection of habitat types that could be potentially impacted along proposed structural measure alignments. Professional judgment and experience with similar structural systems, and engineering assumptions of right-of-way (ROW) footprints were also used to aid in development of the mitigation costs. Mitigation cost estimates were refined for the Optimized TSP, details are described in Section 7 and Appendix C: Environmental. See Section 4.2.5 regarding the preliminary cost estimates for the nonstructural measures. There is no cost for implementing Alternative 1, No-Action. It should be noted that the initial costs used for evaluation and comparison were updated for measures included in the Draft TSP. The latest cost for measures in the Optimized TSP can be found in Section 4.4.3.

4.2.3 Final Array Economics Analysis- Structural Alternatives

The HEC-FDA Version 1.4.2 USACE-certified model was used to calculate the damages and benefits for the Final Array of Alternatives. A Benefit Cost Ratio (BCR) analysis was conducted to evaluate the economic feasibility of each of the measures and alternatives. Expected annual benefits for 50-year period of analysis from 2032 and 2082 were converted to an equivalent annual value using the FY21 Federal interest rate of 2.75 percent.

H&H model outputs and the economics functions were fed into the HEC-FDA, (https://www.hec.usace.army.mil/software/hec-fda/) and those results were tabulated and compared. The economic and engineering inputs necessary for the model to calculate damages and benefits include the structure inventory, contents-to-structure value ratios, vehicles, first floor elevations, and depth-damage relationships, ground elevations, and without-project stage probability relationships. The uncertainty surrounding each of the economic and engineering variables was included. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum, and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

Tables 4-4 through 4-6 show the results for the structural measures in the Final Array including total construction costs, average annual costs, average annual benefits, and BCR. The economic analysis yielded several structural measures that had a positive BCR. Twelve measures within the Final Array of structural Alternatives were screened due to negative net benefits. The measures that were screened and those that were retained to form the Draft TSP are summarized in Section 4.2.10.

Table 4-4. Estimated Costs for Structural Measures in the Final Array of Alternatives

Alt	Real Estate	Relocations	Mitigation–Environmental	Levees and Floodwalls	Pumping Plant	Channels and Canals	Mitigation–Cultural Resources	PED	Construction Management (CM)	Total Cost
4a-Lacombe Levee (S-028)	$8,249,000	$25,860,000	$71,159,000	$26,228,000	$256,426,000	-	$210,000	$64,409,000	$33,502,000	$487,101,000
4a.1-Lacombe Levee Short (S-028)	$6,739,000	$18,302,000	$59,227,000	$25,125,000	$256,426,000	-	$177,000	$62,436,000	$36,137,000	$461,934,000
4b-West Slidell Levee with Lacombe Levee (S-120)	$5,549,000	$13,323,000	$133,368,000	$55,549,000	$847,053,000	-	$316,000	$190,550,000	$102,246,000	$1,347,853,000
5 (S-004, S-010, S-80, S-081)	$7,182,000	$933,000	$160,899,000	$31,035,000	$663,317,000	$8,491,000	$718,000	$147,318,000	$79,049,000	$1,098,943,000
6a-South Slidell (S-075 & S-076)	$6,505,000	$16,000	$67,719,000	$406,711,000	$327,261,000	-	$478,000	$151,940,000	$81,529,000	$1,042,159,000
6b-South Slidell with Eden Isle (S-070, S-075 & S-076)	$6,157,000	$16,000	$98,783,000	$869,237,000	$327,261,000	-	$666,000	$247,229,000	$132,659,000	$1,682,008,000
6c-South Slidell with West Slidell Levee (S-081, S-075 & S-076)	$13,799,000	$887,000	$118,059,000	$265,200,000	$948,358,000	-	$993,000	$250,950,000	$134,656,000	$1,732,902,000
7-Eastern Slidell (S-060, S-069, S-073, S-072)	$5,253,000	-	$74,671,000	$56,284,000	$76,135,000	$12,281,000	$535,000	$31,073,000	$16,673,000	$272,876,000
8-Mile Branch and Lateral A (S-057, S-121)	$7,023,000	-	$5,127,000	-	-	$29,998,000	$153,000	$6,193,000	$3,323,000	$51,818,000
9a-Mandeville Seawall (7.3 feet) Passive Drainage (S-046, 118, S-047)	$12,491,000	-	$8,503,000	$104,568,000	$10,027,000	-	$183,000	$23,671,000	$12,702,000	$172,144,000
9b-Mandeville Seawall (7.3 feet) Pump Stations (S-046, S-118, S-048)	$12,491,000	-	$8,357,000	$51,758,000	$73,860,000	-	$83,000	$25,940,000	$13,919,000	$186,409,000
9c- Mandeville Seawall (18 feet) (S-122)	$12,491,000	-	$8,357,000	$258,503,000	$120,545,000	-	$149,000	$77,803,000	$41,748,000	$519,596,000

Table 4-5. Structural CSRM Measures in Final Array of Alternatives. Net Benefit Summary, FY 2021 Price Level,

FY 21 Discount Rate

	Alt 6a: South Slidell Levee (S-074, S-075 & S-076, S-077)	**Alt 6b: South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077)**	**Alt 5: West Slidell Levee (S-081)**	**Alt 6c: South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)**	**Alt 4a1: Lacombe Levee (S-028)**	**Alt 4b: West Slidell Levee with Lacombe Levee (S-120)**	**Alt 9b: Mandeville Seawall (7.3 feet) (S-46, S-47, S-048, S-118)**	**Alt 9c: Mandevill e Seawall (18 feet) (S-46, S-48, S-118, S-122)**
Project First Cost	$1,042,158,000	$1,682,008,000	$888,576, 000	$1,732,901,000	$461,934	$1,347,853	$172,144	$519,596
Interest During Construction	$67,037,000	$108,196,000	$57,158,000	$111,470,000	$29,714	$86,701	$11,073	$33,423
Total Investment Cost	$1,109,195,000	$1,790,204,000	$945,734,000	$1,844,371,000	$491,648	$1,434,554	$183,217	$553,019
AA Average Annual (AA) Investment Costs	$39,108,100	$63,119,000	$33,345,000	$65,029,000	$17,335	$50,580	$6,460	$19,498
AA Operation & Maintenance (O&M) Costs	$3,264,000	$3,3133400	$2,692,000	$5,956,000	$1,361	$4,150	$1,882	$2,823
Total AA Costs	$42,372,000	$66,432,000	$36,036,000	$70,985,000	$18,696	$54,730	$8,342	$22,322
Without Project Expected Annual Damages (EAD)	278,978	278,978	278,978	278,978	278,978	278,978	278,978	278,978
EAD Reduced Benefits	75,706	93,114	42,455	118,160	8,538	51,173	1,404	9,753

Net Benefits	$33,334	$26,682	$6,419	$47,175	($10,158)	($3,557)	($6,938)	($12,569)
B/C Ratio	**1.8**	**1.4**	**1.2**	**1.7**	0.5	0.9	0.2	0.4

* Table 4-5 includes costs outside of those direct and indirect mitigation costs beyond those calculated in the initial ROM estimates used in screening measures. The Direct Wetland Impact Summary Table by Alternative in Appendix C: Environmental mitigation costs only includes specific environmental costs for direct and indirect impacts to wetlands.

Table 4-6. Structural FRM Measures in Final Array of Alternatives, Net Benefit Summary, Rainfall and Riverine, FY 2021 Price Level, FY 21 Discount Rate

	Alt 8: Mile Branch Lateral A (S-121)	Alt 8: Mile Branch (S-057)	Alt 5: Bayou Bonfouca Detention Pond	Alt 5: Bayou Liberty (S-010)	Alt 5: Bayou Patassat (S-080)	Alt 7: Gum Bayou Diversion (S-072)	Alt 7: Poor Boy Canal (S-073)	Alt 7: Doubloon Bayou (S-069)	Alt 7: Pearl River Levee (S-060)
Project First Cost	$25,625,521	$26,337,370	$151,623,591	$52,655,730	$956,630	$22,174,443	$15,307,082	$34,937,686	$216,511,535
Interest During Construction	$1,648,400	$1,694,200	$9,753,200	$3,387,100	$61,500	$1,426,400	$984,600	$2,247,400	$13,927,200
Total Investment Cost	$27,273,921	$28,031,570	$161,376,791	$56,042,830	$1,018,130	$23,600,843	$16,291,682	$37,185,086	$230,438,735
AA Investment Costs	$961,600	$988,300	$5,689,800	$1,976,000	$35,900	$832,100	$574,400	$1,311,100	$8,124,800
AA O&M Costs	$102,400	$126,800	$12,400	$414,300	$10,000	$107,300	$59,200	$150,700	$1,359,700
Total AA Costs	$1,064,000	$1,115,100	$5,702,200	$2,390,300	$45,900	$939,400	$633,600	$1,461,800	$9,484,500
Without Project EAD	$209,484, 000	$209,484, 000	$209,484, 000	$209,484, 000	$209,484, 000	$209,484, 000	$209,484, 000	$209,484, 000	$209,484, 000
EAD Reduced Benefits	292,000	2,221,000	1,056,000	935,000	133,00	-44,000	1,000	-1,537,000	3,739,000
Net Benefits	-772,000	1,106,000	-4,646,00	-1,455,000	87,000	-983,000	-633,000	-2,999,000	-5,746,000
B/C Ratio	0.3	2.0	0.2	0.4	2.9	0.0	0.0	-1.1	0.4

4.2.4 Final Array Analysis- Nonstructural Alternative

Existing policy established in ER 1105-2-100, Planning Guidance Notebook (2000) requires that USACE analyses formulate, evaluate, and present a plan that reasonably maximizes net National Economic Development benefits. Prior interpretation of this requirement with respect to nonstructural measures and plans was to formulate and evaluate plans at the individual structure level. Because there are numerous problems with that approach, which include but are not limited to: fidelity of depth damage function, uncertainty with individual structure data, overall risk management, and other social effects, the current USACE policy (USACE Planning Bulleting (PB) 2019-03 Subject: Further Clarification of Existing Policy for USACE Participation in Nonstructural Flood Risk Management and Coastal Storm Risk Management Measures) is that 'reasonably maximizing' does not require individual structure benefit-cost analysis.

The nonstructural analysis was based on an inventory of residential and non-residential structures that was developed by CEMVN in 2019 using the NSI version 2.0. This version was used for portions of the study area impacted by CSRM and FRM associated with the FWOP condition. There are 100,252 residential structures and 11,440 non-residential structures in the total structure inventory. According to USACE Planning Bulleting (PB) 2019-03, nonstructural analyses are to be conducted using a “logical aggregation method.” Rather than the individual structure, this selected aggregate is the unit of analysis, and each such aggregate is a separable element that must be incrementally justified. Such aggregates could be structures that share a common floodplain or share other common flood characteristics among others. For this analysis, structures were aggregated according to shared floodplain across St. Tammany Parish. An assessment of all structures located in the 10, 20, 50, and 100-year (10 percent, 5 percent, 2 percent, and 1 percent AEP) floodplains were performed (Figure 4-3). Each incremental floodplain aggregate, the combination of structures being elevated and floodproofed within an incremental floodplain, must be economically justified. Floodplain aggregation across the Parish was employed as a manageable means to account for a large inventory of structures spread out over a large study area. As the study progresses, the floodplain aggregates would continue to be evaluated and refined. Incorporating the source of flooding into the floodplain aggregation would result in a larger number of smaller aggregates to be assessed.

Elevation and floodproofing was used to determine the effectiveness of the nonstructural alternative. Because the study area is most often receiving damages resulting from widespread, low-level flooding, elevation, and floodproofing were determined as being more cost effective than other nonstructural measures, such as relocations. Further assessments were performed on the nonstructural component during the next phase of the study as the engineering modeling was refined. For the analysis, residential structures were to be elevated to the future 100-year stage up to 13 feet above the ground and nonresidential structures to be floodproofed up to 3 feet above the ground.

Due to the different sources of flooding, separate FDA models were simulated for CSRM and FRM and results combined. Two nonstructural plans were developed and analyzed through the process. The first, a comprehensive nonstructural alternative, was analyzed across the entire study area to determine the benefits of a standalone nonstructural plan that did not include any structural measures. Beyond the comprehensive, parish-wide nonstructural alternative, the nonstructural analysis was further refined based on the effectiveness and cost results for the CSRM and FRM structural measures. These refinements included analysis to combine nonstructural measures with structural measures in various groupings by removing nonstructural home elevation and flooding proofing in areas that were addressed by the cost-effective structural measures. This led to a combined alternative with a nonstructural component combined with structural measures.

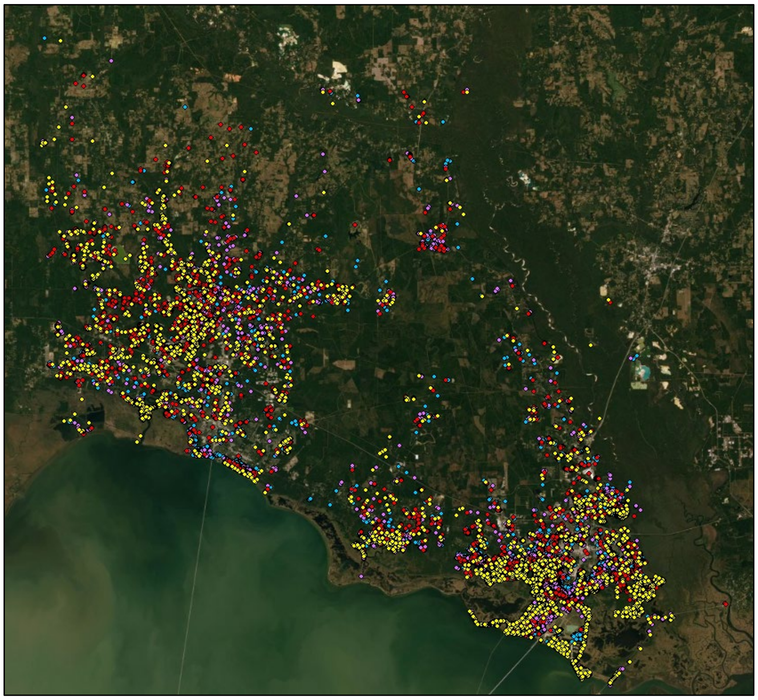

Figure 4-3. Structures Identified by Incremental Floodplain

Blue dots represent structures in the 1 percent or 100 year floodplain, purple are in the 2% (50 year) floodplain, red is within the 4 percent (25 year) floodplain and yellow structures are within the 10 percent (10 year) floodplain. Data from 2018.

4.2.5 Final Array Cost Estimate- Nonstructural Costs

Nonstructural costs were developed both for residential and nonresidential structures. For residential structures, elevation costs were based on the difference in the number of feet between the original first floor elevation and the target elevation (based on the 2082 hydrologic conditions) for each structure. Elevation costs by structure were summed to yield an estimate of total structure elevation costs. The cost for raising a structure was based on data obtained during interviews with representatives of three major metropolitan New Orleans area firms that specialize in structure elevation. Separate cost estimates were developed to flood proof non-residential structures based on their relative square footage using costs developed by contacting local contractors and were escalated to FY 2021 prices. Additional estimates for required administrative activities, real estate cost and contingency were added to the cost estimates. See Appendix F: Economics for additional details regarding the development of cost estimates for the nonstructural alternative and Appendix H: Nonstructural Implementation Plan for implementation of nonstructural features of the TSP.

4.2.6 Final Array Economic Analysis- Nonstructural

4.2.6.1 Final Array- Standalone Nonstructural Plan

The flood damages reduced by combining the cumulative CSRM and FRM floodplain results are displayed in Table 4-7. All floodplains had positive BCRs in the cumulative combined FRM and CSRM analysis. The results were further analyzed incrementally to determine and verify which floodplains were justified. For the initial comprehensive nonstructural plan, the 50-year floodplain for all of St. Tammany Parish (2 percent AEP) was incrementally justified as providing the most net benefits to reduce flood damages in the parish. Appendix F: Economics contains additional data regarding the incremental floodplain analysis.

Table 4-7. Comprehensive Nonstructural Plan for the study area- Standalone Plan

Comprehensive Nonstructural Plan – Combined CSRM/FRM (NS-09 & NS-11)						
	Average Annual Benefits	**Average Annual Cost**	**Net Benefits**	**B/C Ratio**	**Approx. Number of Structures**	**Estimated Costs**
100-Year	$271,833,000	$170,662,000	$101,171,000	1.6	17,900	$4,825,397,000
50-Year	$253,096,000	$131,441,000	$121,655,000	1.9	13,800	$3,716,442,000
20-Year	$212,255,000	$91,293,000	$120,962,000	2.3	9,600	$2,581,277,000
10-Year	$152,100,000	$59,110,000	$92,990,000	2.6	6,100	$1,671,304,000

FY 2021 Price Level, FY 21 Discount Rate

4.2.6.2 Final Array- Nonstructural Portion of the Combined Structural and Nonstructural Plan

Subsequent to evaluation of the standalone nonstructural plan and the evaluation of the structural measures (Section 4.2.3), the PDT was able to compare nonstructural vs structural alternatives for each of the separate subbasins in the study area. Although the nonstructural measures for the West Slidell and South Slidell levee (Alternative 6c) and the Mile Branch Channel Improvements (Alternative 8) both have economically justified nonstructural increments, the corresponding structural measures have higher net benefits. As a result, the nonstructural alternatives in these locations were not included in the broader nonstructural portion of the combined structural and nonstructural plan included in the Draft TSP.

In areas where there were economically justified structural measures, the locations of the comprehensive nonstructural alternative that correspond to justified structural areas were parsed out. The resulting modified nonstructural plan was carried forward and combined with the justified structural measures resulting in a combined structural and nonstructural plan. Benefits of the combined plan were attributed to either risk reduction from structural measures or nonstructural measures, but not both.

The cumulative CSRM and FRM *nonstructural* benefits (1%, 2%, 5% and 10% annual exceedance probability or AEP) for the areas of the study area that would not receive benefits form the implementation of any of the *structural* measures in the TSP, are displayed in Table 4-8. During the initial combined FRM and CSRM nonstructural plan analysis, all floodplains had a positive BCR. Thereafter, the incremental floodplains were determined to be economically justified up to the 2 percent AEP. The structures in the 0-50 year floodplain were in the nonstructural portion of the combined structural and nonstructural plan. The nonstructural plan with the combined FRM and CSRM cumulative 2 percent AEP floodplain, consisted of elevating 6,643 residential structures and dry floodproofing 1,855 nonresidential structures. Additional information regarding the initial incremental floodplain analysis results is presented in Appendix F: Economics.

Table 4-8. Cumulative CSRM and FRM Nonstructural Benefits for locations within the study area not benefited by Economically Justified Structural Measures

	(10%AEP)	(5% AEP)	2% AEP)	1% AEP)
Project First Cost	1,326,554,000	1,755,280,000	2,241,108,000	2,885,893,000
Interest During Construction	4,101,000	5,426,000	6,928,000	8,921,000
Total Investment Cost	1,330,653,000	1,760,704,000	2,248,034,000	2,894,812,000
AA Investment Cost	46,917,000	62,080,000	79,263,000	102,067,000
Benefits EAD Reduced	111,242,000	137,105,000	157,421,000	169,647,000
Net Benefits	64,325,000	75,025,000	78,158,000	67,580,000
B/C Ratio	2.4	2.2	2.0	1.7

4.2.7 Final Array Evaluation and Comparison against Planning Objectives and Constraints

Cost effective measures in the Final Array were compared to the planning objectives and constraints as presented and discussed in Section 2.2 and Section 2.3 of this RDIFR-EIS. Table 4-9 and Table 4-10 summarize the results based on the degree to which the measures satisfy planning objectives without violating planning constraints.

Objective 1 (reduce the risk to public health and safety by reducing flood impacts to structures and critical infrastructure) and Objective 2 (reduce flood damage to structures (i.e., businesses, residential, commercial, and public structures) were evaluated through the performance analysis described in Section 4.2.1. The analysis quantitively measured the reductions in WSEs which informed the subsequent economic analysis to determine the change in the number and frequency of flooded structures compared to without the No Action Alternative. Public infrastructure such as hospitals are included in the nonstructural analysis. All of the cost-effective measures in the Final Array decreased the risk to public health and safety by reducing the number of structures impacted by flooding and also reducing the annual flood damages when compared with the No Action Alternative. The comparative values between measures are included in Tables 4-9 and 4-10. The No Action Alternative does not decrease the risk to public safety. A life safety risk analysis was conducted on Alternatives 4, 5, 6, 7, and 9 resulting in a determination that the measures for channel improvement, detention pond, and/or clearing and snagging did not contribute to an increased risk to life safety. See Section 4.2.9.

Table 4-9. FRM: Evaluation and Comparison of Measures against Planning Objectives (for the Draft TSP)

		Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 5: Bayou Bonfouca Detention Pond	Alt 5: Bayou Liberty (S-010)	Alt 5: Bayou Patassat (S-080)	Alt 7: Gum Bayou Diversion (S-072)	Alt 7: Poor Boy Canal (S-073)	Alt 7: Doubloon Bayou (S-069)	Alt 7: Pearl River Levee (S-060)	Alt 8: Mile Branch Lateral A (S-121)	Alt 8: Mile Branch (S-057)
Obj 1- Public Health and Safety		Does not meet	Yes: reduces population impacted by flood risk (13, 811 structures)	Yes: reduces population impacted by flood risk (80 structures)	Yes: reduces population impacted by flood risk (70 structures)	Yes: reduces population impacted by flood risk (30 structures)	Yes: reduces population impacted by flood risk (0 structures)	Yes: reduces population impacted by flood risk (0 structures)	Yes: reduces population impacted by flood risk (0 structures)	Yes: reduces population impacted by flood risk (400 structures)	Yes: reduces population impacted by flood risk (30 structures)	Yes: reduces population impacted by flood risk (250 structures)
Obj 2 Flood Damage		Does not meet	Yes: EAD reduction $244,563,150	Yes: EAD reduction $1,056,128	Yes: EAD reduction $935,338	Yes: EAD reduction $132,724	Yes: EAD reduction ($43,787)	Yes: EAD reduction $880	Yes: EAD reduction ($1,882,280)	Yes: EAD reduction $3,738,733	Yes: EAD reduction $2,221,189	Yes: EAD reduction $291,747
Obj 3 Interruption Evacuation Routes/ Transportation		Does not meet		Indirect Benefits	Indirect Benefits	Indirect benefits	Indirect Benefits	Indirect Benefits	Indirect Benefits	Indirect Benefits	Indirect Benefits	Indirect Benefits
Obj 4 Community Resiliency	Prepare and Resist	Does not meet	Yes, adapts structure risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard
	Recovery	Does not meet	Potential dipropionate benefits as low income may not have resources to	Reduces Impact to Low Income/ Minority Vulnerable	Reduces Impact to Low Income/ Minority	Reduces Impact to Low Income/ Minority	Reduces Impact to Low Income/ Minority Vulnerable	Reduces Impact to Low Income/ Minority Vulnerable	Reduces Impact to Low Income/ Minority Vulnerable	Reduces Impact to Low Income/ Minority Vulnerable	Reduces Impact to Low Income/ Minority Vulnerable	Reduces Impact to Low Income/ Minority Vulnerable

		Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 5: Bayou Bonfouca Detention Pond	Alt 5: Bayou Liberty (S-010)	Alt 5: Bayou Patassat (S-080)	Alt 7: Gum Bayou Diversion (S-072)	Alt 7: Poor Boy Canal (S-073)	Alt 7: Doubloon Bayou (S-069)	Alt 7: Pearl River Levee (S-060)	Alt 8: Mile Branch Lateral A (S-121)	Alt 8: Mile Branch (S-057)
			participate	Communities	Vulnerable Communities	Vulnerable Communities	Communities	Communities	Communities	Communities	Communities	Communities
	Adapt	Does not meet	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions
Constraints		Does not violate constraints	Does not violate constraints	Does not violate constraints	Does not violate constraints	A low risk HTRW site is within 1 mile and would be further investigated prior to implementation	Does not violate constraints	Does not violate constraints	Does not violate constraints	Does not violate constraints	Does not violate constraints	Does not violate constraints

** The cost information for Alternative 6c and Alternative 8 was updated for the Optimized TSP as further modeling and design was completed.

Table 4-10. CSRM: Evaluation and Comparison of Measures against Planning Objectives (for the Draft TSP)

		Alt 1: No Action	**Alt 2: 50 Year Nonstructural (NS-09 & NS-11)**	**Alt 4a1: Lacombe Levee (S-028)**	**Alt 4b: West Slidell Levee with Lacombe Levee (S-120)**	**Alt 5: West Slidell Levee (S-081)**	**Alt 6a: South Slidell Levee (S-074, S-075 & S-076, S-077)**	**Alt 6b: South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077)**	**Alt 6c: South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)**	**Alt 9b: Mandeville Seawall (7.3 feet) (S-46, S-47, S-048, S-118)**	**Alt 9c: Mandeville Seawall (18 feet) (S-46, S-48, S-118, S-122)**
Obj 1- Public Health and Safety		Does not meet	Yes: reduces population impacted by flood risk (13, 811 structures)	Yes: reduces population impacted by flood risk (600 structures)	Yes: reduces population impacted by flood risk (3,100structures)	Yes: reduces population impacted by flood risk (2,513 structures)	Yes: reduces population impacted by flood risk (4,456 structures)	Yes: reduces population impacted by flood risk (5326 structures)	Yes: reduces population impacted by flood risk (6,969 structures)	Yes: reduces population impacted by flood risk (400 structures)	Yes: reduces population impacted by flood risk (400 structures)
Obj 2 Flood Damage		Does not meet	Yes: EAD reduction $244,563,150	Yes: EAD reduction $8,538,915	Yes: EAD reduction $51,168,356	Yes: EAD reduction $ 42,455,739	Yes: EAD reduction $ 75,698,183	Yes: EAD reduction $93,1105,215	Yes: EAD reduction $118,148,922	Yes: EAD reduction $1,595,911	Yes: EAD reduction $9,752,231
Obj 3 Interruption Evacuation Routes/ Transportation		Does not meet	Indirect benefits	Direct Benefits	Direct Benefits	Directly reduces flooding to Hwy 433 along with Indirect benefits	Indirect benefits	Direct benefits for roads in Eden Isle along with Indirect benefits	Directly reduces flooding to Hwy 433 along with Indirect benefits	Direct benefits	Direct Benefits
Obj 4 Community Resiliency	Prepare and Resist	Does not meet	Yes, adapts structure risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard	Yes, provides infrastructure to reduce risk to known flood hazard
	Recovery	Does not meet	Potential dipropionate benefits as low income may not have resources to participate			Reduces Impact to Low Income/Minority Vulnerable Communities	Reduces Impact to Low Income/Minority Vulnerable Communities	Reduces Impact to Low Income/Minority Vulnerable Communities	Reduces Impact to Low Income/Minority Vulnerable Communities		
	Adapt	Does not meet	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions	Yes, continued design refinement for changing conditions

		Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 4a1: Lacombe Levee (S-028)	Alt 4b: West Slidell Levee with Lacombe Levee (S-120)	Alt 5: West Slidell Levee (S-081)	Alt 6a: South Slidell Levee (S-074, S-075 & S-076, S-077)	Alt 6b: South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077)	Alt 6c: South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)	Alt 9b: Mandeville Seawall (7.3 feet) (S-46, S-47, S-048, S-118)	Alt 9c: Mandeville Seawall (18 feet) (S-46, S-48, S-118, S-122)
Constraints		Does not violate constraints	Does not violate constraints	Does not violate constraints	Does not violate constraints	A low risk HTRW site is within 1 mile and would be further investigated prior to implementation	HTRW site avoided during floodwall construction segment along railroad	Potential concerns with Gulf Sturgeon with Eden Isle segment	Railroad segment & HTRW concerns removed in South Slidell & West Slidell combination	Violates viewshed constraint	Does not violate constraints

** The cost information for Alternative 6c and Alternative 8 was updated for the Optimized TSP as further modeling and design was completed.

Objective 3 is to reduce interruption, to the maximum extent practicable, to the Nation's transportation corridor and evacuation routes e.g., the I-10, I-12, and the I-59 interchange.

Transportation corridors include one or more routes that connect centers of economic activity. Transportation corridors provide transportation and other logistics services that promote trade among the cities and countries along the corridor. Interstate 10 is the major transportation corridor within the study area. A hurricane evacuation route (also called coastal evacuation route or evacuation route) is a highway in the United States that is a specified route for hurricane evacuation. The following are officially designed evacuation routes within the study area: Interstate 12, Lake Pontchartrain Causeway, U.S. Highway 190, U.S. Route 11, LA Highway 59, and Interstate 10 (See Figure 4-4).

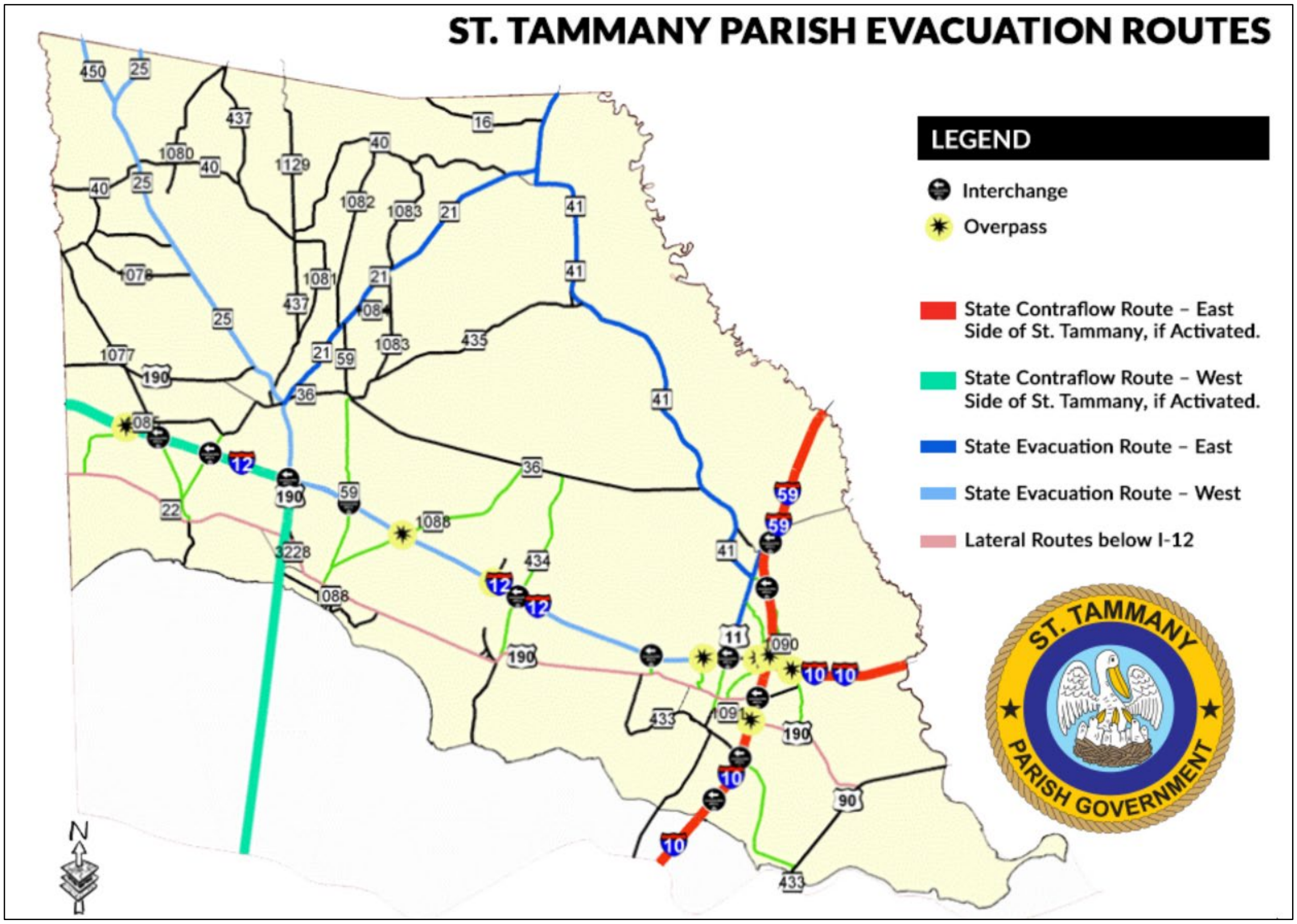

Figure 4-4. Evacuation Routes within the Study Area

The PDT conducted an analysis on frequently flooded roadways within the study area to determine which measures might reduce roadway flooding. Four different input datasets were received from STPG regarding frequently flooded roadways. The flooded roads were digitized into ArcGIS line features and were then densified to include a vertex every 1,000 feet. The flooded road point locations were overlaid with the study elevation grid, and an elevation was assigned to each point feature. The flooded roadways were overlaid to the H&H modeling results to determine which measures reduced flooding to those locations. All alternatives showed varying benefits to minimize roadway flooding, but the Pearl River Levee, Lacombe Levee, and West and South Slidell Levee provided the most direct benefits by reducing flooding on LA Hwy 433 and U.S. Highway 190. These highways are critical evacuation routes and provide access to 1-10 and 1-12 which are transportation corridors and evacuation routes (shown under Objective 3 in Tables 9 and 10).

In addition to the alternatives identified as directly reducing flooding to roadways, the NS and Mile Branch alternatives are expected to indirectly reduce roadway flooding and impacts to smaller roadways, and benefit overall evacuation in the area.

Objective 4 is to increase community resiliency, the sustained ability of a community to use available resources, before, during, and after significant rainfall and or coastal events.

Building community resiliency is a multidimensional effort that incorporates infrastructure, natural, social, financial, and political aspects (NAS 2019). The evaluation of the community resiliency objective was tied to evaluating the degree to which the alternatives and measures were able to reduce or adapt risk to known flooding hazards through the built infrastructure or project features. It is fully acknowledged that this is only a small piece of the overall dynamics that are needed to increase resiliency in St. Tammany Parish. Other aspects of community resiliency, many of which are already ongoing at the local government level, include increasing community preparedness, such as improvements to emergency communications systems and warning times; updates to floodplain management building codes, ordinances, and established hazard mitigation plans; and the ability to quickly address acute and chronic community stressors. A summary of the ongoing local resilience measures beyond the infrastructure and the nonstructural measures proposed in the Final Array of Alternatives is provided in Appendix B: Plan Formulation, Section 3. Objective 4 did not end up being a distinguishing factor in the Final Array of Alternatives.

Alternatives were qualitatively evaluated on their ability reduce or adapt risk to known flooding hazards. All alternatives provided positive benefits to bolster community resilience beyond the No Action Alternative by providing mechanisms to reduce or adapt risk to know flooding hazards. Final Array Evaluation and Comparison against Principle and Guidelines Criteria

The cost effective measures in the Final Array of Alternatives were also evaluated against the four P&G evaluation criteria (shown in Tables 4-11 and 4-12) as defined in P&G Section VI.1.6.2(c). Only those that met the efficiency criteria were further evaluated against the other criteria and presented below.

- *Completeness* is a determination of whether or not the plan includes all elements necessary to achieve the objectives. It is an indication of the degree to which the outputs of the plan are dependent upon the actions of others.
- *Effectiveness* is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities (P&G Section VI.1.6.2(c)(2)).

Alternative plans that do not contribute or minimally contribute to the planning objectives should be dropped from consideration.

- *Efficiency* is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment (P&G Section VI.1.6.2(c)(3)). Benefits can be both monetary and non-monetary. Alternative plans that provided little benefits relative to the cost should be dropped from further consideration.
- *Acceptability* is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies (P&G Section VI.1.6.2(c)(4). Acceptability means a measure or alternative plan is technically, environmentally, economically, and socially feasible. Alternative plans that are clearly not feasible should be dropped from further consideration.

Table 4-11. FRM Measures Summary of the Evaluation Against the P&G Criteria (Includes Alternative 1 and 2)

	Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 5: Bayou Bonfouca Detention Pond	Alt 5: Bayou Liberty (S-010)	Alt 5: Bayou Patassat Channel Improvements (S-080)	Alt 7: Gum Bayou Diversion (S-072)	Alt 7: Poor Boy Canal (S-073)	Alt 7: Doubloon Bayou (S-069)	Alt 7: Pearl River Levee (S-060)	Alt 8: Mile Branch (S-057)	Alt 8: Mile Branch Lateral A (S-121)
Completeness	Does not meet objectives to reduce flood risk	Can be implemented and contributes to addressing identified problems or opportunities	Can be implemented and contributes to addressing identified problems or opportunities	Can be implemented and contributes to addressing identified problems or opportunities	Can be implemented and contributes to addressing identified problems related to flooding around Bayou Patassat	Can be implemented and contributes to addressing riverine and rainfall flooding	Can be implemented and contributes to addressing riverine and rainfall flooding	Can be implemented and contributes to addressing riverine and rainfall flooding	Can be implemented and contributes to addressing identified problems or opportunities Slidell	Can be implemented and contributes to addressing identified problems or opportunities in Covington	Can be implemented and contributes to addressing identified problems or opportunities in Covington
Effectiveness	Would not alleviate any problems or achieve any opportunities.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Determined to be not effective in reducing flooding through H&H modeling	Determined to be not effective in reducing flooding through H&H modeling	Determined to be not effective in reducing flooding through H&H modeling	Determined to be not effective in reducing flooding through H&H modeling	Addresses Problems and Opportunities. Meets goals and objectives.	Determined to be not effective in reducing flooding through H&H modeling
Efficiency	Is cost effective since it does not require a Federal investment	Effective at meeting the objectives	Did not meet efficiency due to BCR below 1. BCR 0.2	Did not meet efficiency due to BCR below 1. BCR 0.4	Effective at meeting objectives BCR 2.9	Did not meet efficiency due to BCR below 1. BCR 0.0	Did not meet efficiency due to BCR below 1. BCR 0.0	Did not meet efficiency due to BCR below 1. BCR	Did not meet efficiency due to BCR below 1. BCR 0.4	Effective at meeting objectives BCR 2.2	Did not meet efficiency due to BCR below 1. BCR 0.3
Acceptability	Acceptable in meeting required laws and policies; Plan provides no solution to the identified problems.	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies; would require further coordination with LDWF regarding Scenic Rivers	Acceptable in meeting required laws and policies; would require further coordination with LDWF regarding Scenic Rivers

Table 4-12. CSRM Measures Summary of the Evaluation Against the P&G Criteria (Includes Alternative 1 and 2).

	Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 4a1: Lacombe Levee (S-028)	Alt 4b: West Slidell Levee with Lacombe Levee (S-120)	Alt 5: West Slidell Levee (S-081)	Alt 6a: South Slidell Levee (S-074, S-075 & S-076, S-077)	Alt 6b: South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077))	Alt 6c:South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)	Alt 9b: Mandeville Seawall (7.3 feet) (S-46, S-47, S-048, S-118)	Alt 9c: Mandeville Seawall (18 feet) (S-46, S-48, S-118, S-122)
Completeness	Does not meet objectives to reduce flood risk	Can be implemented and contributes to addressing identified problems or opportunities	Can be implemented and contributes to addressing identified problems or opportunities	Can be implemented and contributes to addressing identified problems or opportunities	Is not standalone and an add on to the South Slidell Levee	Can be implemented and contributes to addressing identified problems or opportunities in the South Slidell Area.	Can be implemented and contributes to addressing identified problems or opportunities for South Slidell and Eden Isle.	Can be implemented and contributes to addressing identified problems or opportunities in the West and South Slidell Area.	Can be implemented and contributes to addressing identified problems or opportunities in the Mandeville Lakefront Area.	Can be implemented and contributes to addressing identified problems or opportunities in the Mandeville Lakefront Area.
Effectiveness	Would not alleviate any problems or achieve any opportunities.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.	Addresses Problems and Opportunities. Meets goals and objectives.
Efficiency	Is cost effective since it does not require a Federal investment	Effective at meeting the objectives	Did not meet efficiency due to BCR below 1. BCR 0.5	Did not meet efficiency due to BCR below 1. BCR 0.9	Effective at meeting the objectives for the West Slidell area. BCR 1.2	Effective at meeting the objectives for the South Slidell Area BCR 1.9	Eden Isle portion is cost effective but the South Slidell and West Slidell combination provided higher net benefits. BCR 1.5	More efficient at objectives than South Slidell or West Slidell alone BCR 1.7	Did not meet efficiency due to BCR below 1. BCR 0.2	Did not meet efficiency due to BCR below 1. BCR 0.4

	Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 4a1: Lacombe Levee (S-028)	Alt 4b: West Slidell Levee with Lacombe Levee (S-120)	Alt 5: West Slidell Levee (S-081)	Alt 6a: South Slidell Levee (S-074, S-075 & S-076, S-077)	Alt 6b: South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077))	Alt 6c:South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)	Alt 9b: Mandeville Seawall (7.3 feet) (S-46, S-47, S-048, S-118)	Alt 9c: Mandeville Seawall (18 feet) (S-46, S-48, S-118, S-122)
Acceptability	Acceptable in meeting required laws and policies; Plan provides no solution to the identified problems.	Acceptable in meeting required laws and policies	Levee had a medium incremental risk for life safety.	Levee had a medium incremental risk for life safety.	Acceptable in meeting required laws and policies; would require further coordination with LDWF regarding Scenic Rivers	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies	Acceptable in meeting required laws and policies; West Slidell portion would require further coordination with LDWF regarding Scenic Rivers where the levee crosses over a scenic river	Mandeville Lakefront area identified as high incremental risk for life safety due to population in Mandeville.	Mandeville Lakefront area identified as high incremental risk for life safety due to population in Mandeville.

4.2.8 Final Array Evaluation and Comparison Using the System of Accounts

In compliance with EC 1105-2-409, the PDT evaluated measures and alternatives across multiple benefit and impact categories, which included economic (national and regional), environmental (national and regional), and social considerations. These benefits and impacts were captured under the following accounts: NED, RED, OSE, and EQ. A quantitative analysis for the four accounts was developed and can be found in Section 6.4 of this RDIFR-EIS. It is noted that on 5 January 2021, after the Final Array evaluation and after the Draft TSP had already been selected, a USACE Policy Directive on Comprehensive Documentation of Benefits in Decision documents was issued. The policy directive updated the procedures to identify and analyze benefits in total and equally across a full array of benefit categories. Since the TSP had already been selected for this study, the documentation for the previous process is documented in Section 4.2.8. Additional information on the comprehensive benefits of the Optimized TSP are included in Section 6.4.

Factors Considered:

National Economic Development (NED)

- Structure and Content Damage
- Vehicle Damage
- Emergency Costs

Regional Economic Development (RED)

- Jobs
- Labor Income
- Value Added

Other Social Effects (OSE)

- Social Vulnerability and Resiliency
- Community Cohesion
- Recreational Opportunities
- Life Safety

Environmental Quality (EQ)

- Habitat Change
- Threatened & Endangered Species Risk

- Cultural Resources Sites

NED (National Economic Development): changes in the economic value of the national output of goods and services The NED Account represents increases in the net value of the national output of goods and services, expressed in monetary units, and are the direct net benefits that accrue in the planning area, and the rest of the Nation. The benefits, average annual cost and total cost were based on the monetary costs or damages prevented and were ranked accordingly. The benefits for each alternative plan were evaluated based on damages avoided using HEC-FDA. These benefits were used to compare across the Final Array of Alternatives and select the NED plan. The intent of comparing alternative flood risk reduction plans in terms of NED account was to identify the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects were considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED were expressed as the plans' economic benefits, and the adverse NED effects were the investment opportunities lost by committing funds to the implementation of a plan. See Tables 4-13 and 4-14. Alternatives 2, 5, 6 (Alternative 6a, 6b, and 6c) and 8 all provided positive net benefits with a positive BCR.

RED (Regional Economic Development): changes in the distribution of regional economic activity that result from each alternative plan The RED account is intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically, regional income and regional employment. Regional impacts are expected to include an increase in local, state, and national employment statistics as a result of the labor required for construction. Local and regional sales industries, including temporary housing, are expected to increase as a result of temporary laborers coming into the area for construction.

The Final Array is expected to create a long-term increase in economic productivity by providing a more reliable flood risk and coastal storm damage risk reduction system for the study area. Increased reliability could create a long-term economic benefit to existing businesses that rely on reduced flooding for production. An improved risk reduction could also attract new industrial and commercial business to the study area, which would provide a long-term increase in economic productivity through increased revenue and jobs.

Estimated annual project costs were used as proxy construction expenditures. Of total expenditures, a portion will be captured within the local impact area and the remainder of the expenditures will be captured within the state and the nation. Direct expenditures capture direct impacts to the area's employment and income based on the goods and services necessary to complete construction of the alternative. Construction will also generate secondary economic activity often called multiplier effects. This would be realized through companies that supply materials or services to companies engaged in construction. Local restaurateurs, for example, will have higher disposable income because an increase in clientele and as a result, they will spend their dollars to purchase appliances, do home repairs and otherwise put money back into the economy. It should be noted that the extent of the multiplier effect is dependent upon how consumers respond to the additional income, in today's climate consumers might be inclined to save for an emergency rather than spend. In summary, the higher the expenditure, the greater the contribution to the RED account.

Alternatives were ranked as high, medium or low contribution to the RED account. See Tables 4-13 and 4-14.

EQ (Environmental Quality): non-monetary effects on significant resources; *assessment of favorable or unfavorable ecological, aesthetic and cultural or natural resources changes.* The environmental benefits and impacts are discussed in detail as part of the NEPA analysis in Section 5). A summary of impacts for each of the alternatives is included in Table 4.16. Alternatives were summarized as high, medium or low based on their impacts, in cases where benefits are expected a "+" is denoted.

OSE (Other Social Effects): effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts OSE: Final Array of Alternatives were evaluated as low, medium or high on that basis to which they would potential provided improvements or benefits to socially vulnerable groups in risk managed areas, community cohesion, changes in recreation and nature spaces and reduced risk to life and safety for residents in risk-managed area. A social vulnerability index analysis was conducted for the study and life safety risk assessment was considered for structures in the Final Array.

The Final Array provides opportunity for improvement in these areas since it addresses flood damages and life safety risks to several communities in the study area. The implementation of the alternatives in the Final Array would help preserve community cohesion should a significant flood event occur. In addition, risks from future floods and loss of life would be greatly reduced in the areas at high risk for structure and property damages.

Under the No Action alternative, it was assumed that major transportation and evacuation corridors within the vicinity of the study area would likely become more vulnerable to storm damage in the future without action resulting in significant adverse impacts. Although the use of area roads would increase during construction, thereby impacting traffic and causing localized delays, road use would return to normal following construction.

All alternatives provide reduced risk to public health and safety from flood risk.

Table 4-13.FRM Measures Evaluation and Comparison of Systems of Accounts (Includes Alternative 1 and 2)

System of Accounts	Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 5: Bayou Bonfouca Detention Pond	Alt 5: Bayou Liberty (S-010)	Alt 5: Bayou Patassat Channel Improvements (S-080)	Alt 7: Gum Bayou Diversion (S-072)	Alt 7: Poor Boy Canal (S-073)	Alt 7: Doubloon Bayou (S-069)	Alt 7: Pearl River Levee (S-060)	Alt 8: Mile Branch (S-057)	Alt 8: Mile Branch Lateral A (S-121)
NED	None	$136,095,426- Avg. Annual Costs	$5,702,200- Avg. Annual Costs	$2,390,300- Avg. Annual Costs	$45,900- Avg. Annual Costs Lowest Average AAC	$939,400- Avg. Annual Costs	$633,600 -Avg. Annual Costs	$1,461,800- Avg. Annual Costs	$9,484,500 -Avg. Annual Costs	$988,300- Avg. Annual Costs	$1,064,000- Avg. Annual Costs
		$108,467,724- in Net Benefits. Highest net benefits of nonstructural	($4,646,072) - in Net Benefits.	($1,454,962) - in Net Benefits.	$86,824- in Net Benefits.	($983,187) - in Net Benefits.	($632,720) - in Net Benefits.	($3,284,080) - in Net Benefits.	($5,745,767) - in Net Benefits.	$1,232,889 - in Net Benefits. 2.0 BCR	($772,253)-in Net Benefits.
		1.8 BCR	0.2 BCR	0.4 BCR	BCR 2.9	0.0 BCR	0.0 BCR	BCR (1.2)	0.4 BCR	BCR 2.2	0.3 BCR
		High	No	No	High	No	No	None	No	High	No
EQ	Continued impacts include flooding, sea level rise/ subsidence	Low impacts	Medium Impacts to Pine Savanna and waterbottoms	Medium Impacts	Low Impacts	High Impacts	Low Impacts	High Impacts	High Impacts to Pine Savanna Marsh,	High Impacts to Riparian and low impacts waterbottoms	High Impacts to Riparian and low impacts waterbottoms
RED	Does not provide RED benefits	High	low	low	low	low	Low	low	medium	low	Low
OSE	Continued impacts due to continued flooding and risk to life, safety and	High	Medium	Medium	Low	Medium	Low	Low	High	High	High

System of Accounts	Alt 1: No Action	Alt 2: 50 Year Nonstructural (NS-09 & NS-11)	Alt 5: Bayou Bonfouca Detention Pond	Alt 5: Bayou Liberty (S-010)	Alt 5: Bayou Patassat Channel Improvements (S-080)	Alt 7: Gum Bayou Diversion (S-072)	Alt 7: Poor Boy Canal (S-073)	Alt 7: Doubloon Bayou (S-069)	Alt 7: Pearl River Levee (S-060)	Alt 8: Mile Branch (S-057)	Alt 8: Mile Branch Lateral A (S-121)
	community impacts										

Table 4-14.CSRM Measures Evaluation and Comparison of Systems of Accounts.

System of Accounts	**Alt 1: No Action**	**Alt 2: 50 Year Nonstructural (NS-09 & NS-11)**	**Alt 4a: Lacombe Levee (S-028)**	**Alt 4a1: Lacombe Levee short (without western extension) (S-028)**	**Alt 4b: West Slidell Levee with Lacombe Levee (S-120)**	**Alt 5: West Slidell Levee (S-081)**	**Alt 6a: South Slidell Levee (S-074, S-075 & S-076, S-077)**	**Alt 6b: South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077)**	**Alt 6c:South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)**	**Alt 9b: Mandeville Seawall (7.3 feet) (S-46, S-47, S-048, S-118)**	**Alt 9c: Mandeville Seawall (18 feet) (S-46, S-48, S-118, S-122)**
NED		$136,095,426-Avg. Annual Costs	$19,788,400-Avg. Annual Costs	$18,695,500-Avg. Annual Costs	$54,729,700-Avg. Annual Costs	$36,036,200-Avg. Annual Costs	$40,391,100-Avg. Annual Costs	$64,038,000-Avg. Annual Costs	$68,655,800-Avg. Annual Costs	$8,342,000-Avg. Annual Costs	$22,321,700-Avg. Annual Costs
		$108,467,724-in Net Benefits. Highest net benefits of nonstructural	$(11,070,783) in Net Benefits	$(10,158,585) in Net Benefits	$(3,561,344)-in Net Benefits.	$6,414,539-in Net Benefits.	$35,307,083-in Net Benefits	$29,067,215-in Net Benefits	$49,493,122-in Net Benefits. Highest net benefits for structural measure	$(6,746,089)-in Net Benefits.	$(12,569,469)-in Net Benefits.
		1.8 BCR	0.4 BCR	0.5 BCR	0.9 BCR	1.2 BCR	1.9 BCR	1.5 BCR	1.7 BCR	0.2 BCR	0.4 BCR
		high	no	no	no	low	high	medium	medium	no	no
EQ	None	Low impacts	High impacts to marsh and pine habitat	High	High	High	High	High	High	Medium impacts to waterbottoms	Medium impacts to waterbottoms
OSE	Continued impacts due to continued flooding and risk to life, safety and community impact	high	high	high	high	high	high	high	high	low	medium
RED	Continued impacts on regional	High	medium	medium	high	medium	medium	high	high	low	medium

	economics due to continued flood damages.										

4.2.9 Final Array-Life Safety Evaluation

Managing risks to human lives is a fundamental component of the USACE Planning Bulletin 2019-04 “Incorporating Life Safety into Flood and Coastal Storm Risk Management Studies;” EC 1165-2-218 “Levee Safety;” and ER-1110-2-1156 “Dam Safety Policy and Procedures.” For the study, two different life safety analyses were conducted including both a qualitative assessment on the Final Array of Alternatives and a semi-quantitively assessment on the Optimized TSP (See Section 4.4.5). LifeSim would be used to estimate the potential life loss under various overtopping and failure scenarios in PED. Appendix D: Engineering contains additional information.

The qualitative life safety assessment focused on the levees and floodwalls measures since it was determined that the channel improvements, detention pond, and/or clearing and snagging projects were not contributing significantly to the evaluation, nor increased risk to life safety. Potential risk drivers identified include water velocity and depths during flood events, combination of coastal storm, riverine and rainfall flooding in some areas, incremental risk associated with existing flood reduction structures, short warning time, limited availability of stream gage data that inform warning systems and evacuations, and vulnerable populations.

To inform the flood velocity metric, the PDT evaluated model results for a 500-year rainfall event to look at conservative floodplain depth and velocities in the study area.

- The city of Slidell had an average depth of 2- 3 feet and a velocity of 1-2 ft/s at Bayou Bonfouca.
- The city of Mandeville had an average depth of 2 –3 feet with a velocity of 1 -2ft/s at Bayou Castine.
- The town of Madisonville had an average depth of 4 – 5 feet with a velocity of 4 -5ft/s on the Tchefuncte River.
- The city of Covington had an average depth of 2 – 3 feet and a velocity of 4 -5 ft/s on Bogue Falaya River.

To evaluate the warning time and evaluation metric, the PDT coordinated with the parish. The parish follows the Louisiana State Police Contra Flow Plan for evacuation with identified trigger points at H- hour minus 50-40-30-hour marks where H-hour is the arrival of gale force winds. Since 2004, evacuations have occurred in 2005 for Hurricane Katrina, 2008 for Hurricane Gustav and 2012 for Hurricane Isaac. No known evacuations have been conducted for riverine flood events.

The data to inform the metric related to the vulnerable population was not available during the study and would be incorporated during the PED phase of the study.

The results of the assessment of the Final Array of Alternatives are shown in Figure 4-5. Alternatives 4 and 5 were considered substantially similar and received the same ratings. Alternatives 6 and 9 contain floodwalls near populated areas and were evaluated with similar risks. It was assumed that for Alternatives 6 and 9, all variations of the alternatives were similar in terms of life safety risk and were evaluated together. The Alternative 7 life safety evaluation primarily considered the Pearl River levee.

Alternatives	Metric					
	Expected Annual LL[1]	Flood Velocity LLR	Warning Time LLR[2]	Evacuation LLR	Vulnerable Population > 2ft[3]	Incremental Risk[3]
No Action	Low	Medium	Low	Low	-	Low
Non-Structural	Low	Medium	Low	Low	-	Low
Alternative 4a	Low	Low	Low	Low	-	Medium
Alternative 4a.1	Low	Low	Low	Low	-	Medium
Alternative 4b	Low	Low	Low	Low	-	Medium
Alternative 5	Low	Low	Low	Low	-	Medium
Alternative 6	Medium	Medium	Low	Low		High
Alternative 7	Low	Low	Low	Low		Medium
Alternative 8	Low	Low	Low	Low		Low
Alternative 9	Medium	Medium	Low	Low		High

Notes: LL – Life Loss, LLR – Life Loss Risk

1. Expected annual life loss is assumed to be low to medium for all scenarios based on population density
2. Warning time based on the tropical storm forecasting days in advance of event
3. Inundation maps generated through HEC-LifeSIM were unavailable at time of assessment, Incremental Risk is based on evaluation of proposed flood control measure and populations of protected areas

Figure 4-5. Life Safety Matrix

4.2.10 Summary of Evaluation and Comparison of the Final Array of Alternatives

The PDT evaluated measures and alternatives in the Final Array and screened them based on their ability to meet the planning objectives, avoid constraints, environmental impacts and to maximize benefits provided over the 50-year period of analysis from 2032-2082. The Final Array of Alternatives were also evaluated against the P&G criteria and their contributions to Federal objectives and accounts. Table 4-15 summarizes the screening and evaluation of the measures in the Final Array of Alternatives. Table 4-16 provides a summary of the cost-effective measures evaluated in the Final Array of Alternatives. Measures that were determined to be meet screening criteria and that were independent, combinable, and cost effective were moved forward for inclusion as part of the comprehensive combined structural and nonstructural plan. The comprehensive combined structural and nonstructural plan was then compared to the standalone nonstructural plan for the entire parish to determine the Draft TSP.

- Alternative 1 - No Action - was screened. It does not address planning objectives and was screened based on completeness since it would not alleviate problems or provide flood risk reduction benefits. The No Action was cost effective since it did not require a Federal Investment and did meet acceptability criteria. The continued flood damages under the No Action would lead to negative RED, EQ, and OSE impacts in the future. There is a medium flood velocity risk for life safety associated with the No Action Alternative.

- Alternative 2 - Nonstructural - met planning objectives, avoided study constraints and was determined to be complete, acceptable, and effective. Nonstructural measures at the 50-year flood plan combined with structural moved forward to the draft combined structural and nonstructural plan.
    - Regarding efficiency, the comprehensive nonstructural plan, the 50-year floodplain (2 percent AEP) was incrementally justified as providing the most net benefits to reduce flood damages in the parish. The nonstructural plan had positive NED, RED and OSE benefits and the least EQ impacts of the alternative in the Final Array of Alternatives. The alternative ranked medium flood velocity risk for life safety.
    - Screened: The 10, 20, and 100-year floodplain were screened based on efficiency and the 50-year floodplain having the highest net benefits.
    - The standalone comprehensive nonstructural alternative was screened due to the Combined Structural and Nonstructural Plan, providing more net benefits.
- Alternative 4 - Lacombe (4a, 4a.1 and 4b) - was not retained for inclusion in the Draft TSP combined structural and nonstructural plan. Although it met planning objectives and was determined to be complete and effective, the Lacombe levee variations (Alternatives 4a, 4a.1 and 4b) were screened based on efficiency due to a negative BCR. The levee had a medium incremental risk for life safety.
    - Screened Measures: S-028, S-120
- Alternative 5 - Bayou Liberty/ Bayou Vincent/Bayou Bonfouca
Bayou Patassat Channel Improvements (Clearing and Snagging) – was initially retained for inclusion into the Draft TSP combined structural and nonstructural plan. The measure was determined to be complete, effective, efficient, and acceptable during initial evaluation of the Final Array of Alternatives. The measure met planning objectives and avoided study constraints (low risk related to HTRW constraints). There is a HTRW site located a mile away from the clearing and snagging location that would be examined further, but it is expected to present a low risk. The measure is expected to have positive NED, RED, and OSE benefits, and low EQ impacts. *It should be noted that during TSP optimization the Bayou Patassat feature was ultimately removed due to being non cost effective. See Appendix F: Economics.*

    For the combined structural and nonstructural plan, the West Slidell levee was combined with the South Slidell levee as it was determined that these two measures combined produced the greatest net benefits. This combination was also determined to be complete, effective, efficient and acceptable. The combination of the South Slidell alignment with the West Slidell alignment removed an area that was an HTRW concern from the South Slidell alignment, reducing implementation risk. The measure is expected to have positive NED, RED, and OSE benefits. The West Slidell levee is expected to result in EQ impacts on Big Branch Wildlife Refuge and Bayou Liberty Louisiana Scenic Waterway, but they would be offset by the anticipated land swap and nature based designs for the floodgate at Bayou Liberty. This alternative was determined to be a low risk related to life safety. The West Slidell levee is not a standalone measure and therefore is not complete when not combined with the South Slidell levee.

- Screened Measures:S-004, S-010

- Bayou Bonfouca Detention Pond and Bayou Liberty Channel Improvements were determined to be complete and effective at addressing problems and opportunities and acceptable, but screened on efficiency due to a negative BCR. Even though cost effective, the West Slidell levee was screened as a standalone since a combination of the West Slidell and South Slidell levee produced greater net benefits and West Slidell is not a complete standalone measure.

- Alternative 6 - South Slidell Storm Surge - portion retained for inclusion into the combined structural and nonstructural plan. The South Slidell Levee (Alternative 6a), South Slidell Levee with Eden Isle (Alternative 6b) and the Combined South Slidell and West Slidell Levee (Alternative 6c) all had a positive BCR, but these measures were not all separable and could not all be selected. The West Slidell and South Slidell levee combination provided the greatest net benefits for this area and was the only alternative moved forward. The combination was determined to be complete, effective, efficient, and acceptable, meeting planning objectives and avoiding study constraints. The measure is expected to have positive NED, RED, and OSE benefits. EQ impacts to managed habitat impacts and the West Slidell levee impacts on Big Branch Wildlife Refuge and Bayou Liberty Louisiana Scenic waterway. There is a high incremental risk for life safety due to population in Slidell.

    - Screened Measures: The South Slidell levee was screened as a standalone but combined with the West Slidell levee.

- Alternative 7 - Eastern Slidell - was screened and not included in the combined structural and nonstructural plan.

    - Screened Measures: S-060, S-069, S-072, and S-073.

    - The Pearl River levee, Doubloon Bayou channel improvements, Gum Bayou Diversion, and Poor Boy Canal improvements were all screened based on efficiency due to a negative BCR. The Pearl River Levee Alignment E was screened based on not meeting the planning objectives, P&G criteria, and the estimated implementation costs exceeding the potential damages avoided. Additionally, Doubloon Bayou Channel Improvements, Gum Bayou Diversion, and Poor Boy Canal Improvements were determined to not be effective in reducing flooding through the H&H modeling as only minor reductions in WSE or in some cases substantial increases in WSE were observed. All were identified as a medium incremental risk for life safety.

- Alternative 8 - Upper Tchefuncte/Covington - Mile Branch – a portion moved forward to the combined structural and nonstructural plan. Coordination is ongoing regarding managed habitat impacts and actions on Mile Branch since it is designated as a State designated scenic stream. The combination was determined to be complete, effective, efficient, and acceptable, meeting planning objectives and avoiding study constraints. The measure is expected to have positive NED, RED, and OSE benefits. There is a low risk related to life safety. EQ impacts are expected to be temporary and non- significant related to terrestrial habitat, with some additional impacts to aquatic habitat during construction, which are being compensated for with creation of a backwater area off of Mile Branch.
    - Screened Measures: S-121.
    - Lateral A channel improvements were screened based on Efficiency due to a negative BC ratio. Additionally, Lateral A channel improvements were determined to not be effective in reducing flooding through the H&H modeling as only minor reductions in WSE were observed.
- Alternative 9 - Mandeville Lakefront- none of the variations (Alternatives 9a, 9b, or 9c) were included in the TSP.
    - Screened Measures: S-046, S-047, S-048, S-118, and S-122.
    - All structural measures that made up the Mandeville Lakefront alternative were screened based on efficiency due to a negative BCR. This area was identified as high incremental risk for life safety due to population in Mandeville.

Table 4-15. Summary Evaluation and Comparison Final Array of Alternatives. The measures in bold were moved forward to the TSP (combined structural and nonstructural plan).

	Meet Planning Objectives (Section 4.2.6)					Avoid Constraints (Table 4.2.6)	Resource Impacts (section 5)															
Alt/Measures	Increase Public Health and Safety	Reduce Flood Damage (Table 4-4)	Reduce Interruption Transportation	Increase Community Resiliency	l Resource Resiliency		Wetlands	P&U Soils	Aquatics	EFH	Wildlife	T&E	WQ	Air Quality	HTRW	Cultural	Noise	Aesthetics	Recreation	Socioeconomic	Navigation	EJ
1-No Action	No					Yes	Wetland loss would follow current trends	Development would continue to threaten P&U soils	There would be more open water for fisheries. Less spawning/ refugia habitats	Beneficial impacts from more water bottom habitat. Adverse impact from loss of cover, spawning and nursery grounds	As wetlands are lost and habitat is converted to open water, wildlife would move into adjacent areas including developed areas looking for cover and food sources	Continued threat due to loss of habitat and increased development. National trends to support T&E protection would continue	Impacts to WQ would follow current trends	AQ would follow current trends	No impact	No impact. Trends would continue into future	No impact	No impact	No impact	Continued threat from storms and flood risk	No impact	Risk to minority and low income population groups
2-Non Structural (Standalone Parish wide) 100 year	Y	Y	I	Y		Yes	Wetland loss would follow current trends	Development would continue to threaten P&U soils	There would be more open water for fisheries. Less spawning/ refugia habitat	Beneficial impacts from more water bottom habitat. Adverse impact from loss of cover, spawning and nursery grounds	As wetlands are lost and habitat is converted to open water, wildlife would move into adjacent areas including developed areas looking for cover and food source	Continued threat due to loss of habitat and increased development. National trends to support T&E protection would continue	Impacts to WQ would follow current trends	Short-term. Parish is in attainment	No Impact	Potential effect on known and undocumented archeological resources and historic built resources, modifications to viewshed and visual landscape	No Impact	Viewshed	No Impact	Temporary	No Impact	Temporary
2-Non Structural (Standalone Parish wide) 50 year	**Y**	**Y**	**I**	**Y**		**Yes**	Wetland loss would follow current trends	Development would continue to threaten P&U soils	There would be more open water for fisheries. Less spawning/ refugia habitat	Beneficial impacts from more water bottom habitat. Adverse impact from loss of cover, spawning and nursery grounds	As wetlands are lost and habitat is converted to open water, wildlife would move into adjacent areas including developed areas looking for cover and food source	Continued threat due to loss of habitat and increased development.	Impacts to WQ would follow current trends		No Impact		No Impact		No Impact		No Impact	

2-Non Structural (Standalone Parish wide) 25 year	Y	Y	I	Y		Yes	Wetland loss would follow current trends	Development would continue to threaten P&U soils	There would be more open water for fisheries. Less spawning/ refugia habitat	Beneficial impacts from more water bottom habitat. Adverse impact from loss of cover, spawning and nursery grounds	As wetlands are lost and habitat is converted to open water, wildlife would move into adjacent areas including developed areas looking for cover and food source	National trends to support T&E protection would continue	Impacts to WQ would follow current trends		No Impact		No Impact		No Impact		No Impact	
2-Non Structural (Standalone Parish wide) 10 year	Y	Y	I	Y		Yes	Wetland loss would follow current trends	Development would continue to threaten P&U soils	There would be more open water for fisheries. Less spawning/ refugia habitat	Beneficial impacts from more water bottom habitat. Adverse impact from loss of cover, spawning and nursery grounds	As wetlands are lost and habitat is converted to open water, wildlife would move into adjacent areas including developed areas looking for cover and food source	Continued threat due to loss of habitat and increased development.	Impacts to WQ would follow current trends		No Impact		No Impact		No Impact		No Impact	
4a-Lacombe Levee (S-028)	Y	Y	I	Y		Yes	Loss of Pine Savanna, Riparian, Marsh															
4a.1-Lacombe Levee Short (S-028)	Y	Y	I	Y		Y	Loss of Pine and Swamp	P&U soils would be impacted for borrow	Temp short term impacts to Migration, Spawning	Conversion of marsh habitat to uplands. Loss of nursery, spawning habitat off set by mitigation					No RECs within 1-mile radius			Viewshed, Louisiana Scenic Streams	Impacts to NWR, LA Scenic Stream		Recreational boating	
4b-Lacombe Levee combined with West Slidell Levee (S-120)	Y	Y	I	Y		Y	Loss of Pine Savanna, , Marsh															
5-West Slidell Levee	Y	Y	Y	Y		Y																
5-Bayou Bonfouca Detention Pond	Y	Y	N	Y		Y	Loss of Pine Savanna				Adverse impacts resulting from Habitat shift, Mortality, Displacement; Beneficial impacts by restoring habitat via mitigation	May affect NLAA Gulf Sturgeon or critical habitat, NLAA Quillwort; RCW, Indian Manatee, gopher tortoise	Short term impacts due to turbidity. SWPPP and LDPS permit required				Short-term	Viewshed				Temporary, positive long-term impacts
5-Bayou Liberty Channel Improvements	Y	Y	N	Y		Y									No RECs within 1 mile radius			Viewshed, Louisiana Scenic Streams	Impacts to NWR, LA Scenic Stream		Temporary Recreational boating	
5-Bayou Patassat Channel Improvements - Clearing and Snagging	**Y**	**Y**	**I**	**Y**		**Low risk HTRW site**			Temp short term impacts to Migration, Spawning	Short term, Temporary impacts to water bottoms								Viewshed				
6a-South Slidell (S-075 & S-076)	Y	Y	I	Y		Low risk HTRW site	Adverse impacts to PS, Marsh.	P&U soils would be lost for borrow							(1) NPL site, (1) TSCA site,							

6b-South Slidell with Eden Isle (S-070, S-075 & S-076)	Y	Y	Y	Y		Critical habitat sturgeon; Low Risk HTRW	Conversion of marsh to uplands offset by creation of marsh. Impacts to PS would be offset by restoring of low quality site by active mgmt.								(2) ACRES sites, (6) TRI sites found within a 1 mile radius				Big Branch Marsh NWR		Short term temp impacts to Rec boating	
6c-South Slidell with West Slidell Levee (S-081, S-075 & S-076)	**Y**	**Y**	**Y**	**Y**		**Y**																
7-Pearl River Levee	Y	Y	Y	Y		Y													Pearl River WMA, Louisiana Natural and Scenic Rivers System			
7-Gum Bayou Channel Improvements - Diversion(S-072)	Y	N	N	Y		Y									No RECs within 1 mile radius							
7-Poor Boy Canal Channel Improvements - Dredging (S-073)	N	M	N	I		Y												Viewshed, Louisiana Natural and Scenic Rivers System			Short term temporary impacts to Rec boating	
7-Doubloon Bayou Channel Improvements -Dredging (S-069)	N	N	N	N		Y													Louisiana Natural and Scenic Rivers System			
8-Mile Branch Channel Improvements (S-057)	**Y**	**Y**	**I**	**Y**		**Y**	Adverse long term impacts to loss of 36 acres Riparian habitat				Loss of 3 acres of water bottoms. Offset by creation of additional water bottoms. Permanent Loss of wildlife riparian habitat											
8- Lateral A Channel Improvements (S-121)	N	M	I	Y		Y									1 brownfield site							
9a-Mandeville Seawall (7.3 feet) Passive Drainage (S-046, 118, S-047)	Y	Y	I	Y		Y																
9b-Mandeville Seawall (7.3 feet) Pump Stations (S-046, S-118, S-048)	Y	Y	I	Y		Y	Adverse impact to BLH Swamp, Marsh	P&U soils would be impacted for borrow							No RECs within 1 mile radius			Viewshed	Mandeville Lakefront Park, East Lakefront Children's Park			
9c- Mandeville Seawall (18 feet) (S-122)	Y	Y	I	Y		Y																
Borrow	**NA**	**NA**	**NA**	**NA**																		Temporary

	NED Benefits (Sec. 4.2.9)	RED Benefits (Sec 4.2.9)	EQ Impacts (Sect 4.2.9)	OSE Benefits (Sec. 4.2.9)	Life Safety from Structure (Section 4.2.10)	P&G Criteria (Section 4.2.8)				BCR (Table 4-5, 4-6, 4-7, 4-8)	Estimated Number of Structures Benefitted	Total Cost (Table 4-4 & Table 4-5, 4-6, 4-7, 4-8)	Notes	Moved forward and included in the Combined Alternative (TSP)
Alt/Measures						Completeness	Effectiveness	Efficiency	Acceptability					
1-No Action	N	N	N	N	low	N	N	Y	N	-		0	Screened	No
2-Non Structural (Standalone Parish wide) 100 year	Y	Y	low	Y	low	Y	Y	Y	Y	1.6	17,900	$4,825,397,000	Screened 50 year NS more efficient	No
2-Non Structural (Standalone Parish wide) 50 year	Y	Y	low	Y	**low**	**Y**	**Y**	**Y**	**Y**	**1.9**	**13,800**	**$3,716,442,000**	**Portion of NS plan for areas not covered by the Economically justified structural measures moved forward**	**Partial**
2-Non Structural (Standalone Parish wide) 25 year	Y	Y	low	Y	low	Y	Y	Y	Y	2.3	9600	$2,581,277,000	Screened-50 year NS more efficient	No
2-Non Structural (Standalone Parish wide) 10 year	Y	Y	low	Y	low	Y	Y	Y	Y	2.6	6100	$1,671,304,000	Screened- 50 year NS more efficient	No

4a-Lacombe Levee (S-028)	N	Y	Y	Y	med	Y	Y	N	Y	0.5	600	$487,101,000	Screened- Efficiency; negative B/C ratio	No
4a.1-Lacombe Levee Short (S-028)	N	Y	Y	Y	med	Y	Y	N	Y	0.5	580	$461,934,000	Screened- Efficiency; negative B/C ratio	No
4b-Lacombe Levee combined with West Slidell Levee (S-120)	Y	Y	Y	Y	med	Y	Y	N	Y	0.9	3,100	$1,347,853,000	Screened- Efficiency; negative B/C ratio	No
5-West Slidell Levee	Y	Y	Y	Y	med	N	Y	Y	Y	1.2	2,500	$888,576, 000	Screened as standalone; combined into 6c	No
5-Bayou Bonfouca Detention Pond	N	Y	Y	Y	N/A	Y	Y	N	Y	0.2	80	$151,623,591	Screened- Efficiency; negative B/C ratio	No
5-Bayou Liberty Channel Improvements	N	Y	Y	Y	N/A	Y	Y	N	Y	0.4	70	$52,655,730	Screened- Efficiency; negative B/C ratio	No
5-Bayou Patassat Channel Improvements-Clearing and Snagging	Y	Y	Low	Y	**N/A**	**Y**	**Y**	**Y**	**Y**	**2.9**	**30**	**$956,630**	**High BC ratio**	**Yes**
6a-South Slidell (S-075 & S-076)	Y	Y	Y	Y	high	Y	Y	Y	Y	1.8	4,500	$1,042,159,000	Moved forward under 6c	No
6b-South Slidell with Eden Isle (S-070, S-075 & S-076)	Y	Y	Y	Y	high	Y	Y	Y	Y	1.4	5,400	$1,682,008,000	Screened- not most effective for the area	No
6c-South Slidell with West Slidell Levee (S-081, S-075 & S-076)	Y	Y	Y	Y	**high**	**Y**	**Y**	**Y**	**Y**	**1.7**	**7,000**	**$1,732,902,000**	**Most effective variation**	**Yes**
7-Pearl River Levee	N	Y	Y	Y	med	Y	N	N	Y	0.4	400	$216,511,535	Screened- Efficiency; negative B/C ratio; did not meet planning objectives or P&G criteria	No
7-Gum Bayou Channel Improvements-Diversion(S-072)	N	Y	Y	Y	N/A	N	N	N	N	0	0	$22,174,443	Screened- Efficiency; negative B/C ratio; did not meet planning objectives or P&G criteria	No

7-Poor Boy Canal Channel Improvements-Dredging (S-073)	N	Y	Y	Y	N/A	N	N	N	Y	0	0	$15,307,082	Screened- Efficiency; negative B/C ratio; did not meet planning objectives or P&G criteria	No
7-Doubloon Bayou Channel Improvements-Dredging (S-069)	N	Y	Y	Y	N/A	N	N	N	Y	-1.1	0	$34,937,686	Screened- Efficiency; negative B/C ratio	No
8-Mile Branch Channel Improvements (S-057)	Y	Y	Y	Y	**low**	**Y**	**Y**	**Y**	**Y**	**2**	**250**	**26,337,000**		**Yes**
8- Lateral A Channel Improvements (S-121)	N	Y	Y	Y	low	Y	Y	N	Y	0.3	30	25,600,000	Screened- Efficiency; negative B/C ratio	No
9a-Mandeville Seawall (7.3 feet) Passive Drainage (S-046, 118, S-047)	N	Y	Y	Y	high	Y	Y	N	Y	0.2	400	$172,144,000	Screened- Efficiency; negative B/C ratio	No
9b-Mandeville Seawall (7.3 feet) Pump Stations (S-046, S-118, S-048)	N	Y	Y	Y	high	Y	Y	N	Y	0.2	400	$186,409,000	Screened- Efficiency; negative B/C ratio	No
9c- Mandeville Seawall (18 feet) (S-122)	N	Y	Y	Y	high	Y	Y	N	Y	0.4	400	$519,596,000	Screened- Efficiency; negative B/C ratio	No
Borrow														

Table 4-16. Summary of Cost-Effective Structural Measures of the Final Array shown alongside the Cumulative Justified Nonstructural Increment at the 2% AEP/50 Year Floodplain

	Alternative 5 West Slidell Levee (S-081)	Alternative 6 South Slidell Levee (S-074, S-075 & S-076, S-077)	Alternative 6 South Slidell Levee with Eden Isle (S-070, S-074. S-075, S-076. S-077))	**Alternative 6 South Slidell with West Slidell Levee (S-074, S-075, S-076, S-077, S-081)**	**Alternative 6 Bayou Patassat Clearing Snagging (S-080)**	**Alternative 8 Mile Branch Channel Improvements (S-057)**	**Alternative 2 Rest of Parish Nonstructural (NS-09 & NS-11) 50 year**	Combined Plan- Structural & NS 2% AEP (50 -year) for rest of the parish outside of structural influence	Parish Wide Nonstructural Plan Cumulative to the 2% AEP 50 Year floodplain (NS-09 & NS-11)
First Cost	888,576,000	1,042,158,000	1,682,008,000	**1,732,901,000**	**956,630**	**26,337,370**	**2,241,108,370**	3,939,245,000	4,501,184,454
Benefits	42,455,000	75,706,000	93,114,000	**118,160,000**	**133,000**	**2,221,000**	**157,421,000**	277,935,000	244,563,150
AA Cost	36,036,000	42,372,000	66,432,000	**70,985,000**	**45,900**	**1,115,100**	**79,263,000**	149,080,000	136,095,426
Net Benefits	6,419,000	33,334,000	26,682,000	**47,175,000**	**87,000**	**1,106,000**	**78,158,000**	128,855,000	108,467,724
B/C Ratio	1.2	1.8	1.4	**1.7**	**2.9**	**2.0**	**1.9**	1.8	1.8
Approx. # structures	2,500	4,400	5,300	**7,000**	**30**	**250**	**8,500**	15,800	13,800

Bolded measures moved forward to the comprehensive combined plan for the Parish (Draft TSP)

4.3 SELECTION OF DRAFT TSP (JUNE 2021)

Based on the evaluations described in Sections 4.2.1-4.2.10, and summarized in Section 4.2.10 and Table 4-15, the independent, combinable, cost-effective measures with a BCR value greater than 1 were moved forward for inclusion as part of the comprehensive combined structural and nonstructural plan (Table 4-16). For FRM, the two justified measures, Bayou Patassat Channel Improvements (clearing and snagging) (S-080) and the Mile Branch Channel Improvements (S-050), were separable and combinable and both moved forward for the Draft TSP. For CSRM, the West Slidell Levee, South Slidell Levee, South Slidell Levee with Eden Isle and the Combined South Slidell and West Slidell Levee all had a positive BCR, but these measures were not all separable and could not all be selected. The West Slidell (S-081) and South Slidell (S-075, S-076) levee combination provided the greatest net benefits for this area and was the only alternative moved forward for CSRM. The nonstructural measures (NS- 08, NS-09, NS-10, NS-11) that address structures in the 0-50 year floodplain (2 percent AEP) in areas not benefited by the structural measures were also moved forward.

The combined structural and nonstructural FRM/CSRM plan containing the combined West and South Slidell levees (from Alternative 6c), Bayou Patassat channel improvements-clearing and snagging (from Alternative 5), Mile Branch channel improvements (from Alternative 8) and nonstructural (from Alternative 2) for eligible structures in the 50-year floodplain that do not benefit from the structural measures resulted in a BCR of 1.8 with $128,855,000 in net benefits (Table 4-16). This combined structural and nonstructural plan was then compared to the "nonstructural only" plan (entire Alternative 2), which also had a BCR of 1.8, but the net benefits were lower (Table 4-16). The combined structural and nonstructural plan was moved forward as the NED plan and the TSP. The draft IFR-EIS with the Draft TSP was released for public review on 11 June 2021. After the release of the draft IFR-EIS, the PDT conducted additional engineering, economic and environmental investigations on the Draft TSP as part of the Feasibility Level Design phase of the study. Information gathered through these additional investigations, in conjunction with consideration of concerns raised by the public and by agencies, assisted the PDT in further refining the Draft TSP. Subsections 4.3.1 and 4.4 provide a summary of these investigations and how public and agency concerns were addressed. Additional details on the Draft TSP is included in Appendix D: Engineering.

The individual measures included in the Draft TSP previously described in Section 4.1 are summarized below. Figures for the Draft TSP can be found in Section 2.6 of Appendix B: Plan Formulation.

2021 Draft TSP*

1. **A comprehensive plan to address flooding parish-wide and includes CSRM, FRM, and nonstructural measures. The TSP is the NED Plan.**

- 2021 Nonstructural Plan-CSRM and FRM-***Nonstructural flood risk reduction*** for eligible structures in the rest of St Tammany Parish not covered by the structural measure of the TSP.
  - Voluntary Program including approximately 8,498 structures to be elevated (6,643 residential) or floodproofed (1,855 nonresidential) to the future 100 year flood stage. *For additional details refer to Section 4.1 Alternative 2; Figure 4-5; Appendix F for analysis and Appendix H for preliminary implementation guidance.*

- 2021 FRM-***Bayou Patassat Channel Improvements*****- Clearing and Snagging-
  - Approximately 0.17 miles (900 feet) of clearing and snagging would occur in Bayou Patassat between Bayou Vincent Pump Station and US Route 11. *For additional details refer to Section 4.1 Alternative 5; Figure 4-6; Appendix D**

- 2021 CSRM-***South Slidell and West Slidell Levee and Floodwall System***
  - The levee floodwall system is comprised of approximately 16.3 miles of levee and floodwall and includes five pump stations, and eight floodgates. There would also be a total of seven culverts and sluicegates, eight vehicular gates, one railroad gate along the Norfolk Southern Railroad, and eight road ramps. The I-10 would be raised over the new levee section by constructing ramps. *For additional details refer to Section 4.1 Alternative 6c; Figure 4-7; Appendix D*

- 2021 FRM-***Mile Branch Channel Improvements***-
  - Channel Improvements include clearing and grubbing and mechanical dredging of Mile Branch. The channel bottom would be lowered by 5 feet. Approximately 20 acres of channel would be cleared and grubbed prior to mechanical dredging. *For additional details refer to Section 4.1 Alternative 8; Figure 4-8; Appendix D*

*Features included in the Draft TSP released in the 2021 draft IFR-EIS underwent additional analysis and design and were refined as documented in Section 6.
**Note the Bayou Patassat Measure was included in the Draft TSP released in the 2021 draft IFR-EIS; additional analysis removed this measure from the Optimized TSP.

4.3.1 Further Investigation and Reevaluation of FRM/CSRM Measures for the Eden Isle Community in Slidell, Louisiana

Subsequent to the selection of the Draft TSP but prior to the public release of the Draft IFR-EIS in 2021, the NFS requested that USACE investigate additional FRM and CSRM measures for the Eden Isle community. The PDT coordinated with the NFS, the STPG, the STLDCD, and other stakeholders to discuss and investigate the development of additional measures. USACE conducted a sensitivity analysis to determine if the estimated change in benefits, impacts and/or costs associated with a refined alignment at Eden Isle to incorporate into the Draft TSP. Further analysis confirmed that there was not a justified alignment to incorporate Eden Isle into the levee and floodwall system of the Draft TSP. The structures in Eden Isles are however included in the nonstructural portion of the Draft TSP. For additional information See Appendix B: Plan Formulation.

Although the Eden Isle measures were not selected as part of the NED plan under this study authorization, State or local government entities may consider Eden Isle risk reduction features for implementation under other Non-Federal authorizations or programs.

4.4 FINAL FEASIBILITY DESIGN AND OPTIMIZATION OF THE TENTATIVELY SELECTED PLAN

Subsequent to the release of the Draft IFR-EIS, additional engineering, economic, and environmental investigations on the separate features of the Draft TSP were conducted as part of the Feasibility Level Design phase of the study. Information gathered through these additional investigations, together with the consideration of comments received from the public, stakeholders, the USFWS, and the NMFS regarding the South Slidell and West Slidell levee and floodwall System, (levee and floodwall system) assisted the PDT in further refining the Draft TSP.

Differences in the Draft TSP as compared to the Optimized TSP are shown in Table 4-17 and Figure 4-6. A summary of the optimized structural measures of the TSP (CSRM South Slidell and West Slidell levee and floodwall system and the FRM Mile Branch Channel Improvements) are included in Section 6 and described in detail in Appendix D: Engineering.

The FRM structural measure Bayou Patassat Channel Improvements was screened due to the clearing and snagging not being as effective as the H&H modeling originally estimated. An updated economics analysis yielded a BCR of 0.5 resulting in the lack of economic justification.

The nonstructural components of the TSP were also optimized during final feasibility level of design to refine the aggregation of the nonstructural plan. See Section 4.4.2.7 and Appendix F: Economics for detail on the nonstructural plan refinement.

4.4.1 CSRM Measure- Final Feasibility Level Optimized Levee and Floodwall System

The subsections below provide a summary of the investigations to address public and agency concerns. In addition, adjustments/refinements were made on the Draft TSP based on updated Future with Project modeling and included changes to minimize induced flooding, identify hydraulic efficiencies, adjust tie-in locations and heights, refine the locations, capacities and dimensions of various structures (i.e., gates, pump stations, etc.) (Appendix E: Hydrologic & Hydraulics). The screening and evaluation of alignment shifts considered efforts to minimize the taking of structures or induce flooding on communities, which includes businesses, residential, and infrastructure. A RSLC analysis (was conducted for three rates of RSLR in accordance with Engineering Regulation 1100-2-8162 to determine how the different rates of RSLR would impact project benefits (Section 4.4.2.2 of Appendix E: Hydrologic & Hydraulics).

The Optimized alignment for the South Slidell and West Slidell levee and floodwall alignment is further detailed in Appendix D: Engineering and Appendix E: Hydrologic & Hydraulics. See Figure 4-6 and Table 4-17. The impact analysis for the Optimized TSP alignment for the levee and floodwall system has been updated in light of the revised design, features and alignment in Section 5, Environmental Consequences.

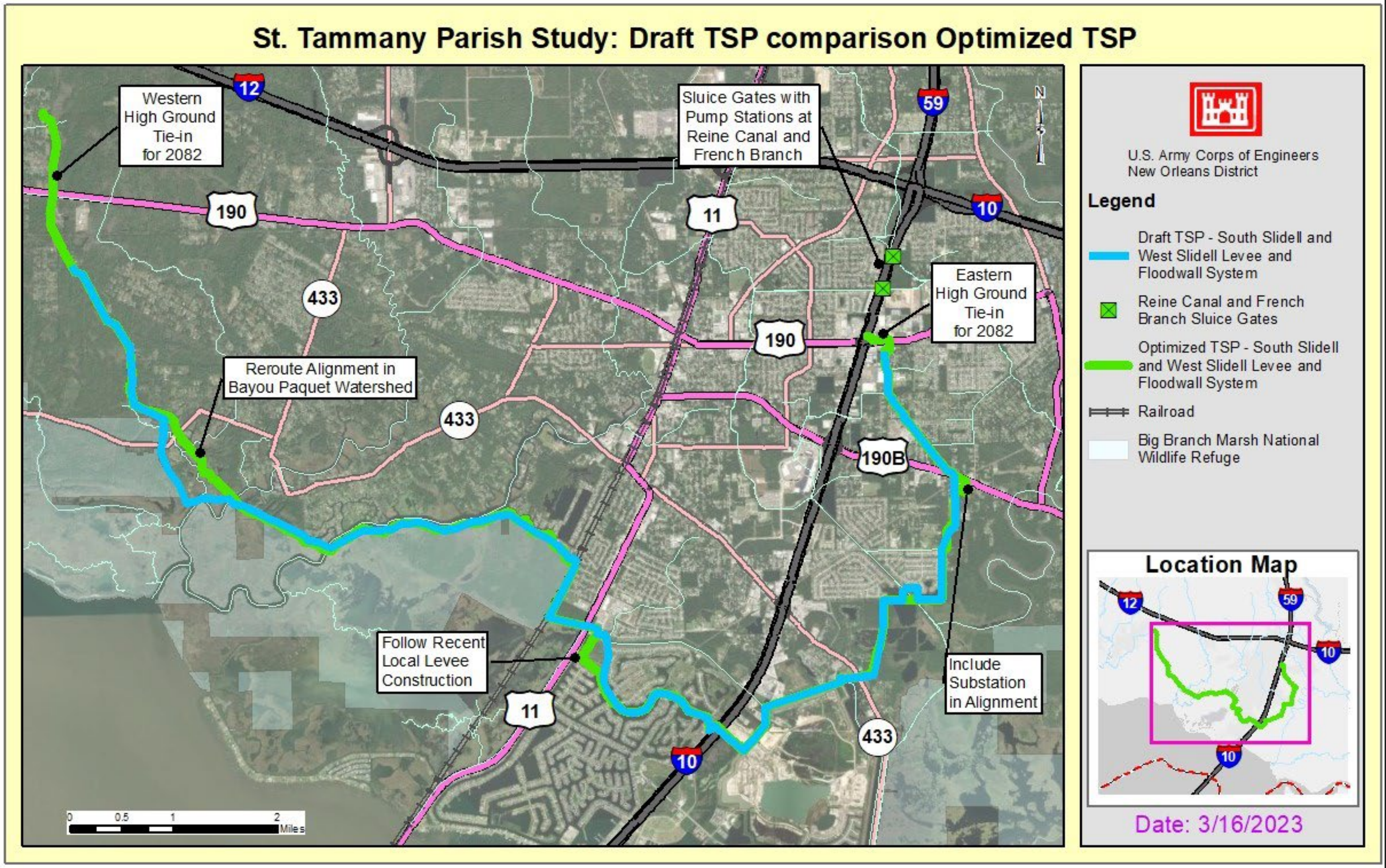

Figure 4-6. Comparison of the Draft TSP alignment with the Optimized TSP alignment for the South Slidell and West Slidell Levee and Floodwall System

Table 4-17. Comparison of the Draft TSP alignment with the Optimized TSP alignment for the South Slidell and West Slidell Levee and Floodwall System

Attribute	Draft TSP Alignment Alternative 6c (June 2021)	Optimized TSP Alignment Alternative6-3-C (April 2023)
Total Length	16.3 miles (85,900 feet)	18.5 miles (97,700 feet)
Length of Floodwall	2.3 miles (12,200 feet)	3.5 miles (18,200 feet)
Length of Levee	14 miles (73,700 feet)	15 miles (79, 500 feet)
Temporary Acres of Construction for Levee and Floodwall system	169 acres **Initial construction for levees only**	100 acres
Permanent Acres for Levee and Floodwall system	Not available	450 acres
Elevation Range (Depends on location)	13 feet to 15 feet (year 2032) 15.5 feet to 18.5 feet (year 2082) (depending on location)	13.5 feet to 16 feet (year 2032) 17.5 feet to 20 feet (year 2082) (depending on location)
Pump Stations	5	8
Culverts/ Sluice Gates/Lift Gates	8	13
Number of Vehicular Flood Gates	8	18
Number of Pedestrian Floodgates	1	1
Railroad Gates	1	1
Road Ramps	8	6
Length of Levee/ Floodwall on or directly adjacent to Refuge property	4.3 miles	3.4 miles
Length of Levee/ Floodwall directly on Refuge property	3.5 miles	3.3 miles
Mitigation Cost	$118,059,000	$42,739,711
Fill (Borrow Material) Required	1,528,000 cubic yards ** For the Draft TSP the amount of fill required was only counted for the initial construction**	7,239,000 cubic yards (initial cons plus future lifts) 3,000,000 cubic yards for initial construction only

4.4.2 Investigations into Optimization of Draft TSP.

The following items were investigated in optimizing the Draft TSP:

1. Optimization based on Feasibility level of Design
    a. Revisions based on Future with Project modeling included.
        i. changes to minimize induced flooding.
        ii. identification of hydraulic efficiencies.
        iii. adjustment to tie-in locations and heights.
        iv. refinement of locations, capacities and dimensions of various structures (i.e., gates, pump stations, etc.). including optimization of structures to meet/not restrict current navigational flow.
    b. Refinements to incorporate critical infrastructures.
    c. Real Estate refinements to the levee and floodwall alignment to avoid impacts to roads and structures.
    d. Investigations into elevating road surface of the I-10 to ramp over the new levee section and stay above the hydraulic design elevation for year 2082.
2. Optimization of the levee and floodwall alignment based on comments received during the Public Comment period on the draft IFR-EIS.
    a. Investigations regarding Military Road (eastern portion of Draft TSP alignment).
    b. Investigations regarding Old Spanish Trail/LA Highway 433 (southeast portion of Draft TSP alignment).
3. Optimization of the levee and floodwall alignment to avoid, minimize, and reduce impacts to Big Branch Marsh National Wildlife Refuge (BBMNWR).
    a. Investigations to avoid, minimize, and reduce impacts to BBMNWR near Bayou Paquet Road.
    b. Investigations to avoid, minimize, and reduce impacts to BBMNWR near LA Highway 433 (West Slidell).
4. Additional investigations into East Slidell terminus of the South Slidell and West Slidell Levee and Floodwall System.

4.4.2.1 Investigation Regarding Optimization of the Levee and Floodwall Alignment Based on Comments Received During the Public Comment Period on the DIFR and DEIS

The Notice of Availability for the DIFR-EIS was published in the Federal Register on 11 June 2021, initiating the 45-day public review period for the study. The comment period closed on 26 July 2021. During the comment period, members of the public raised questions and concerns regarding the sections of the levee and floodwall alignment, including the Military Road and Old Spanish Trail/LA Highway 433 locations. Many residents who lived in communities outside of the proposed levee and floodwall alignment, questioned why their neighborhoods had been excluded from the alignment and requested that the USACE reconsider the alignment to incorporate additional structures within the area to receive risk reduction. The PDT evaluated potential incremental adjustments to the alignment to incorporate the communities along Military Road and Old Spanish Trail/ LA Highway 433. The additional investigations revealed that shifts or adjustments to the alignment (to include these areas) would not provide effective or efficient benefits. Furthermore, many of the variations in the alignment which were the subject of these additional investigations, also had adverse environmental, social or real estate impacts and therefore, these variations in the alignment were screened from further consideration. Also, although certain structures remain outside the levee and floodwall system, these structures were considered for eligibility in the nonstructural plan. Structures that would incur flooding in the 1 percent, 2 percent and 4 percent event are included in the nonstructural plan based on subaggreation that was completed during feasibility level design.

4.4.2.1.1 Investigation Regarding Variations to the Eastern End of the Alignment to Include Military Road Communities (Screened)

At the request of stakeholders and the public, changes to the eastern end of the alignment to incorporate additional communities along Military Road (U.S. Highway 190) were investigated. (Figure 4-7). All variations of the alignment cut through heavily populated and urbanized areas and would require extensive coordination to design and implement practical engineering features. After a thorough evaluation, the PDT determined that none of the proposed alignment adjustments to include Military Road would be effective or efficient and those alignment variations were screened from further consideration based on major factors such as, engineering constructability, economic, and practicality considerations; natural and human environmental impact; and life safety and flood risk concerns.

4.4.2.1.2 Investigation Regarding Military Road Alignment (Screened)

Military Road is a Federal highway south of the intersection at Gause Blvd/Herwig Bluff Road (U.S. Highway 190) in Slidell. North of this intersection, the road is a state highway (U.S. Highway 190). The stakeholders proposed Military Road alignment running along the middle turn lane of the U.S. Highway 190 (Military Road Alignment). Any levee and floodwall alignment that traverses the existing right of way of a state and/or federal highway would require coordination between the appropriate state and Federal agencies to determine the obligations for operation, maintenance, repairs, rehabilitation, replacement, inspections, repairs to the features of the Optimized TSP, flood-fighting and other similar concerns.

CEMVN contacted the state of Louisiana, Department of Transportation and Development for feedback on traffic design and construction issues. The Federal Highway Administration (FHWA) has intersection sight distance (ISD) requirements to ensure proper visibility when vehicles cross the road. In order to satisfy FHWA requirements, openings in the floodwall to would be required to accommodate vehicular traffic along Military Road. These opening would be in the form of extremely long (hundreds of feet) floodgates. Large roller gates or swing gates would be impractical from a maintenance, construction, and cost perspective and visibility along Military Road would be cut off completely due to the height of the floodwall resulting in safety concerns. See Figures 4-8 through 4-10.

The construction of a Military Road alignment would also directly and indirectly impact the pine savanna/hardwood and wetland habitat in the area and thereby require compensatory mitigation. In addition, the pine savanna/hardwood habitat may be used by the endangered red-cockaded woodpecker and result if further adverse T&E impacts. Fragmentation of this habitat would result in impacts to terrestrial wildlife and avian species that require larger tracts of forested habitat to thrive.

Although the Military Road alignments are not included in the NED plan, these CSRM measures may be evaluated for future implementation by State or local government entities by a third party under a future study or authorization.

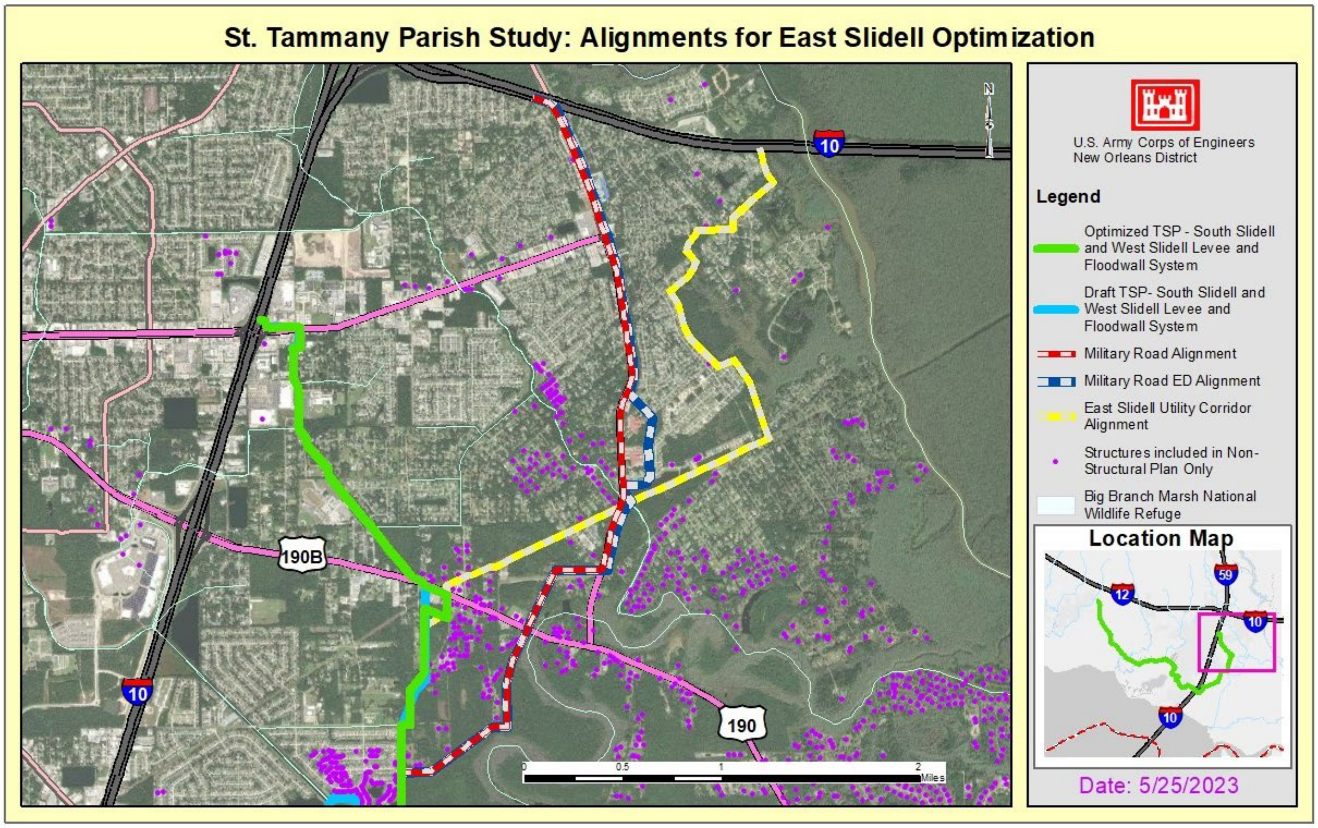

Figure 4-7. Alignments Considered during Optimization of the Eastern Portion of the Levee and Floodwall System

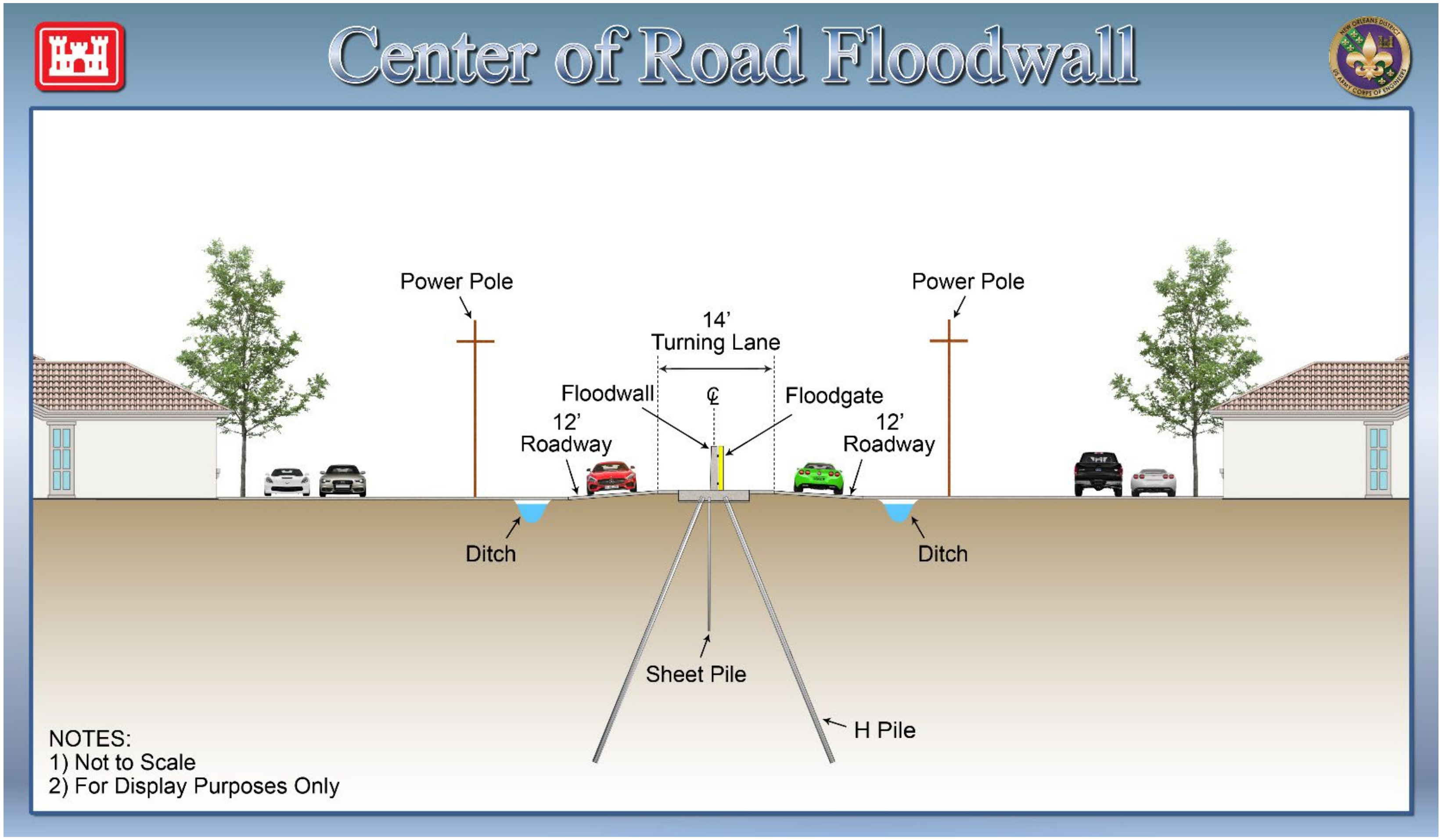

Figure 4-8. Visualization of a Typical Side View of Center of the Road Floodwall Along the Turning Lane (Center) of Military Road

4.4.2.1.3 Investigation Regarding a USACE Military Road Alignment (Screened)

CEMVN investigated an alignment in the proximity of Military Road (USACE Military Road Alignment) to reduce concerns expressed by LA DOTD as described above. By moving the alignment to the side of the road, traffic issues would be minimized on the southern half of U.S. Highway 190. This alignment would provide risk reduction to the Cypress Cove Elementary school and the Honey Island Elementary school. The urban area to the north is so densely populated that the alignment was moved closer to Highway 190 The alignment would require a large number of vehicular gates and also create access issues for business and driveways. The number and size of the structures needed for this alignment and the urban environment location led the PDT to conclude that the alignment would not be practical, effective, or efficient. See Figure 4-9.

A post and panel style deployable floodwall system was considered for the approximately 2 mile reach of floodwall along Military Road. The stem system would only be in place during a high water event. However, there many impracticalities associated with this option, including labor requirements, erection lead time, high maintenance, system width, and storage requirements. This system would also prevent emergency access from unprotected areas.

Any levee and floodwall alignment that traverses the existing right of way of a state and/or federal highway would require coordination between the appropriate state and Federal agencies to determine the obligations for operation, maintenance, repairs, rehabilitation, replacement, inspections, repairs to the features of the Optimized TSP, flood-fighting and other similar concerns.

This alignment also has similar impacts to the pine savanna/hardwood and wetland habitat as described under the Military Road alignment. Fragmentation of this habitat would result in impacts to terrestrial wildlife and avian species that require larger tracts of forested habitat to thrive.

The USACE Military Road alignment was considered impractical and screened out.

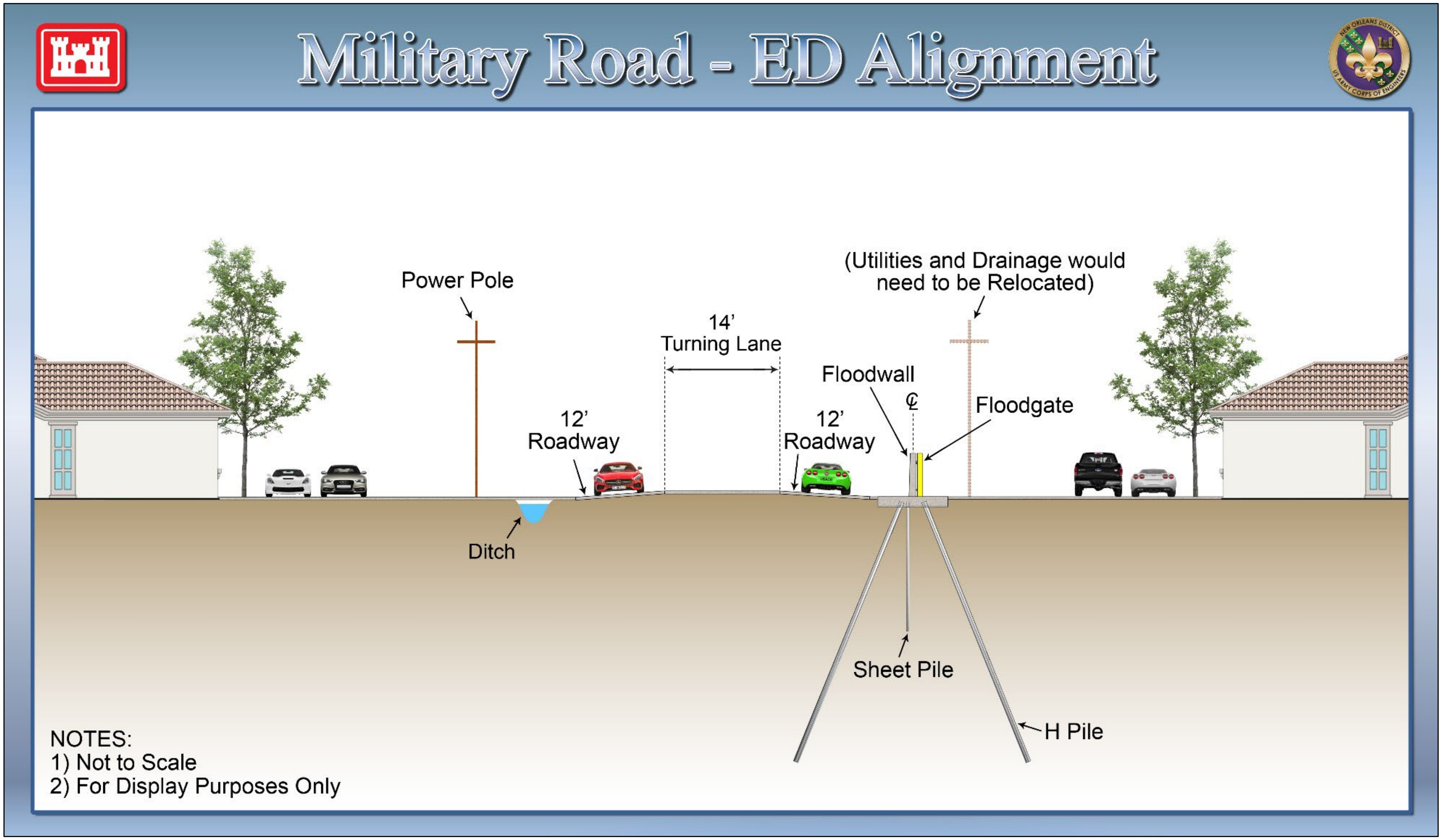

Figure 4-9. Visualization of USACE Military Road Alignment

Note: Each property would require a gate for access

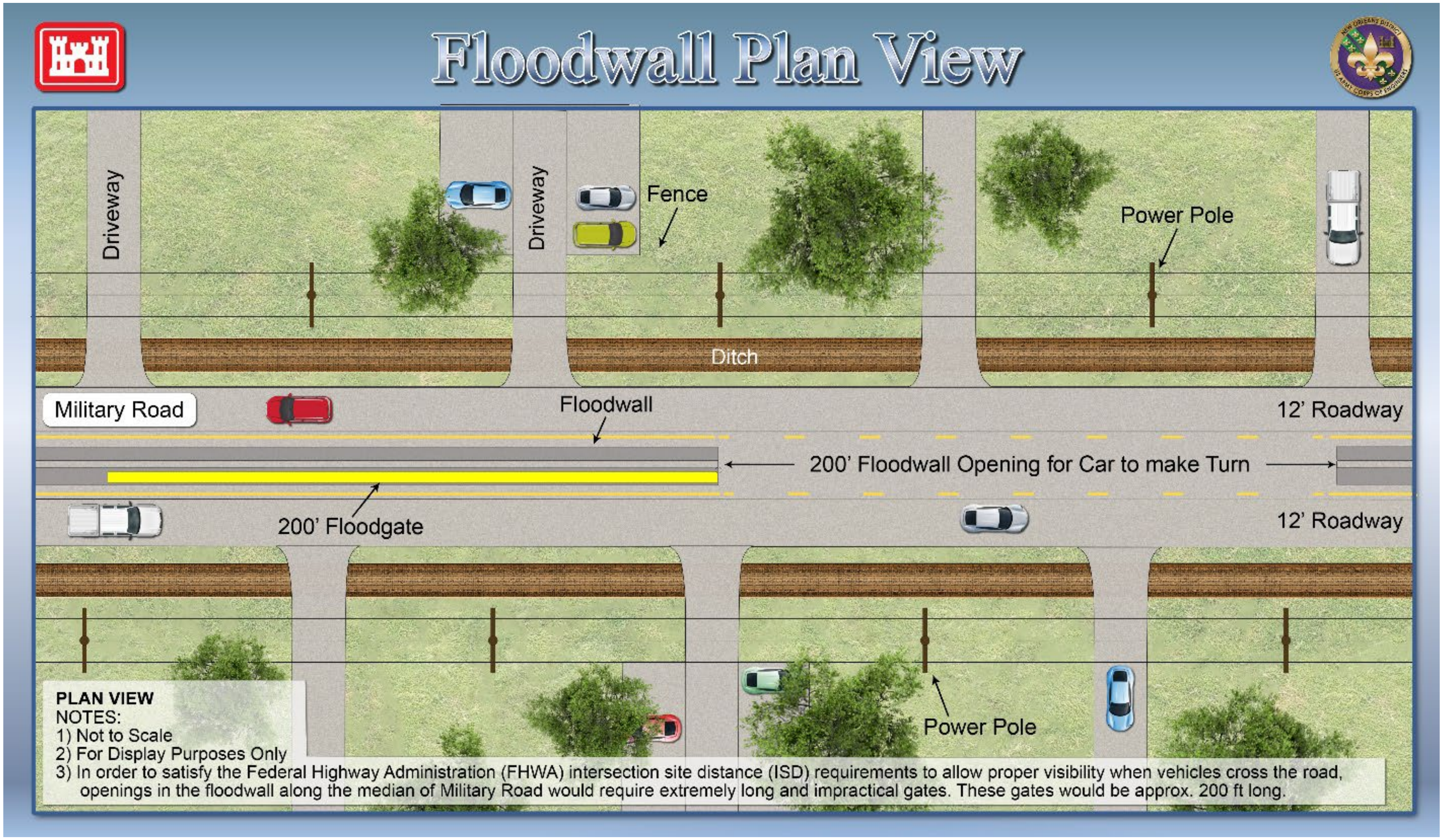

Figure 4-10. Visualization of a Typical Plan View of an Alignment Running Alongside of Military Road

4.4.2.1.4 Investigation Regarding East Slidell Utility Alignment (Screened)

Subsequent to the screening of the stakeholder proposed and USACE Military Road alignments, the PDT proposed an alignment on the eastside of Military Road (East Slidell Utility alignment) to incorporate the communities in the vicinity of Military Road and avoid the highway and densely populated areas. This alignment would provide risk reduction to more properties when compared to the Draft TSP and the other Military Road alignments. This is a densely populated area, with hundreds of homes that would be disturbed by the construction of a floodwall and other features. There is a significant safety risk with this alignment as communities closer to the Pearl River to the south and east of the alignment (flood side of the alignment) would not be able to evacuate when the floodgates are closed. Therefore, a bridge or ramp would be necessary to provide emergency access over a floodwall during a high water event.

Any levee and floodwall alignment that traverses the existing right of way of a state and/or federal highway would require coordination between the appropriate state and Federal agencies to determine the obligations for operation, maintenance, repairs, rehabilitation, replacement, inspections, repairs to the features of the Optimized TSP, flood-fighting and other similar concerns.

This alignment would traverse along the Pearl River resulting in impacts to bottomland hardwoods, wetlands, and adversely affect aquatic and terrestrial wildlife utilizing the habitat impacts requiring compensatory mitigation. Any impacts to the Pearl River are designated critical habitat for threatened Gulf sturgeon and would require Section 7 formal consultation.

This alignment was ultimately screened out due to the large construction cost and environmental impacts of an emergency access bridge or ramp.

Induced Flooding – All of the proposed Military Road alignments (Military Road and USACE Military Road alignments, and the East Side Utility Corridor alignment), are close to the Pearl River, which is a main source of flooding for St. Tammany Parish. The riverine inducements outside of the Draft TSP alignment would be greater for the Military Road variations when compared to the Optimized TSP alignment. Additionally, inducements on the flood side due to surge might be greater with all Military Road variations because they are in closer proximity to the source of surge (Gulf of Mexico and Lake Pontchartrain) than the eastern extent of the Optimized TSP alignment.

Relocations (electrical, water and sewage) – For all alignments including the Draft TSP and Optimized TSP alignment, there would be potential complications with utilities due to the large number of structures; however, this was not a deciding factor in selection of the Optimized TSP.

Social Impacts – All alignments on the eastern end including the Draft TSP alignment and the Optimized TSP alignment, would have various degrees of social impacts associated with having an intrusive floodwall in the near vicinity of properties. Social impacts include, but are not limited to:

- Impacts from real estate buyouts affecting community cohesion;
- Increased safety risks from road closures, traffic delays, congestion, reduced visibility, and access;
- Ingress/Egress concerns resulting from numerous access gates;
- Impacts resulting from relocations of utilities;
- Noise impacts resulting from construction equipment.

Floodplain Impacts – The analysis showed that 75 percent of the structures in the communities added through the NFS and the USACE Military Road alignments, the Draft TSP alignment, and the East Side Utility Corridor alignment are already outside of the 100-year floodplain and would not provide extra flood risk reduction by being included in the structural plan. About 21 percent of structures within the 100-year floodplain elevation, and about 4 percent of structures are within the 50-year floodplain. These structures are included in the nonstructural plan.

Critical Infrastructure – Risk related critical infrastructure in the area including schools, hospital and electrical substations was identified and evaluated in connection with the proposed eastern end refinements. Three electrical substations and critical infrastructure in the area were examined to determine their floodplain elevation. The electrical substations would be included in the NFS and the USACE Military Road alignments and the East Side Utility Corridor alignment, but only one substation is incorporated into the Optimized TSP (two of the three substations are already elevated).

Cultural Resources – Potential impacts to cultural resources did not factor into the decision-making regarding these alignments since cultural resource surveys have not been conducted at this phase of the study.

Environmental Justice (EJ) – Figure 4-11 shows the Draft TSP alignment intersecting 16 census block groups, but in particular, six Census Block Groups that are considered areas of EJ concern; including Block Groups numbered 408062, 408063, 408064, 408072, 411061, 412133. Figure 4-11 also shows the location of the 18 residential structures that would be acquired, represented by a red dot. Four of the 18 residential structures potentially being acquired are in block group numbers 408062 and 408072, areas of EJ concern. The 14 other residential structures are in Block Groups that are not majority minority or low-income.

The USACE Military Road alignment, also passes through the same census block group (408062) just to the east of the Draft TSP alignment. Impacts to housing along this stretch of the Optimized TSP levee alignment appear minimal. Once the USACE Military Road alignment crosses U.S. Highway 190, there are no EJ communities of concern. It is expected that there would be more residential acquisitions along the Military Road alignments (north of U.S. U.S. Highway 190) compared to the Draft TSP, but in terms of EJ, these acquisitions are not in an area of EJ concern. Ultimately the analysis showed that the Military Road alignments may have fewer impacts on EJ, but more potential impacts from housing acquisition. The Optimized TSP alignment is expected to require more mitigation for the potential impacts of residential acquisition.

Real Estate – For the Military Road and USACE Military Road alignments, it is anticipated that additional acquisition costs would be required for damages incurred at individual properties. The Military Road and USACE Military Road alignments and the Eastern Slidell Utility alignment, could result in the induced flooding of a large number of structures as a result of the implementation of the project. As a result, real estate acquisition costs and the number of properties to be included in the nonstructural plan could increase significantly.

Principles and Guidelines (P&G) Criteria: Effectiveness, Efficiency, Completeness and Acceptability – The variations in alignments were considered using the P&G criteria. All of the alignments, including the Draft TSP, would be constructed in a densely populated urban area with major design, construction, operation and maintenance issues. The practicality, timeliness, and ability to successfully implement the project features in this setting, varies based on how densely populated the area along the alignment is. All of the alignments would require vehicular access gates, the number of which depending on the density of the structures.

The East Side Utility Corridor alignment is not acceptable due to the safety concerns related to the blockage of evacuation routes. The Military Road and USACE Military Road alignments are not acceptable due to safety and implementation concerns associated with this highway. Further, the Military Road alignments (stakeholder and USACE alignments, and the East Side Utility Corridor alignment) are not cost effective and are not efficient. There was a significant cost increase resulting from the shift in the alignment east to Military Road, thereby necessitating the construction of additional length of floodwall and ancillary engineering structures. Table 4-18 shows the number of water control structures and vehicular gates in the location where the Draft TSP and the Optimized TSP alignment split from the Kings Point Levee, as compared with the Military Road and USACE Military Road alignments. The Optimized TSP alignment is less costly and requires five fewer water control structures and eight fewer vehicular gates than the Military Road and USACE Military Road alignments.

Table 4-18. Comparison of Structures–Military Road Alignments and the Draft and Optimized TSP Alignments

	Military Road Alignment	**Military Road USACE MVN ED Alignment-**	**Portion of Draft TSP (Kings Point to USACE Eastern Terminus)**	**Portion of Optimized TSP (Kings Point to USACE Eastern Terminus)**
Water control structures (sluice gate or lift gate)	8	9	2	4
Vehicular gates	14	15	5	7

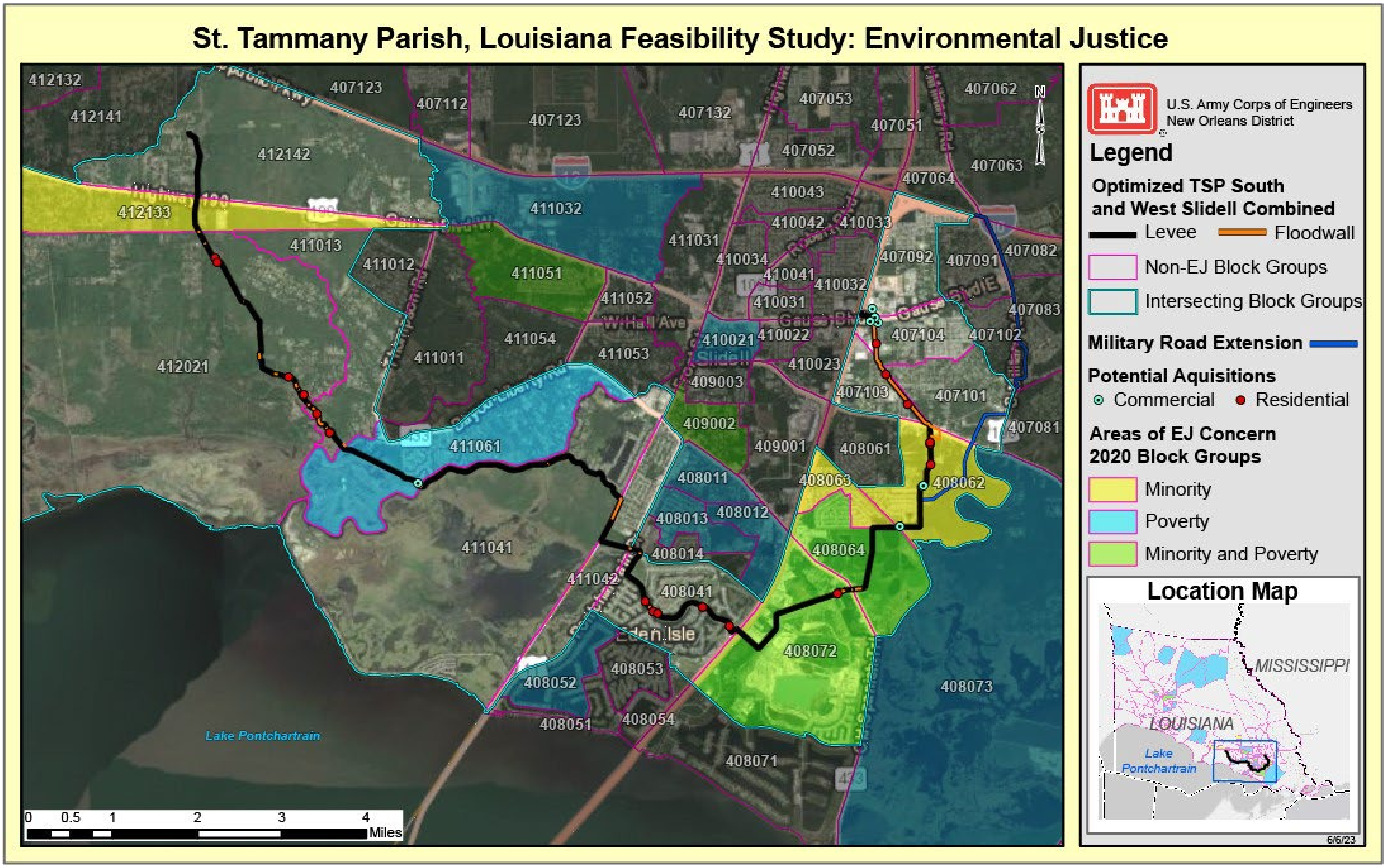

Figure 4-11. Census Block Groups along the South Slidell and West Slidell Alignments for Draft TSP

4.4.2.1.5 Investigation Regarding Old Spanish Trail LA Highway 433 (Southeast) Communities (Screened)

The area depicted in Figure 4-12 was also investigated by the PDT to determine the benefits and impacts associated with including additional communities in the east of Old Spanish Trail. The potential extension was evaluated to determine what additional features would be needed and the potential benefits estimated. This alignment extension as shown in Figure 4-12 would require approximately 1.78 miles (9,400 feet) of alignment to be added to the system, it would also require a drainage gate to cross the Spanish Trail borrow canal to maintain hydraulic connectivity. No pumping is required for the system when it is closed at this location. The canal is fed predominantly by backflow from Lake Pontchartrain and overland flow from the northeast. Therefore, its flooding sources are cut off when the alignment is in place. This potential alignment also requires two lift gates: one at an existing ditch near Mayfair Drive and a second lift gate at a topographic depression near Lank Street.

This area was also evaluated to determine if there would be concerns regarding emergency evacuation with the potential extension. Mayfair Drive would be cut off from evacuation. Residences on LA Highway 433 South could evacuate to U.S. Highway 190 and to the I-10. In addition to the engineering aspects, moving the alignment from the location of the Draft TSP to include the extension around the neighborhoods would result in additional direct impacts to BLH forest and wetland habitat. The alignment would skirt along the BBMNWR property resulting in additional indirect impacts to refuge property. The potential for additional direct and indirect impacts would require additional compensatory mitigation. Potential impacts to cultural resources did not factor into the decision to eliminate this alignment since cultural resource surveys have not been conducted at this phase of the study.

The cost to extend the length of the levee and incorporate the necessary structures exceeds the estimated damages in this area. Incorporating an extension of the levee and floodwall system would not be efficient.

This alignment would also incorporate an EJ community into the protected side of the system, that is not included in the Draft TSP, thereby resulting in an additional benefit to this EJ community that is located to the south along Old Spanish Trail.

There may be additional requirement for acquisition of properties on the east side of the alignment, resulting in an increased cost for lands, easements and rights-of-way (LER) required for the project.

It should be noted that although incorporation of the structures included into the structural plan (South and West Slidell Levee and Floodwall System) was not cost-efficient, these areas were considered in the nonstructural plan and those houses that would incur flooding in the 2 percent AEP event are included in the nonstructural plan.

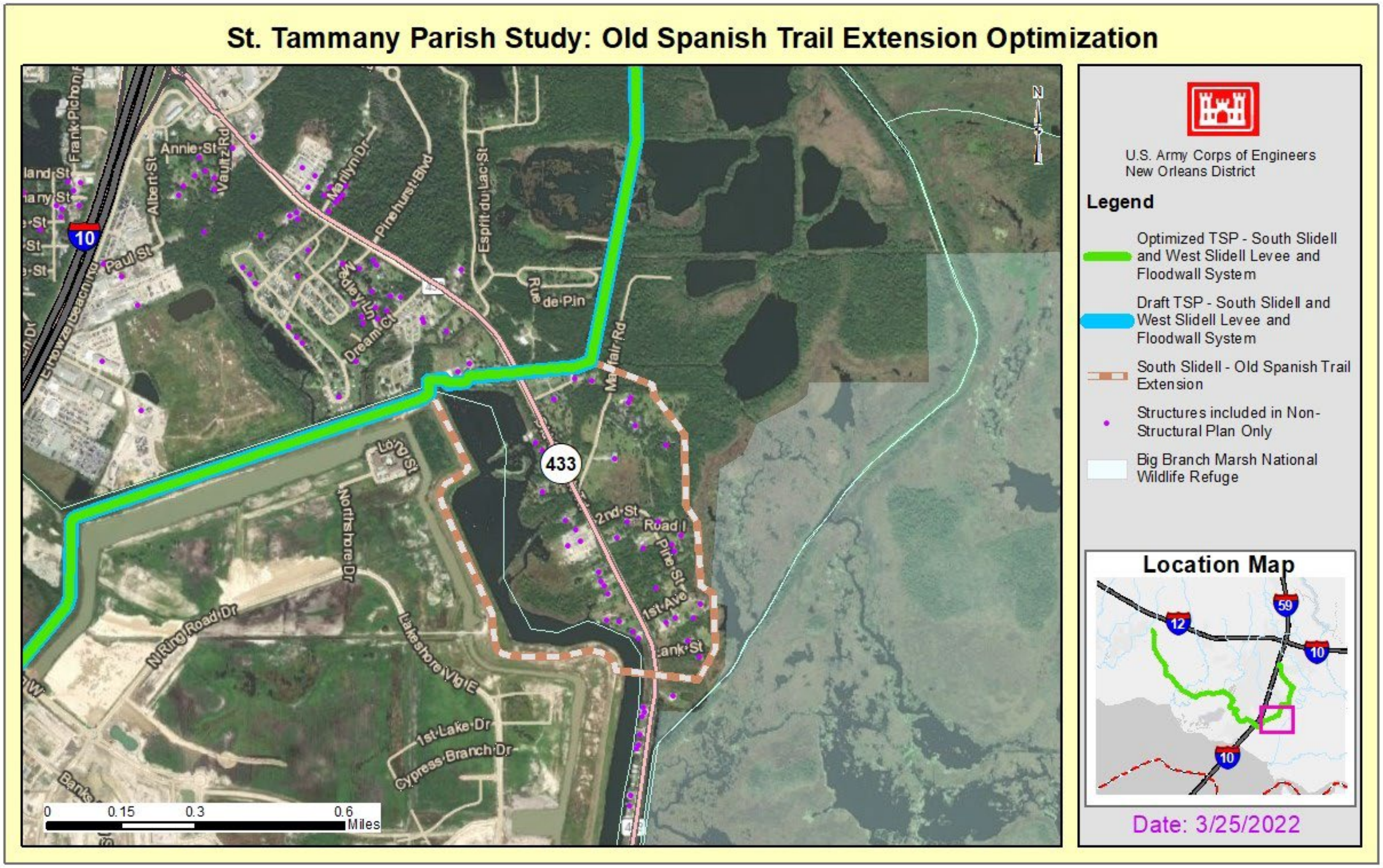

Figure 4-12. Alignment Considered during Optimization of the Old Spanish Trail Extension (Southeastern Portion of the Levee and Floodwall System)

4.4.2.2 Investigation Regarding Optimization of the Levee and Floodwall Alignment Based on Comments Received During the Public Comment Period on the DIFR and DEIS

Resource agencies expressed concerns over the proposed levee alignment in the BBMNWR and avoiding and minimizing impacts to wetlands. In coordination with the resource agencies, efforts were made to identify ways to avoid and minimize impacts to wetlands and pine savanna/pine hardwood habitat as well as refuge property. During the optimization and refinement of the Draft TSP, the PDT worked with the resource agencies to identify potential ways to avoid and minimize impacts to the BBMNWR from the Draft TSP footprint. Figure 4-13 illustrates the various alignment changes investigated along with the Draft TSP alignment (shown in solid blue) and the Optimized TSP alignment (shown in green) that was selected. The options explored to reduce impacts are described below.

4.4.2.2.1 Investigations into Proposed Bayou Paquet Road-Adopted

A few alignments changes were proposed in the vicinity of Bayou Paquet Road with the main purpose of avoiding impacts to the BBMNWR. See Figure 4-13.

4.4.2.2.2 Investigations into Proposed Bayou Paquet/Bayou Liberty Alignment (Dashed Blue Alignment) (Screened)

Changes in the alignment from the Draft TSP westward north of Bayou Paquet Road and south along Bayou Liberty were identified though H&H modeling to be more hydraulically efficient. The proposed changes to the Draft TSP alignment would reduce the need for two pump stations to only one pump station/floodgate complex which in turn, would reduce the construction, operation and maintenance costs and also cause less disruption to existing aquatic habitat. Although this change in the alignment would be more efficient, it would increase the direct footprint of the levee on BBMNWR beyond what was proposed in the Draft TSP. Therefore, these changes in the Draft TSP alignment were rejected due to these additional direct impacts on the BBMNWR. See Figure 4-13.

4.4.2.3 Alignment along BBMNWR

To avoid impacts to the BBMNWR and reduce the number of structures required along waterways, the Draft TSP alignment was moved further east thereby removing 0.1 miles (824 ft) of direct alignment on the BBMNWR and another 1.0 miles (5,280 feet) that ran along the border of the refuge. In addition to moving the footprint off and away from the BBMNWR, this Optimized alignment resulted in the following benefits:

- The Draft TSP alignment enclosed the waterways leading to Bayou Paquet, which disrupted floodplain connectivity for the small tributary to Bayou Liberty. Enclosure of the waterway could potentially increase flood risk because the reduction in floodplain area gives rainfall runoff less area to dissipate and causes water stages to increase in the remaining floodplain. The alignment change to the east minimized the enclosure of Bayou Paquet in the protected side of the alignment.

- Furthermore, the Draft TSP necessitated two major pump station/floodgate complexes (at Bayou Liberty and at Bayou Paquet) that were very close to each other. There were concerns about high construction, operation and maintenance costs associated with this alignment. There were also concerns on how the operation of one pump station/floodgate complex would affect the other. The green alignment was incorporated into the Optimized TSP.
- The Bayou Paquet sluice gate was changed in optimization to sector/navigable gate to not impact recreational navigation.
- The Optimized TSP alignment crosses Bayou Paquet at two different locations, whereas the previous alignment crossed the Bayou Paquet waterway at three different locations. Optimizing the alignment would lead to a reduction of one water control structures. The fewer waterway crossings also reduces disruption to existing aquatic habitat.
- Since the primary driver of the green Optimized TSP alignment (shown in Figure 4-13) was to keep the levee off of the BBMNWR, the alignment does not follow high ground and intersects low lying segments of the Bayou Paquet floodplain. Potential limited induced flooding is expected along the segments of low lying terrain the green alignment intersects.
- With this optimization focused on avoiding refuge impacts, there are 8 structures that would be excluded from the levee and floodwall system which are represented with the purple dots in Figure 4-13. The removed structures would be considered eligible for participation in the nonstructural feature of the Draft TSP.

It is noted that although these segments were not selected as the NED plan under this study authorization, they may be suitable for consideration for implementation by State or local government entities under Non-Federal authorizations or programs.

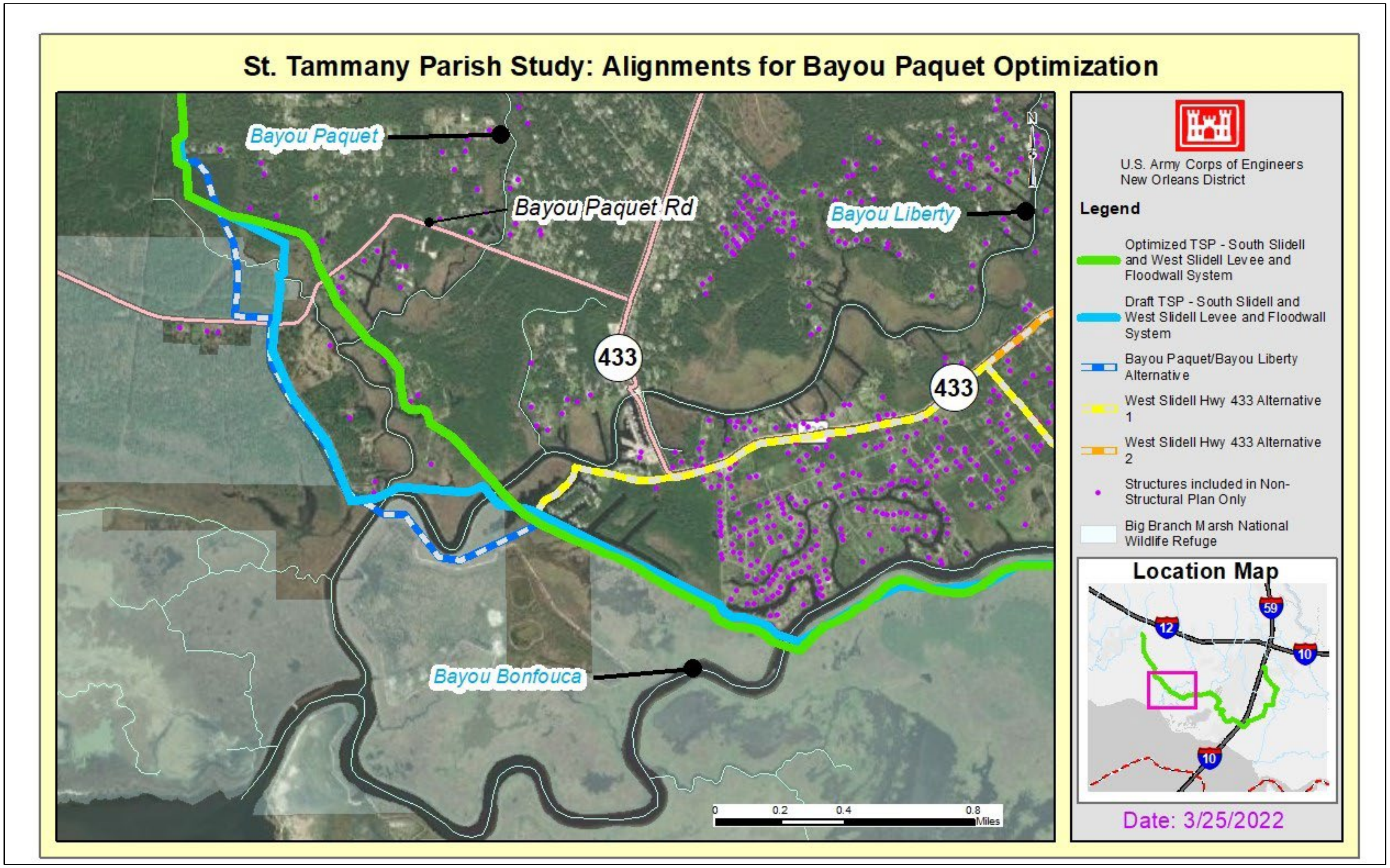

Figure 4-13. Alignment Variations Considered at Bayou Paquet

4.4.2.4 Investigations into West Slidell LA Highway 433, Alignments 1 and 2 (Screened)

To further avoid direct impacts to the BBMNWR, two additional alternatives (West Slidell LA Highway 433, Alignment 1 and Alignment 2) were considered to remove the levee and floodwall footprint from the BBMNWR. Refer to Figure 4-14 and the yellow and orange alignments in the proximity of LA Highway 433 in West Slidell. These alignment variations considered would require construction of features along the well developed areas along LA Highway 433 necessitating access at each intersection of a driveway or road as illustrated in Figure 4-15. These potential adjustments were not adopted based on engineering and constructability considerations. The major factors considered are included below.

Levee and Floodwall Placement – There were limited options for the placement of the levee and floodwall system for either Alignment 1 or 2 along LA Highway 433. See Figure 4-16.

- There is insufficient highway right-of-way along LA Highway 433 for a levee without the need to purchase or significantly impact a large quantity of properties. (An example of significant impact: a levee in someone's front yard whose driveway must be realigned to go over the levee and back onto LA Highway 433). The lack of available space would require construction of a floodwall rather than a levee. The floodwall would have a higher cost per liner foot than a levee.
- Placement of a floodwall system along LA Highway 433 was considered. A floodwall in the middle of the road cuts off visibility entirely traveling along LA Highway 433. It would require extremely long (roller or swing gates more than 100 feet wide) and impractical sizes for gates. These gates would be needed to satisfy Federal Highway Administration (FHWA) intersection sight distance requirements to allow proper visibility when a vehicle is crossing the road. Larger gates are not practical from a cost, construction, safety, and operation and maintenance perspective. CEMVN has contacted LA DOTD for feedback on traffic and other transportation challenges.
- A floodwall on either side of the road is not practical. This alignment would need smaller openings when compared with a floodwall in the middle of the road but would prevent access to properties in the neighborhood for emergencies. Such an alignment would create potential safety issues for storm events. Once the floodgates are closed, people would not be able to evacuate. This safety issue removed this from further consideration.
- If a floodwall was constructed on the south side of the LA Highway 433, the property owners would not have risk reduction in place but would have to cede property for construction purposes.
- Constructing a road on top of levee was also considered and determined not to be a practical choice for an alignment.
- Access gates or ramps would be required at each driveway and roadway to complete the system.

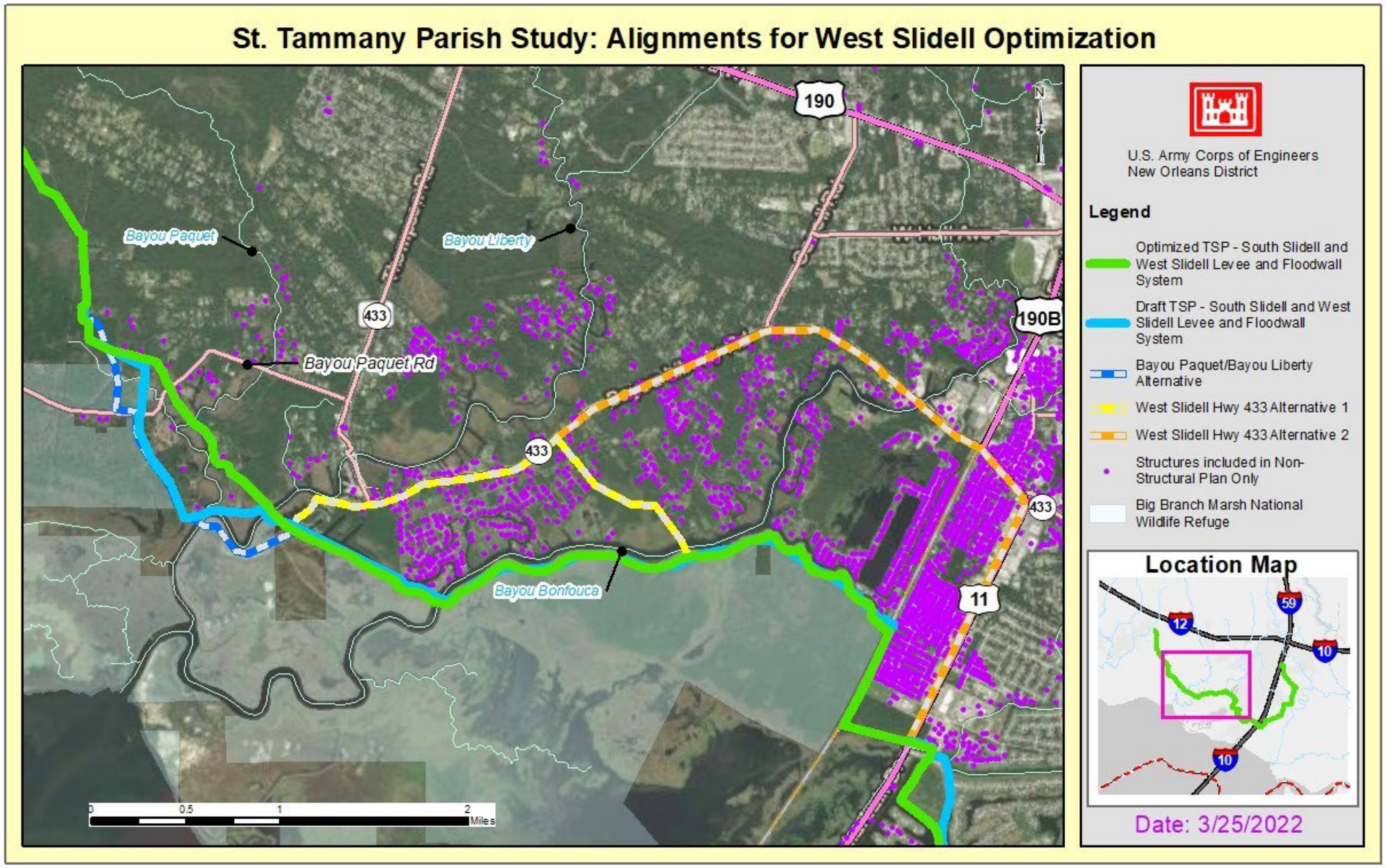

Figure 4-14. Alignments Considered during Optimization in West Slidell for the Levee and Floodwall System

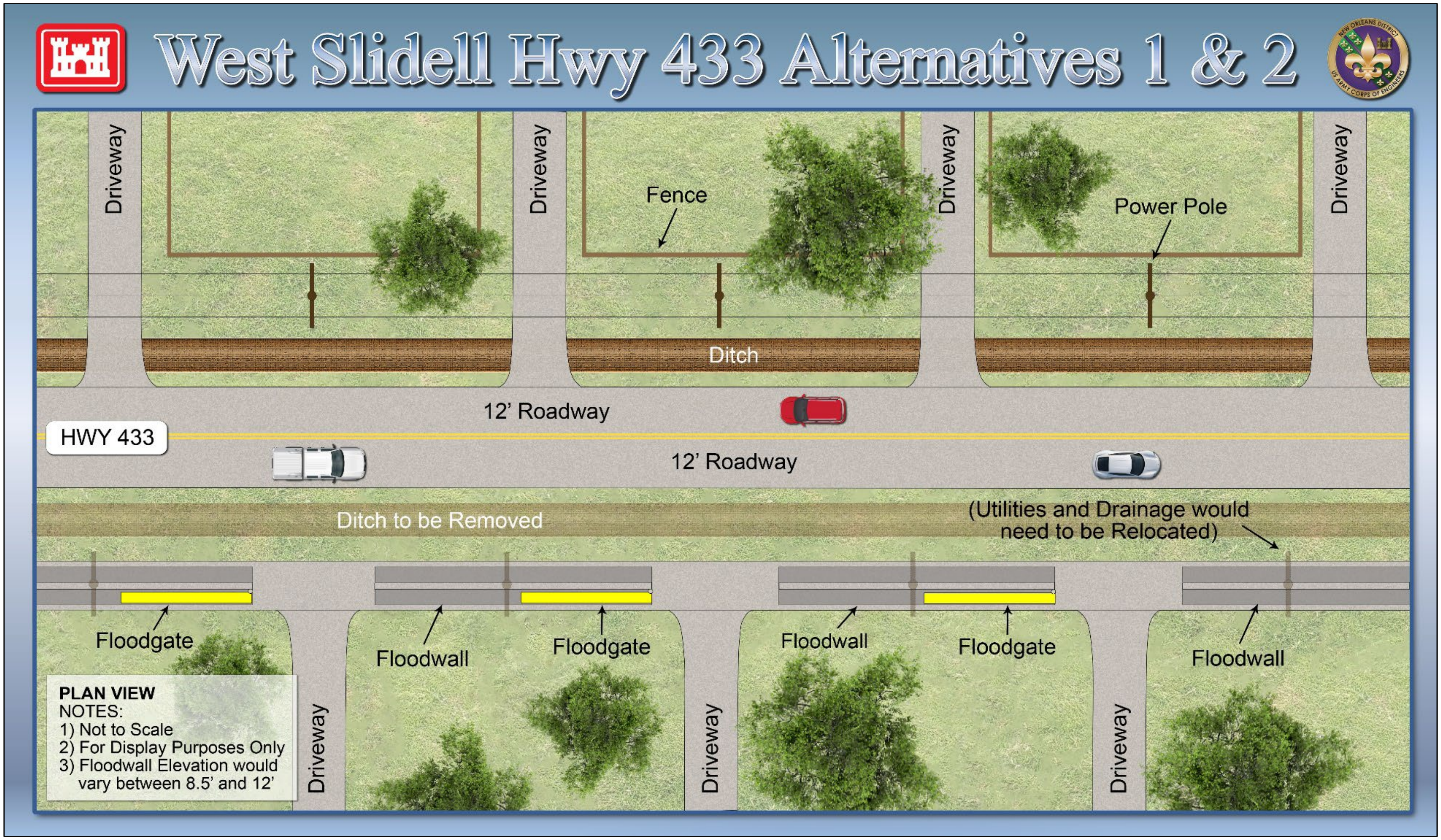

Figure 4-15. Visualization of a Typical Plan View of an Alignment Running on the side of LA Highway 433

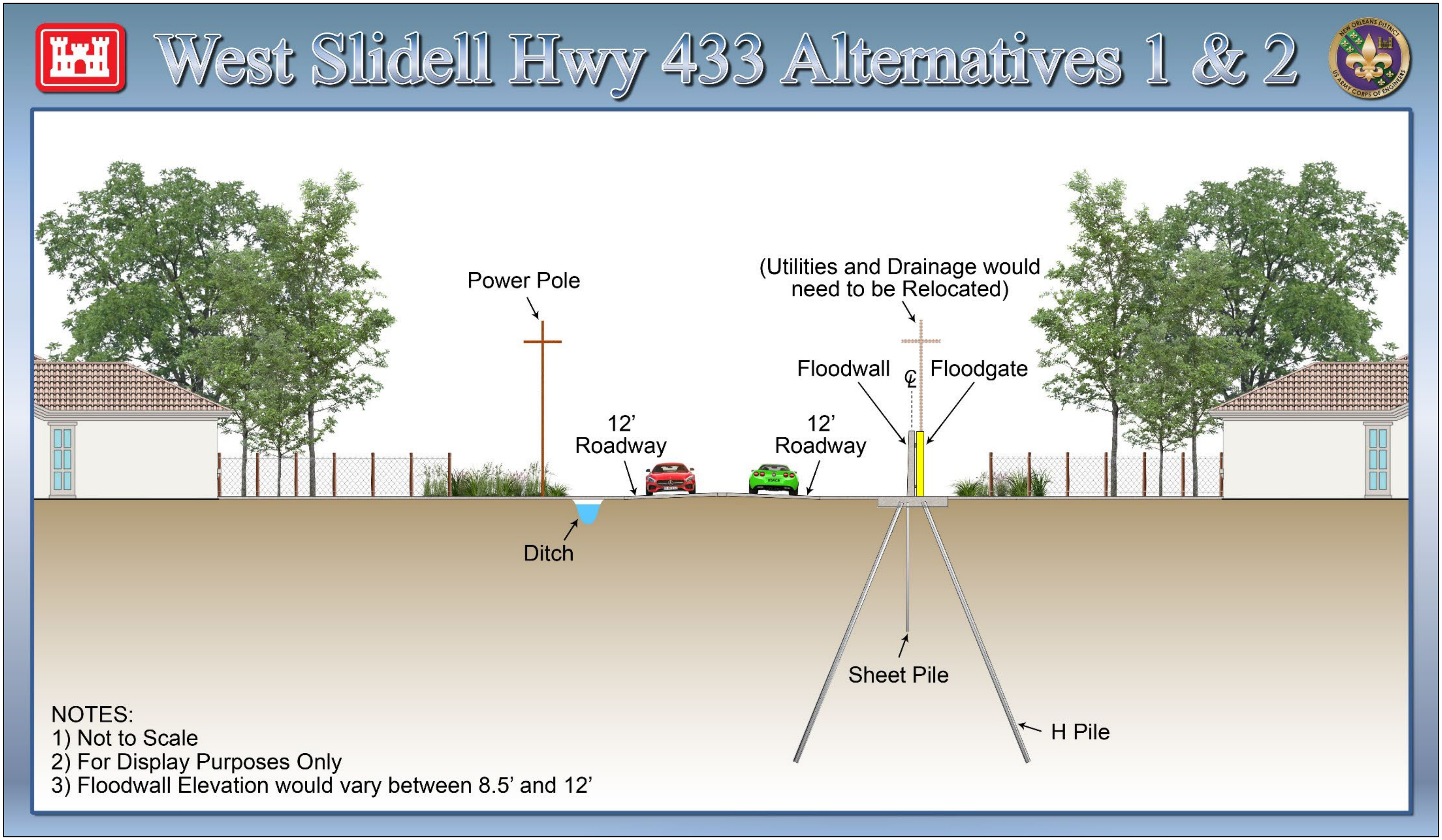

Figure 4-16. Visualization of a Typical Plan View of an Alignment Running on the side of LA Highway 433

Note: Each property would require a gate for access

Engineering Features

- West Slidell LA Highway 433, Alignment 1 (yellow and white alignment) – Analysis shows that if a floodwall was placed on the south side of LA Highway 433, additional structures would be needed. These structures would be as follows: seven vehicular gates for road access and eight driveways that would need vehicular access. If the wall was placed on the north side of LA Highway 433, there would be additional road gates and access to driveways needed.
- West Slidell LA Highway 433, Alignment 2 (orange and white alignment) – Preliminary analysis shows that if a floodwall was placed on the south side of LA Highway 433, additional structures would be needed. These structures would be as follows: 36 road gates and 81 driveways that would need access. If the wall was placed on the north side of LA Highway 433, there would be additional road gates needed.

Induced Flooding – Both West Slidell Alignments 1 and 2 are located in close proximity to structures on the flood side, whereas the Optimized TSP alignment does not have urban development located on the flood side. Using best engineering judgement, it was presumed that the West Slidell LA Highway 433, Alignments 1 and 2 would likely cause inducements on the flood side of the alignment directly impacting properties outside of the risk reduction features.

Relocations (electrical, water and sewage) – For both West Slidell Alignments 1 and 2, considered it is expected that there are potential complications with utilities due to the large number of structures.

Social Impacts – Social and Economic Concerns include impacts from real estate buyouts disrupting community cohesion. Increased safety risks resulting from road closures, traffic delays, congestion, reduced visibility during construction as well as egress concerns resulting from the numerous rollover gates across driveways/access points. There would be disruption to daily lives resulting from impacts of utility relocations.

HTRW – There would be an increase in HTRW concerns with these two alignments since they would both be constructed in a heavily developed area.

Cultural Resources – Potential impacts to cultural resources did not factor into the decision to eliminate these alignments since cultural resource surveys have not been conducted at this phase of the study.

Economic Analysis – The West Slidell LA Highway 433, Alignment 2 would remove approximately 1,000 structures from the protection of the levee and floodwall risk reduction system. These structures are depicted by purple dots in Figure 4-14. This would equate to approximately 10 percent of the benefits being removed from the entire levee and floodwall alignment. The removed structures would be considered eligible for participation in the nonstructural plan feature of the Draft TSP.

Environmental Justice – Moving the Draft TSP alignment north along LA Highway 433 would exclude more residential structures on the unprotected side of the system. Even though this area is not an EJ concern, it is likely that there are smaller pockets of EJ households that would be included, but this is not a disproportionate impact since non EJ households would be exposed too. The community just north of LA Highway 433 is an area of EJ concern (poverty) and would likely feel construction impacts which would be require mitigation through best management practices (BMP).

Real Estate – Adoption of the West Slidell LA Hwy 433, Alternatives 1 and 2 could potentially result in a large number of structures impacted by induced flooding as a result of the project. This would result in a significant increase in properties to be included in the nonstructural plan, and potential buy-outs when induced flooding results in a complete taking. Costs for real estate acquisitions would increase significantly with these two alternatives. Additionally, the eastern end of Alternative 2 would impact properties along Pontchartrain Drive, a large commercial corridor. Real estate cost estimates were not prepared as a part of the analysis of these alternatives, but it is anticipated that the increase in cost for acquisition of LER would be significant.

P&G Criteria: Effectiveness, Efficiency, Completeness and Acceptability – The variations were considered under the context of the P&G criteria. The West Slidell LA Highway 433, Alignments 1 and 2 that were investigated would be constructed through a community that is densely populated presenting design, construction and operation and maintenance concerns. These two alignments would require gates to allow access and the number of gates depends on the number of properties.

The West Slidell LA Highway 433, Alignments 1 and 2 are not acceptable due to the safety concerns with the alignments blocking evacuation routes. These two alignments also carry a high risk of not being cost effective due to the significant cost increase from levee to floodwall along with the anticipated large number of access gates and RE acquisitions required. Since both of the West Slidell LA Highway 433, Alignments have constructability and engineering concerns and would exclude up to 1,000 structures at a high risk for induced flooding. These two alignments are also at high risk for not being efficient as compared to the Optimized TSP and as a result, both were screened from consideration.

It is noted that although these segments were not selected as the NED plan under this study authorization, they may be suitable for consideration for implementation under other Non-Federal authorizations or programs.

Second Iteration of PDT Investigations into East Slidell terminus of the South Slidell and West Slidell Levee and Floodwall System

After the initial investigation into the South Slidell and West Slidell levee and floodwall system in 2022, the PDT received additional comments in 2023 from stakeholders requesting further consideration of the East Slidell alignment options as a comprehensive alternative rather than an increment. As noted in the sections above, the PDT looked at three alignments in the Military Road area as increments (shown in Figure 4-7). Continued evaluation and screening was done on these alignments and found to not be incrementally justified produced fewer net benefits and demonstrated potential for significant constructability issues and increased mitigation costs, which would further reduce the net benefits.

To address the additional stakeholder comments, the PDT considered the Military Road alignment (shown on Figure 4-7) and a combination of the Military Road Alignment and East Slidell Utility Corridor Alignment as alternative end reaches for the comprehensive plan. The combination alternative is referred to as the East Slidell Alignment as shown on Figure 4-17. For the second iteration, the PDT used the results of the initial investigations for these alignments and the costs developed for the Draft TSP. An economics analysis was conducted to determine the additional damage reduction benefits each alignment would incorporate and the cost that the alternative construction could support. The Military Road alignment could support approximately $230 million in construction costs with the additional damage reduction benefits provided. The East Slidell could support approximately $250 million in additional construction costs. The estimated construction cost of the levee and floodwall alignment incorporating Military Road and the East Slidell segments were both above the estimated additional costs and both were thus confirmed not to be the NED plan.

The East Slidell Alignment was determined to have a BCR greater than one but had lower net benefits over the Optimized TSP. The East Slidell Alignment also carries greater risks related to cost increases due to the constructability along the development and wetland interface, and its required mitigation costs in comparison to the Optimized TSP.

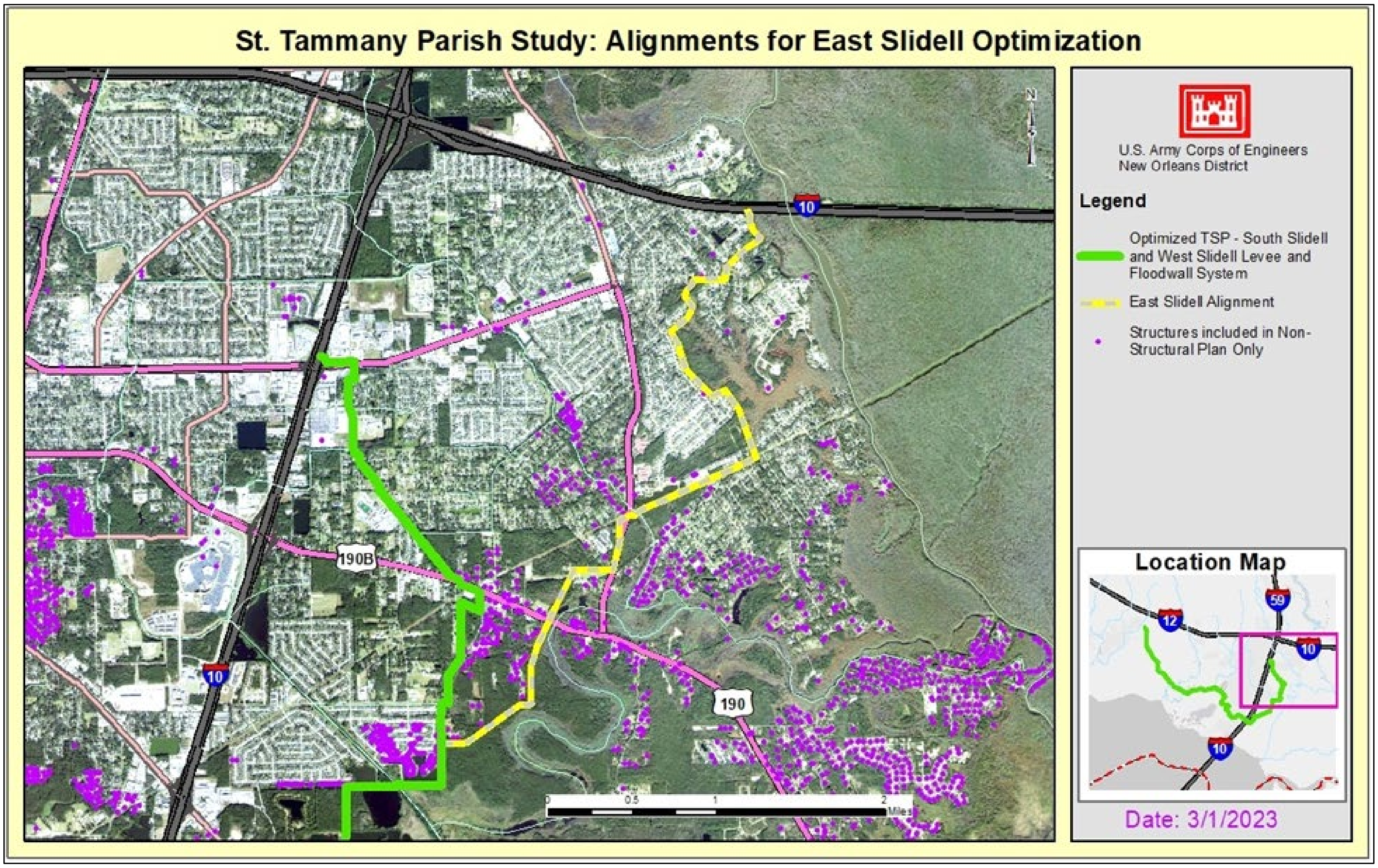

Figure 4-17. Comparison of Optimized TSP and East Slidell Alignment

Per ER 1105-2-100 the NED plan recommending Federal action is to be the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment, which remains the Optimized TSP. It is noted that although these segments were not selected as the NED plan under this study authorization, they may be suitable for consideration for implementation by State or local government entities under Non-Federal authorizations or programs.

Table 4-19. Summary of the Potential Increased Risk Associated with the Alignment Shifts Investigation as Compared to the Draft TSP Alignment

	Increased Risk related to Constructability and Practicality Concerns	Increased Safety Risk	Increased Flood Risk	Increased Risk for Habitat and Species Impacts	Increased Risk for Relocations	Increased Risk for EJ	Increased Risk for Cultural Resources	Increased Risk to Violate Effectiveness Criteria	Increased Risk to Violate Efficiency Criteria	Increased Risk to Violate Completeness Criteria	Increased Risk to Violate Acceptability Criteria	Additional length required for floodwall and levee system	Increased Engineering Structures required	Increased RE Acquisitions	Increased environmental mitigation cost
Military Road NFS Alignment	yes	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes
Military Road CEMVN ED Alignment	yes	no	yes	yes	yes	no	no	yes	yes	yes	no	yes	yes	yes	yes
East Slidell Alignment (as shown in Figure 13)	yes	yes	yes	yes	yes	no	no	yes	yes	yes	no	yes	yes	yes	yes
Eastern Slidell Utility Alignment	yes	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes
Spanish Trail Extension	no	no	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes
Bayou Paquet/Bayou Liberty CEMVN ED Alignment	no	no	no	yes	no	no	no	no	no	no	Yes	no	no	no	yes
West Slidell Alignment 1	yes	yes	yes	no	yes	yes	no	yes	yes	no	no	no	yes	yes	no
West Slidell Alignment 2	yes	yes	yes	no	yes	yes	no	yes	yes	no	no	yes	yes	yes	no
Alignment along BBMNWR	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no

4.4.2.5 FRM Measure- Final Feasibility Level Optimization of Mile Branch Channel Improvements

The optimization of Mile Branch consisted of further analysis of the structural and civil features that were outlined in the Draft TSP. The assumptions and analysis for the replacement of the bridges were further developed. It was identified that there is no existing bridge to connect both sides of Mile Branch on W. 18th Avenue. This location was eliminated from the list of bridge replacements. It was identified that there is a pedestrian bridge (part of Tammany Trace Bike Trail) on W. 27th Avenue that crosses the Mile Branch. This location was added as a potential bridge replacement. Refinements were conducted to the ROW assumptions for the channel improvements, which included identifying staging areas and assuming that one of the staging areas would become a backwater area after project completion. Information on the existing utilities for Mile Branch was received from the NFS, which was used to perform analysis and provide assumptions for disposition of the relocations to include in the cost effort. Table 4-20 shows a comparison between the Draft TSP and Optimized TSP Mile Branch Channel Improvements.

Table 4-20. Summary Comparison Table of TSP for Mile Branch

Attribute	Mile Branch Channel Improvements Draft TSP 2021	Mile Branch Channel Improvements Optimized TSP 2023
Total Length of improvements	2.15 miles (11,341 feet)	2.15 miles (11,341 feet)
Material to be Mechanically Dredged	130,000 cubic yards	130,000 cubic yards
Access Roads for both clearing and for bridge replacement	0	0
Number of staging areas for clearing and grubbing and mechanical dredging and for bridge replacement	Not developed for clearing and grubbing, 7 for bridge replacements.	18 (7 for bridge replacements, 10 for clear and grubbing and mechanical dredging and one that becomes a backwater area)
Number of Bridge Replacements of Culverts	7	7
Temporary ROW	34 acres for clear and grubbing and mechanical dredging	7.3 acres (2.2 acres for bridge replacements and 5.1 acres for clear and grubbing and mechanical dredging)
Permanent ROW	None developed at the time of the initial draft	38.8 acres (34 acres for clear and grubbing and mechanical dredging and 4.8 acres for one staging area that becomes a backwater area)

4.4.2.6 FRM Measure-Bayou Patassat Clearing and Snagging

Subsequent to the Draft TSP selection, it was discovered that the clearing and snagging of Bayou Patassat would not be as effective as the H&H modeling originally estimated. An updated analysis of the measure yielded a BCR of 0.5. As a result, the measure was removed as part of the Optimized TSP.

4.4.2.7 Nonstructural Plan Final Feasibility Level Optimized

The nonstructural measures, reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use of the floodplains, or by accommodating existing uses to the flood hazard. NS measures differ from structural measures in that they focus on reducing the consequence of flooding for a specific structure rather than reducing the probability of flooding in that area (for example elevating a structure in an area that is flooded to reduce damages rather than reducing the flooding source). A combined structural and NS measure based was retained and included in the Draft TSP presented in the 2021 initial draft IFR-EIS. The Draft TSP included floodproofing and structure raising to reduce damages from the flood hazard were considered for the entire parish in areas of documented flood damage

The draft nonstructural TSP feature was further examined and divided into 20 sub aggregates based on combinations of structures that had the same source of flooding and community characteristics. See Table 4-21 and Figure 4-18. This included consideration of underserved communities as identified by the Justice 40 criteria.

An incremental floodplain or flood frequency analysis was then conducted for each of the 20 developed aggregates. The results showed that 16 of the 20 aggregates were economically justified up to the 4 percent (25 year) AEP Floodplain (Table 4-21), Coastal Slidell was economically justified up to the 2 percent (50 year) AEP Floodplain and coastal Lacombe, coastal Mandeville, and coastal Madisonville were economically justified up to the 1 percent (100 year) floodplain. The Optimized Nonstructural Plan includes 6,684 structures that would reduce flood risk and coastal storm damage to structures that are not included in the areas benefitted from the structural measures of the TSP. A depiction of the structures included in the nonstructural plan are included in Figure 4-18.

Table 4-21. Aggregate Name and Floodplain

Aggregate Name	Percent AEP Floodplain
Abita River Rural	4%
Bayou Castine	4%
Bayou Chinchuba	4%
Bogue Chitto River	4%
Lacombe Bayou	4%
Rural Bogue Falaya	4%
Rural Little Bogue Falaya	4%
Rural Pearl River	4%
Rural Tchefuncte	4%
Tchefuncte	4%
Urban Abita River	4%
Urban Bogue Falaya	4%
Urban Little Bogue Falaya	4%
Urban Pearl River	4%
Urban Tchefuncte;	4%
Western Tchefuncte.	4%
Coastal Slidell	2%
Lacombe Coastal	1%
Coastal Mandeville	1%
Coastal Madisonville	1%

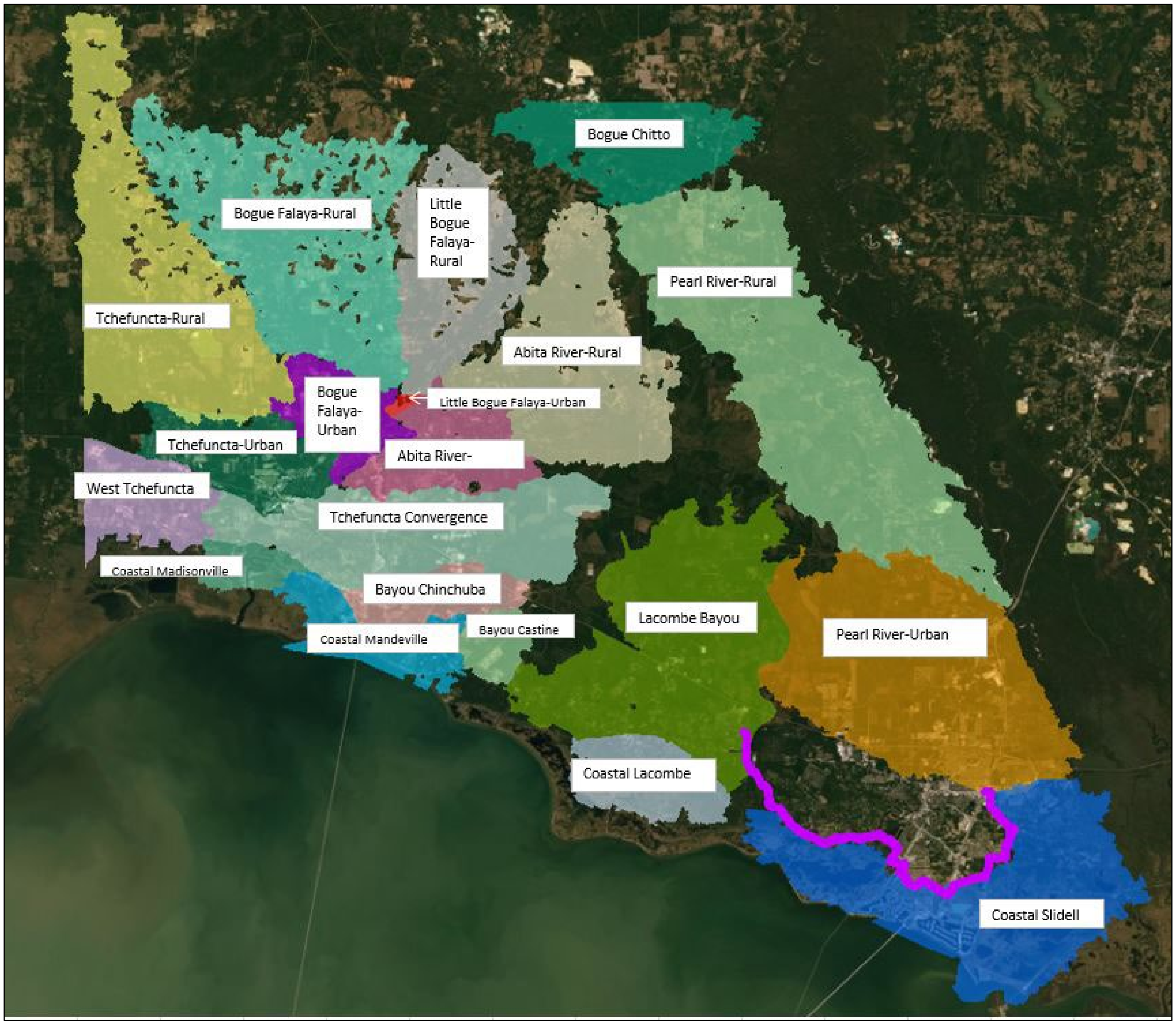

Figure 4-18. Nonstructural Sub Aggregates

4.4.3 Revised Optimized TSP Cost Estimates

Total cost and estimated annual costs for the measures in the Optimized TSP were revised. The cost estimates include planning, engineering and design, construction, construction management, real estate, and environmental and cultural mitigation costs, all of which include contingencies. Refer to Appendix D: Engineering for Cost Annexes 8-11 and Table 4-22.

A revised construction schedule was developed for the Optimized TSP. For the nonstructural component, construction would occur from 2025-2032. For the levee and floodwall system, construction would occur from 2025-2076. Additional levee lifts would occur three times post initial construction at 5-7 years, 15-20 years, and 30 years. For the Mile Branch Channel Improvements, construction would occur from 2025-2032. The first levee lifts would be overbuilt and allowed to settle for several years before the later levee lifts are constructed. Assumptions regarding scope of subsurface investigations for the study may be underestimated due to the lack of subsurface investigations available. The current assumptions for levee are based on typical sections. During PED, design would consider potential stability or seepage berms, geotextile reinforcement, and/or ground improvements, which may need additional real estate procurement. The design life of hydraulic steel structures is 100 years which applies to the pump stations and gates for this study. The design of hydraulic steel structures would follow ETL 1110-2-584.

Structural feature costs for the levee and floodwall system were updated based on the refined ED design and quantities developed for the Optimized TSP. Specific changes were previously described in 4.4.1 and 4.4.2.5.

Mitigation costs due to unavoidable habitat impacts were calculated for the impacted habitats in the Optimized TSP. Professional judgment and experience with similar structural systems, and engineering assumptions of right-of-way (ROW) footprints were also used to aid in development of the mitigation costs. Mitigation cost estimate estimates for the Optimized TSP can be found in Section 7 and in Appendix I: Mitigation Plan.

Real estate costs were updated based on the revised acreages of the Optimized TSP and the estimated number of affected ownerships, available sales data was utilized to estimate the values of the real property rights required for the structural features of the project, including damages to remainder properties (if any) in partial acquisitions, the estimated values of any affected improvements, residential and non-residential relocations, and acquisition and administrative costs. For the non-structural feature of the Optimized TSP, the associated acquisition, administrative, and residential relocation costs were revised based on the revised estimate of the number of structures eligible for the project. Further information on the development of the RE can be found in Appendix G: Real Estate Plan.

For the structural measure, **cultural** archaeology survey is estimated at $382.03 per acre and mitigation assumes 10 percent surveyed is NRHP eligible. Architectural survey is $589.90 per built resource located within the project footprint. Architectural mitigation assumes 10 percent surveyed is NRHP eligible. Borrow survey is estimated to be $598.66 per acre.

The **nonstructural plan** costs were revised related to RE and cultural. Refer to Appendix G: Real Estate Plan for updated RE costs. Cultural nonstructural costs were developed by using archaeological/architectural survey is $1769.00 per structure (6,684). Archaeological mitigation assumes 10 percent surveyed is National Register of Historic Places (NRHP) eligible. The architectural mitigation assumes mitigation can be grouped into historic areas within the study area; a total of seven areas are projected for total architectural mitigation with each area estimated at $150,000.

Cost contingencies may require adjustment as the study progresses, which will be coordinated during reviews.

4.4.4 Economic Analysis for the Optimized TSP

The HEC-FDA Version 1.4.2 USACE-certified model was used to calculate the damages and benefits for the Final Array of Alternatives. An updated Benefit Cost Ratio (BCR) analysis was conducted to evaluate the economic feasibility of the Optimized TSP. Expected annual benefits for 50-year period of analysis from 2032 and 2082 were converted to an equivalent annual value using the FY21 Federal interest rate of 2.75 percent.

The updated H&H model outputs on the Optimized TSP and the economics functions were fed into the HEC-FDA, (https://www.hec.usace.army.mil/software/hec-fda/) and those results were tabulated and compared. The economic and engineering inputs necessary for the model to calculate damages and benefits include the structure inventory, contents-to-structure value ratios, vehicles, first floor elevations, and depth-damage relationships, ground elevations, and without-project stage probability relationships. The uncertainty surrounding each of the economic and engineering variables was included. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum, and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

The Optimized TSP is comprised of the Slidell Levee, the Mile Branch Channel Improvements, and the nonstructural plan, which consists of elevating 5,583 residential structures up to 13 feet and dry floodproofing of 827 nonresidential structures up to 3 feet. Each measure is economically justified and contributes to the overall net benefits of the plan, which has an overall benefit to cost ratio of 2.4 (shown in Table 4-23).

Table 4-22. Estimated Costs for Structural Measures in the Optimized TSP

Alt	Relocations	Fish and Wildlife Relocations	Roads, Railroads & Bridges	Buildings, Grounds & Utilities	Cultural Resource Preservation	Levees and Floodwalls	Pumping Plant	Channels and Canals	Floodway Control & Diversion Structure	Lands and Damages	PED	CM	Total Cost
Alt 2 – NS Plan	-	-	-	$1,248,027,000	$18,554,000	-	-	-	-	$223,243,000	$63,329,000	$25,332,000	**$1,578,486,000**
Alt 6c – South Slidell and West Slidell Levee and Floodwall System	$23,916,000	$80,734,000	-	-	-	$861,892,000	$742,725,000	-	$116,611,000	$47,471,000	$374,314,000	$200,851,000	**$2,448,516,000**
Alt 8 – Mile Branch Channel Improvements	$863,000	$153,000	$20,177,000	-				$13,239,000		$25,645,000	$7,056,000	$3,786,000	**$70,919,000**

Table 4-23. Net Benefit Summary of the TSP, FY23 Price Level, FY 23 Discount Rate, $1,000s

Measure	Slidell Levee	Mile Branch Channel Improvements	Nonstructural	Recommended Plan
Project First Cost	$2,440,973	$77,002	$1,934,084	$4,452,059
Interest During Construction	$105,378	$6,433	$5,979	$117,790
Total Investment Cost	$2,546,351	$83,435	$1,940,063	$4,569,849
AA Investment Costs	$86,564	$2,942	$68,403	$157,909
AA O&M Costs	$7,609	$162	$0	$7,771
Total AA Costs	$94,173	$3,104	$68,403	$165,680
Without Project EAD	$572,971	$572,971	$572,971	$572,971
EAD Reduced Benefits	$162,588	$3,472	$236,702	$402,762
Net Benefits	$68,415	$368	$168,300	$237,083
B/C Ratio	1.7	1.1	3.5	2.4

4.4.5 Life Safety Risk Indicator (LSRI) for Optimized TSP

In an effort to develop a consistent way to recommend projects that warrant funding based on risk to life safety, USACE has developed the LSRI tool, which provides a relative representation of the life risk (average annual life loss) that would be reduced if a given structural or non-structural flood damage reduction project was constructed. The LSRI is intended to serve as a budget tool to prioritize studies and projects starting with the FY25 budget development process. (For more information on the USACE budget development process, see the latest Budget Engineer Circular and Program Development Manuals). The LSRI builds off of and replaces the Life Safety Hazard Index (LSHI) tool by incorporating not just consequence information, but also likelihood of the consequences.

The levee and floodwall system that is part of the Optimized TSP was modeled using the LSRI software. The results of which show an LSRI value of 6.682 meaning if this project were not built, then this area would experience an average annual life loss of 6.682 people per year. Additionally, the cost per statistical life saved (CSSL) for St. Tammany is $10,623,109 annually. To arrive at these values, the maximum storm surge event the levee is designed to protect against, 14 feet, was used. The LifeSim model allowed for 8 to 24 hours of warning time before the first structure got wet. The population of the proposed area was developed using the default NSI 2022 values.

Further detail on the Life Safety Analysis can be found in Appendix F: Economics.

4.5 OPTIMIZED TSP CONFIRMATION

Based on the information presented in Section 4.4, the Optimized TSP still has the lowest total cost (including mitigation), the highest BCR, and the highest net benefits. In conclusion, the Optimized TSP was confirmed as the plan that maximizes NED benefits while protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

4.5.1 Optimized TSP 2023

- A comprehensive plan to address flooding parish-wide and includes CSRM, FRM, and nonstructural measures. The TSP is the NED Plan.

- CSRM and FRM ***Nonstructural flood risk reduction*** for eligible structures in in the rest of St. Tammany Parish not covered by the structural measure of the TSP.
    - Voluntary Program including approximately 6,410 structures (5,583 residential to be elevated) and (827 nonresidential to be floodproofed). *For additional details refer to Section 4.4.2.7; Appendix F: Economics for analysis and Appendix H: Nonstructural Implementation Plan for preliminary implementation guidance.*

- CSRM – South Slidell and West Slidell Levee and Floodwall System
    - The levee and floodwall system is comprised of approximately 18.5 miles of levee and floodwall. There would be eight pump stations, 13 culverts/sluice gates/lift gates, 18 vehicular floodgates, 1 pedestrian floodgate, 1 railroad floodgate, and six road ramps. The I-10 road surface would be raised to construction elevation 22.0 ft to ramp over the new levee section to stay above the hydraulic design elevation for year 2082, to ensure the entire pavement section remains above the hydraulic design elevation across the interstate. *For additional details refer to Section 4.4.1, Alternative 6; Appendix D: Engineering.*

- FRM – Mile Branch Channel Improvements
    - Channel Improvements include clearing and grubbing and mechanical dredging of Mile Branch. The channel bottom would be lowered by 5 feet. Approximately 21 acres of channel would be cleared and grubbed to

mechanical dredging. *For additional details refer to Section 4.4.2.5, Alternative 8; Appendix D: Engineering.*

Section 5
Environmental Consequences

5.1 ENVIRONMENTAL CONSEQUENCES

In accordance with NEPA, this section includes the scientific and analytic basis for comparison of the alternatives include the Optimized TSP and the "No-Action" Alternative. The alternatives are assessed for their potential impacts on the relevant resources discussed in Section 3. Measures within each of the alternatives were analyzed together, where possible, due to similar impacts for each resource. The terms "TSP" and "proposed action" are used interchangeably in this section (and elsewhere in this RDIFR-EIS).

The discussion includes an analysis of potential beneficial and adverse effects on the resources including a discussion of direct, indirect, and cumulative impacts, the relationship between short-term uses and long-term productivity, and any irreversible or irretrievable commitments of resources.

The alternatives assessed below include those alternatives that were carried forward following the evaluation of the Final Array against the system of accounts and selection and optimization of the TSP as summarized in Section 10, 4.2.11 and Section 6.

The June 2021 Draft IFR-EIS included an assessment of the final array of alternatives. Several of these measures have since been eliminated following the evaluation as summarized in Section 4.2.10-4.2.11 and Section 6 to select and optimize the TSP. Those that were screened for having a negative BCR are not included. The June 2021 Draft IFR-EIS evaluated the following Alternatives and measures in the Final Array:

- **Alternative 1: No Action Alternative.**
- **Alternative 2: Nonstructural Plan**
  - 2-Non Structural (Standalone Parish Wide) 100 year
  - 2-Non Structural (Standalone Parish Wide) 50 year
  - 2-Non Structural (Standalone Parish Wide) 25 year
  - 2-Non Structural (Standalone Parish Wide) 10 year
- Alternative 6: South Slidell and West Slidell
  - 6a South Slidell Levee (S-075, S-076)
  - 6b South Slidell and Eden Isle Levee (S-070, S-075, S-076)
  - **6c South Slidell and West Slidell Levee (S-081, S-075, S-076)**
- Alternative 8: Upper Tchefuncte/Covington
  - Mile Branch Channel Improvements (S-057)
  - Lateral A Channel Improvements (S-121)

Optimized TSP - The Optimized TSP is a combination of features identified within the various alternatives. Refer to Section 4.2.11 for selection of the Draft TSP and Figure 6-1, Figure 3-1, and Section 6 for discussion of the Optimized TSP. Features that were carried forward to form the Optimized TSP include the following:

- Nonstructural Plan
- 6c South Slidell and West Slidell Levee (S-081, S-075, S-076)
- Mile Branch Channel Improvements (S-057)

6c South Slidell and West Slidell Levee

This measure of the Optimized TSP is a 18.5 mile levee and floodwall alignment with a combination of earthen levees and floodwall. The I-10 road surface would be raised to elevation 22.0 to ramp over the new levee section to stay above the hydraulic design elevation for year 2082, to ensure the entire pavement section remains above the hydraulic design elevation across the interstate by constructing ramps to the preliminary design elevation of 15 feet. Permanent right-of-way required for the construction of the levee alignment would be 45,083 acres and would require approximately 7.2 million cubic yards of fill over the 50-year period of analysis. There would be 8 pump stations, 13 culvert/sluice gates/ lift gates, 18 vehicular floodgates, 1 pedestrian floodgate, 1 railroad floodgate, 6 road ramps, and 5 floodgates.

Borrow sources considered were the same for each of the alternatives formulated and would be obtained from five identified sites. The borrow sites MS-1 and MS-2 are commercial operating sources that were evaluated in Individual Environmental Reports (IER) #19, #23, and #31 for the Lake Pontchartrain and Vicinity Hurricane and Storm Damage Risk Reduction System (HSDRRS) projects. The discussion, analysis and documentation of environmental compliance pertaining to MS-1 (called the Pearlington Dirt borrow site in IER 19, Pearlington Dirt Phase II borrow site in IER 23) and MS-2 (called the Port Bienville borrow site in IER 31) contained in those IERs are incorporated by reference herein. The remaining three borrow sites are STP-5, STP-6, and STP-9.

Mile Branch

This measure consists of channel improvements on the lower 2.15 miles (11,341 ft channel) of Mile Branch in Covington, Louisiana. The proposed work would consist of approximately 21 acres of channel that would be cleared and grubbed prior to mechanical dredging. The mechanical dredging would consist of a maximum of 130,000 cubic yards of fill dredged from the channel. For the channel improvements, approximately 38.8 acres of permanent ROW would be needed. This area would include 25 ft on each side of the Mile Branch channel. Included in the 38.8 acres, there would be 4.8 acres for a staging area that would become a backwater area after construction is complete. For the channel improvements, approximately 5.1 acres temporary ROW would be needed.

There are no surveys available for this area for this study, and no surveys will be conducted during the study phase. The existing elevations used for the hydraulic analysis and design of the Optimized TSP were obtained from the LIDAR raster dataset. Designs are based on existing information gathered from reports provided by the non-Federal sponsor as shown on Table 1.2 in the main report.

Design refinements would occur during PED based on field data collections. For example, future surveys would determine the final channel section and bridge replacements. Based on data collected, the design would be refined to minimize impacts to aquatic and riparian habitat and real estate. Riparian Zone bioengineering techniques and nature-based-solutions (NBS) would be incorporated as appropriate during PED in coordination with the NFS and resource agencies. One of the staging areas would become a backwater area after construction activities are completed. The conceptual backwater area has been proposed by MVN Environmental for Mile Branch. This concept would have to be further developed during PED. MVN Engineering has not performed any design of this concept during the study phase.

Mile Branch improvements would include seven (7) bridge replacements. Approximately 2.2 acres would be required as temporary ROW for staging along the various areas of the bridge replacements.

Table 5-1 is a summary table of the potential environmental consequences by resource for each alternative considered. The No Action plan alternative would result in a continuation of existing trends and is not included in the table. However, it is included in the assessment of impacts throughout this section for a comparative analysis.

Table 5-1 Summary Environmental Consequences by Resource and Final Alternative

Resource	Alt 2: Non-Structural Plan	Optimized TSP *
Wetlands–Fresh/intermediate Marsh	Minimal indirect	122.5 acres 40 net acres -47.5 AAHU
Wetlands-Pine Savanna/ Flatwood Forests	Minimal indirect	441 acres 150 net acres -75.12 AAHU
Wetlands - Riparian Habitat	Minimal indirect	35 acres
Uplands	indirect	-1,103 acres
Aquatic Resources/ Fisheries	No impact	Direct & indirect impacts
Essential Fish Habitat (EFH)	No impact	Direct & indirect impacts
Wildlife	Indirect impacts	Direct & indirect impacts
T&E; Protected Species	Limited indirect impacts	NLAA T&E or their critical habitat; potential impacts to protected species
Cultural Resources	PA agreement	PA agreement
Recreation Resources	No Impact	Direct & Indirect Impacts
Aesthetics	Indirect Impacts	Direct & indirect Impacts
Air Quality	In Attainment	In Attainment
Water Quality	Temporary	Temporary
Prime and unique Farmland	No impact	Direct Impacts
Noise Quality	Temporary Impact	Temporary Impact
Socioeconomics	Direct & Indirect impacts	Direct & Indirect impacts
Navigation	No Impact	Temporary Impacts

*** Refers to all features of Optimized TSP except the nonstructural plan**

5.1.1 Relevant Resources Affected

5.1.1.1 Wetlands Resources

Initially, features within the Final Array of Alternatives were assessed remotely utilizing GIS surveys, the National Wetland Inventory and USGS data for Hydrologic Unit Codes (HUC) 08090201and 0318004. Following the release of the June 2021 Draft IFR-EIS and as a result of comments received from resource agencies, the Optimized TSP was further assessed utilizing the USACE certified wetland value assessment (WVA) model for Fresh/intermediate marsh and specific species models utilizing the Habitat Evaluation

Procedures for Pine Savanna/Flatwood habitat. See Appendix C: Environmental for a data map generated from USFWS National Wetland Inventory and the habitat model assessments.

Alternative 1: No Action Plan

Direct, Indirect, and Cumulative Impacts: Wetland resources would continue to be threatened by sea level rise and subsidence into the future. Continued development would both directly and indirectly affect wetlands through direct removal or indirectly by segmentation, changes in hydrologic patterns and changes to water quality. Current development trends would be expected to continue in the floodplains converting wetlands to uplands. Current trends and patterns of wetland loss and conversion to open water would be expected to continue into the future. The riparian habitat along the Mile Branch would continue to be threatened by encroachment of development. The stream would continue to be subject to the erosive forces of the fast moving water during storm events.

Other local, state and regional efforts would be expected to continue to restore important wetland resources through programs such as CWPRRA, the State Master Planning and Watershed initiatives.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Direct, Indirect, and Cumulative Impacts: Flood-proofing, structure raising, and relocations are all options under this alternative. Flood-proofing and structure raising is not anticipated to result in direct impacts to wetlands. There may be indirect impacts resulting from runoff from construction sites. Relocations could result in both adverse and beneficial impacts. Home (yards) relocations could convert to natural areas over time if not part of a restoration program to return the area to natural habitat. Wetlands could develop in these areas overtime if the drainage patterns, hydrology are conducive to wetland development as well as the continue trends of subsidence and sea level rise. Relocating residents to other neighborhoods and communities could result in wetlands in other locations being converted for development of homes or indirectly impacting wetlands by changes in drainage patterns and hydrology resulting from residential development in other areas.

Optimized TSP (Levees and Mile Branch Improvements)

Following the release of the draft IFR-EIS, additional engineering and H&H analysis were conducted to optimize the TSP. Additional impact assessments were also conducted to quantify the potential impacts resulting from implementation of the Optimized TSP utilizing the 2017 USACE certified Wetland Value Assessment fresh/intermediate coastal marsh model and the Habitat Evaluation Procedures (HEP).

South Slidell and West Slidell and Levee: Implementation of this alternative would result in both direct and indirect impacts to wetlands and pine savanna habitat. Table 5-2 presents the details on habitat impacts to both the NWR property and to private property. Total direct losses to the NWR are anticipated to be approximately 21 acres (1.2 net acres) of pine savanna and 77 acres (29 net acres) of fresh/intermediate marsh impacts and indirect impacts to 30 acres (.25 net acres) of PS habitat. Pine savanna habitat and fresh/intermediate marsh within the proposed levee footprint would be converted into an earthen levee. Lands directly removed from the management of the NWR would be compensated through a land exchange with property in the NWR acquisition boundary that is of equal dollar value, habitat type and quality. The land exchange would be further developed during PED.

The habitat evaluation team (comprised of habitat specialist from the Interagency team) conducted a wetland value assessment utilizing the certified model approved for regional use for Civil Work projects. To quantify impacts to pine savanna fish and wildlife resources the HET utilized the species-specific HEPs in the absence of a pine savanna community model. The HEP models are similar to the WVA model, in that habitat quality and quantity are measured for baseline conditions and predicted future conditions for the Optimized TSP. The USFWS expressed concerns for utilizing the HEP approach as the HEP models are species-based models and only quantify habitat quality associated with a single species instead of measuring the overall health of the ecosystem and its ability to support a diversity of fish and wildlife resources. The Service chose the red-cockaded woodpecker (RCW) (Tirpak et al. 2009) and the pine warbler (USFWS 1982) to measure impacts to pine savanna habitats in the project area.

Based on the WVA and HEP analysis, there would be total direct impacts to 441 acres of pine savanna/flatwood habitat and 122.5 acres of fresh/intermediate marsh; There would be no indirect impacts to marsh habitat and approximately 230 acres of indirect impact to pine savanna/flatwood habitat from project induced hydrologic changes near the levee/floodwall alignment and flood gates.

Direct impacts to NWR for fresh/intermediate marsh are anticipated to be approximately 33 AAHU's and direct impacts to pine savanna/flatwood habitat are anticipated to be 10 AAHU for red-cockaded woodpeckers and 3 AAHUs for pine warblers. Indirect impacts are anticipated to be 7 AAHUs for red-cockaded woodpeckers and 2 AAHUs for pine warblers.

Based on the HEP analysis there would be a direct loss of approximately 150 net acres of pine savanna habitat (10 AAHU for RCW and 46 AAHU for pine warbler). Net acres equate to the difference between future without project conditions and future with project conditions at the end of the 50-yr period of analysis. There would be losses to approximately 40 net acres of fresh/intermediate marsh habitats (48 AAHUs).

Table 5-2. Habitat Impacts

Refuge Impacts	Direct *			Indirect			Total Net Acres	Total Net AAHU	Total Impact Acres
	Acre Impact	Net Acres	AAHU	Acre Impact	Net Acre	AAHU			
Fresh/ Intermediate Marsh	-77	-29	33	0	0	0	-29	33	-77

Pine Savanna/ flatwood	-21	-1.19	RCW 10	-36	-0.25	RCW 7	-1.44	RCW 17	-57
			PW 3			PW 2		PW 5	
Private Impacts	**Direct**			**Indirect**			**Total Net Acres**	**Total Net AAHU**	**Total Impact Acres**
	Acre Impact	**Net Acres**	**AAHU**	**Acre Impact**	**Net Acre**	**AAHU**			
Fresh/ Intermediate Marsh	-45.5	-11	14	0	0	0	-11	14	-46
Pine Savanna/ flatwood	-171	-145	PS RCW 0 RCW 0 PW 43	-201	0 -3	PS RCW 0 PS PW 11 RCW 0	-148	PS RCW 0 RCW 0 PS PW 11 PW 45	-373
						PW 2			
Riparian Habitat	-35	-35	22.9	0	0	0	-35	0	-35
Stream Habitat	-3	-3	na	na	na	na	-3	na	-3

PS-protected side of levee alignment, PW – Pine Warbler; RCW – Red-Cockaded woodpecker

* Direct impacts on the NWR are exchanged with land of equivalent value, habitat type and quality via a Land exchange

Mile Branch Channel Improvements: The Mile Branch channel improvements start at the intersection of Mile Branch and U.S. Highway 190, crossing U.S. Highway 190 Business, and end at the confluence of Mile Branch and the Tchefuncte River. This alternative consists of channel improvements on the lower 2.15 miles (11,341 feet channel) of Mile Branch in Covington. The preliminary design assumes an existing bank elevation of 1 foot, a 10-feet bottom width at elevation (-) 5 feet. The bank is at 1V:3H slope. The improvements include clearing and grubbing and mechanical dredging of the channel. The channel bottom would be lowered by 5 feet. Approximately 21 acres of channel would be cleared and grubbed prior to mechanical dredging. An assumed maximum of 130,000 cubic yards of material may be mechanically dredged from the channel. Mile Branch improvements would include seven bridge replacements.

Habitat within the Mile Branch riparian zone is composed of mixed pine/hardwood stands. Neither a WVA model nor a certified community model was available for the HET to assess the riparian habitat within the study schedule constraints. However, because bottomland hardwoods are an integral component of the overstory along Mile Branch the HET agreed to use the bottomland hardwood WVA. Concern was expressed by the HET that the habitat quality of pine/hardwood habitats may be inappropriately undervalued by utilizing the BLH WVA to assess the mixed pine/hardwood riparian habitat

It is anticipated that widening the Mile Branch Channel would directly impact approximately 35 acres (23 AAHU) of riparian habitat consisting of a mix of BLH and loblolly pine. There is limited space between the channel and the adjacent housing community, therefore all impacts are considered direct and there would be no indirect impacts. During PED, consideration would be given to bioengineering techniques to restore the lost habitat functions and values resulting from the channelization of Mile Branch. Techniques that would be considered include planted riprap, inclusion of pools and riffles in the deepening/widening of channel. It is anticipated that the site would revegetate naturally upon construction completion. The loss of riparian habitat would adversely impact aquatic organisms through the loss of shade and increasing water temperature. In addition, riparian habitats serve to help stabilize streambanks and reduce floodwater velocity. The dredged material would be hauled off by truck. Dredging activities would temporarily increase water turbidity in the water column and decrease water quality temporarily. Any seed source in the dredge material could result in revegetation downstream where the sediment settles.

Cumulative effects are anticipated to be shifts in vegetation from one habitat type to another. Riparian habitats throughout the country are threatened by development and are in decline.

Nonstructural Plan: An estimated total of 6,410 structures could benefit from nonstructural risk reduction, including homes to be elevated to the future 100-year stage up to 13 feet and nonresidential structures floodproofed up to 3 feet. The floodproofing of these structures address the structures in the 4 percent, 2 percent, and 1 percent AEP floodplain that are not included in the areas benefitted from the structural measures of the TSP. It is estimated that 5,583 homes would be elevated and 827 structures floodproofed.

Flood-proofing, structure raising, and relocations are all options under this alternative. Flood-proofing and structure raising are not anticipated to result in direct impacts to wetlands. There may be indirect impacts resulting from runoff from construction sites. Relocations could result in both adverse and beneficial impacts. Home (yards) could convert to natural areas over time if not part of a restoration program to return the area to natural habitat. Wetlands could develop in these areas overtime if the drainage patterns, hydrology are conducive to wetland development as well as the continue trends of subsidence and sea level rise. Relocating residents to other neighborhoods and communities could result in wetlands in other locations being converted for development of homes or indirectly impacting wetlands by changes in drainage patterns and hydrology resulting from residential development in other areas.

Mitigation: As a result of anticipated impacts discussed above, mitigation for the loss of habitat is required to be in full and replaced in-kind for the habitat lost. Reference Appendix I Mitigation plan for the detailed discussion regarding mitigation planning . The non-refuge pine savanna and riparian habitat impacts would be compensated for by purchasing credits from a mitigation bank within the watershed for that habitat type.

Fresh/intermediate marsh would be offset by the construction of a mitigation site identified as M2. The M2 marsh mitigation site is l on the north shore of Lake Pontchartrain, east of the Causeway Bridge near Lacombe. This alternative is shown in the Engineering Appendix D on Plate number C-04 and C-05. The proposed site would be approximately 200 acres. The assumed existing elevation is -1.65' NAVD88. This would be verified during PED. Initial target elevation for dredge fill would be to approximate elevation +2.5 NAVD88, to ultimately hit a target marsh elevation of +1.0 NAVD88. At this 35% design level, total perimeter retention would be required to retain dredge material and allow for vertical accretion. Approximately 14,718 linear ft of new retention dike would be required along the perimeter of the marsh creation footprint. The dike would be built with borrow from within the footprint. The dike would be built with a 5 ft crown width to elevation +4.8' NAVD88, to provide one ft of freeboard during pumping operation and allow for settlement. This dike would be degraded in year 1, upon settlement and dewatering of the created marsh platform. The degraded material can be disposed of in the original borrow canal if settlement allows or cast into the open water immediately outside of the project footprint. Spill boxes or weirs would be constructed at pre-determined locations within the retention dike to allow for effluent water release from within the marsh creation area. If deemed necessary by the construction contractor, low level interior weir or baffle dikes can be constructed to assist in vertical stacking of dredged material.

Marsh creation would require approximately 2,200,000 cubic yards of borrow material. A 134 acre borrow site has been identified just off the north shoreline of Lake Pontchartrain. There would be a 2000 ft buffer between the existing shoreline and the borrow area limit. Borrow material would not be obtained deeper than 10 ft below the existing lake bottom, except that a tolerance of 1-ft below this target elevation will be provided the contractor to account for inaccuracies in the dredging process. To assure adequate borrow, the fill quantity was doubled to account for unsuitable materials, unknown utilities, unidentified anomalies, and/or unsighted cultural finds. An access corridor of approximately 7,340 linear feet would be necessary to pump material from the lake to the proposed marsh creation site. The access corridor would serve as a pipeline corridor and to offload equipment as necessary, to transport personnel to and from the worksite. The contractor would be instructed to minimize usage and damage within the access corridor, by using existing waterways for daily transportation of supplies and personnel where possible.

<u>*Levee Borrow Sources:*</u> The borrow sources are either existing commercially operating borrow sites or open fields/agricultural land (evaluated further below). However, a wetland jurisdictional determination would be conducted during PED to determine whether any wetland sources existing within the sites identified for borrow. Should there be an identification and delineation of wetlands, those areas would be avoided, and a buffer would be established around the wetland perimeter to preserve the integrity of the wetland habitat. The CEMVN has a long standing policy of avoiding impacting wetlands for borrow sources and would continue to maintain that policy into the future. Therefore, there would be no impact to wetland resources as result of borrow excavation.

5.1.1.2 Upland Resources

<u>Alternative 1: No Action Alternative Plan</u>

<u>*Direct, Indirect, and Cumulative Impacts:*</u> There would be no impacts to uplands resources if the proposed action did not take place. Forested uplands in the project area would continue to be directly and indirectly impacted by the present natural and anthropogenic factors (e.g.

development, invasive species) into the future. Erosional forces from major flood events would continue to permanently adversely impact upland resources. Long-standing water (approximately 1 mo.) due to flooding on upland forests could result in stunting the growth of the habitat. As upland trees are lost due to erosional forces from high river flows or mortality from inundation or saltwater intrusion less desirable species could take over.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Direct, Indirect, and Cumulative Impacts: Elevating homes would not directly impact vegetation outside the construction footprint in any surrounding areas, although the shading could potentially result in shifting plant communities. Construction activities related to elevating homes and connecting utility lines would cause direct impacts to lawns and flowerbeds and landscaped areas.

Optimized TSP (Levees and Mile Branch Improvements)

The levee and channel clearing structural measures would be constructed in a manner that allows for drainage following flood events. Complete mortality of flood-sensitive species within upland forests is not anticipated as the gates and pumps would be constructed and operated in a manner that allows upland areas to drain following flood events. Some mortality could result with a transition to the more flood-tolerant species over time.

Elevating homes would not directly impact vegetation in surrounding areas beyond the immediate areas surrounding the homes' footprints, although the shading created by raising the structures could potentially result in shifting plant communities. In cases where a home or land acquisition may take place, this could indirectly impact visual resources by removing a viewer from a given area. In areas where there is public access from a street or roadway, these nonstructural elements would not change the view shed. Houses being raised are currently present, their elevation would change, but the site is still occupied either way. In the case of a home acquisition, if a home is removed and open land is created, this could be considered as a benefit to drivers looking for natural scenery or a loss to an established neighborhood.

Levee Borrow Sources: The borrow sources are either commercially operating borrow sites or open fields/agricultural land. Approximately 1,103 acres of grassland could be adversely impacted by the conversion of open fields to borrow pits.

5.1.1.3 Soils: Prime and Unique Farmlands

Alternative 1: No Action Plan

Direct, Indirect, and Cumulative Impacts: This alternative would not have an effect on prime and unique farmland. Soil would continue to experience both anthropogenic and natural impacts.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Direct, Indirect, and Cumulative Impacts: Implementing nonstructural measures such as elevating and floodproofing would have no direct or indirect impacts on prime and unique farmlands. The relocation of households could potentially adversely affect prime and unique farmlands if it increased residential development on those soils.

Optimized TSP (Levees and Mile Branch Improvements)

Approximately 143 acres of prime and unique farmlands would be impacted by construction of a levee on top of the soils. Farmland would be directly adversely impacted within approximately 13 percent of the levee footprint and associated staging areas.

Borrow Sources: Borrow sites MS-01 (Pearlington) and MS-02 (Bienville) in Mississippi are not currently listed as having prime and unique farmlands. These sites are operating as commercial businesses selling sell borrow material. Borrow site STP-5 would impact approximately 62 acres, STP-6 would impact less than one acre, and STP-9 would impact approximately 5 acres. Impacts to prime and unique farmlands would require coordination with the Natural Resources Conservation Service. Table 5-3 lists the potential borrow sources and the specific borrow needs from each site.

Table 5-3. Potential Borrow Site Identification for the St. Tammany Parish Feasibility Study

Site #	Site Name	Location	Estimated Borrow Pit Acreage	Estimated Fill Volume (cubic yards)	Prime and Unique Farmland Soil
STP-5	Cleared Site 5	Lacombe, LA	73	1,817,700	62 acres
STP-6	Cleared Site 6	Slidell, LA	10	249,000	<1 acre
STP-9	Cleared Site 9	Slidell, LA	17	423,300	5 acres
MS-1	Pearlington Dirt, Pearlington Dirt Phase II (IER 19,23)	Hancock County, MS	326	8,000,000	None
MS-2	Port Bienville (IER 31)	Hancock County, MS	677	16,857,300	None

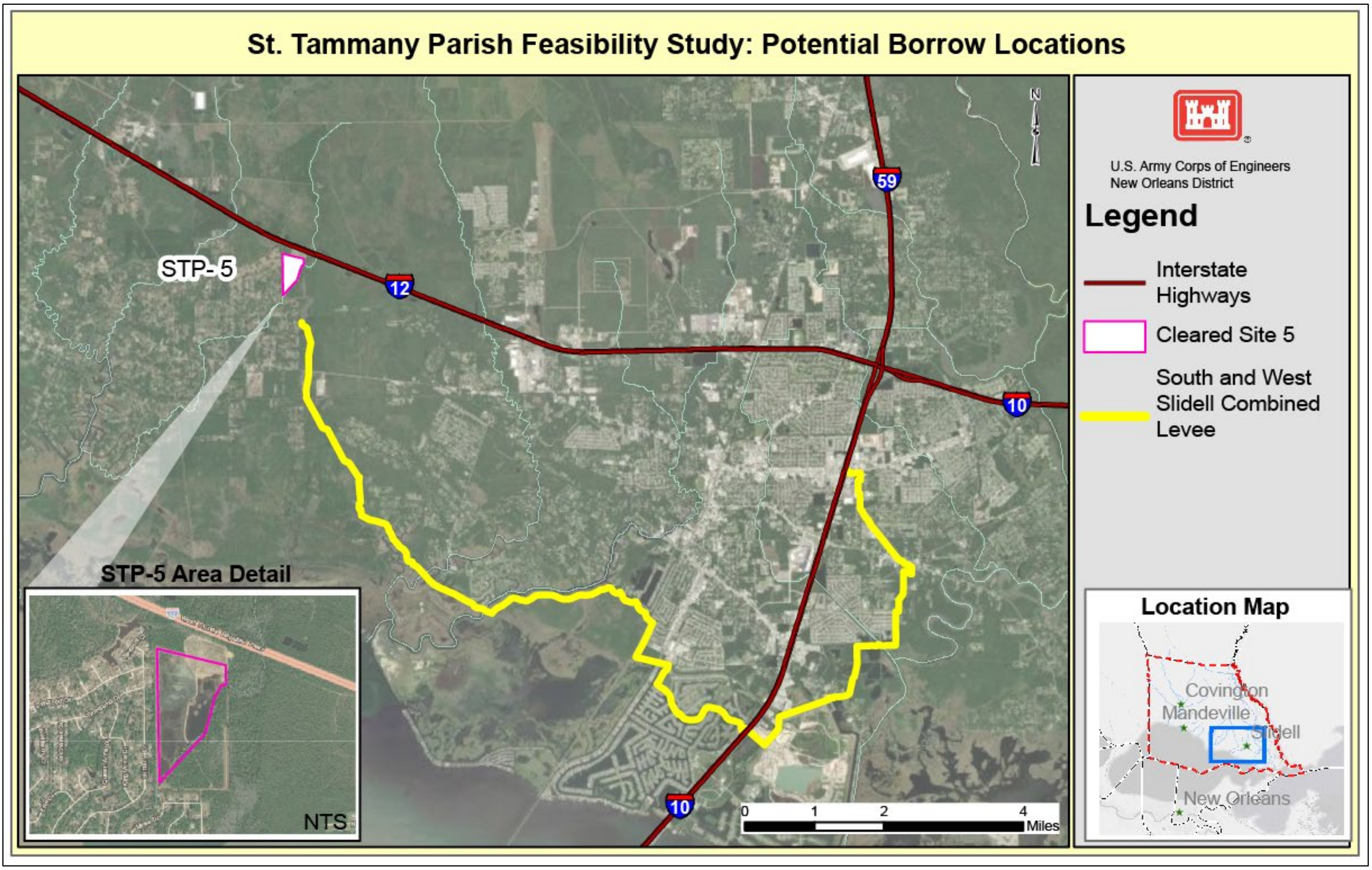

Figure 5-3. Borrow Site STP - 5

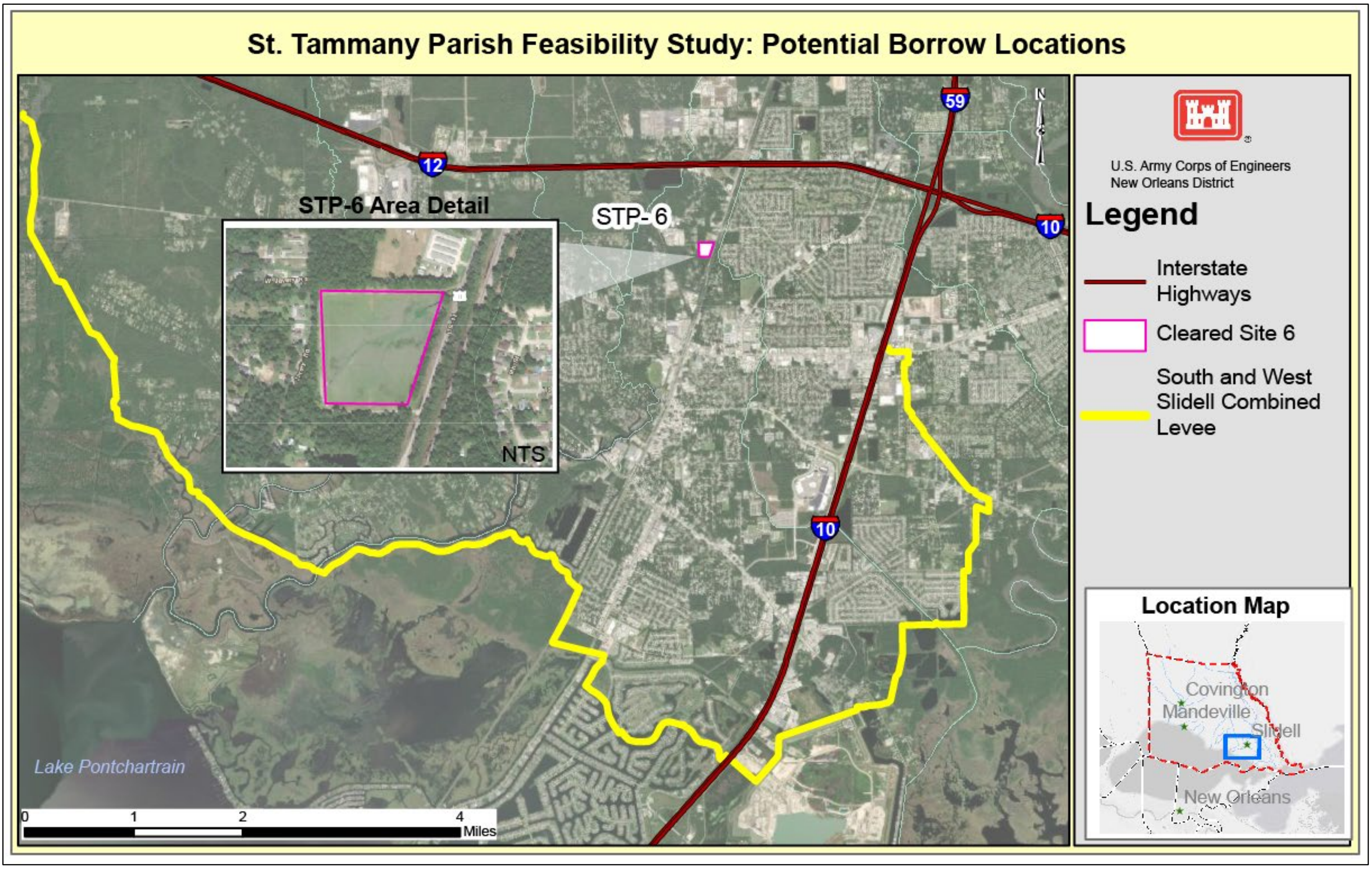

Figure 5-4. Borrow Site STP-6

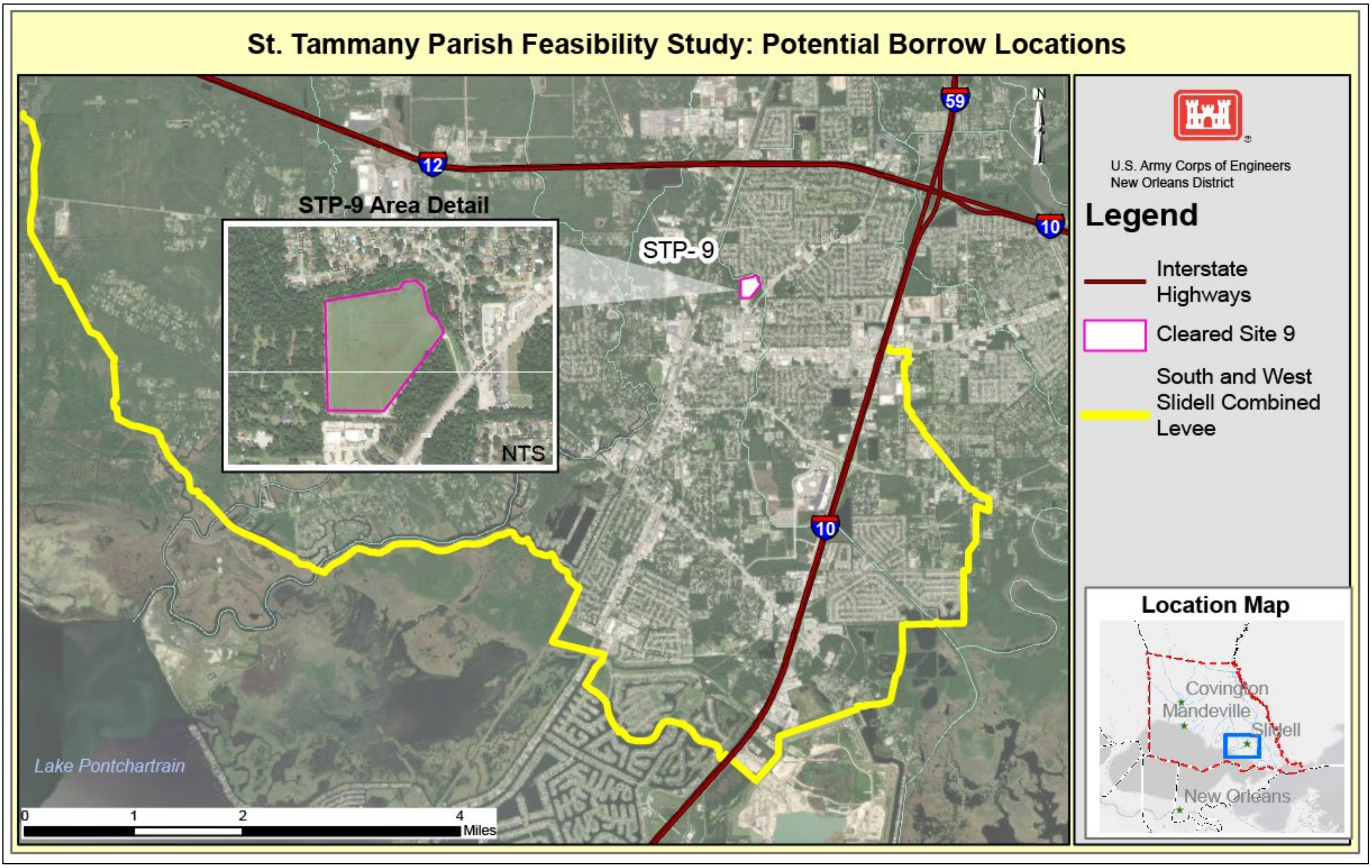

Figure 5-5. Borrow Site STP-9

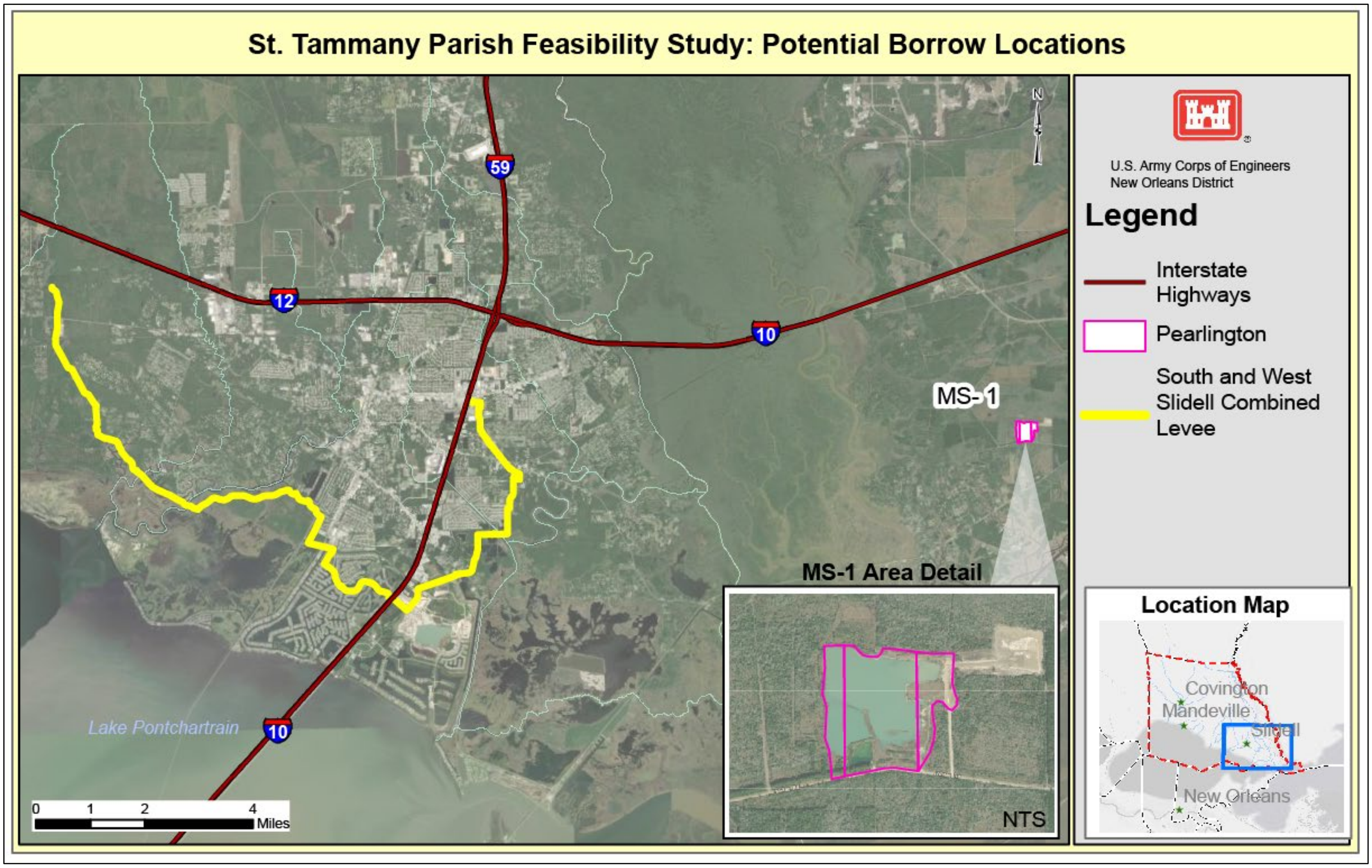

Figure 5-6. Borrow Site MS-1(Pearlington Dirt (IER 19), Pearlington Dirt, Phase II (IER 23))

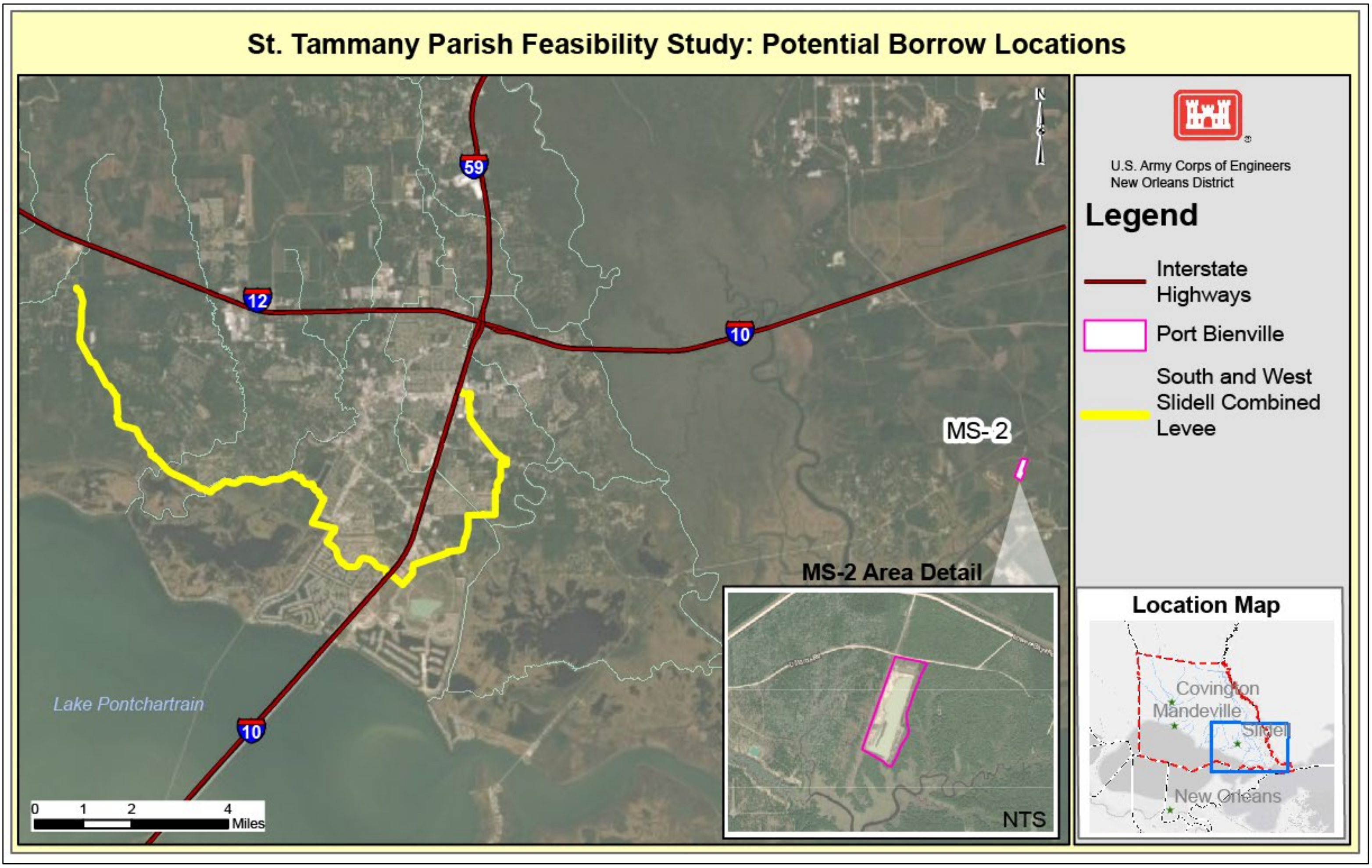

Figure 5-7. Borrow Site MS-2 (Port Bienville (IER 31))

5.1.1.4 Aquatic and Fishery Resources

Alternative 1: No Action Plan

Direct, Indirect, and Cumulative Impacts: Without implementation of the proposed action, aquatic resources and fisheries in the study area would continue to be directly and indirectly impacted by the present natural and anthropogenic factors. These include ongoing issues related to stormwater management, increasing development, and nutrient runoff that negatively impact aquatic resources and fisheries.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Direct, Indirect, and Cumulative Impacts: Flood-proofing, structure raising, and relocations are all options under this alternative. Implementation would have no impact to aquatic resources within the study area.

Optimized TSP (Levees and Mile Branch Improvements)

West Slidell and South Slidell Levees: Implementation of this levee measure would have direct impacts to migration and spawning aquatic species. Any aquatic species on either side of the levee footprint would likely experience direct impacts from construction and alterations of drainage and flow into Lake Pontchartrain. Indirect impacts would be shifts in vegetative communities related to changes in hydrology, with construction impacts being only temporary. Vegetative communities provide foraging and refugia for aquatic species that can be used for spawning and shelter.

The portion of the earthen levee that parallels and then crosses Bayou Bonfouca, crosses Bayou Liberty and Bayou Pacquet, the sluice gate #2 located at Minor tributary off Bayou Bonfouca and sluice gate #3 off Bayou Paquet would be expected to effect migration patterns of estuarine dependent marine organisms, such as Brown shrimp, White Shrimp, and other aquatic species to and from coastal habitats adversely affecting fish production. Navigable gates such as the Bayou Pacquet, Bayou Liberty and Bayou Bonfouca would be expected to affect aquatic species and fish migration as a result of changes in water patterns and velocity during certain periods of the year. The operations plans of the various sector gates, lift gates, and sluice gates would not be closed until certain conditions are met. No structure can be closed or re-opened when the pressure head differential exceeds the structure design capability. No structure can be re-opened until storm force winds have dropped to a level safe for personnel to access the aera and operation the machinery. The Preliminary Draft Operating plan located in Environmental Appendix C, Annex Q is considered preliminary for the purpose of assessing potential impacts to fisheries. The preliminary plan would be further refined during PED. The Further H&H modeling and design consideration for fish friendly structures, such as consideration of sloped ramps to the floodgate sill, would be further considered during PED. Both behavioral and physical responses govern migration and affect passage of fishery and aquatic organisms through structures. These responses may vary by species and life stage of the aquatic organism. Most marine fishery species are relatively planktonic in early life stages and are dependent on tidal movement to access coastal marsh nursery areas. For this reason, in general, the greater the flow through a structure into a hydrologically affected wetland area, the greater the marine fishery production functions provided by that area (USFWS DCAR, 2023). The design of the floodgates would incorporate nature based features. These features would be further developed during PED.

Cumulative impacts would be the additive impact of converting approximately 123 acres of fresh/intermediate marsh to uplands resulting in permanent vegetation shifts. These permanent habitat shifts also impact spawning and migration patterns of aquatic species that rely upon the waterways disrupted by the placement of levees and structures. Noise and vibration from construction activities would be expected to only cause a temporary impact by potentially scaring away those present in the immediate vicinity, though they would be expected to return upon completion. Operations of any pump stations would contribute to noise and vibration during high water events. Further details regarding these operations can be found in Appendix D: Engineering.

Mile Branch Channel Improvements: Implementation of the channel clearing in Mile Branch would have direct impacts to migration and spawning aquatic species due to construction activity and changes in flow altering vegetative communities. The Mile Branch is a highly incised stream that has intermittent flows but higher flows generally during flood events. Following flash flows, slow moving water riffles and pools remain. The pools of water would be home to many species of macro-invertebrates such as mayflies, stoneflies, water beetles, dragonflies, caddisflies, minnows, tadpoles, and mollusks. Early stages of perch, bluegill and bass may be found in Mile Branch. The macro-invertebrates and fish fry would likely be permanently impacted by the channelization/excavation activities. Following construction activities, they would return and repopulate the stream to the extent that pools and riffles would be designed into the stream. Nature based methods would be further considered during PED. Direct impacts would be the conversion of a stream system consisting of microhabitats suitable to macro-invertebrates to a channelized system that is devoid of diversity in depth of water or pools/riffles. The removal of the vegetation within the stream and bankline would remove the shade that keeps the stream water cool indirectly impacting the aquatic species inhabiting the area. Cumulative impacts would entail a permanent removal of vegetation to a channel devoid of vegetation. The removal of vegetation and pools would adversely affect spawning and migrating aquatic species Cumulatively, these measures would likely stabilize the banks that being lost by erosive forces. Stabilizing stream banks via engineering methods such as riprap provide benefits by reducing sedimentation of the stream and reducing turbidity, but it can also result in adverse impacts such as loss of shade provided by riparian habitat, increases in warmer waters and lower dissolved oxygen.

Nonstructural Plan: Implementation would have no impact to aquatic resources within the study area.

Mitigation: Restoring a fresh/intermediate marsh area would increase spawning, nursery, forage, and cover habitat for fisheries resources over the long term. For approximately 5 years after project construction the project area would be above daily tidal inundation and only partially vegetated, so maximum fisheries benefits would not be realized until after this

5-year period has elapsed. Turbidity during borrow excavation and fill placement would temporarily impair visual predators and would impact filter feeders, but these impacts are expected to cease after construction and benthic species would rebound once construction is complete. Fish access to this area would be extremely limited until the material consolidated and settled to an elevation conducive to natural emergent marsh habitats. It is expected this “lag” time would be approximately 5 years. Once the success criteria have been achieved, this area would once again serve its traditional functional role in the local ecosystem. It is probable that crab fishermen sometimes place crab traps within the proposed borrow area as the practice is common throughout Lake Pontchartrain. Shrimp fishermen may venture into the area either pulling trawls or pushing “skimmer” nets. The fishermen and their gear would be temporarily displaced during project construction, and the borrow area may be less productive for up to a year after project construction due to loss of benthic animals from the dredging operation. The depth restriction on the borrow pit, preventing it from being more than 10 feet in total depth, would minimize the chance that the area would suffer from low oxygen conditions post construction.

Levee Borrow Sources: There would be no impact to aquatic and fishery resources as result of borrow excavation as described in 5.3.

5.1.1.5 Essential Fish Habitat (EFH)

Alternative 1: No Action Plan

Under the future without project conditions there would be no impact to EFH resulting from taking no action. Current water quality trends impacting fisheries would continue. Subsidence and sea level rise would continue to result in the loss of wetlands, which would affect EFH.

Alternative 2: Nonstructural Plan (within Optimized TSP)

No impact on EFH. Current water quality trends impacting fisheries would continue. Subsidence and sea level rise would continue to result in the loss of wetlands, which would affect EFH.

Optimized TSP (Levees and Mile Branch Improvements)

Estuarine wetlands are the primary type of EFH that would be impacted with construction of the levee. The nonstructural component would have no effect on EFH. Construction of the levee and channel clearing measures would directly impact estuarine emergent wetlands by changing hydrology in the area, thus affecting post-larval and sub-adult brown and white shrimp, as well as post-larval and sub-adult red drum. Brown shrimp, white shrimp, and blue crabs may be directly impacted through the filling of shallow open water areas with dredged materials, but these species could potentially benefit indirectly from the abundance of introduced detritus. Where tidal waters designated as EFH would be converted to a non-tidal elevation, loss of EFH would result. Cumulatively, these impacts would be considered minimal due to the large size of the basin, and similar EFH located within the parish. There is no EFH in the Mile Branch thus there would be no impacts to EFH resulting from proposed actions taking on Mile Branch. An operations and maintenance plan for structures included in the TSP (Figures 5-8 and 5-9) will be developed during PED. A mitigation plan has been formulated and can be found in Appendix I: Mitigation Plan.

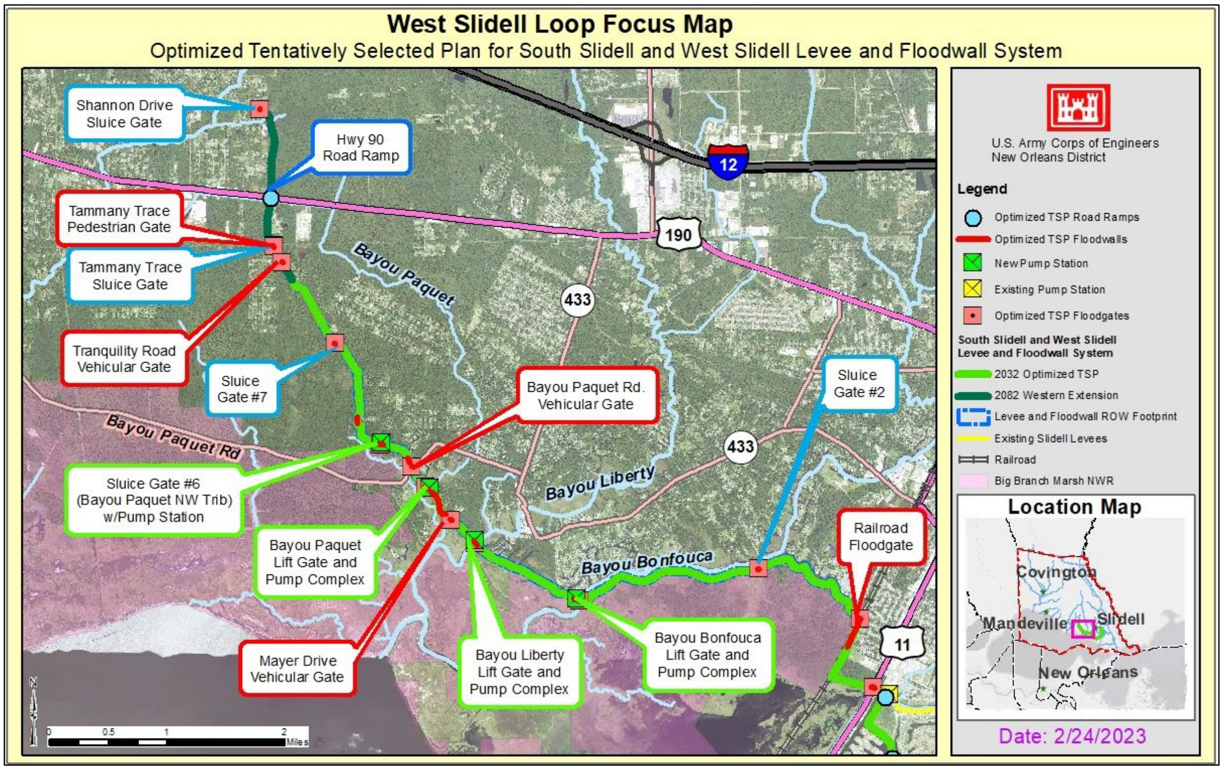

Figure 5-8. From Appendix D: Engineering Figure D:10-4 West Slidell Levee and Floodwall System – Optimized Tentatively Selected Plan Focus with Structures

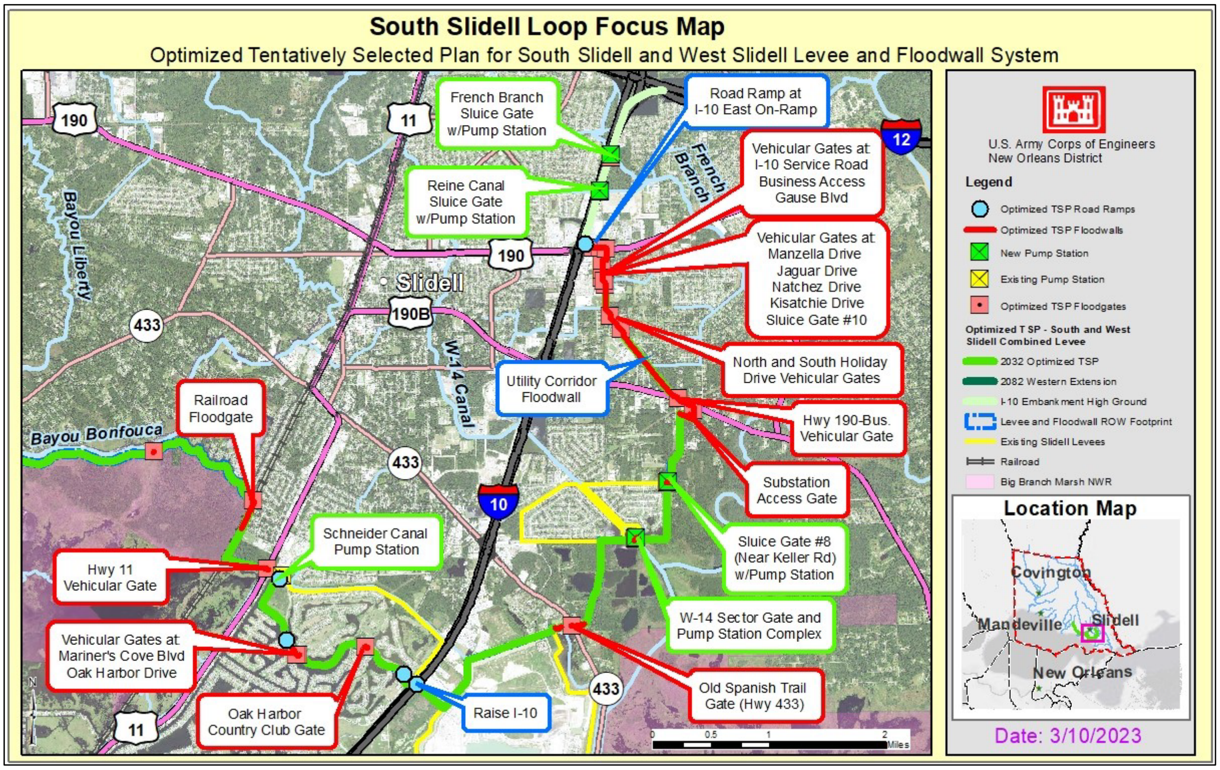

Figure 5-9. From Appendix D: Engineering Figure D:10-6 South Slidell Levee and Floodwall System-Optimized Tentatively Selected Plan Focus with Structures

Mitigation: The existing essential fish habitat at the M2 mitigation site includes estuarine water bottom, estuarine water column, and submerged aquatic vegetation. These habitats would be largely converted to another type of essential fish habitat – estuarine intertidal herbaceous wetlands (marsh). Benthic resources within the borrow site would be lost until they can re-colonize the borrow area. The borrow area would not be excavated more to more than 10 feet deep thereby minimizing the possibility of anoxic conditions. Fisheries access to the marsh mitigation area would be extremely limited during the initial 3-5 years of the project life while the pumped-in sediments are dewatering and subsiding. The M2 area was once a functional marsh system that provided nursery and feeding habitat to local fisheries. Over time, the proposed actions would result in an increase of functional marsh and associated shallow water habitat thereby accomplishing the required level of mitigation and offsetting adverse impacts to certain categories of EFH. The adverse impacts to essential fish habitat that would result from the proposed actions may affect, but should not adversely affect, managed species considering the small acreage involved relative to Lake Pontchartrain, plus the project would provide long-term benefit to the managed species by providing intertidal wetlands, a valuable type of essential fish habitat.

Indirect impacts to managed species include increased turbidity and disturbance of Lake Pontchartrain in the vicinity of the borrow area. These species may be temporarily displaced.

Implementation of the proposed action would result in sufficient EFH habitat improvement to offset adverse impacts to fresh/intermediate marsh EFH and open water designated as essential fish habitat from the construction of the Optimized TSP.

Levee Borrow Sources: There would be no impact to essential fish habitat resources as result of borrow excavation as described in 5.3.

5.1.1.6 Wildlife

Representative species found in the area, and impacted by each alternative, are analyzed here and can be found in Appendix C: Environmental. Annex P,

Alternative 1: No Action Plan

Direct, Indirect, and Cumulative Impacts: Without implementation of the action alternative, terrestrial habitat loss as the result of continued flooding, erosion, and coastal storm surge damage would likely continue at the present rate, resulting in a reduction of diversity and availability for resident wildlife.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Direct, Indirect, and Cumulative Impacts: Flood-proofing, structure raising, and relocations are all options under this alternative. Flood-proofing and structure raising would only temporarily directly impact terrestrial and arboreal wildlife habitat during construction, but the anthropogenic factors related to ongoing development within the parish negatively impacting terrestrial wildlife would continue. Relocations would entail residents moving out of their existing homes, and this could be considered a cumulative benefit to wildlife resources if the area is allowed to revegetate and go undeveloped.

Optimized TSP (Levees and Mile Branch Improvements)

West Slidell and South Slidell Levees: Implementation of this levee measure would directly result in the loss of marsh and forested habitat for terrestrial wildlife species with the potential for species mortality and displacement for species present during construction. Conversion of marsh to uplands would reduce use and function of these areas for brown pelicans, seabirds, dabbling and diving ducks, coots, and gallinules and other species that feed in the shallow open waters, it is anticipated they would utilize adjacent areas of open water habitat that are abundant in close proximity to the proposed features. Indirect impacts would be on adjacent habitats that would experience a burden due to displacement of wildlife to those adjacent areas. Where there is a permanent loss of habitat resulting from construction, the affected species would not return or utilize the affected habitat in the same manner. Mobile wildlife would be impacted by the construction noise and vibration and likely leave the area. These impacts are expected to be temporary and the wildlife would return once construction activities are complete. There could be adverse impacts to adjacent habitat resulting from the wildlife migration if the carrying capacity is already weakened or threatened with over population. Less mobile species would suffer from the construction activity and likely suffer death from the placement of dirt directly on them or from being run over by construction equipment. Noise and vibration from construction activities would be expected to only cause a temporary impact by potentially scaring away those present in the immediate vicinity, though they would be expected to return upon completion.

Cumulatively, these levee measures play a role in converting habitat from one type to another. Some wildlife species could benefit more from conversion of a habitat from one type to another and other species could be adversely impacted. Stabilizing stream banks via engineering methods serves a similar function as the riparian habitat but results in loss of vitally important riparian habitat that provides other functions such as shade to the stream system thereby benefiting dissolved oxygen, wildlife corridor providing food and shelter. These same methods could serve to benefit the streambanks by reducing erosive forces resulting from high velocity water movement. The reduction in streambank erosion would also benefit aquatic species through reduced sedimentation and turbidity.

Mile Branch Channel Clearing: Implementation of the channel clearing would directly result in the loss riparian habitat for terrestrial wildlife species due to construction activities. The area is in a highly developed residential area, and the species in the vicinity of the area are highly adaptive to the presence of anthropogenic activity. Riparian habitats serve as a corridor for wildlife to pass. The removal of this habitat would have a direct and indirect impact on wildlife in the area. Less mobile wildlife may be run over by construction equipment resulting in death or severe injury. The construction activity would scare off more mobile species to adjacent areas to see cover and food. This may result in wildlife being run over by cars when fleeing. It is likely that displaced wildlife would wander the developed areas seeking suitable habitat for food and cover. Nature based solutions would be considered during PED such as planting trees among the riprap on the banks, adding pools and riffles to the channel bottom to create diversity of habitat for wildlife and aquatic organisms alike. It is anticipated that any displaced wildlife will return to the area if similar habitat exists following completion of construction.

Cumulatively, these measures would likely stabilize terrestrial habitat that is being lost to erosion by preventing future flooding and storm surge from impacting the area.

Nonstructural: Flood-proofing and structure raising would only temporarily directly impact terrestrial and arboreal wildlife habitat during construction, but the anthropogenic factors related to ongoing development within the parish negatively impacting terrestrial wildlife would continue. Relocations would entail residents moving out of their existing homes, and this could be considered a cumulative benefit to wildlife resources if the area is allowed to revegetate and go undeveloped.

Mitigation: Direct impacts to wildlife would result from the conversion of shallow open water to emergent marsh habitat. This conversion would reduce use and function of these areas for brown pelicans, seabirds, dabbling and diving ducks, coots, and gallinules and other species that feed in the shallow open water in this location, but it is anticipated they would utilize adjacent areas of open water habitat that are abundant in close proximity to the proposed features. It is anticipated that the project areas would experience improved overall wetland habitat functions once construction and establishment of the proposed marsh are achieved.

These actions would create or enhance emergent marsh habitat for terrestrial and semi-aquatic species such as nutria, muskrat, mink, river otter, and raccoon. Reptiles including the American alligator, western cottonmouth, water snakes, speckled kingsnake, rat snake, and eastern mud turtle are likely to utilize and populate the proposed marsh area as well. Amphibians expected to colonize the area include the bullfrog, southern leopard frog, and Gulf coast toad. The edges and small areas of open water than would form over time would also provide feeding habitat for common wading bird species including great blue heron, green heron, tricolored heron, great egret, snowy egret, yellow-crowned night-heron, black-crowned night-heron, and white ibis. Incidentally created mudflats and shallow-water areas would provide habitat for numerous species of shorebirds and seabirds. Shorebirds expected to use such areas include American avocet, willet, black-necked stilt, dowitchers, and various species of sandpipers. White pelican, brown pelican, black skimmer, herring gull, laughing gull, and several species of terns would be expected to forage in and near the project area. Migratory and resident non-game birds, such as the boat-tailed grackle, red-winged blackbird, seaside sparrow, northern harrier, belted kingfisher, and marsh wrens, would also use the project areas. Game birds using the area would include the clapper rail, sora rail, Virginia rail, American coot, common moorhen, and common snipe in addition to resident and migratory waterfowl. Indirectly, species that utilize shallow open water habitats would be displaced by the habitat conversion. However, these species would have the opportunity to utilize adjacent shallow open water areas. Many species utilizing the current habitat type would thrive with the additional foraging, cover, and resting habitat the project would create. A rise in turbidity at the borrow site could immediately reduce water quality in the area; however, those effects would be temporary and would be reduced by movement of the tides. This project would help to offset an overall loss in the basin of intermediate and brackish marsh and BLH-Wet habitat necessary for many wildlife species.

The maintenance of pine savanna habitat on the refuge would provide habitat utilized by species such as songbirds, white-tailed deer, raccoons, squirrels, and rabbits.

These projects, when added to other past, present, and reasonably foreseeable ecosystem restoration and mitigation projects in the basin, would prevent the net loss of intermediate, brackish and BLH wetland function and overall decline of wildlife species within the basin and would be beneficial in both preserving the species bio-diversity and combating the current trend of conversion of coastal marsh to open water, which would be accelerated due to sea level rise.

<u>Levee Borrow Sources:</u> Each of the five borrow sources currently consists of land cleared of vegetation, and two are specifically commercial borrow sites. Wildlife that have remained in the general vicinity would be impacted by noise and vibration during construction activities, displacing to adjacent properties. Utilization, likely foraging, of the sites by any remaining wildlife in the cleared fields would be changed. to more tolerant wildlife species of noise and constant disturbance

5.1.1.7 Threatened, Endangered, and Protected Species

Impacts associated with construction activity, such as impacts to water quality, near spawning areas are known to negatively affect Gulf sturgeon and need to be taken into account when considering the construction schedule. The USFWS has provided a series of lifecycle features in their planning aid letter to USACE that details physical biological features to consider aiding in scheduling. Critical habitat for Gulf sturgeon is found in the study area and could be affected by each structural alternative in a similar manner.

Each of the five borrow sources currently consist of land cleared of vegetation, and two are specifically commercial borrow sites. Of the listed species that have been identified, the gopher tortoise is known to be drawn to cleared land, and there may be bald eagles and red-cockaded woodpecker clusters in adjacent forested land. Surveys performed by the USFWS determined no evidence of gopher tortoises or their burrows are located within the project area. Therefore, the proposed action is not likely to adversely affect tortoises. In addition, a USFWS cluster analysis determined that red-cockaded woodpecker clusters located within the project area are not likely to be adversely affected by construction activities due to suitable habitat nearby.

Protected species that have remained in the general vicinity would be impacted by noise and vibration during construction activities, displacing to adjacent properties. Utilization, likely foraging, of the sites by any remaining wildlife in the cleared fields would be changed due to removal of vegetation during excavation.

The construction of levees can result in temporary and/or permanent impacts to migratory birds and the habitats upon which they depend for various life requisites. USFWS has concerns regarding the direct and cumulative impacts resulting from the loss and fragmentation of forest and grassland habitats, and the direct and indirect impacts that these losses would have upon breeding migratory birds of conservation concern within the West Gulf Coast Plain Bird Conservation Region (https://www.fws.gov/migratorybirds/pdf/grants/birdsofconservationconcern2008.pdf). Many migratory birds of conservation concern require large blocks of contiguous habitat to successfully reproduce and survive.

Alternative 1: No Action Plan

No direct impacts to endangered species or their critical habitat would occur. This includes “at-risk” species of concern for USFWS as well. Existing conditions would persist and listed species would likely continue to be subject to institutional recognition and further regulations and federal management.

Cumulative impacts of this alternative would be continued habitat loss and degradation for protected species in the coastal areas of the parish.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Flood-proofing, structure raising, and relocations are all options under this alternative. This alternative would not result in direct impacts to threatened, endangered, and protected species. Limited indirect impacts could be caused by flood-proofing and structure raising during construction activities. When combined with the structural alternatives, there would be no additional impacts to this resource. This includes “at-risk” species of concern for USFWS as well. See Appendix C: Environmental for more information.

Optimized TSP (Levees and Mile Branch Improvements)

This alternative would not impact the Pearl or Bogue Chitto Rivers where the Ringed Map Turtle is known to occur. Therefore, this proposed alternative would have no effect on the species.

Direct and Indirect Impacts to West Indian Manatee: Proposed construction at the M2 mitigation site would convert approximately 200 acres of shallow open water to brackish marsh. The average depth at this location is less than 2 feet and is not prime habitat for manatee foraging due to the limited amount of grass beds and access to deeper waters. The proposed borrow location would be approximately 134 acres within Lake Pontchartrain and would be more conducive to manatee moving through the area based on depth and access to deeper waters, but foraging potential is still low based on the limited amount of grass beds. During borrow excavation, increased turbidity would occur, but would be reduced by the movement of the tides. Based on the footprint and location of the borrow area in relation to the 403,000-acre lake, and implementation of standard manatee protection measures, impacts would not likely adversely affect the manatee

Indirect impacts on T&E species are effects that could occur later in time than direct impacts, but still are reasonably certain to occur. No permanent indirect impact to manatees are expected to occur from construction of the propose project. Indirect impacts could occur due to turbidity from construction which would be minimized by utilizing dikes to contain the dredged material within the brackish marsh creation area. In addition, any runoff from construction activities on land would be controlled through the use of best management practices and adherence to regulations governing stormwater runoff at construction sites and staging areas.

Procedures to Avoid Impacts to West Indian Manatee:

To minimize the potential for construction activities to cause adverse impacts to manatees, the following standard manatee protection measures, developed by the USFWS, Lafayette, Louisiana Field Office, would be implemented when activities are proposed that would impact habitat where manatees could occur: All contract personnel associated with the project would be informed of the potential presence of manatees and the need to avoid collisions with manatees. All construction personnel would be responsible for observing water-related activities for the presence of manatees. Temporary signs would be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., the work area), and at least one sign would be placed where it is visible to the vessel operator. If a manatee is sighted within 100 yards of the active work zone, special operating conditions would be implemented, including: moving equipment would not operate within 50 feet of a manatee; all vessels would operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, would be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area of its own accord, special operating conditions would no longer be necessary, but careful observations would be resumed. Any manatee sighting would be immediately reported to the USFWS (337-291-3100) and the LDWF, Natural Heritage Program (225-765-2821).

Direct and Indirect Impacts to Gopher Tortoises. Based on the site survey conducted on June 14, 2022, half of the areas assessed appeared to be uninhabitable for gopher tortoises due to the dense forests completely covering these areas. There was no evidence of gopher tortoises, or their burrows observed within the project area. Therefore, it was determined that the proposed project would not likely adversely affect Gopher Tortoises.

Direct and Indirect Impacts to Red-Cockaded Woodpecker: Construction of the proposed project could remove suitable RCW nesting trees. In a survey of the project area conducted by USFWS, four RCW clusters were identified. A foraging habitat analysis determined the proposed project did not significantly impact the amount of suitable habitat available to these clusters.

RCWs may be physically injured if struck by construction equipment or materials during construction. This effect is discountable due to the ability of the species to move away from the project site if disturbed. RCWs are mobile and are able to avoid construction noise, moving equipment, and placement or removal of materials during construction.

Mitigation Plan - Maintenance of the Refuge PSR-01 Pine Savanna site through routing-controlled burns would over time restore suitable RCW habitat for foraging and nesting. The controlled burns would scare away birds utilizing that area temporarily until the fire is gone and smoke clears. RCWs are mobile and are able to avoid construction noise, moving equipment, and placement or removal of materials during maintenance activities (controlled burns).

Indirect impacts from construction activities would be controlled through the use of best management practices and adherence to regulations governing stormwater runoff at construction sites and staging areas. No permanent indirect impact to RCWs are expected to occur from construction of the proposed project.

Based upon literature review, available survey data, the current status of the species, the environmental baseline for the action area, and the effects of the action, the USACE has determined that implementation of the proposed action is not likely to adversely affect RCWs.

Direct and Indirect Impacts to Gulf Sturgeon: Hypoxic and anoxic conditions can occur in deep borrow pits that tend to accumulate organic material. This accumulation would be reduced for the M2 borrow pit within Lake Pontchartrain by limiting the depth of the pit to 10 feet. Therefore, effects to Gulf sturgeon from hypoxic or anoxic conditions are discountable.

Gulf sturgeon may be physically injured if struck by construction equipment, vessels, or materials during dredging. This effect is discountable due to the ability of the species to move away from the project site if disturbed. Gulf sturgeon are mobile and are able to avoid construction noise, moving equipment, and placement or removal of materials during construction. NMFS has previously determined in dredging Biological Opinions (e.g., (NMFS 2007)) that, while ocean-going hopper-type dredges may lethally entrain sturgeon, non-hopper type dredging methods, such as the cutterhead dredging method used in this project, are slower and extremely unlikely to adversely affect Gulf sturgeon.

The construction activities and related construction noise may prevent or deter Gulf sturgeon from entering the project area. However, we believe the effect to Gulf sturgeon from temporary avoidance from the project area due to construction activities, including related noise, will be insignificant. The size of the area which animals will avoid is relatively small in comparison to the available similar habitat nearby, which Gulf sturgeon will be able to use during construction. Disturbances and loss of habitat access will be temporary, limited to approximately days of in-water construction. After the project is completed, Gulf sturgeon will be able to return to the project area.

We believe the effect to Gulf sturgeon from the potential loss of foraging habitat due to dredging will be insignificant. Gulf sturgeon are opportunistic feeders that forage over large areas and will be able to locate prey beyond the small dredging footprint (approximately 134 acres). Also, impacts to foraging resources from dredging are temporary since benthic invertebrate populations in dredged areas have been observed to recover in 3-24 months after dredging (Culter and Mahadevan 1982; Saloman et al. 1982; Wilber et al. 2007).

No permanent indirect impact to gulf sturgeon are expected to occur from construction of the propose project. Indirect impacts could occur due to turbidity from construction which would be minimized by utilizing dikes to contain the dredged material. In addition, any runoff from construction activities on land would be controlled through the use of best management practices and adherence to regulations governing stormwater runoff at construction sites and staging areas.

Procedures to Avoid Impacts to Gulf Sturgeon:

To reduce impacts to Gulf sturgeon, a cutterhead dredge would be utilized to remove borrow material from the designated borrow area. This equipment is slower moving and has not been identified as equipment that would impact Gulf sturgeon. Additionally, Gulf Sturgeon avoidance *Routes of Effect to Gulf Sturgeon Critical Habitat:*

On March 19, 2003, the Service and the NMFS published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. The project is located in critical habitat unit 8. The essential features/primary constituent elements (PCEs) are present in Unit 8 and are those habitat components that support feeding, resting, sheltering, migration, and physical features necessary for maintaining the natural processes that support those habitat components. The following are the primary constituent elements for Gulf sturgeon critical habitat that are present and CEMVN’s response on how the proposed action for M2 borrow area in critical habitat would affect these elements. Only three of the four PCEs are likely to be affected. The CEMVN has determined the proposed action will result in “No destruction or adverse modification” of Gulf sturgeon critical habitat based on these responses for the three PCEs.

(1) Abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, molluscs and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages.

Dredging may remove substrates containing sturgeon prey items (PCE 1). USACE believes the effect to PCE 1 from dredging will be insignificant since the estimated impact is relatively small compared to the surrounding area available (approximately 134 acres) and prey items will still be present in the areas outside the dredging footprint. Effects to PCE 1 are also expected to be temporary and short-term in nature, consisting of a temporary loss of benthic invertebrate populations in the dredged areas. Observed rates of benthic community recovery after dredging range from 3-24 months (Culter and Mahadevan 1982; Saloman et al. 1982; Wilber et al. 2007). The relatively species-poor benthic assemblages associated with low salinity estuarine sediments can recover in periods of time ranging from a few months to approximately one year, while the more diverse communities of high salinity estuarine sediments may require a year or longer.

(1) Water quality including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.

Localized and temporary reductions in water quality (PCE 2) through increased turbidity may result from dredging. We believe the effect to PCE 2 from localized and temporary increased turbidity will be insignificant because:

The action area is also in a high wave/current area where we do not expect construction-induced turbidity to remain and where turbidity curtains are not practical to use.

Effects to temperature, salinity, pH, hardness, oxygen content, and other chemical characteristics of PCE 2 are not expected to result from dredging activities. Therefore, there is no effect to these aspects of PCE 2 from localized and temporary turbidity due to dredging.

(2) Sediment quality including texture and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages.

We believe the effect to PCE 3 from dredging will be insignificant. During prior consultations (BAs for SER-2010-4236 and SER-2014-14728, hereby incorporated by reference), surveys were conducted by USGS and NOAA that used remote imagery to determine bottom substrates within Lake Pontchartrain. The majority of Lake Pontchartrain bottoms were defined as having sandy composition and thus prime habitat for sturgeon.

The borrow site is approximately 2000 feet from the shoreline and likely receives fine sediment from wave induced shoreline erosion. The sandier composition areas, which are located further into the lake center, would be avoided, and thus minimizing impacts to sturgeon foraging. Given that prime habitat is available nearby, any Gulf Sturgeon that may be present would likely congregate in the ample nearby prime habitat, especially during construction. No permanent alteration of habitat composition is expected to occur within the action area. See Appendix C: Environmental for more information.

Direct and Indirect Impacts to Louisiana Quillwort: The proposed project could result in crushing and/or uprooting of Louisiana Quillwort by heavy machinery and/or foot traffic. However, these impacts are expected to be temporary, occurring mostly during construction of the Project.

Indirect impacts could occur due to siltation from construction activities reducing the ability of plants to absorb sunlight. Impacts are expected to be limited to construction times.

Procedures to Avoid Impacts to Louisiana Quillwort:

Impacts to Louisiana Quillwort could be reduced through use of best management practices and adherence to regulations governing stormwater runoff at construction sites and staging areas. In addition, monitoring for the presence of plant colonies at construction sites and prohibiting use of heavy machinery in these areas would minimize potential negative impacts to the species.

Levee Borrow Sources: There would be no impact to threatened, endangered and protected species resources as result of borrow excavation as described in 5.3.

5.1.1.8 Louisiana Scenic Rivers

Alternative 1: No Action Plan

There would be no impacts to Louisiana Scenic Rivers if no federal action is taken. Current trends would continue such as loss of habitat due to erosive forces of heavy stream flows during flooding events.

Alternative 2: Nonstructural Plan (within Optimized TSP)

There would be no impacts to Louisiana Scenic Rivers if no federal action is taken. Current trends would continue such as loss of habitat due to erosive forces of heavy stream flows.

Optimized TSP (Levees and Mile Branch Improvements)

Dredging would impact of the Mile Branch by channelizing approximately 2.15 miles of the state scenic stream. The proposed work would consist of approximately 21 acres of channel that would be cleared and grubbed prior to mechanical dredging. This would result in a direct loss of vegetation and shallow water thus impacting edge habitat, foraging habitat, and the loss of nursery or refugia areas for many aquatic species. With increased velocity there would be a reduction in SAV which would likely result in increases in dissolved oxygen as well. (cover and foraging for many species, SAV increases DO) and increased turbidity. Increased deeper water and the loss of canopy cover may also effect refugia and water temp. Dredging would remove invertebrates, benthic organisms, SAV, fish spawning beds, etc. (temporary impacts).

The dredging of the channel would result in a disruption and temporary impacts to aquatic habitat. The area would reestablish itself following the construction activity all be it the environment would be altered. Construction activities include the addition of riprap to stabilize the streambanks. Removing the riparian habitat to widen the stream would result in a loss of shading to aquatic organisms taking refuge in the cooler shaded water. This is likely a permanent impact since there is a narrow strip of land available for any forested habitat to reestablish. Design refinements would occur during PED based on field data collections. For example, future surveys would determine the final channel section and bridge replacements. Based on data collected, the design would be refined to minimize impacts to aquatic and riparian habitat and real estate. Riparian Zone bioengineering techniques and nature-based-solutions would be incorporated as appropriate during PED in coordination with the NFS and resource agencies. One of the staging areas would become a backwater area after construction activities are completed to offset impacts to the stream water bottom. The backwater area would be approximately 4.8 acres and designed to allow water to flow back and forth from the Mile Branch at a certain elevation that would be determined during PED. The backwater area would include some small islands and varying water bottom depths. Trees would be planted on the island and around the area to establish shade and cover.

The mechanical dredging would consist of a maximum of 130,000 cubic yards of fill dredged from the channel.

The Liberty Bayou Scenic Stream would be impacted by the construction of the floodgate on the Bayou. The levee alignment would cross the scenic stream impacting the scenic viewshed of the area. As the alignment crosses the scenic stream a pump station and navigable lift gate would be constructed on the stream. The pump station would have a pumping capacity of 1800 cfs. Construction of the lift gate would temporarily impact navigation of recreational vessels. A bypass channel would be constructed to allow recreational vehicles to traverse through the area. The experience of enjoying a scenic stream would be disrupted by the construction noise and potential changes in air quality resulting from operation of construction equipment. The navigable gate would be designed to mimic the existing width of the bayou as much is as possible and would include a gradual slope so that fish and larvae may traverse the structure. This design would include smaller sluice gates on both sides of the lift gate to simulate the natural opening of the bayous. There would be direct adverse impacts to aquatic organisms and less mobile species resulting from the construction activities. There would be both direct and indirect permanent impacts to aquatic organisms resulting from higher levels of turbidity caused by construction. Best management practices would be employed to reduce the turbidity levels but it cannot be reduced completely. Aquatic organisms could be buried in silt and killed by construction equipment. Fisheries in the area would be scared away from the area as a result of the construction activity. The bypass channel would all fish to migrate the bayou. At times, the bayou does have low dissolve oxygen. This could be exacerbated by construction activities due to the higher turbidity levels expected and construction of the bypass channel.

During PED, the PDT would consider additional fish-friendly studies and input provided by the NFS, USFWS, NMFS, and LDWF criteria, including the rock arch and rock ramp designs.

Mitigation Plan: The proposed mitigation plan would not impact Scenic Streams.

Levee Borrow Sources: There would be no impacts resulting borrow excavation.

5.1.1.9 Hydrology and Hydraulics

Riverine Modeling was performed for the 2, 5, 10, 25, 50, 100, 200, and 500-year rainfall events for existing conditions and With-Project base (year 2032) and future conditions (year 2082). Coastal storm surge and wave modeling was completed for the without-project condition (No Action Plan alternative) and statistical analysis determined the 10, 20, 50, 100, 200, 500, 1000-year base (year 2032) and future conditions (year 2082). Water surface elevation results for each frequency were extracted and provided to the PDT for use in economic, environmental, and engineering analyses.

With-Project model runs and analyses were performed for the structural FRM measures. Analysis of With-Project benefits and impacts was completed for the structural CSRM measures. The Final Array of Alternatives includes the No Action Alternative (Alternative 1), a Non-structural Alternative (Alternative 2), and six structural alternatives (numbered Alternatives 4 through 9), for a total of 8 alternatives and 26 measures evaluated for both FRM and CSRM structural projects (see Table 5-3. for a summary of the structural measures in the Final Array of Alternatives that underwent hydrologic and hydraulic modeling and analysis). The alternatives may be more clearly understood as regions of potential projects. FRM alternative analysis was completed through Hydraulic Engineering Center-River Analysis System (HEC-RAS) modeling. CSRM alternative analysis was completed through estimation of storm surge water level changes. With-project analyses are more fully presented in Section 0 of Appendix E: Hydrologic % Hydraulics.

Table 5-3. Summary of Final Array Structural Alternatives Evaluated Prior to TSP Milestone

	Alternative Name	Measure	Project Type
Alternative 5	Bayou Liberty/ Bayou Vincent/ Bayou Bonfouca	Bayou Liberty Channel Improvements	FRM
		Bayou Patassat Channel Improvements	FRM
		Bayou Bonfouca Detention Pond	FRM
Alternative 6	South Slidell Storm Surge	Eden Isle Levee	CSRM
		Slidell Levee	CSRM
Alternative 8	Upper Tchefuncte/Covington	Mile Branch Channel Improvements	FRM
		Mile Branch Lateral A Channel Improvements	FRM

Measures within alternatives were analyzed to determine the response to the specific measure. Measures were modeled together in instances where they were not expected to affect the other. When one measure was expected to influence the hydrology and hydraulics of another measure, they were modeled in distinct model geometries. Appendix E: Hydrologic &Hydraulics, Table E:6-1. defines how each measure was modeled, either jointly or independently. To gain further efficiencies in model runs, precipitation and inflows were removed over the 2D areas far away from the proposed projects to streamline model run time. These are identified in Table E:6-1. as well. Each model geometry was run for each frequency event 2-year to 500-year for both current (2032) and future (2082) conditions. This totaled to 80 model simulations and results to be processed for analysis. Hydraulic model results were provided for analysis of flood damages in the form of GIS Rasters showing the maximum water surface elevation during each frequency storm stimulation.

Sea Level Rise

To evaluate potential future changes in project performance due to relative sea level change, ER 1100-2-8162 requires planning studies and engineering designs to be formulated and evaluated considering all possible rates of Sea Level Change (SLC): low, intermediate, and high. The ER directs to the USACE Sea Level Change Curve Calculator online tool to develop the three rates. For the high-subsidence area of coastal Louisiana, the Sea-Level Calculator for Non-NOAA Long-Term Tide Gauges was used specifically, results may be seen in Figure:5-10. After comparing and evaluating the rates determined by the calculator, the PDT determined that the ‘intermediate’ rate of sea level rise (SLR) should be used in this study for future conditions model runs in the analysis of alternatives. This topic is discussed further in Section 4.4.2.2 of Appendix E: Hydrologic & Hydraulics.

USACE Curves computed using criteria in USACE EC 1165-2-212

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Gauge User Entered Values All values are in feet			
Year	USACE Low	USACE Int	USACE High
2032	0.87	1.01	1.46
2037	0.97	1.15	1.73
2042	1.08	1.30	2.01
2047	1.19	1.46	2.31
2052	1.30	1.62	2.63
2057	1.41	1.78	2.97
2062	1.52	1.95	3.33
2067	1.62	2.12	3.71
2072	1.73	2.30	4.10
2077	1.84	2.48	4.52
2082	1.95	2.67	4.95
2087	2.06	2.86	5.40
2092	2.17	3.05	5.87
2097	2.27	3.25	6.36
2100	2.34	3.38	6.66

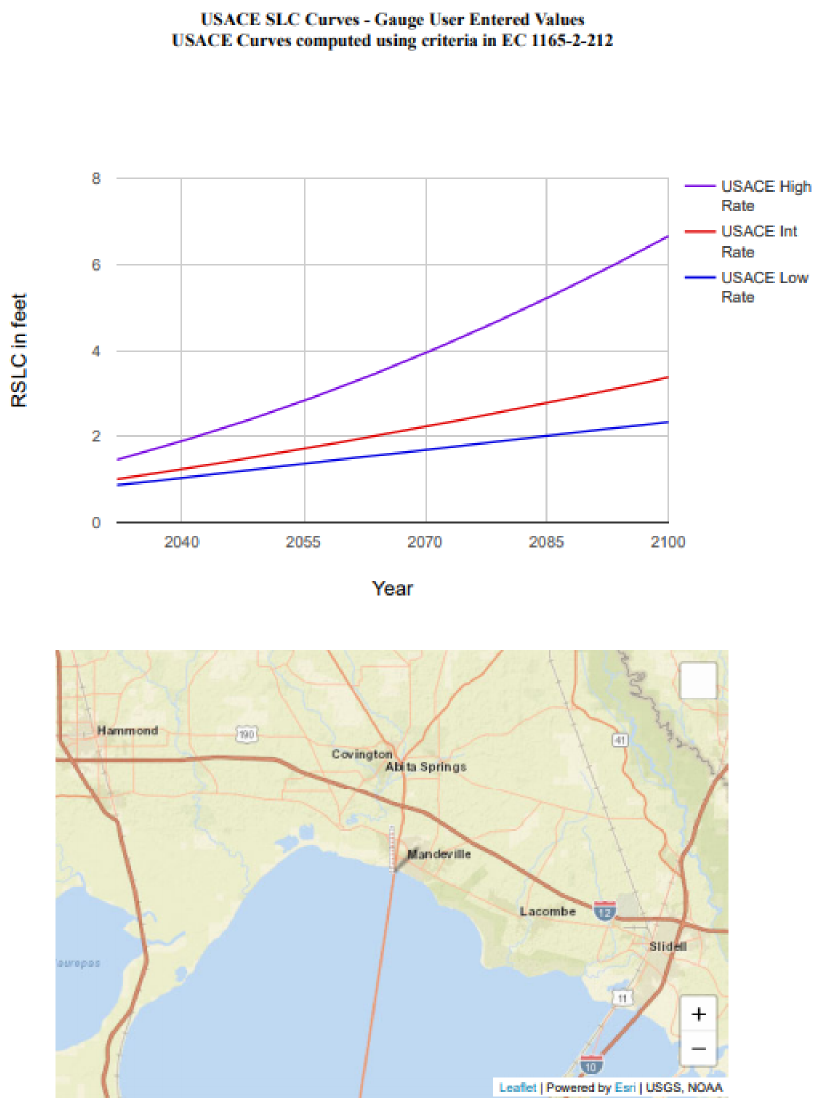


Figure 5-10. USACE Sea Level Change Curves

Impacts of varying rates of SLR can be seen further inland in locations of major waterways described in Section 3, which act as a conduit for fluctuating water surface elevations (WSEs) in Lake Pontchartrain. For example, upstream on Bayou Liberty at the Hwy 190 crossing (approximately 4.5 miles inland), there is a 0.15 foot difference in maximum WSE between low SLR (LSLR) and high SLR (HSLR) for the 100-year 2082 event. For the 10-year event, the impacts of SLR would be felt further inland, this can be seen in the H&H report, Figure E: 14- 8 which depicts the existing condition SLR difference map for the 10-year event. WSEs would be impacted for the 10-year event, from the coastline to I-12 crossing along Bayou Liberty and Bayou Bonfouca.

Relative Sea Level Change

Global, or eustatic, sea level rise and regional subsidence have affected the study area and are projected to continue affecting the area. Together, these two processes are referred to as “relative sea level change” in USACE guidance (USACE ER 1100-2-8162; EP 1100-2-1). River basins in St. Tammany Parish eventually drain to Lake Pontchartrain. Higher sea levels in the future reduce the hydraulic gradient which somewhat slows the drainage of storm runoff, increasing flooding levels from the same amount of rain. USACE guidance provides a low, intermediate, and high rate to use for project evaluation. The intermediate rate was selected for use in the alternative evaluation phase. For planning purposes, this study assumed a project completion, or base, year of 2032. The end of the 50-year planning horizon would be 2082. Calculated changes in relative sea level by the year 2032 are 0.5 feet for the Mandeville gage and 0.4 feet for the Rigolets gage. Calculated changes in relative sea level by the year 2082 are 2.2 feet for the Mandeville gage and 1.7 feet for the Rigolets gage. These values were added on to the established downstream boundary conditions

Alternative 1: No Action Plan

Without Federal action, the current trends for riverine flooding and coastal storm surge would continue to adversely impact the area.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Implementation of the nonstructural plan would not result in direct or indirect impacts to hydrology and hydraulics.

Alternative 8: Upper Tchefuncte/Covington

The FRM measure for this alternative is the enlargement of the Mile Branch Channel and the Lateral A Channel Improvements. They were both modeled in the Channel improvement model geometry. Bogue Chitto and Pearl River inflows were removed from the simulations. Precipitation was removed for 2D Areas Pearl and 726.

As described in Appendix E: Hydrologic & Hydraulics it was determined that the Alternative 8 measures could be modeled jointly in a single geometry. Mile Branch and Lateral A were both modeled as a modification to the 2D Area mesh Manning’s n override regions and terrain

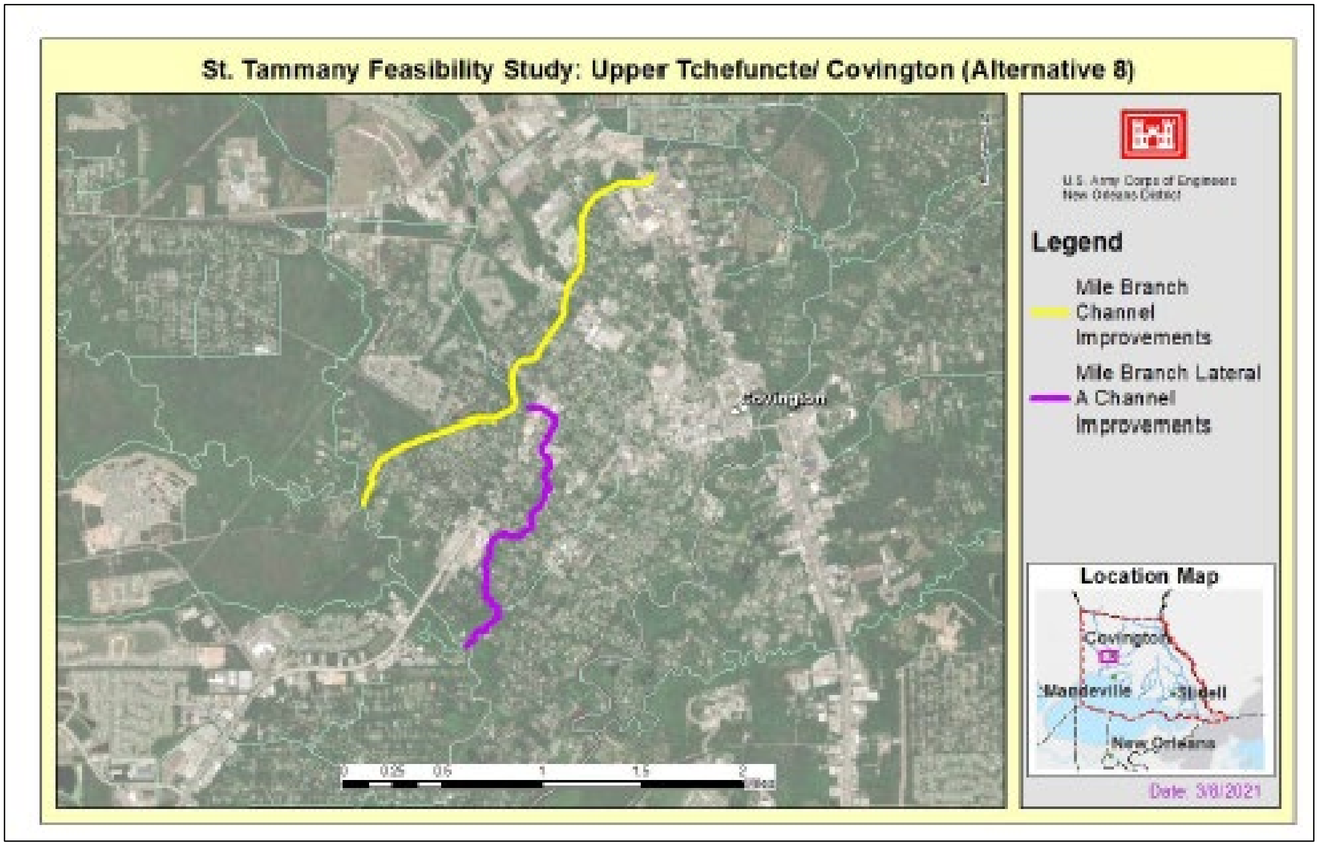


Figure 5-11. Upper Tchefuncte/ Covington Measures

Existing conditions model runs have 0.04 Manning's n override region over the extents of Mile Branch and Lateral A. For the with-project simulations, a Manning's n override region of 0.03 was placed over the channel improvement extents for Mile Branch and Lateral A to simulate a cleared channel. Figure 5-12 depicts the channel improvements applied to both Mile Branch and Lateral A. Additionally, both channels were deepened by 5 feet along the channel improvements extents from the existing invert elevation, maintain 3H:1V side slopes along each reach, maintain a 10 feet bottom width along each reach, and maintain the same channel slope as existing conditions.

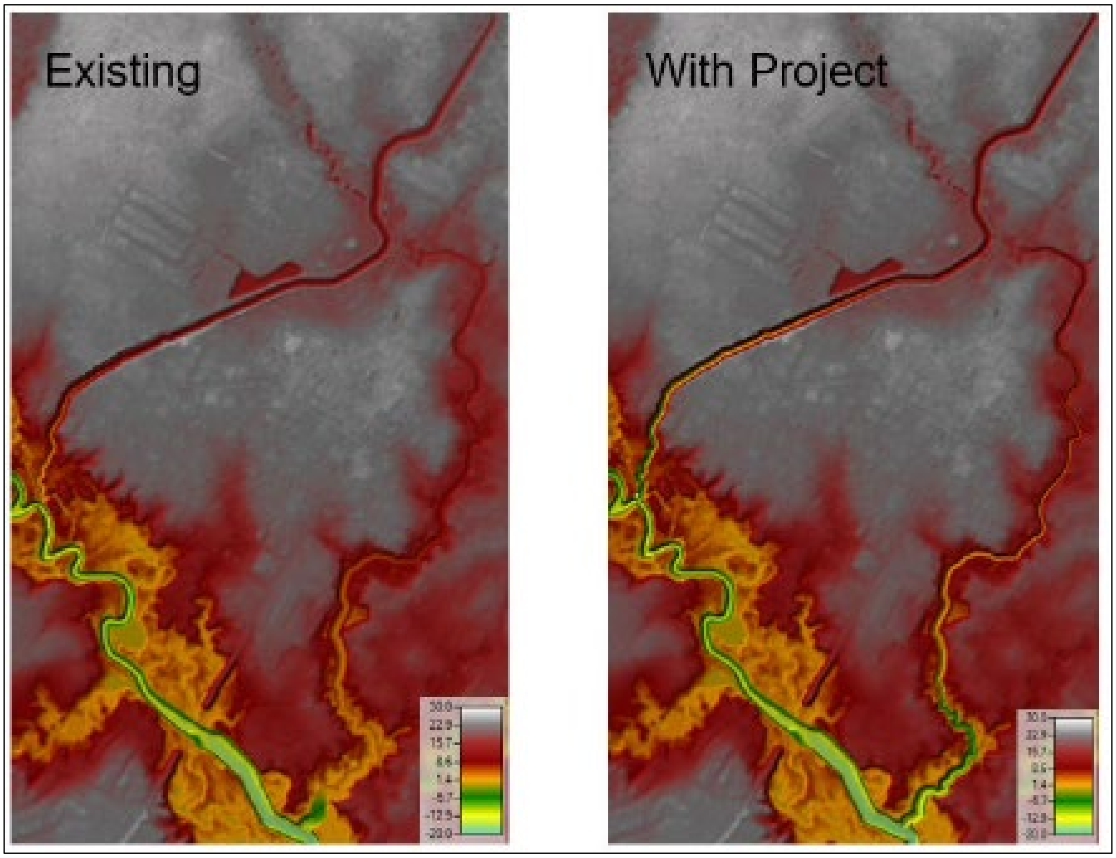


Figure 5-12. Mile Branch and Lateral A Existing Conditions (Left) and With-Project Dredging (Right)

Drainage Features Associated Mile Branch and Lateral A Channel Improvements: These measures came from the 1991 USACE Tangipahoa, Tchefuncte, and Tickfaw Rivers Reconnaissance Study. That study recommended the deepening of both Mile Branch and Lateral A to provide flood protection up to the 25-year frequency storm. These measures were modeled by deepening both rivers' inverts by 5 feet along the entire reach. Both Mile Branch and Lateral A drain into the Tchefuncte River. No specific interior drainage information was requested.

ADCIRC CSRM Alternative Analysis

Alternative analysis of the CSRM alternatives involved delineating areas protected by proposed alternatives, estimating impacts on the exterior of the proposed alternatives, determining preliminary design elevations for alignments, and estimating capacities of interior drainage facilities where proposed alignments cross large waterways.

The measures proposed in the Final Array of Alternatives were not directly modeled in ADCIRC. Determining storm surge response to proposed systems, and for a wide range of storms, requires numerous simulations of storms with different characteristics. Future modeling of the Tentatively Selected Plan (TSP) is required to show detailed responses to the proposed system.

Areas that would be protected by proposed future Federal levees were determined using a Louisiana statewide lidar dataset. Design elevations, described in Section 5.1, were continued to meet existing high ground. Contour lines of that tie-in elevation form the remaining sides of the polygon that represents the area protected by each proposed levee alignment.

Alternative 6 South and West Slidell

South Slidell Storm Surge. Figure 5-13 illustrates the two measures investigated under Alternative 6 along with existing alignments in the South Slidell region. Figures 5-14 and 5-15 depict the alternative analysis performed for the following two measures of Alternative 6: Alternative 6a- the South Slidell Federal levee alignment with pump stations and Alternative 6b- the South Slidell Federal levee alignment with pump stations plus Eden Isle. The analysis for these measures is explained in Section 6.2. Please note Alternative 6c3 is a combination of features evaluated in Alternative 5 and 6.

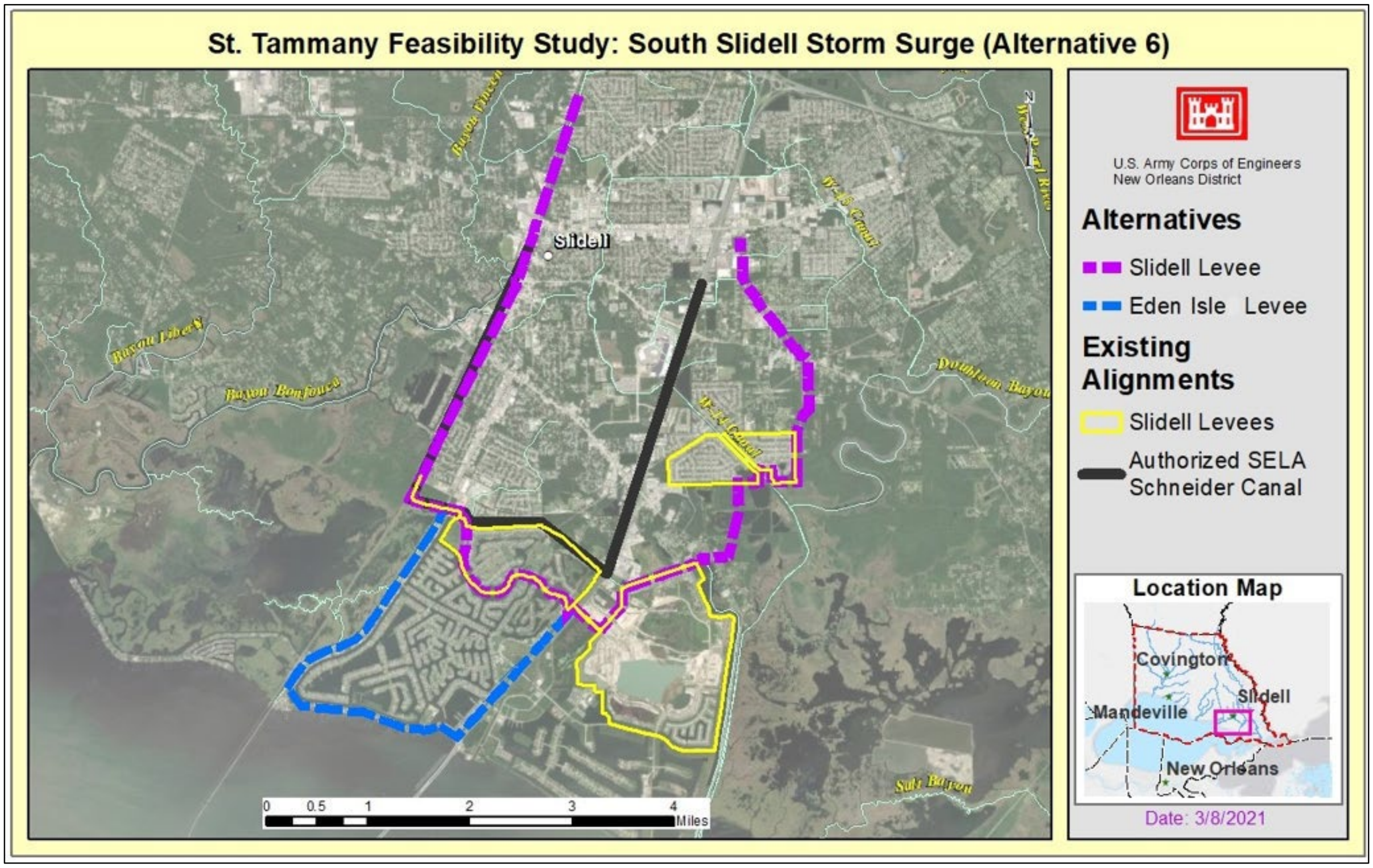


Figure 5-13. Alternative 6 Measures: Proposed Slidell Levee Alignment and Eden Isle Levee

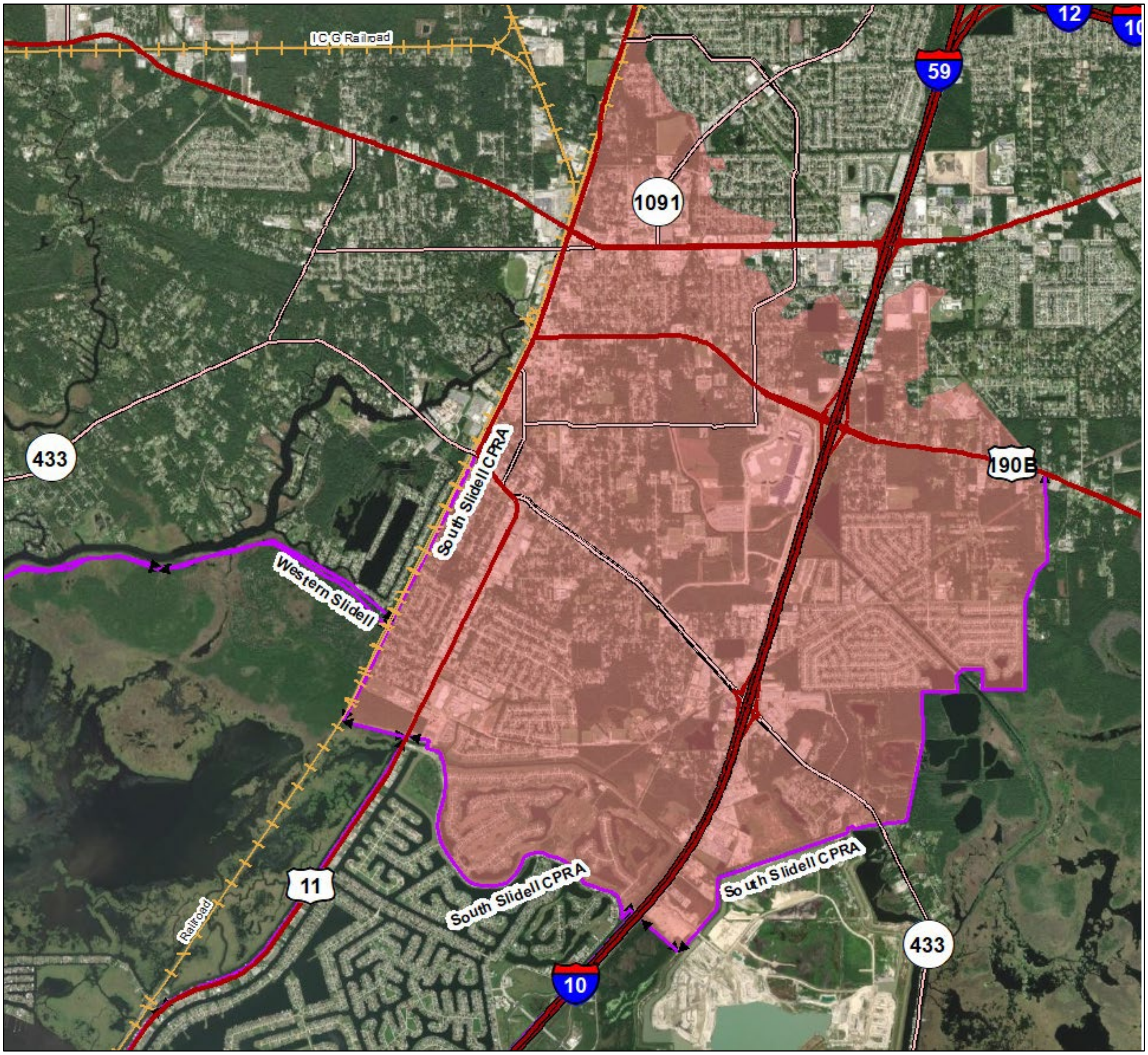


Figure 5-14. South Slidell (CPRA Alignment) Protected Area

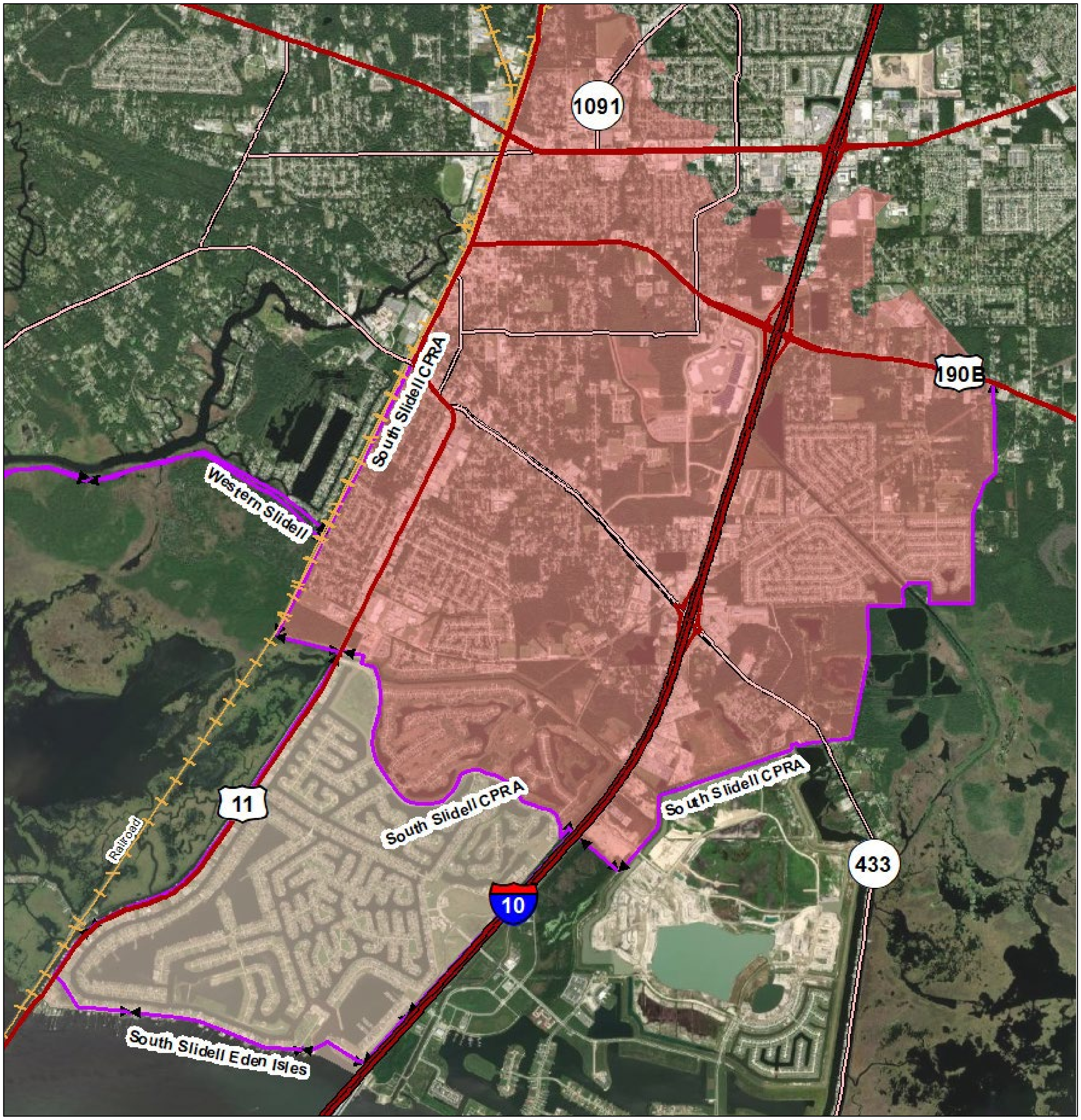


Figure 5-15. South Slidell and Eden Isle Protected Area

<u>Drainage Features Associated with Slidell Levee:</u> Interior drainage estimates were performed for alternative analysis to provide estimated capacities for hydraulic infrastructure for other disciplines' analysis. It should be noted that no in-depth interior drainage modeling has been completed for this phase of the study.

W-14 Floodgate/Pump Station: A new floodgate and pump complex would be required at the intersection of the Slidell Levee alignment and the W-14 canal. The 10-year flow used for capacity of pump station design is 1,200 cfs.

Schneider Canal Pump Complex: There is a pumping station at the intersection of Schneider Canal and the proposed levee alignment, which was constructed by the city of Slidell. The 1990 USACE Schneider Canal, Slidell, LA Hurricane Protection Reconnaissance Report previous report identified a capacity of 100 cfs. It is important to note that the Schneider Canal pump station was constructed by the City of Slidell at a capacity of 850 cfs. It is unlikely that additional capacity is needed there. The existing pump station does not have fronting protection, but that need has been identified in the ongoing USACE Southeastern Louisiana, Louisiana Project (SELA) Schneider Canal hurricane protection study.

Optimized TSP (Levees and Mile Branch Improvements)

HEC-HMS 4.8: The latest version of the USACE Hydraulic Engineering Center's (HEC)-Hydrologic Modeling System (HMS) available at the time of model development was used for the hydrologic modeling. A new HEC-HMS model was developed for the Optimized TSP phase of the St. Tammany Parish Feasibility Study. Elements from the HEC-HMS model used in the Alternative Analysis phase were carried over to the newly-developed HMS model for the Optimized TSP phase. Further discussion on the HEC-HMS model utilized for this study may be found in Section 10 of Appendix E: Hydrologic & Hydraulics.

The latest version of the USACE Hydraulic Engineering Center's (HEC)-River Analysis System (RAS) available at the time of model development was used for the hydraulic modeling in this study. A new HEC-RAS model was developed for the Optimized TSP phase of the St. Tammany Parish Feasibility Study. Various elements from the HEC-RAS model used in the Alternative Analysis phase were carried over to the newly-developed model for the Optimized TSP phase. Further discussion on the HEC-RAS model utilized for this study may be found in Section 12 of Appendix E: Hydrologic & Hydraulics.

Advanced Circulation (ADCIRC) Model: Coastal modeling simulations used the ADCIRC v55 coupled with the Simulating WAves Nearshore (SWAN) model to develop storm surge elevations, wave heights, and wave periods. A suite of 36 synthetic tropical storms were conducted using the CSTORM modeling framework (Massey et al., 2011) and run using the Onyx supercomputer as part of the Department of Defense (DoD) High Performance Computing Modernization Program (HPCMP). ADCIRC statistics were computed using MATLAB code developed by ERDC. The coastal modeling process is discussed in more detail in Section 13 of Appendix E: Hydrologic & Hydraulics.

St. Tammany New Alignment and Changes to With-Project Modeling:
After the selection of the Tentatively Selected Plan and during feasibility-level design, the PDT considered minor shifts of the alignment for various considerations, also referred to the optimization of the TSP. This process is described in more detail in the main RDIFR-EIS. Some shifts were accepted and incorporated into the final engineering analysis. The change

of the new alignment was minor enough (within the distance of one ADCIRC element) to not to re-run the suite of ADCIRC storms.

HEC-RAS With-Project Analysis: As previously stated, three different HEC-RAS model geometries were generated: without-project, with-project with pumps, and with-project with gates. The without-project geometry contains no structural projects identified in the Optimized TSP. Both with-project geometries have all structural projects outlined in the Optimized TSP, and a description of how they were modeled are outlined in the following sections of this RDIFR-EIS. Two with-project geometries were needed because Alternative 6c3, the CSRM levee, required independent modeling of the pumping complexes and water control structures to properly size those elements of the system.

Mile Branch Modeling Methodology: The TSP defines Mile Branch as both a channel deepening and clearing and snagging project and can be seen in Figure 5-16. The Mile Branch channel improvements start at the intersection of Mile Branch and U.S. Highway 190, crossing U.S. Highway 190 Business, and end at the confluence of Mile Branch and the Tchefuncte River. The channel improvements are conducted on the lower 2.15 miles (11,341 feet channel) of Mile Branch in Covington. The improvements include clearing and grubbing and mechanical dredging of the channel to deepen it. The preliminary design assumes an existing bank elevation of 1 foot, a 10 feet bottom width at elevation (-) 5 feet. The bank is at 1V:3H slope. The channel bottom will be lowered by an average of 5 feet with a smooth slope between the beginning and end of the project. Approximately 21 acres of channel will be cleared and grubbed prior to mechanical dredging. Clearing and grubbing includes the removal trees, vegetation, debris, trash, or other obstructions within the channel. An assumed maximum of 130,000 cubic yards of material may be mechanically dredged from the channel.

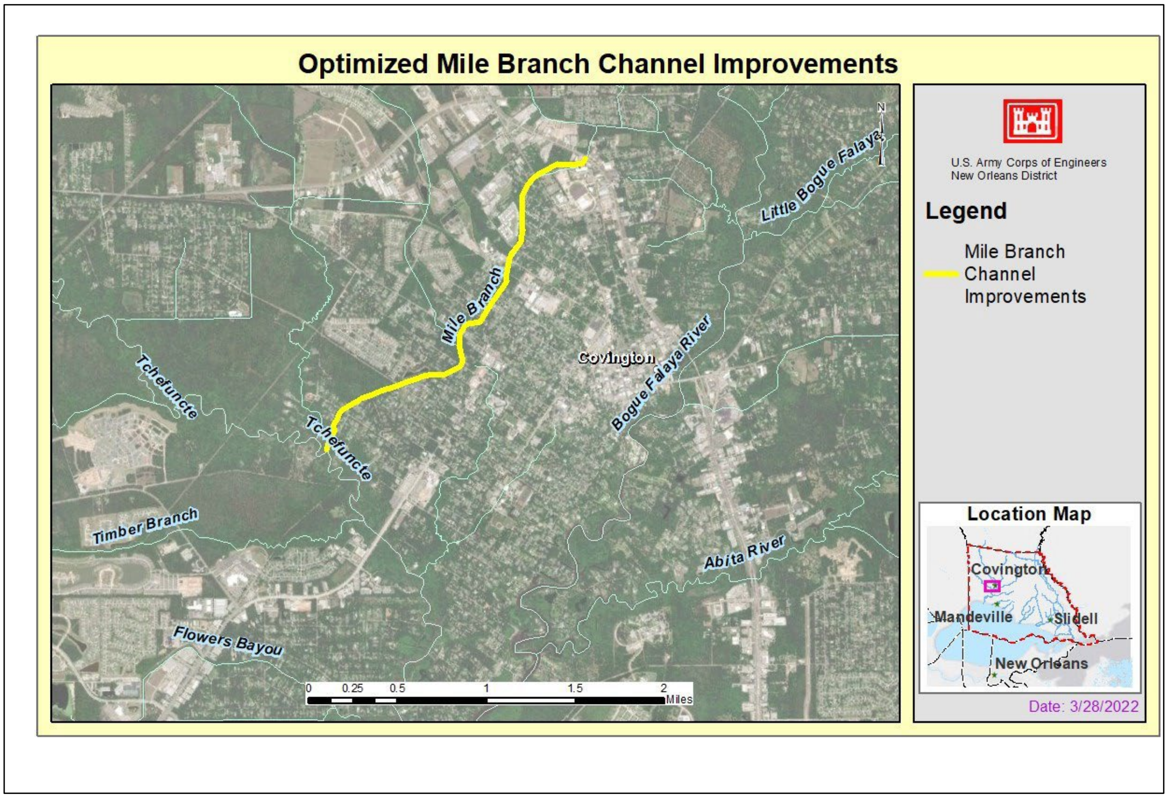


Figure 5-16. Optimized Mile Branch Channel Improvements

To model this in HEC-RAS, a new terrain was made to apply only to the with-project runs. A channel modification layer was applied from the I-190 crossing downstream to the confluence with the Tchefuncte River. The channel modification has 1V:3H side slopes, a 10 feet wide bottom width and the channel invert is lowered along the entire extent of the project. The lowering of the channel invert was approximately 5 feet at the beginning and 5 feet at the end of the modification layer. The surface terrain varies a small amount along the extent of the modification layer, so the cut along the extent of the project is not precisely 5 feet from the surface, but it is within a small margin of error. Figure 5-17 depicts the channel modification applied to the with-project terrain. Additionally, a manning's override region of 0.025 was placed over the extent of the project to represent a cleared and snagged channel, and is sourced from the Louisiana Department of Transportation (LaDOTD) Hydraulics Manual.

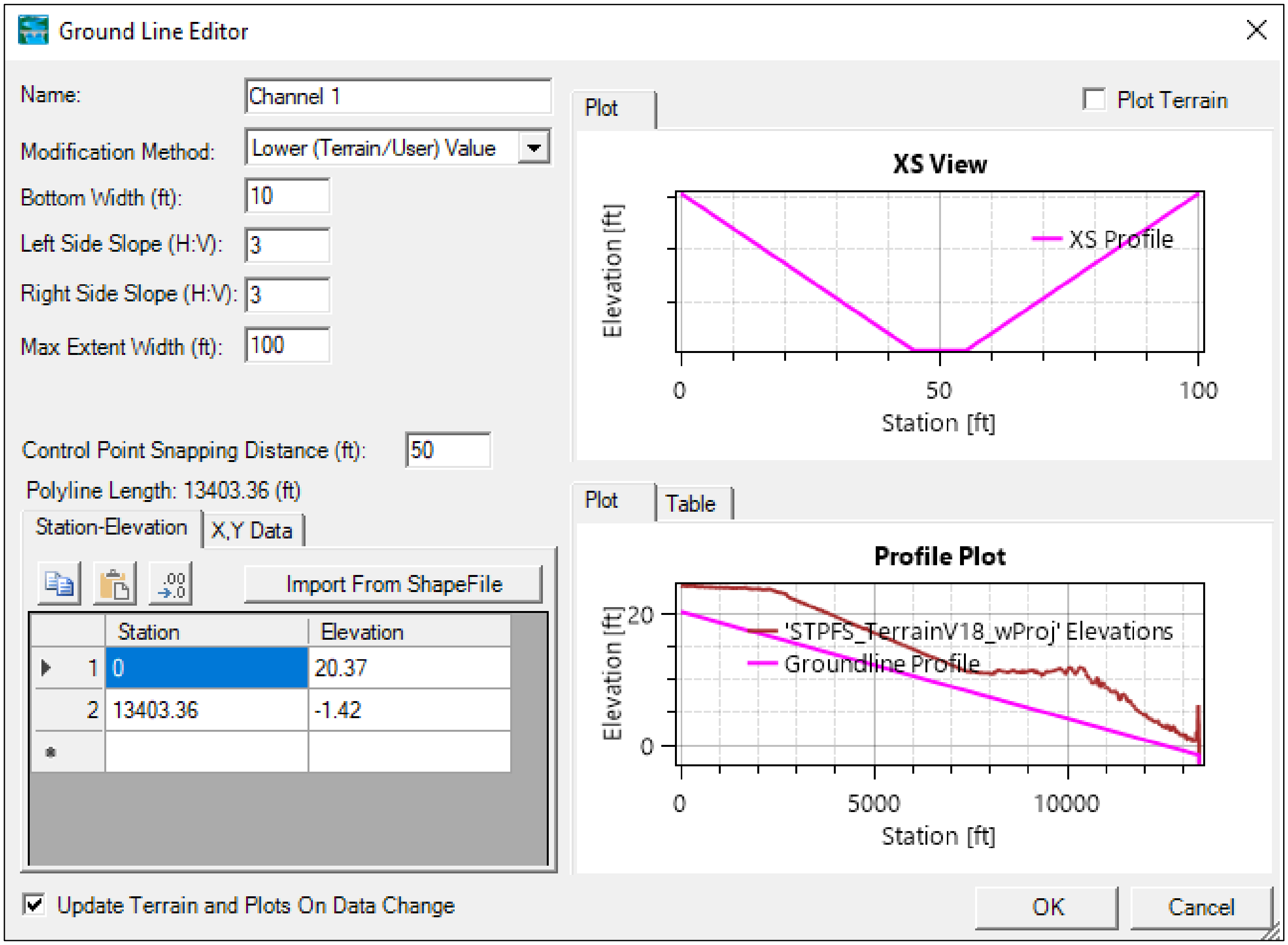


Figure 5-17. Depiction of Channel Modification used to Apply the Mile Ranch Channel Deepening to the with Project Terrain

Mile Branch Modeling Results: The Mile Branch dredging and channel improvement project proved to be effective at reducing WSEs around the project area. Reductions were seen within the floodplain of Mile Branch for each frequency event (2-year – 500-year). Additionally, with the project in place, Mile Branch stays within its banks for the 2-year – 10-year events. For frequency events 25-year – 500-year Mile Branch overtops its banks. Results also indicated that with the project in place on Mile Branch, reductions are seen on Mile Branch Lateral A. With reduction in overtopping volume that overflows from Mile Branch to Mile Branch Lateral A, it inherently reduces WSEs in the floodplain of that neighboring waterway as well. It should be noted that benefits do not extend past the confluence of Mile Branch and the Tchefuncte River.

There are also reductions upstream of where Mile Branch intersects with Hwy 190. The area directly upstream of Mile Branch is the flood plain for the Bogue Falaya River, and for the 100-year 2032 and 2082 events, lowering’s range from 0.1 foot-0.25 foot. For the 10-year 2032 and 2082 events, lowering’s upstream of this crossing range from 0.1 foot to 0.3 foot.

Very small lowering’s, in the hundredths range, are also seen on the Bogue Falaya where the floodplain interacts with the upstream end of Mile Branch at this location. Additionally, for the 100-year runs, a small inducement can be seen on the Tchefuncte River in the hundredths range, which is located between the confluence of Mile Branch and Lateral A. This is likely caused by the additional volume that is channeled to the Tchefuncte River with the project in place along Mile Branch. This inducement does not exit the existing floodplain of the Tchefuncte River and dissipates downstream after passing the confluence of Mile Branch Lateral A. Difference maps depicting the change in WSE with the project in place may be seen in Appendix E, Annex C for 10-year and 100-year frequency events, baseline (2032) and future (2082) along with each SLR scenario.

Additionally, model runs were performed at Mile Branch to investigate the impacts of only clearing and snagging the channel, and no dredging. Three frequency events were selected to perform this analysis including the 10-year, 25-year, and 100-year baseline (2032) with the Intermediate SLR rate at Lake Pontchartrain. Figure 5-18 depicts difference maps of the TSP at Mile Branch compared to only clearing and snagging the Mile Branch Channel for the 10-year 2032 event. Findings indicate that with clearing and snagging of the channel only, and no dredging, the magnitude of WSE lowering’s is not as high. For example, clearing and snagging lowers WSEs by a maximum of 0.35 foot in various locations. Whereas the proposed TSP of dredging, clearing and snagging the channel achieves WSE reductions of up to 1.5 foot for the 10-year 2032 event in some locations. Additionally, only clearing and snagging the channel causes an inducement upstream of Hwy 190 for the 10-year, 25-year, and 100-year runs. This is occurring because clearing and snagging the channel moves water at a faster rate from the Tchefuncte River up to Hwy 190 crossing. Directly upstream of the project, where the inducement is occurring, WSEs are compounding due to insufficient storage in the channel to store the increased volume of flow that travels down the Mile Branch channel at a faster rate.

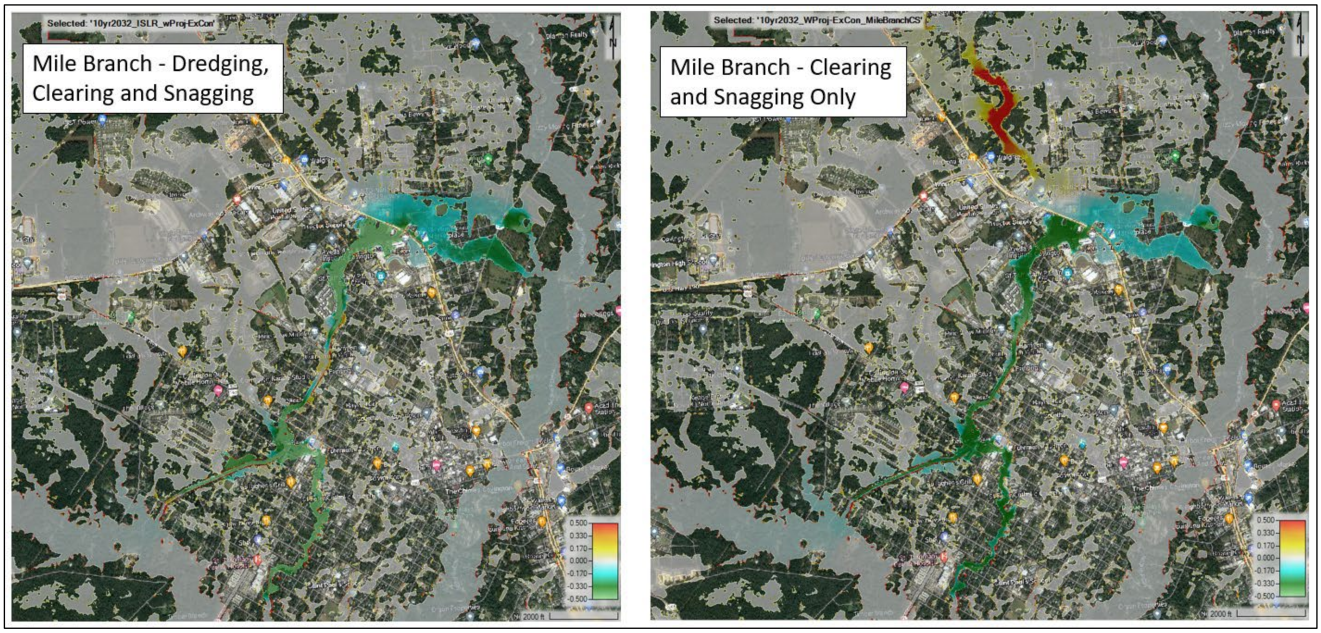


Figure 5-18. Difference Maps for the 10yr 2032 event with the ISLR rate at Lake Pontchartrain, in the vicinity of Mile Branch comparing the proposed TSP with dredging, clearing and snagging of the channel (left) and only clearing and snagging of the channel (right)

<u>*South Slidell and West Slidell Levee and Floodwall System:*</u> The Optimized TSP for the levee and floodwall system consists of a combination of portions of the West Slidell levee alignment proposed in Alternative 5 and the South Slidell levee alignment proposed in Alternative 6. The two alignments would be connected by a new railroad gate across the existing Norfolk Southern Railway Corp. railroad tracks. The initial draft of the levee and floodwall system was further refined after additional modeling, and PDT, agency and public comments to create the Optimized TSP. The Optimized TSP alignment for the levee and floodwall system consists of a total of approximately 18.4 miles (96,950 feet) of levee and floodwall, with approximately 15 miles (79,100 feet) of levees constructed in separate (non-continuous) segments, and 3.4 miles (17,850 feet) of separate (non-continuous) segments of a floodwall. Refer to Figure 5-19 for the levee alignment. The Optimized TSP also consists of pump stations, floodgates, vehicular floodgates, and ramps.

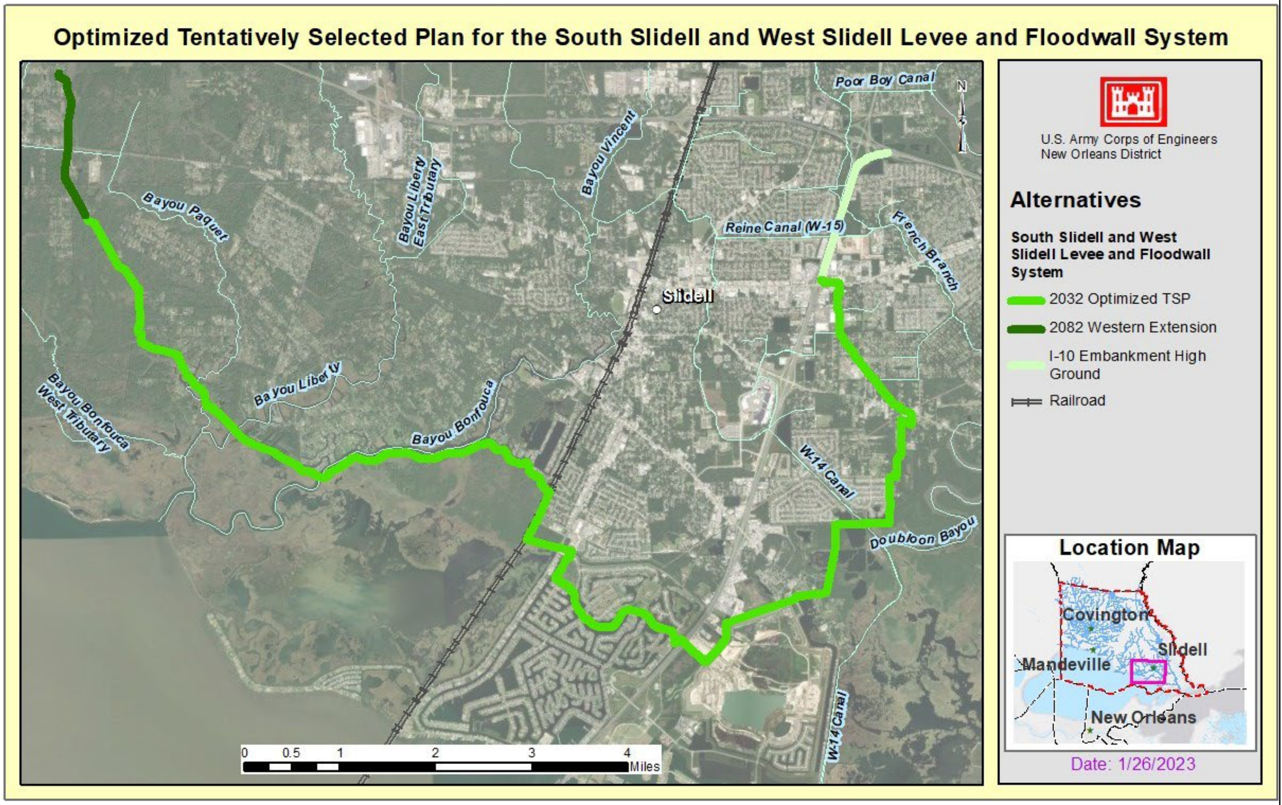


Figure 5-19. Optimized Tentatively Selected Plan for the South Slidell and West Slidell Levee and Floodwall System

South Slidell and West Slidell Levee and Floodwall System Modeling Results
Analysis of the results with the final pumping capacities and gate dimensions shows that with-project maximum water surface elevations are no more than 0.5 foot higher than without-project maximum WSEs for the design rainfall event on the interior of the alignment at locations of structures for the 10-year baseline (2032) event. A few other observations were made during result analysis.

Two sets of simulations were completed to consider flood risk with and without coincident Pearl River flooding. When modeling large Pearl River floods coincident with rainfall flooding, the higher stages and larger depth from the Pearl River flood wave mask any changes to WSEs near the project location for each rate of SLR. This resulted in compounded flood impacts near the downstream region of the model domain, where Slidell, LA is located.

In order to evaluate the changes in maximum water surface elevation on the exterior of the alignment, two different sets of runs with varying inflows on the Pearl River and Bogue Chitto were ran. The first set of runs used a historic mean value for the Pearl River and Bogue

Chitto River. This allowed an evaluation of the inducements without masking the rainfall WSE changes between with and without project more clearly. The historic mean inflow for the Bogue Chitto River using gage 2492000 near Bush, LA is 2,010 cfs, and for the Pearl River using gage 2489500 near Bogalusa, LA is 10,100cfs. The second set of runs utilized the calculated Frequency Flows discussed in the boundary condition section of this RDIFR-EIS.

Difference maps are generated for the historic mean inflow runs to illustrate the changes in WSE with the project, without contribution of major flooding from the Pearl River Basin. The maps can be reviewed in Appendix E, Annex C for the Slidell Levee. Figure 5-20 depicts the 10 year 2032 difference map denoting the change in WSE with the project in place for the intermediate rate of SLR. Discussion of results for the mean inflow runs are grouped into three regions, and delineations of these regions are depicted in Figure 5-20.

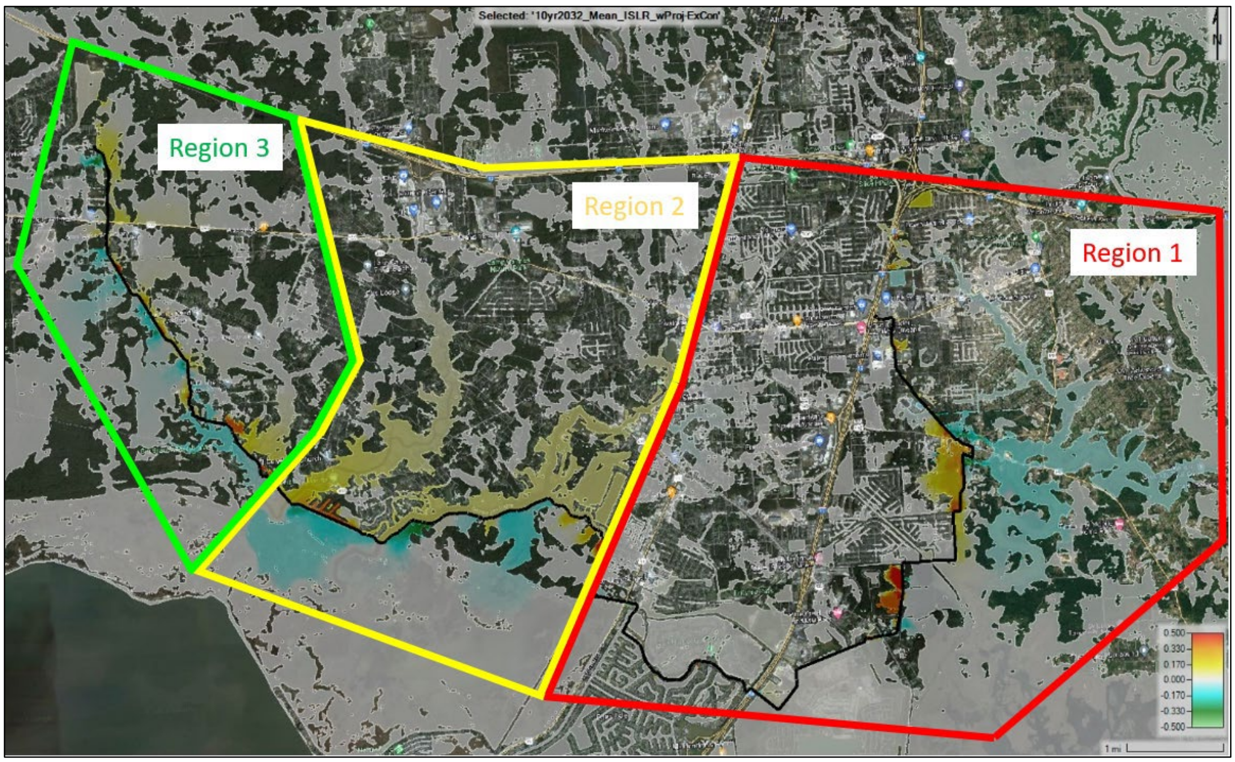


Figure 5-20. 10yr 2032 Event Difference Map Depicting WSE Increases and Lowering's for the Intermediate Rate of SLR and Mean Inflows on the Bogue Chitto River and Pearl River

Note: Regions correlate to areas discussed in the following results section. For a comprehensive description of difference maps refer to Annex C of this report.

The first region discussed for the mean inflow runs will be the Eastern extent of the levee, from Norfolk Southern Railroad to the Pearl River floodplain, and Figure 5-20 outlines this area in red and will be referred herein as Region 1. On the Eastern side of the levee, reductions can be seen on the flood side for each rainfall event, specifically concentrated around Doubloon Bayou and the W-14 Canal. Reduction in WSE for each frequency remains 0.05 foot-0.25 foot directly along the flood side of the levee for the 10-year 2032 and 2082 runs. Reductions for the 100-year 2032 and 2082 runs on the flood side of the levee in this same location remain in the range of 0.15 foot-0.75 foot. For both the 10-year and 100-year events, the magnitude of reductions gradually reduces further East of the levee. Reductions remain concentrated in the Doubloon Bayou channel and floodplain. This is occurring because the drainage path East of I-10, which generally drains from Northwest to Southeast, is being obstructed by the levee. In turn, there are also inducements on the protected side of the levee for each event. Inducements in Region 1 on the protected side north of Kingspoint Levee range between 0.20 foot-0.40 foot for the 10-year event, 2032 and 2082 runs. In this same location on the protected side for the 100-year events, the range of inducements are between 0.40 foot-0.88 foot. There is also a small detention pond located directly south of the Kingspoint Levee that has increased WSE with the project in place. This inducement is partially due to terrain data not capturing the bathymetry of this detention area, therefore exaggerating the inducement. For the 10-year event 2032 and 2082 runs, the inducement remains below 0.5 foot. For the 100-year event, the inducement remains below 1.4 feet.

The second area discussed for the mean inflow runs is along the central reaches of the levee alignment, between Bayou Liberty and the Norfolk Southern Railroad. Figure 5-20 outlines this area in yellow and will be referred herein as Region 2. Within Region 2, the levee alignment crosses two major waterways in the parish: Bayou Liberty and Bayou Bonfouca. The alignment crosses these two waterways and their floodplains perpendicularly. As can be seen in Figure 5-20, along with the other difference maps in Appendix E: Hydrologic & Hydraulics, Annex C, inducements are evident on the protected side along this extent of the levee. This is occurring because the drainage paths for these two waterways are being obstructed. Inducements for the 10-year events (baseline and future) range between 0.1-0.4 foot on the protected side. Approximately 0.75 miles upstream of the levee crossing with Bayou Liberty, the inducements within the channel reduce to a negligible range (below a tenth of a foot). Approximately 0.25 miles upstream of the levee crossing with Bayou Bonfouca, the inducements within the channel on the protected side reduce to a negligible range (below a tenth of a foot). For the 100-year events, the floodplain of these two waterways perform differently and converge together in the low lying terrain between them. Inducements on the protected side for the 100-year events range between 0.1 foot – 0.9 foot. Highest inducements are closest to the levee alignment and decrease further upstream from the crossing in both waterways. Inducements decrease to a negligible range (below a tenth of a foot) approximately 1.70 miles upstream of the Bayou Liberty crossing. Additionally, approximately 1.95 miles upstream of the Bayou Bonfouca crossing inducements reduce to a negligible range. As would be anticipated, WSE reductions are seen on the flood side of the levee in Region 2. Reductions are concentrated in two locations on the flood side of the levee: the floodplain of Bayou Bonfouca, and the floodplain between the two waterways. Reductions to WSE for the Bayou Bonfouca floodplain range between 0.1 foot-0.3 foot for the 10-year events and 0.2 foot-0.7 foot for the 100-year events. The second location of reductions to WSE on the flood side between the two waterways has a lower magnitude of reductions. For the 10-year 2032 and 2082 runs, the range of WSE reductions remains between 0.1 foot-0.25 foot. For the 100-year event, the reductions in WSE range between 0.1 foot-0.2 foot.

The Western portion of the alignment, west of the Bayou Liberty crossing, is the final region results will be discussed for the mean inflow runs and is outlined in green on Figure 5-20 and will be referred to Region 3 herein. Reductions can be seen along the flood side of the levee ranging from 0.1 foot-0.3 foot in some locations for the baseline and future 10-year events. The 100-year 2032 and 2082 runs have reductions on the flood side that range from 0.10 foot-0.40 foot. One main drainage path in Region 3 that is obstructed is Bayou Paquet. In this location on the protected side, the 10-year events exhibit a range of inducements between 0.1 foot-0.2 foot and the 100-year events exhibit inducements between 0.1 foot-0.30 foot. Other locations of protected side inducements are in locations of low lying terrain, and for the 10-year events remain below 0.5 foot. The ranges of these inducements can be evaluated further reviewing the difference maps in Appendix E: Hydrologic & Hydraulics Annex C.

Difference maps are generated for the coincident frequency inflow runs to illustrate the changes in WSE with the project during a coincident precipitation and Pearl River basin flood event. The maps can be reviewed in Annex C for the Slidell Levee. Figure 5-21depicts the 10-year 2032 difference map denoting the change in WSE with the project in place for the intermediate rate of SLR. Discussion of results for the coincident frequency inflow runs are grouped into three regions, and delineations of these regions are depicted in Figure 5-20.

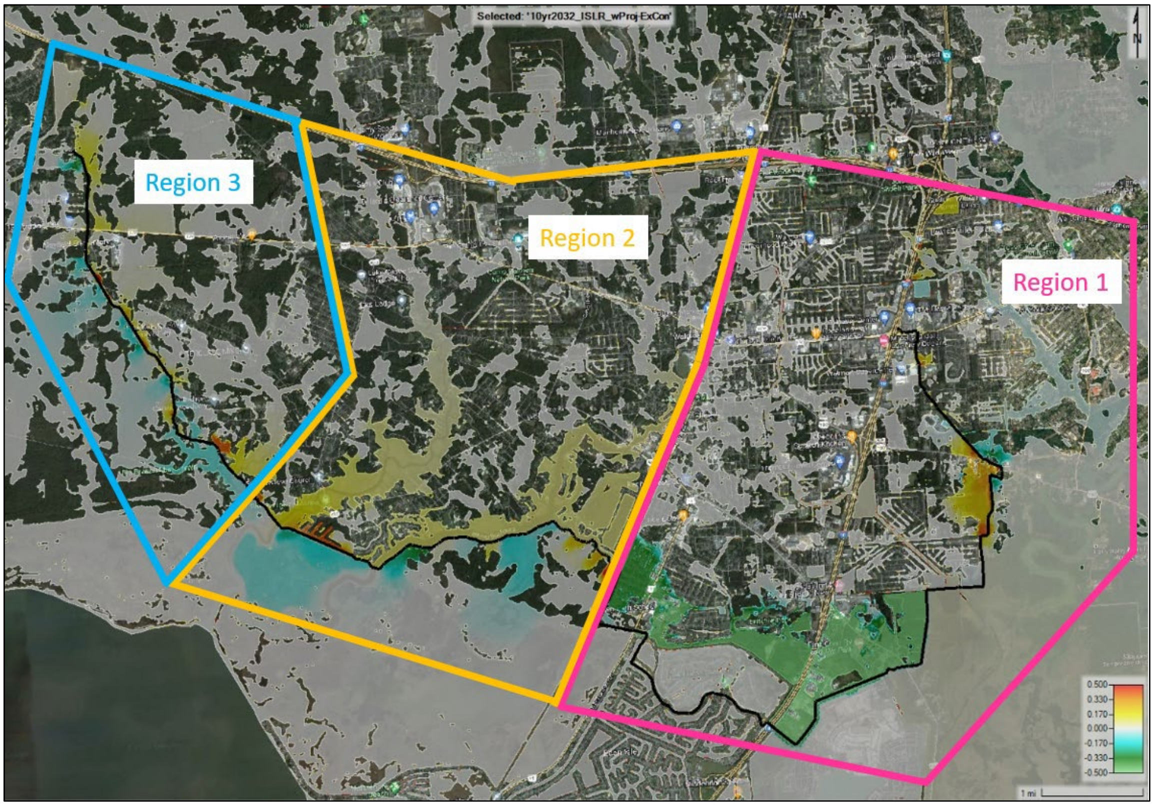


*Figure 5-21. 10yr 2032 Event Difference Map Depicti*ng WSE Increases and Lowering's for the Intermediate Rate of SLR and Coincident Frequency Inflows on the Bogue Chitto River and Pearl River

Note: Regions correlate to areas discussed in the following results section. For a comprehensive description of difference maps refer to Appendix E: Hydrologic & Hydraulics, Annex C of this report.

The first region discussed for the coincident frequency inflow runs will be the Eastern extent of the levee, from Norfolk Southern Railroad to the Pearl River floodplain, and Figure 5-21 outlines this area in pink and will be referred herein as Region 1. During the 10-year event both baseline and future runs for the protected side of the levee show inducements localized around the identified locations for pump and gate complexes and are consistent with the mean inflow maximum WSE increases. Inducements for the baseline and future 10-year runs remain between 0.2 foot-0.4 foot and are focused just north of the Kingspoint Levee. This indicates that for the 10-year event, regardless of the Pearl River Basin flood wave, the hydraulic performance on the protected side of the alignment will remain consistent as compared to a scenario where mean inflows are being generated in the Pearl River Basin. One location which performs differently with the coincident flooding is the region East of the railroad and south of Kingspoint Levee. There is an evident reduction in WSE, up to half a foot for the 10-year runs, that is not exhibited in the runs with a historic mean Pearl River basin flood wave. This is occurring because the flood wave from the Pearl is being obstructed from entering the low lying terrain on the protected side of the levee. These observations are consistent between each frequency run. Within Region 1, for the 100-year event runs, the hydraulics on the flood side and protected side of the levee perform differently than the 10-year event runs.

The flood wave comes down from the Pearl River Basin and propagates westward toward the Slidell area, and causes inducements on the flood side of the alignment. The flood side inducement caused by the flood wave ranges from 0.1 foot-0.2 foot for the 100-year event. The magnitude of the inducement dissipates while traveling Eastward and Southward, away from the proposed levee alignment and toward Lake Pontchartrain. Similar to the 10-year runs, the 100-year runs also exhibited substantial WSE decreases on the interior of the alignment South of Kingspoint levee because the Pear River flood wave is blocked. However, unlike the 10-year runs, North of Kingspoint levee experience a reduction of WSE up to 0.5 foot on the protected side. This is likely because the 100-year flood wave from the Pearl River is far larger and propagates further than the 10-year; therefore, the levee is obstructing a larger volume of water.

The second area discussed for the coincident frequency inflow runs is along the central reaches of the levee alignment, between Bayou Liberty and the Norfolk Southern Railroad. Figure 5-21 outlines this area in orange and will be referred herein as Region 2. For the 10-year events, this area performs in kind with the mean inflow runs; refer above for inducements and reductions described for the 10-year event in Region 2. This is occurring because the Pearl River Basin flood wave does not propagate west far enough to impact this area for the coincident 10-year flood event in the Pearl River. The 100-year, 2032 and 2082 runs perform differently in this region as compared to the mean inflow runs. For both 100-year events, there are reductions on the protected side of the levee, which were not exhibited in the mean inflow runs. The WSE lowering's on the protected side of the alignment range from 0.5 foot to 2 feet. The locations of lowering's in Region 2 are hydraulically connected to locations East of the Norfolk Southern Railroad, which also exhibited lowering's because the 100-year flood wave was obstructed. This indicates that the Pearl River basin flood wave propagates west of the Norfolk Southern Railroad during existing conditions. With the project in place, the levee is able to obstruct the flood wave and reduces flood impacts to much of the Slidell area. Locations of inducements on the protected side of the alignment are consistent with those seen in the mean inflow runs for the 100-year runs.

The Western portion of the alignment, west of Bayou Liberty is the final region results will be discussed for the coincident frequency inflow runs and is outlined in blue on Figure 5-21 and will be referred to Region 3 herein. For the 10-year and 100-year events, 2032 and 2082 runs, this area performs hydraulically the same as the mean inflow runs. This is likely occurring because the Pearl River Basin flood wave is not able to propagate west far enough to impact this Region 3 for the coincident 10-year or 100-year flood event in the Pearl River. It is evident that for the 10yr event during current conditions, the flood wave does not propagate west of the Norfolk Southern railroad. For the 100-year event during current conditions, the flood wave from the Pear River Basin does not propagate further West than Bayou Liberty. Refer above to the mean inflow results section for inducements and reductions described for the 10-year and 100-year events in Region 3.

HEC-RAS Modeling – Coincident Rainfall and Sea Level Rise Analysis
As discussed in the Climate Assessment, Appendix E: Hydrologic & Hydraulics Section 11, the low, intermediate, and high rates of sea level rise were all modeled in conjunction with the frequency inflows to ensure the PDT can properly evaluate impacts of sea level rise and coincident flood impacts of rainfall. The downstream boundary stages used in the SLR analysis for low, intermediate and high can be reviewed in Table E: 12-2 of Appendix E: Hydrologic & Hydraulics. To evaluate the impact of sea level rise, the RAS model domain was split into an East and West region with the unincorporated community of Lacombe, Louisiana, as the separating boundary.

East of Lacombe, LA
To conclude the analysis east of Lacombe, LA, study area contains the Pearl River Basin along with other larger waterways including Bayou Bonfouca, Bayou Liberty, and W-14 Canal. In order to evaluate the extent that SLR impacts the region, a difference grid is generated comparing the high and low rates of SLR for the 10-year and 100-year, 2032 and 2082 events for the with and without project production runs. Figures in Appendix E: Hydrologic & Hydraulics Annex C take the HSLR WSE output minus the LSLR WSE output, resulting in a map layer displaying the WSE difference between the two SLR conditions. These difference grids are generated for both the coincident frequency and the mean inflows for the two upstream boundary conditions (Pearl River and Bogue Chitto).

The impacts of SLR with coincident frequency inflows on the Eastern side of the parish are exhibited from the coastline of Lake Pontchartrain inland approximately 4-6 miles, and varies along the extent of the coastline. In general, the impact zone of SLR remains south of I-12 along the Eastern side of the parish coastline for the 10-year and 100-year runs. Impacts of varying rates of SLR can also be seen further inland in locations of major waterways listed above, which act as a conduit for fluctuating WSEs in Lake Pontchartrain. For example, upstream on Bayou Liberty at the Hwy 190 crossing (approximately 4.5 miles inland), there is a 0.15 foot difference in maximum WSE between LSLR and HSLR for the 100-year 2082 event. For the 10-year event, the impacts of SLR will be felt further inland, this can be seen in Figure 14-8, which depicts the existing condition SLR difference map for the 10-year event. WSEs will be impacted for the 10-year event, from the coastline to I-12 crossing along Bayou Liberty and Bayou Bonfouca.

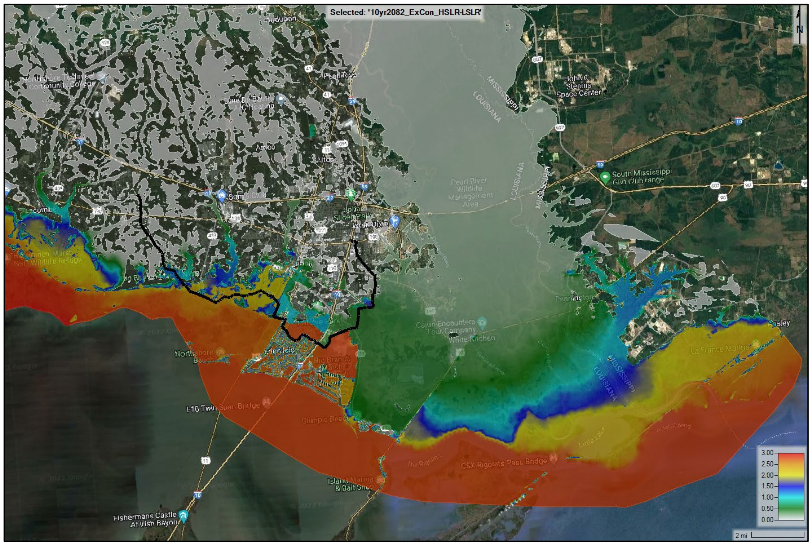


Figure 5-22. 10yr 2082 Event Existing Condition HSLR-LSLR with Coincident Frequency Inflows on Pearl River and Bogue Chitto River

The differences in performance of the 2032 (baseline) runs compared to the 2082 (future) runs is also assessed. It is found that for the 10-year event, baseline runs where the model domain is over solid land, the WSE difference between the HSLR and LSLR scenario ranges from 0 foot-0.4 0foot (refer to Annex C for visual aid). For the corresponding 10-year future runs where the model domain is over solid land, the WSE difference between the HSLR and LSLR scenario ranges between 0 foot-3 foot. It should be noted this is consistent between existing conditions and with-project runs, and that relationship will be discussed further below. For the 2082 runs, a larger portion of the Pearl River Basin floodplain exhibits impact from varying levels of SLR in comparison to the 2032 runs. Overall, it may be concluded that the 2032 runs are not as sensitive to varying rates of SLR as compared to the 2082 runs. This indicates that the backwater effects of higher downstream boundaries for the future condition will cause greater impact to WSEs further inland.

An evaluation is also performed on the comparison of SLR impacts with respect to the with-project and existing conditions runs. Figure 5-22 depicts the 10-year 2082 event with-project simulation and can be compared to Figure 5-23 to evaluate the differences between with-project and existing conditions simulations. It is found that with the project in place, the impacts of SLR are exhibited the same extent inland as the existing conditions runs. WSE changes in similar magnitude are exhibited from the shoreline to the I-12 crossing, consistent with the existing conditions runs. This indicates that the sizing of the gate structures along the alignment at locations of waterway crossings and low lying terrain maintains the existing conditions hydraulics in the area well. This also indicates that the presence of the levee will not aid in mitigating impacts caused by rising sea levels over time for more frequent precipitation events, such as the 10 year.

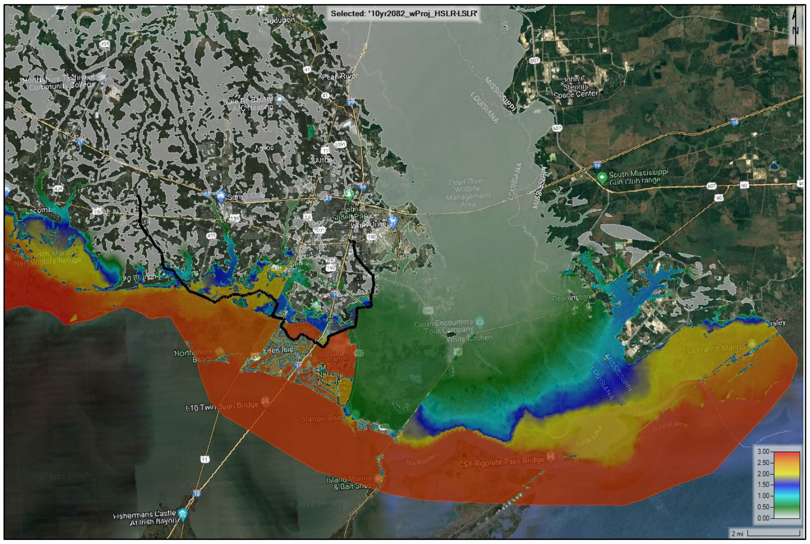


Figure 5-23. 10yr 2082 Event With-Project HSLR-LSLR with Coincident Frequency Inflows on Pearl River and Bogue Chitto River

Hydraulically, the study area performs differently to the various rates of SLR with a historic mean inflow from the Pearl River and Bogue Chitto River as compared to the coincident frequency inflows. Figure 5-24 and Figure 5-25 depict the difference in WSE between LSLR and HSLR for the 10-year 2082 event existing conditions and with-project simulations respectively. It is evident that the mean inflow runs exhibit impacts from varying rates of SLR further inland than the frequency inflow runs. For example, in the Pearl River basin, WSEs will be impacted as far as 15 miles inland. Additionally, in the Slidell area East of Norfolk Southern Railroad, WSE vary by higher magnitudes between the HSLR and LSLR simulations for the mean inflows. For the 10-year 2082 event mean inflow runs near the project area, WSE differences between the HSLR and LSLR simulations range between 0.5 foot-2.75 feet. This indicates that the Pearl River flood masks the impact of SLR to the area in the simulations. It also shows that this area is more susceptible to SLR with historically mean inflows from the Pearl and Bogue Chitto. West of the Norfolk Southern Railroad, WSEs vary from the coastline to the I-12 crossing for the 10-year 2082 event with mean Pearl River Basin inflows. This is the same distance inland as the frequency inflow runs.

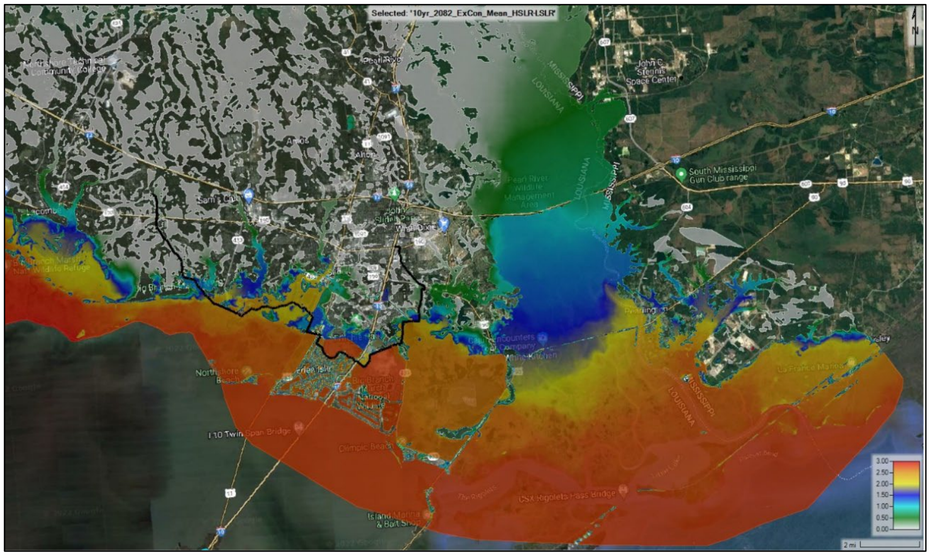


Figure 5-24. 10yr 2082 Event Existing Conditions HSLR-LSLR with Mean Inflows on the Pearl River and Bogue Chitto River

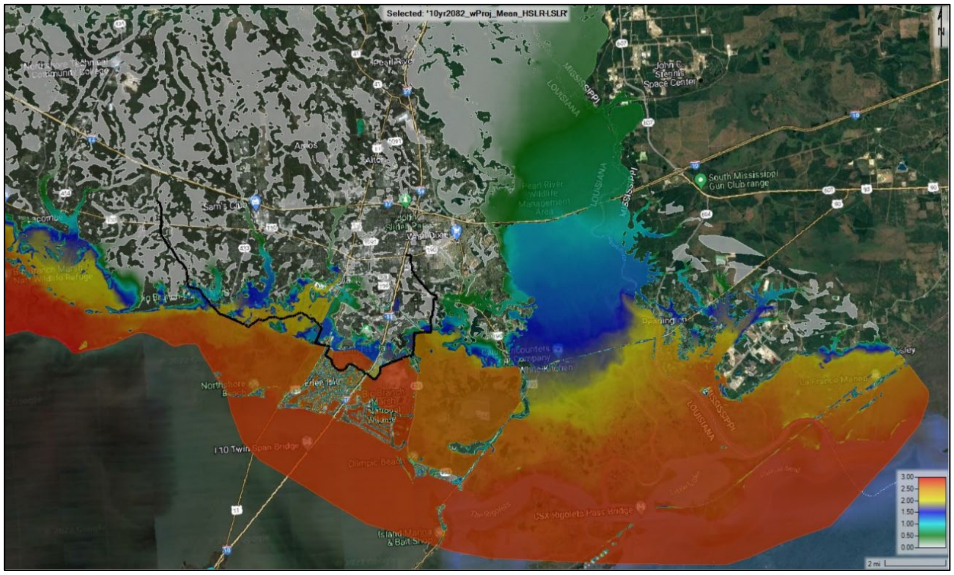


Figure 5-25. 10yr 2082 Event With-Project HSLR-LSLR with Mean Inflows on the Pearl River and Bogue Chitto River

Upon reviewing the 100-year future runs, the same conclusion may be drawn that the mean frequency inflow runs are more susceptible to SLR as compared to the frequency inflow runs. Figure 5-26 and Figure 5-27 show the 100-year 2082 with-project runs with mean and frequency inflows respectively. It is evident that during the higher frequency events, the mean inflow runs have greater varying SLR impacts as compared to the coincident frequency inflows. The differences between the mean and coincident frequency inflows remain on the flood side of the levee alignment. Therefore, it can be concluded that unlike for the coincident frequency inflow runs, the levee does in fact aid in abating the impacts from SLR for the higher frequency events when there is a historic mean Pearl River Basin flood. This also indicates that the Pearl River flood masks the impact of SLR to the area in the simulation East of the Norfolk Southern Railroad. West of the Norfolk Southern Railroad, SLR WSE differences are similar magnitude between the frequency inflow and historic mean inflow runs.

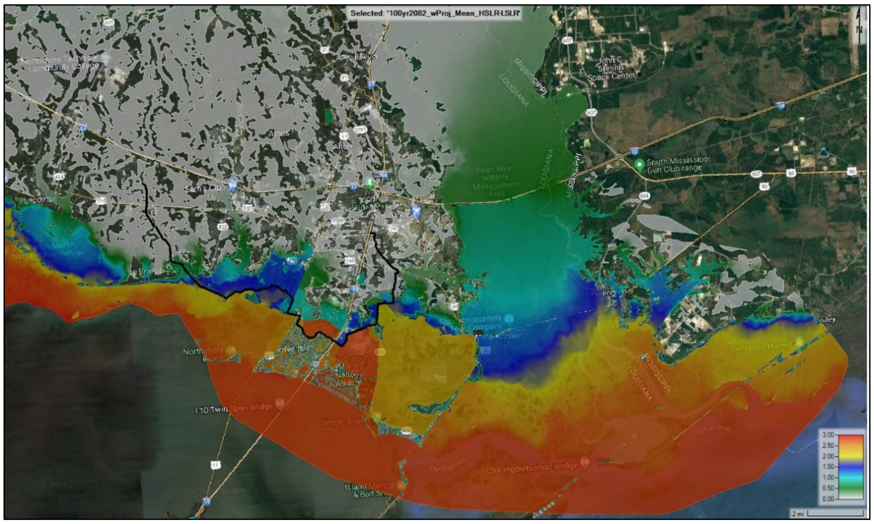


Figure 5-26. 100yr 2082 Event With-Project HSLR-LSLR with Mean Inflows on the Pearl River and Bogue Chitto River

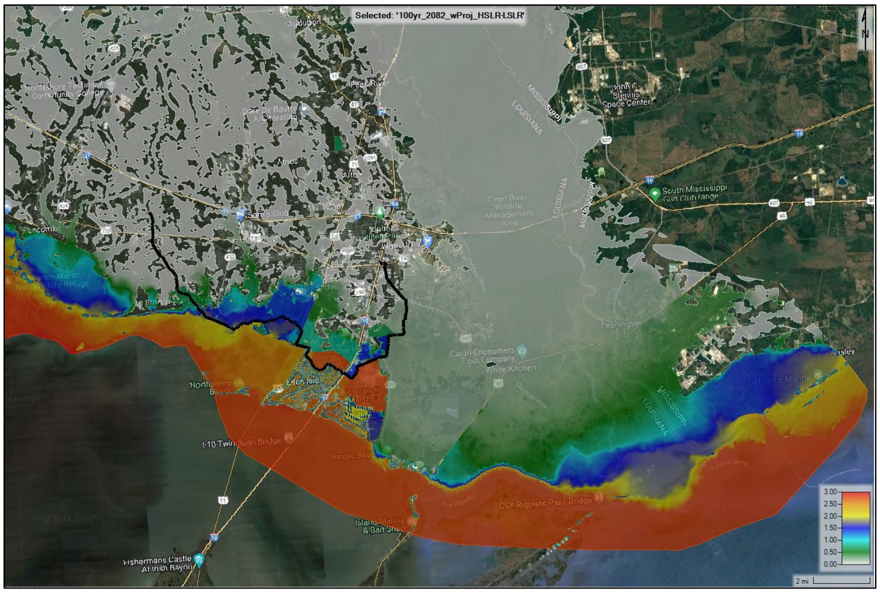


Figure 5-27. 100yr 2082 Event With-Project HSLR-LSLR with Frequency Inflows on the Pearl River and Bogue Chitto River

In conclusion, the Slidell area will be impacted in different ways when considering the various rates of SLR in conjunction with varying precipitation and Pearl River Basin flooding scenarios. This area experiences greater backwater effects and flooding for more frequent precipitation events, such as the 10-year. These backwater effects are exaggerated for the future (2082) runs as compared to the baseline (2032). This is the case for both the Pearl River Basin frequency inflows and the mean historic inflows. It is also concluded that with a mean historic Pearl River flood, the impacts to WSEs from varying rates of SLR are more exaggerated than when there are coincident frequency floods in the Pearl River Basin. Another finding for the region east of Lacombe, Louisiana, is that waterways hydraulically connected to Lake Pontchartrain act as a conduit for fluctuating WSEs in the lake, and propagate impacts from SLR further inland. Additionally, the WSE differences between the HSLR and LSLR scenarios for the with-project runs are not substantially different compared to the existing conditions runs. This indicates that the proposed levee system will not be conducive for reducing risk associated with future rising sea levels. A full description and analysis is included in Appendix E: Hydrologic & Hydraulics.

West of Lacombe, LA: The Western region of the study area contains the Tchefuncte River and its large tributaries including but not limited to the Abita River and the Bogue Falaya. Difference grids denoting the change in maximum WSE between the HSLR and LSLR scenarios for the 10-year and 100-year, 2032, and 2082, existing condition and with-project runs for the Western region of the parish are also in Appendix E: Hydrologic & Hydraulics Annex C for review. As stated above, the difference maps for both Pearl River coincident frequency and mean runs are in Appendix E: Hydrologic & Hydraulics Annex C.

The impacts of SLR with coincident frequency inflows on the Western region of the parish are seen from the coastline of Lake Pontchartrain inland approximately 1-7 miles, and varies along the extent of the coastline. As stated in the east of Lacombe section, the impact of SLR is viewed further inland along waterways hydraulically connected to Lake Pontchartrain. Between Lacombe and the western boundary of Mandeville, the SLR impact zone reaches a maximum of 1.8 miles inland along waterways Bayou Castine and Bayou Chinchuba. Further west, from the Tchefuncte River estuary north to the city of Covington, the impacts of SLR can be seen as far as 7 miles from the coast for the 100-year events and 8.3 miles for the 10-year events along the Tchefuncte River floodplain. This is approximately 2-3 miles north of I-12, which was the upper boundary for the impact zone of SLR on the eastern side of the parish. These findings indicate that the Tchefuncte River poses a threat in regard to rising sea levels for communities in the center of the parish, miles inland from the coast.

Similar to the eastern half of the parish, this region also exhibits impacts from SLR due to the backwater effects of Lake Pontchartrain. For example, Figure 5-28 and Figure 5-29 depict the existing condition future simulation difference between HSLR and LSLR, for the 10-year and 100-year precipitation events respectively. The impact of SLR for the 10-year event is exhibited inland to the extent of Abita Springs, Louisiana, and well into Covington, Louisiana. For the 100-year, the impacts from SLR do not make it into Covington, Louisiana. This shows that more frequent and smaller storms, such as the 10-year, are more susceptible to impacts from SLR due to backwater effects of higher stages in Lake Pontchartrain as compared to larger precipitation events.

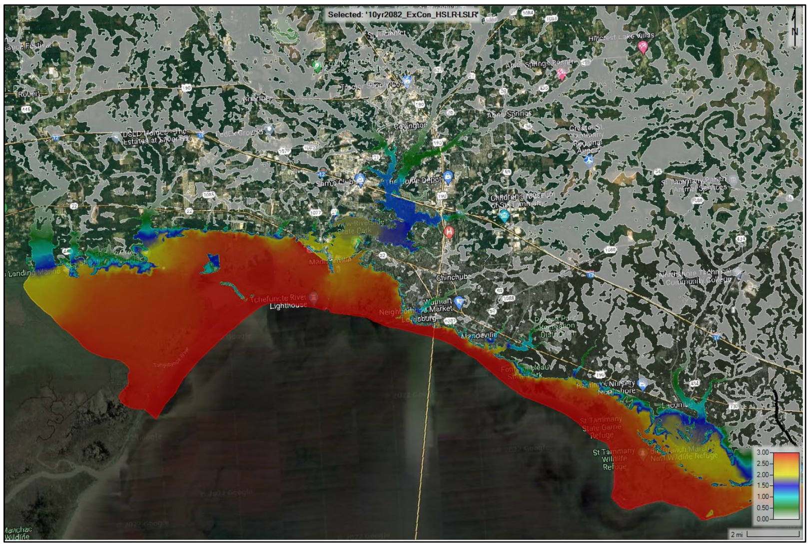


Figure 5-28. 10yr 2082 event Existing Condition HSLR-LSLR with Frequency Inflows on the Pearl River and Bogue Chitto River

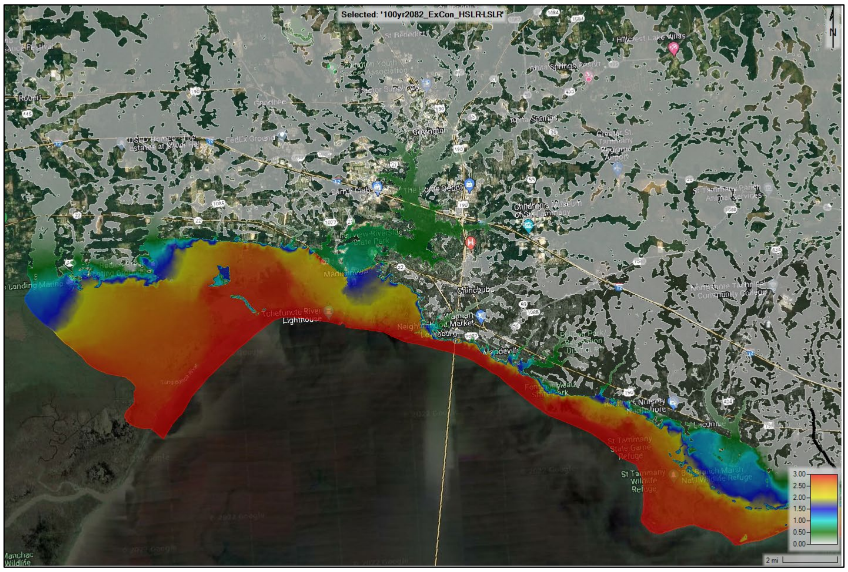


Figure 5-29. 100yr 2082 Event Existing Condition HSLR-LSLR with Frequency Inflows on the Pearl River and Bogue Chitto River

Further investigation on how SLR impacts the proposed Optimized TSP project at Mile Branch was also conducted. Figure 5-30 depicts the change in WSE with respect to High and Low SLR for the 10-year 2082 events for the existing conditions with-project runs, using mean inflows on the Pearl River and Bogue Chitto River. Similarly, Figure 5-29 shows the same simulations but with frequency inflows on the Pearl River and Bogue Chitto. As can be seen for both the mean inflow and frequency inflow runs, Mile Branch exhibits a change of less than 0.2 foot for both the existing conditions channel and with-project simulations. The changes to WSE with respect to SLR remain near the confluence of Mile Branch and the Tchefuncte River and propagate up the channel until the W 11th Avenue crossing for the existing condition. For the with-project condition, WSE changes propagate slightly further up the channel past the W 11th Avenue crossing, approximately 200 feet upstream of that crossing. Changes in WSE remain at or below 0.2 foot in this small reach of the Mile Branch channel. It can be concluded that the historic mean inflows and coincident frequency inflows do not have an impact on the hydraulics on the project area at Mile Branch. Furthermore, upon reviewing difference maps in Annex C for the West of Lacombe, Louisiana region, the differences between the mean inflow runs and frequency inflow runs are not significant in the central portion of the parish. This indicates that the Pearl River Basin flooding impacts do not propagate west of Lacombe, Louisiana.

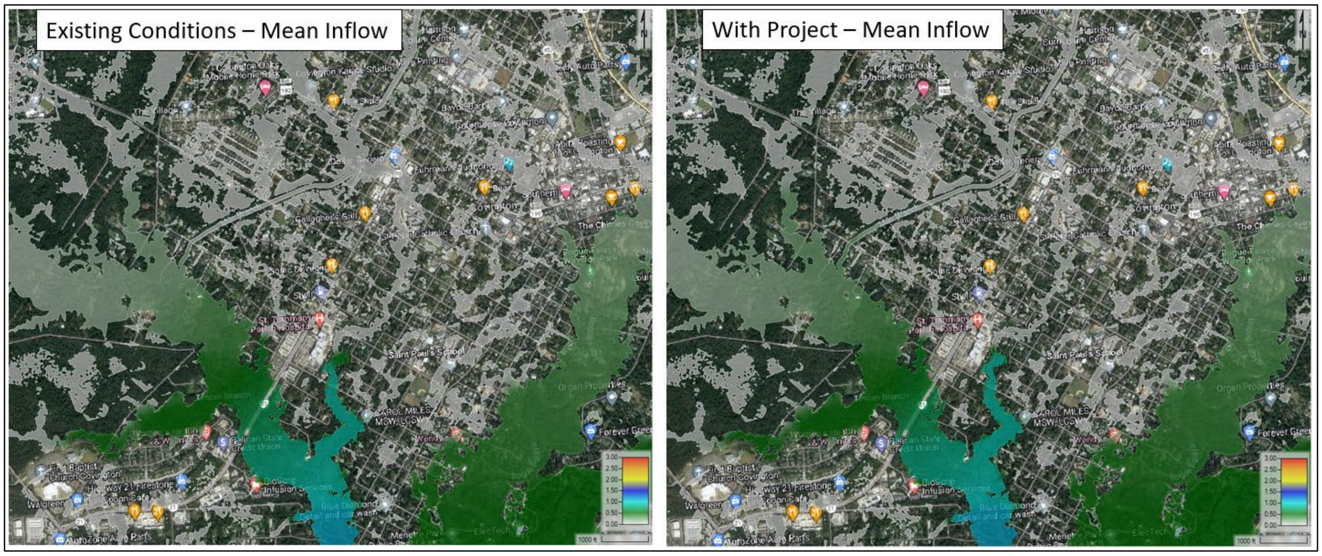


Figure 5-29. 10yr 2082 *E*vent

Note: Existing Condition (left) and With-Project (right), depicting the change in WSE between the HSLR-LSLR simulations with mean inflows on the Pearl River and Bogue Chitto River; zoomed into Mile Branch project area.

5.1.1.10 Water Quality

Alternative 1: No Action Plan

Direct, Indirect, and Cumulative Impacts: No direct impacts to water quality would occur with implementation of the No Action Alternative. Indirect impacts as a result of not implementing the proposed action would be the continued degradation of water quality as the project area continues to erode as a result of flood events and human development in the Area of Potential Effect (APE).

Alternative 2: Nonstructural Plan (within Optimized TSP)

Direct, Indirect, and Cumulative Impacts: This alternative would not result in measurable impacts to water quality. Elevating homes that are adjacent to waterways may result in indirect impacts to water quality of the waterways by causing temporary turbidity. These impacts would be temporary and not adversely affect current water quality trends.

Optimized TSP (Levees and Mile Branch Improvements)

The levee and floodwall system consists of a combination of the West Slidell levee alignment proposed in Alternative 5 and the South Slidell levee alignment proposed in Alternative 6. The two alignments would be connected by a new railroad gate across the existing Norfolk Southern Railway Corporation railroad tracks.

The Optimized TSP alignment for the levee and floodwall system would consist of approximately 18.5 miles (97,700 feet) of levee and floodwall, which includes approximately 15 miles (79,500 feet) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 feet) of separate (non-continuous) segments of a floodwall. The Optimized TSP consists of pump stations, floodgates, vehicular floodgates, and ramps.

The Mile Branch channel improvements is the second structural project located in Covington Louisiana. The channel improvements begin at the intersection of Mile Branch and U.S. Highway 190, crossing U.S. Highway 190 Business, and end at the confluence of Mile Branch and the Tchefuncte River. The improvements would include clearing and grubbing and mechanical dredging of the channel. The channel would also be widened and deepened. The proposed work would consist of approximately 21 acres of channel that would be cleared and grubbed prior to mechanical dredging.

The Marsh Mitigation Site (M2) is located within the Big Branch Marsh Wildlife Refuge near the confluence of Bayou Lacombe and Lake Pontchartrain. The estimated footprint of the mitigation site is 200 acres of marsh with a dike perimeter of 16,067 feet. Marsh Mitigation Site would obtain borrow material from Lake Pontchartrain to be accommodated.

Activities that would take place on the flood side of the existing and proposed levee and T-Wall alignments within Waters of the United States (e.g., navigable waterways, wetlands, etc.) would have the potential to increase turbidity, suspended sediments, Biological Oxygen Demand, and decrease Dissolved Oxygen. There would also be the potential for nutrient enrichment associated with suspended sediments during dredging and fill placement operations that could possibly lead to localized algae blooms. Localized short-term increases in turbidity could possibly lead to a temporary displacement of aquatic organisms. Where concrete pours occur adjacent to or within waterbodies for armoring to protect against erosion and scour, temporary minor impacts on water quality would occur. However, any such direct impacts would be expected to be minor and temporary.

Activities that would take place on the protected side of the existing and proposed levee would be expected to have little to no effect on water quality. Earth-moving activities during construction disturb soils and can create indirect water quality effects in the event of uncontrolled runoff or poor sediment control practices during construction. Adherence to permit requirements, best management practices (BMPs), and an approved sediment control plan by the construction contractor would minimize the risk of these indirect water quality effects.

Where wetland fill occurs, this would permanently eliminate the affected wetlands' ability to perform water quality functions, causing a major permanent impact on water quality. Fill material that would be used for levee construction would be tested in advance to eliminate placement of contaminants that could adversely affect water quality. Additionally, to help alleviate some water column impacts during construction, construction-related runoff into the wetlands and open water would be managed by construction contractors through implementation of BMPs and a SWPPP.

Water level fluctuations in the surrounding wetlands and waterbodies would continue to be regulated by water control structures, and no significant effects on normal water fluctuations would be expected to occur outside of a storm event. Furthermore, no significant alteration of salinity gradients would be expected to occur from the placement of fill material for levee construction.

CEMVN will obtain a CWA Section 401 Water Quality Certification from the Louisiana Department of Environmental Quality for the Optimized TSP prior to a decision on the proposed action.

There would be no anticipated permanent cumulative effects to water quality associated with these measures. As discussed previously, there would be construction-related water quality degradation that would have a temporary effect.

Mitigation Plan: Open water, broken marsh, SAVs, and mud substrate would be replaced with fresh/intermediate marsh, increasing spawning, nursery, forage and cover habitat for fisheries resources over the long term. For approximately 5 years after project construction the project area would be above daily tidal inundation and only partially vegetated, so maximum fisheries benefits would not be realized until after this 5-year period has elapsed. Turbidity during borrow excavation and fill placement would temporarily impair visual predators and would impact filter feeders, but these impacts are expected to cease after construction and benthic species would rebound once construction is complete. Temporary water quality impacts from turbidity are not anticipated to be substantial enough to cause impairment of the water body's designated uses as defined under the standards of Louisiana Administrative Code, Title 33, Part IX, Chapter 11. Water quality impacts in the fill area would temporarily add to the water quality impairment of this sub-segment, but these impacts would be minimized through best management practices and would diminish to background levels after construction.

Borrow Sources: There would be no impact to water quality resources resulting from excavation of borrow

5.1.1.11 Air Quality

The U.S. Environmental Protection Agency (USEPA), under the requirements of the Clean Air Act (CAA), has established NAAQS for six contaminants, referred to as "criteria" pollutants (40 CFR 50). These are 1) carbon monoxide (CO), 2) nitrogen dioxide (NO_2), 3) ozone (O_3), 4a) particulate matter less than 10 microns in diameter (PM10), 4b) particulate matter less than 2.5 microns in diameter (PM2.5), 5) lead (Pb), and 6) sulfur dioxide (SO_2). The NAAQS standards include primary and secondary standards. The primary standards were established at levels sufficient to protect public health with an adequate margin of safety. The secondary standards were established to protect the public welfare from the adverse effects associated with pollutants in the ambient air. The primary and secondary standards are presented in Table 5-4.

The USEPA Green Book Nonattainment Areas for Criteria Pollutants (Green Book) maintains a list of all areas within the United States that are currently designated "nonattainment" areas with respect to one or more criteria air pollutants. Nonattainment areas are discussed by county or MSA. MSAs are geographic locations, characterized by a large population nucleus, that are comprised of adjacent communities with a high degree of social and economic integration. MSAs are generally composed of multiple counties. Review of the Green Book indicates that St. Tammany Parish is currently in attainment for all Federal NAAQS pollutants, including the 8-hour ozone standard (USEPA 2019). This classification is the result of area-wide air quality modeling studies. Therefore, further analysis required by the CAA general conformity rule (Section 176(c)) is not required.

Table 5-4. Primary and Secondary NAAQS for the Six Contaminants Established by EPA

National Ambient Air Quality Standards [3][4]				
	Primary Standard		**Secondary Standard**	
Criteria Pollutant	**Concentration Limit**	**Averaging Time**	**Concentration Limit**	**Averaging Time**
Carbon monoxide	9 ppmv (10 mg/m^3)	8-hour (1)	None	
	35 ppmv (40 mg/m^3)	1-hour (1)		
Sulfur dioxide	0.03 ppmv (80 µg/m^3)	Annual (arithmetic mean)	0.5 ppmv (1300 µg/m^3)	3-hour (1)
	0.14 ppmv (365 µg/m^3	24-hour (1)		
Nitrogen dioxide	0.053 ppmv (100 µg/m^3)	Annual (arithmetic mean)	Same as primary	
Ozone	0.075 ppmv (150 µg/m^3)	8-hour (2)	Same as primary	
	0.12 ppmv (235 µg/m^3)	1-hour (3)	Same as primary	
Lead	0.15 µg/m^3	Rolling 3-month average	Same as primary	
	1.5 µg/m^3	Quarterly average	Same as primary	
Particulate Matter (PM_{10})	150 µg/m^3	24-hour (4)	Same as primary	
Particulate Matter ($PM_{2.5}$)	15 µg/m^3	Annual (5) (arithmetic mean)	Same as primary	
	35 µg/m^3	24-hour (6)	Same as primary	

(1) Not to be exceeded more than once per year.
(2) The 3-year average of the fourth-highest daily maximum 8-hour average at each monitor within the area over each year must not exceed 0.075 ppmv.
(3a) The expected number of days per calendar year with maximum hourly averages above 0.12 ppm must be equal to or less than 1.
(3b) As of June 15, 2007, the U.S. EPA revoked the 1-hour ozone standard in all areas except for certain parts of 10 states.
(4) Not to be exceeded more than once per year on average over 3 years.
(5) The 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15 µg/m^3.
(6) The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within the area must not exceed 35.5 µg/m^3.

Alternative 1: No-Action Plan:

With implementation of this alternative, no direct or indirect impacts to air quality would occur.

Alternatives 2 Non-Structural Plan (within Optimized TSP)

With the implementation of this alternative there would be adverse, short-term direct and indirect impacts to air quality from noise and pollution. Additional effects may also arise from an increase in traffic required to deliver equipment, materials, and construction workers to the area. However, due to the short duration of the construction work, any adverse impacts to ambient air quality would be expected to be short-term and minor and would not be expected to cause or contribute to a violation of Federal or state ambient air quality standards. Once all construction activities associated with the construction work cease, air quality within the vicinity would be expected to return to pre-construction conditions. Thus, the ambient air quality in St. Tammany Parish would not change from current conditions, and the status of attainment for the parishes would not be altered.

Optimized TSP (Levees and Mile Branch Improvements)

With the implementation of this alternative there would be adverse, short-term direct and indirect impacts to air quality from noise and pollution. Additional effects may also arise from an increase in traffic required to deliver equipment, materials, and construction workers to the area. However, due to the short duration of the construction work, any adverse impacts to ambient air quality would be expected to be short-term and minor and would not be expected to cause or contribute to a violation of Federal or state ambient air quality standards. Once all construction activities associated with the construction work cease, air quality within the vicinity would be expected to return to pre-construction conditions. Thus, the ambient air quality in St. Tammany Parish would not change from current conditions, and the status of attainment for the parishes would not be altered.

Similar impacts would be expected from construction of the mitigation sites M-2 and PSR-01. Regular controlled burns of the pine savanna mitigation site would occur over a period of several days that would result in temporary short-term adverse impacts to ambient air quality. Once the controlled burns are complete air quality within the vicinity would be expected to return to pre-burn conditions. Cumulative effects would be similar. Apart from the short-term effects, the ambient air quality in St. Tammany Parish would not change from current conditions, and the status of attainment for the parishes would not be altered.

Borrow Sources: There would be temporary minor impacts to air quality resources as result of borrow excavation, the action would add additional impact by obtaining material from existing operating pits or sites that have been previously cleared and are designated as borrow sites as described in 5.3 and previously for Alternatives 2, 6, and 8

5.1.1.12 Hazardous, Toxic, and Radioactive Waste (HTRW)

USACE policy is to avoid the use of project funds for Hazardous, Toxic, and Radioactive Waste (HTRW) removal and remediation activities. See ER 1165-2-132 Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance For Civil Works Projects (26 June 1992), and the American Society for Testing and Materials (ASTM) E 1527-13, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (ASTM, 1997). Pursuant to USACE policy, potential Hazardous, Toxic, and Radioactive Waste concerns are to be identified early and construction in HTRW-contaminated areas is to be avoided to the extent practicable. Residential structures that are 4 units or less are exempt from asbestos and lead abatement regulations unless they are being demolished, which will not occur under the Nonstructural Plan since the acquisition or buy-out of properties is not included in the Optimized TSP.

An American Society for Testing and Materials (ASTM) Phase I Environmental Site Assessment (ESA) and asbestos investigation site reconnaissance was conducted on 1-22 October 2021 to assess the potential for HTRW materials within the footprints for each of the alternatives in the Final Array of Alternatives.

A second updated ASTM Phase I ESA for the Optimized TSP was completed on 8 March 2023. See Appendix C: Environmental for the full report. The March 2023 ESA determined that there is a low probability of encountering HTRW during construction of the Optimized TSP including the borrow sites. The Phase I ESA included the following tasks: 1) the review of HTRW Phase I Environmental Database Review Corridor Reports and state and federal databases (e.g., Resource Conservation and Recovery Act Information, Toxic Release Inventory, Superfund Enterprise Management System, Assessment, Cleanup and Redevelopment Exchange System, and state databases on underground storage tanks and hazardous waste programs, etc.) to identify Recognized Environmental Conditions (RECs), and 2) site reconnaissance to accessible regions of the subject areas to determine if RECs are within the proposed project right of way (ROW). The public crossing of the creeks and bayous were inspected for the presence of pipes, containers, tanks or drums, ponds or lagoons, car bodies, tires, refrigerators, trash dumps, electrical equipment, oil drilling equipment, gas or oil wells, discoloration of vegetation or water sheens, discoloration of soils, out-of-place dirt mounds or depressions in the landscape, evidence of fire, stressed soils with lack of vegetation, discoloration of vegetation, animal remains, unusual animal behavior, biota indicative of a disturbed environment, and odors indicative of poor water quality or chemical presence. Indicators were found during the site visits.

Prior to construction and after a right-of-entry for on-site HTRW investigations is provided by the property owner, an ASTM E 1527-13 Phase II ESA will be completed. If the Phase II ESA identifies contamination, the property owner will be notified in writing of the remediation that is required and that the work must be performed by a licensed HTRW remediation professional. If the presence of HTRW, asbestos, or asbestos-containing materials in a damaged or friable form is confirmed on the property, the property owner shall be obligated, at his sole cost and expense, to conduct all necessary response and remedial activities in full compliance with applicable local, state, and federal laws and regulations and provide proof thereof before USACE makes a final determination as to whether the structure meets the eligibility requirements. In addition, documentation from a third party licensed HTRW remediation professional must be provided by the property owner to the USACE with sufficient evidence to support that the contamination has been successfully and properly remediated. See Appendix C: Environmental.

Alternative 1: No-Action Plan

There would likely be no potential for direct or indirect effects to HTRW because implementation of the action would not occur.

Alternative 2: Nonstructural Plan (within Optimized TSP)

Any HTRW concerns would be handled by the NFS and reported to USACE HTRW Specialist for record.

Optimized TSP (Levees and Mile Branch Improvements)

Personnel from CEMVN conducted a 2nd site reconnaissance on 23 January 2023 and 26 January 2023. The site reconnaissance was conducted via public access roads and public parks for this feasibility study. The mitigation sites (M2 and PSR001) were not accessible due to location and lack of ROE. The proposed borrow sites were viewed from public access roads due to lack of ROE. The areas were inspected for the presence of pipes, containers, tanks or drums, ponds or lagoons, car bodies, tires, refrigerators, trash dumps, electrical equipment, oil drilling equipment, gas or oil wells, discoloration of vegetation or soils, water sheens, out-of-place dirt mounds or depressions in the landscape, evidence of fire, stressed soils with lack of vegetation, animal remains, unusual animal behavior, biota indicative of a disturbed environment, and odors indicative of poor water quality or chemical presence. Within Mile Branch, two oil containment booms were found within the water way on 26 January 2023, located at 30.486420, -90.105369 (Appendix C: Environmental, Photos 15-22). The point source for the usage of the oil containment booms is currently unknown. In addition to the two oil containment booms, waste tires and a rusted 55-gallon drum were found within the water way. Louisiana Department of Environmental Quality (LDEQ) was informed of the findings on 27 January 2023. On 14 February 2023, LDEQ informed USACE that the oil containment booms are trash booms installed by the city. The 55-gallon drum was found to contain no product. Prior to any construction, another site evaluation would need to be conducted per requirements of the ASTM.

Desktop research that included the review of government environmental databases, historical aerial photographs, and historic topographic maps was conducted on the proposed project areas including borrow areas and mitigation areas. No evidence of RECs that would affect the proposed construction was found within the ROW. RECs were found within a one-mile radius of the ROW, but these RECs should pose a low risk due to the distance they are from the ROW.

5.1.1.13 Cultural, Historic, and Tribal Trust Resources

CEMVN has determined that the proposed action constitutes an Undertaking as defined in 36 CFR § 800.16(y). CEMVN proposes to adopt a programmatic approach in accordance with 36 CFR § 800.14(b) to determine the Area of Potential Effects (APE) for structural and nonstructural measures in consultation with LA SHPO and participating Tribe(s) pursuant to 36 CFR § 800.16(d). The APEs would incorporate both direct effects (e.g., access, staging, and construction areas) and indirect effects (e.g., visual), including all areas of proposed ground disturbance. Furthermore, CEMVN may consider information provided by other parties, such as the NFS, local governments, and the public, when establishing APEs.

Accordingly, the USACE is developing a Programmatic Agreement (PA), in consultation with the NFS, LA SHPO, Advisory Council on Historic Preservation (ACHP), federally-recognized tribes, and other interested parties, to fulfill its Section 106 procedures, described in Section 8.13 (Environmental Laws and Regulations: NHPA of 1966). The PA, entitled *Programmatic Agreement Among the U.S. Army Corps of Engineers, New Orleans District; Louisiana State Historic Preservation Officer of the Department of Culture, Recreation & Tourism; Louisiana Coastal Protection and Restoration Authority Board; The Choctaw Nation of Oklahoma; Regarding the St. Tammany Parish, Louisiana Flood Risk Reduction Project*, outlines the steps needed to identify and evaluate cultural resources and make determinations of effects (see Appendix C: Environmental). This PA would be executed prior to the USACE signing the Record of Decision.

As such, all field survey, evaluation, and reporting required to make NRHP eligibility determinations for Section 106 compliance would largely be deferred to the PED/Construction phase. If direct adverse effects to cultural resources are identified and cannot be avoided or minimized, such impacts would be mitigated through the procedures outlined in the PA. The PA would then govern the CEMVN’s subsequent NHPA compliance efforts and any additional conditions or requirements would be documented at that time.

Alternative 1: No Action Plan

Impacts to cultural and historic resources within the study area have resulted from both natural processes (e.g., erosion) and human activities (e.g., land development, dredging, agriculture, and vandalism). Riverine environments are dynamic, and impacts to cultural and historic resources in the area would remain largely the same as present due to natural processes including anthropogenic modifications of the landscape as well as human alterations. Cultural resources may remain vulnerable to damage or complete loss from coastal and fluvial flooding.

Alternative 2: Nonstructural Plan (within Optimized TSP)

<u>*Direct, Indirect, and Cumulative Impacts:*</u> This alternative includes the introduction of new visual elements and/or modifications to built-environment resources (i.e., elevation, flood proofing, relocations and/or acquisition (demolition) that may directly affect known and undocumented historic built resources in a manner that may diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association and

ground disturbing activities (e.g., access, staging, foundation work, utility relocations and hardening, demolition) within the footprint that may directly affect known and undocumented archeological resources in a manner that may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

This alternative includes elevation, flood proofing, relocations, and/or acquisition (demolition) measures that may indirectly result in the potential successive introduction of new visual elements and/or modifications to the viewshed and overall visual landscape of known and previously undocumented cultural resources that may be listed or eligible for listing in the NRHP. These cultural resources could potentially include historic built resources, NRHDs, National Historic Landmarks (NHL), other built-environment resources, and/or TCPs. The introduction of new visual elements and/or modifications that are inconsistent with the historic or cultural character of these resources could indirectly diminish the integrity of the property's setting, feeling, or association and/or cause changes to the integrity of feeling or character associated with a historic resource or TCP.

The cumulative impacts to cultural resources would be the additive combination of impacts by this and other Federal, state, local, and private flood risk reduction efforts including authorized USACE construction projects adjacent to the study area (see: Section 1.6). In addition to those direct and indirect impacts described above, successive additions and/or modifications to the visual landscape may result in cumulative adverse effects to cultural resources by introducing elements that are inconsistent with their historic or cultural character. In conjunction with similar repetitive impacts from other large-scale nonstructural projects in the region, this could lead to the loss of connection to place and cause a net loss of cultural diversity within St. Tammany Parish.

Optimized TSP (Levees and Mile Branch Improvements)

Nonstructural Plan

This alternative includes the introduction of new visual elements and/or modifications to built-environment resources (i.e., elevation, flood proofing, relocations and/or acquisition (demolition) that may directly affect known and undocumented historic built resources in a manner that may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association and ground disturbing activities (e.g., access, staging, foundation work, utility relocations and hardening, demolition) within the footprint that may directly affect known and undocumented archeological resources in a manner that may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

This alternative includes elevation, flood proofing, relocations, and/or acquisition (demolition) measures that may indirectly result in the potential successive introduction of new visual elements and/or modifications to the viewshed and overall visual landscape of known and previously undocumented cultural resources that may be listed or eligible for listing in the NRHP. These cultural resources could potentially include historic built resources, NRHDs, National Historic Landmarks (NHL), other built-environment resources, and/or TCPs. The introduction of new visual elements and/or modifications that are inconsistent with the historic or cultural character of these resources could indirectly diminish the integrity of the property's setting, feeling, or association and/or cause changes to the integrity of feeling or character associated with a historic resource or TCP.

West Slidell Levee

Archaeological sites 16ST20, 16ST40, and16ST42 are located within the levee footprint and would require further investigation as to whether they may be adversely affected by construction. No previously recorded historic built resources are located within the proposed alternative. This measure includes ground disturbing activities involving access, staging, construction of structural features (levee, access gate, floodgates, sluicegates, pump stations, vehicular floodgate and road ramp), borrow fill, and/or other direct effects to above-ground historic properties (i.e. demolition). These activities may directly impact both known and undocumented cultural resources listed or eligible for listing in the NRHP not limited to: archaeological sites; historic built resources; cemeteries or other sites that may contain human remains, funerary objects, sacred objects, or objects of cultural patrimony; and TCPs; that exist both within the footprint and associated areas in a way that will diminish the integrity of these property's location, design, setting, materials, workmanship, feeling, or association. Cultural Resources surveys would likely be required to identify existing cultural resources.

This measure includes the introduction of new visual elements (levee, access gate, floodgates, sluicegates, and pump stations) to the area's viewshed that have the potential to indirectly impact known and previously undocumented cultural resources that may be listed or eligible for listing in the NRHP. The introduction of new visual elements that are inconsistent with the historic or cultural character of these resources could indirectly diminish the integrity of the property's setting, feeling, or association and/or cause changes to the integrity of feeling or character associated with a historic resource or TCP. Implementing the proposed action may have beneficial indirect impacts to cultural and historical resources by providing an added level of rainfall and coastal storm risk reduction to known and unknown cultural resources in the project vicinity on the protected side of the levee, thereby reducing the damage caused by rainfall and coastal storm flood events.

6a: South Slidell Levee and Floodwall System

<u>*Direct, Indirect, and Cumulative Impacts:*</u> Site 16ST152 (Salmen Brick Factory) is located on the east bank of Bayou Bonfouca adjacent to the proposed alternative and would require further investigation as to whether it may be adversely affected by the channel improvements. Site 16ST153 (Guzman) is located within the proposed alternative; however, the historic site was recommended not eligible due to disturbance and lack or research potential. Previously recorded historic built resources are located adjacent to the proposed alternative. This alternative includes components within the local Slidell Olde Town Preservation District. Additionally, the recently listed Teddy Avenue Residential District is located approximately two blocks east from the proposed alternative. This measure includes ground disturbing activities involving access, staging, construction of structural features (levee, floodwall, pump stations, floodgate, gate complex, road ramp), borrow fill, and/or

other direct effects to above-ground historic properties (i.e. demolition). These activities may directly impact both known and undocumented cultural resources listed or eligible for listing in the NRHP not limited to: archaeological sites; historic built resources; cemeteries or other sites that may contain human remains, funerary objects, sacred objects, or objects of cultural patrimony; and TCPs; that exist both within the footprint and associated areas in a way that would diminish the integrity of these property's location, design, setting, materials, workmanship, feeling, or association. Cultural resources surveys would likely be required to identify existing cultural resources.

This measure includes the introduction of new visual elements (levee, floodwall, pump stations, floodgate, gate complex, road ramp) to the area's viewshed that have the potential to indirectly impact known and previously undocumented cultural resources that may be listed such as the Teddy Avenue Residential District, or eligible for listing in the NRHP. The introduction of new visual elements that are inconsistent with the historic or cultural character of these resources could indirectly diminish the integrity of the property's setting, feeling, or association and/or cause changes to the integrity of feeling or character associated with a historic resource or TCP. Further, the cumulative loss of contributing elements to historic districts could lead to the loss of NRHP qualifying characteristics and/or criteria. Conversely, Implementing the proposed action may have beneficial indirect impacts to cultural and historical resources by providing an added level of rainfall and coastal storm risk reduction to known and unknown cultural resources in the project vicinity on the protected side of the levee, thereby reducing the damage caused by rainfall and coastal storm flood events.

6c: South Slidell and West Slidell Levee and Floodwall System

The direct, indirect, and cumulative impacts to cultural resources for the considered action would be similar to Measure: West Slidell Levee and Measure 6a South Slidell Levee and Floodwall System described previously.

Additionally, the Optimized TSP includes proposed alignment changes in the vicinity of Bayou Paquet Road to avoid impacts to the BBMNWR and reduce the number of engineering structures required along waterways. This optimized portion includes three archaeological sites (16ST19, 16ST139, and 16ST279) and one previously identified historic built resource (52-02368) that are located within or directly adjacent to the levee footprint and would require further investigation as to whether they may be adversely affected by construction.

Mile Branch Channel Improvements

Background: In 1996, R. Christopher Goodwin & Associates, Inc. conducted cultural resource field investigations for Mile Branch (22-1996). Approximately 14 percent of the corridor was determined to have a high potential for the presence of prehistoric and historic archaeological resources. Survey was conducted on 5.4 acres. The remaining 23.7 acres were not surveyed because right-of-entry was denied by landowners. No cultural resources sites were recorded as a result of the survey and testing. Two historic built resources were recorded adjacent to Mile Branch. Both were recommended not eligible for listing in the NRHP. Site 16ST273 (Wilson Cemetery) is located within the right-of-way on North Columbia Street. The cemetery is still in use and should be avoided.

Direct, Indirect, and Cumulative Impacts: One archaeological site, Wilson Cemetery (16ST273), is adjacent to the alternative at the northern end. A staging area (that would become Backwater improvements) is proposed just east of this cemetery. There are previously recorded historic built resources adjacent to the location of this alternative; however, there are no previously recorded historic built resources within the footprints of this alternative. This measure includes ground disturbing activities involving access, staging, clearing and grubbing, mechanical dredging, replacement of culverts or bridges, and/or other direct effects to above-ground historic properties (i.e. demolition). These activities may directly impact both known and undocumented cultural resources listed or eligible for listing in the NRHP not limited to: archaeological sites; historic built resources; cemeteries or other sites that may contain human remains, funerary objects, sacred objects, or objects of cultural patrimony; and TCPs; that exist both within the footprint and associated areas in a way that would diminish the integrity of these property’s location, design, setting, materials, workmanship, feeling, or association. Cultural resources surveys would likely be required to identify existing cultural resources.

The indirect impacts to cultural resources for this alternative would be similar to Measure: Bayou Bonfouca Detention Pond described previously.

The cumulative impacts to cultural resources would be the additive combination of impacts by this and other Federal, state, local, and private flood risk reduction efforts including authorized USACE construction projects adjacent to the study area and other projects that will alter the hydrology of St. Tammany Parish (see: Section 1.6).

Mitigation measures of the Optimized TSP: There are no known archaeological sites or previously recorded historic built resources within the mitigation measures of the Optimized TSP. This measure includes ground disturbing activities that may directly impact undocumented cultural resources listed or eligible for listing in the NRHP in a way that would diminish the integrity of these property’s location, design, setting, materials, workmanship, feeling, or association. Cultural Resources surveys would likely be required to identify existing cultural resources.

Levee Borrow Sources

Direct, Indirect, and Cumulative Impacts: All available information suggests that it is highly unlikely that cultural resources exist within the proposed borrow areas. With implementation of the proposed action, any undiscovered cultural resources may be damaged during borrow excavation and construction operations. Cultural resource surveys were completed for ST5, ST9, MS-1, and MS-2 (Table 5-5) and no cultural resources were identified within those borrow areas. As a result, it is unlikely that direct impacts to cultural resources would occur within those sites. Additionally, borrow site ST6 has not been surveyed for cultural resources; however, the city of Slidell constructed the West Diversion Detention Pond in

1998 (USACE 2012). As a result, it is unlikely that intact cultural deposits exist within the previously disturbed ST6 borrow area.

In the unlikely event that undocumented cultural resources exist within the proposed borrow areas, the CEMVN would use the developed PA that outlines the steps necessary to identify and evaluate cultural resources and complete the Section 106 of the NHPA process.

With implementation of the proposed action, no indirect or cumulative impacts to cultural resources would be anticipated.

Table 5-5. Summary of Cultural Resources and Surveys within the Proposed Borrow Sites

Borrow Site	Previously Recorded Cultural Resources	Previous Survey	Previous Survey Coverage	Other Notes:
ST5	None	22-3725	Full	Phase I cultural resources survey on behalf of St. Tammany Parish for a 156.41 acre (63.30 ha) tract on Cypress Bayou in St. Tammany Parish, Louisiana (22-3725; Kuttruff et al. 2011). No cultural resources were identified within the ST5 borrow site.
ST6	None	None	None	City of Slidell constructed the West Diversion Detention Pond in 1998 (USACE 2012).
ST9	None	22-3151	Full	Phase I cultural resources survey on behalf of USCAE for five proposed detention ponds along the north side of the existing W-14 drainage canal (22-3151; Moreno et al. 2012). The parcel surveyed included 30.28 acres (12.25 ha). No cultural resources were identified within the ST9 borrow site. A determination of No Historic Properties Affected was submitted to the LA SHPO on 9 Sept 2008 and 22 Sept 2011. SHPO concurred with CEMVN's determination on 7 Oct 2008 and 16 Nov 2011.
MS-1	None	07-395	Full	MS-1 was investigated for cultural resources for IER #19 and #23 for the HSDRRS projects. At that time, the Mississippi Division of Archives and History (MDAH) had no record of listed or eligible historic properties within MS-1. A Phase I survey of the proposed borrow area did not identify any cultural resources within the Pearlington site (07-395; Pumphrey 2007). The MS SHPO concurred with CEMVN's determination on 22 Nov 2006.
MS-2	None	09-0690	Full	MS-2 was investigated for cultural resources for IER #31 for the HSDRRS projects. A Phase I cultural resources assessment was performed for the Port Bienville contractor-furnished borrow area and no NRHP listed or eligible cultural resources were identified (09-0690; Thorne 2008). Concerns were raised by the Jena Band of Choctaws and the Mississippi Band of Choctaws about potential unrecorded burials within the proposed borrow area. At that time, a Memorandum of Agreement (MOA) was signed between the two tribes as well as by M. Matt Durand, L.L.C. of Port Bienville Clay Mine, L.L.C. outlining procedures to allow use of the borrow area and to care for unexpected discoveries should these occur. It is unknown if this MOA has expired pursuant to its duration provision. If the agreement expired before the undertaking or mitigation measures have been completed, CEMVN must reinitiate consultation to develop a new MOA to resolve the adverse

				effects from the proposed undertaking. The new agreement may acknowledge, incorporate, or continue already agreed upon measures.

5.1.1.14 Noise and Vibration

Alternatives 1 No Action Plan and Alternative 2 Non-Structural Plan (within Optimized TSP)

Direct, indirect and cumulative impacts: These alternatives would not have an impact on noise and vibration.

Optimized TSP (Levees and Mile Branch Improvements)

Construction activities in each of the measures would consist of heavy equipment associated during levee construction, diversion construction, and channel clearing. Overall, to the extent that construction activities occur within a 1000-ft of residences or communities, noise and vibration impacts are anticipated to remain low to moderate during construction and within the staging area, and is expected to temporarily disturb wildlife and residences. Some noise and vibration impacts may be potentially reduced by the use of electricity for the construction equipment. More information on equipment used during construction can be found in Appendix D: Engineering.

There would be temporary noise and vibration impacts from the construction of the mitigation site M-2 resulting from dredging activities for borrow in Lake Pontchartrain and placement of materials in the mitigation site. Temporary minor noise impacts would result from construction equipment utilized to construct the mitigation site. There would also be minor temporary impacts resulting from controlled burns of the PSR-1 mitigation sites from ATVs, UTVs traversing the area managing the controlled fires. Should there be tree thinning, there would be temporary minor noise impacts from that activity. Once construction activities cease noise levels typical of the area would return to background levels.

Levee Borrow Sources: There would be temporary minor impacts to noise and vibration resources as result of borrow excavation, the action would add additional minor impact to the existing conditions by obtaining material from existing operating pits or sites that have been previously cleared and are designated as borrow sites as described in 5.3 and above for Alternatives 2, 4, 5, 7, 8, and 9.

5.1.1.15 Aesthetics

The forecasting of what the study area's visual landscape would look like in the future is determined by:

1. Physical and ecological changes (e.g., land use or vegetative succession).
2. Identifying trends in recreation and land use.
3. Reviewing government agencies' planning documents.

The extent of effort involved for forecasting the study areas' visual landscape's future is limited by time and the availability of relevant information. Additionally, physical and ecological changes combined with trends in recreation and land use may be found elsewhere is this document. Therefore, the focus of this section is on identifying relevant study area planning documents containing information related to desired visual resources' conditions; these include:

4. The Bogue Falaya Park Master Plan (https://www.covingtonplan2030.com/related-plans).
5. The Bogue Chitto National Wildlife Refuge's Comprehensive Conservation Plan (https://www.fws.gov/refuge/Bogue_Chitto/what_we_do/conservation.html).
6. The Big Branch National Wildlife Refuge's Comprehensive Conservation Plan (https://www.fws.gov/refuge/Big_Branch_Marsh/what_we_do/conservation.aspx).

The aforementioned planning documents contain information on planned improvements in Bogue Falaya Park and conservation measures for resources in the national wildlife refuges.

Alternative 1: No Action Plan

Under the No Action alternative, impacts to aesthetics would not occur as a result of the proposed action. Continuing trends of development would continue to affect aesthetic resources. Projects and plans implemented by private, corporate and government entities, such as the plans for improvements to the Bogue Falaya Park and Bogue Chitto Refuge would also affect aesthetic resources.

Alternative 2: Nonstructural Plan (within Optimized TSP)

The direct, indirect, and cumulative impacts to visual resources caused by the nonstructural alternative are detailed in the cultural resources' section; these impacts would include the introduction of potentially visually distressful elements into the area's viewshed and/or modifications to the built-environment that includes elevating historic structures.

Optimized TSP (Levees and Mile Branch Improvements)

The direct, indirect, and cumulative impacts to visual resources caused by this alternative are detailed in the cultural and recreational resources' sections; these impacts would include the introduction of potentially visually distressful elements into the area's viewshed and any Optimized TSP related alterations to the Louisiana Natural and Scenic Rivers System. Additional impacts may be caused by modifications to the built-environment that involves elevating historic structures.

Reestablishment of marsh sites for mitigation would add to the viewshed. The regular controlled burns of the mitigation PSR-01 would temporarily introduce visually distressful elements into the area's viewshed due to the smoke filled air.

Levee Borrow Sources: The visual character of the study area's proposed borrow areas identified as location's 5, 6, and 9 are institutionally and technically insignificant; public significance is undetermined. The proposed borrow areas (5,6, and 9) are adjacent to residential areas. The adjacent residents may determine that the borrow areas are visually distressful. This visual distress may occur if the soil removal process exposes the nearby residents line of sight to an area cleared of vegetation.

5.1.1.16 Recreation

Alternative 1: No Action Plan

Without intervention, conditions within the recreational environment would continue to evolve as they have in the past and would be dictated by the natural land use patterns and processes that have dominated the area in the past. Access to recreational resources along the shoreline and associated marsh may decrease with continued erosion impacts from wind and wave action. Land loss would likely continue and there could be an overall loss of habitat within the system that once provided cover, resting, nesting, and foraging habitat. The loss of these habitats, and the effect such losses would have on wildlife and aquatic species, could cause recreational resources in the basin to transition.

Alternative 2: Nonstructural Plan (within Optimized TSP)

The nonstructural features would have no impact to recreational resources depending on the methods used. Refer to the Optimized TSP analysis below for a discussion of potential impacts from implementing this alternative.

Optimized TSP (Levees and Mile Branch Improvements)

Direct, indirect, and cumulative impacts

The nonstructural features should have no impact to recreational resources depending on the methods used. A direct impact from flood proofing park buildings could be that the recreational use would be temporarily unavailable during flood proofing work, but the facilities may be available for public use sooner after a flood event. An indirect impact of elevating structures on building costs of future recreational camps could result in fewer camps being constructed.

With the proposed levee measures, recreational resources tied directly to Big Branch Marsh National Wildlife Refuge would closely correspond to the environmental effects of hydrology alterations in the refuge. During construction and while in operation, the proposed gate complexes on Bayou Paquet, Bayou Liberty, and on Bayou Bonfouca would temporarily impact the flow and recreational boating and fishing on the bayous. When the proposed features are in operation, recreational boats would not be able to traverse the bayous at these locations (see also 5.1.1.18 Navigation).St. Tammany Trace would also see temporary, indirect impacts such as interrupted access related to construction of the levee. Coordination with the NFS and local stakeholders would be implemented to minimize potential recreational impacts at St. Tammany Trace.

The proposed Mile Branch measure would directly impact the free flow of tributaries of the Tchefuncte River, which is part of the Louisiana Natural and Scenic Rivers System

("Louisiana Scenic Rivers Act". Acts 1988, No. 947, §1, eff. July 27, 1988). (See also 5.1.1.8 Louisiana Scenic Rivers)

Mitigation Sites: The mitigation features and backwater area would have no adverse impacts to public recreation resources including, but not limited to wildlife observation, boating, fishing and hunting. Benefits to public recreation resources would be minimal and closely correspond with terrestrial and aquatic wildlife resources within this document.

Levee Borrow Sources: For the five borrow sources identified, the proposed measures would not directly or indirectly impact existing recreation resources in the region. In some cases, depending on how the end site is left, the habitat may be suitable to support some recreational activities (i.e., wildlife viewing and fishing), but these benefits are expected to be minimal, and sites would not be open to public access.

5.1.1.17 Socioeconomics

Impacts to the human environment would be considered significant if:

Socioeconomic impacts resulted in a substantial shift in population trends or adversely affected regional spending and earning patterns.

Alternative 1 - No Action Plan

There would be no direct impact on the human environment under this alternative. The trends would continue as presented in the future without project condition.

There would be no indirect impacts under the No Action Alternative.

Alternative 2: Nonstructural Plan (within Optimized TSP) – see below discussion in Optimized TSP.

Optimized TSP (Levees and Mile Branch Improvements)

Population and Housing

Direct impacts include the potential for damage to structures, landscaping, and driveways while the structure is being elevated. There could be potential inconvenience to residents having to move and store their personal possessions and relocate to a temporary residence while their residences are being elevated. Additionally, access to the residence would be impeded during the time the residence is being elevated. Temporary relocation of individuals and families could entail different travel routes through unfamiliar areas, longer commute times to work, school, and other destinations for typical life activities (e.g., shopping, doctor visits, etc.). The change in commute times could be a positive or negative impact since the relocation could temporarily move individuals and families either closer or farther away from their destinations. During construction of the levee and channel improvements, commute times could be increased for residents in some communities due to certain access points being blocked temporarily. Indirect impacts for the levee, channel improvements, and the elevation of structures would include reduced risk of damages from flooding events for population and housing. This risk reduction would lead to greater stability and sustainability of population and housing resources. However, if a residence is elevated, access to the elevated residences could be more difficult, especially for the elderly and physically handicapped, even if retrofitted with an elevator and other special access improvements. Additional indirect impacts would be the different visual appearance of neighborhoods and communities with a few elevated structures located within a community of nearby structures that are not elevated.

Direct impacts for the non-structural measures include the potential for damage to structures, landscaping, and driveways while the structure is being elevated. There could be potential inconvenience to residents having to move and store their personal possessions and relocate to a temporary residence while their residences are being elevated. Additionally, access to the residence would be impeded during the time the residence is being elevated. Temporary relocation of individuals and families could entail different travel routes through unfamiliar areas, longer commute times to work, school, and other destinations for typical life activities (e.g., shopping, doctor visits, etc.). The change in commute times could be a positive or negative impact since the relocation could temporarily move individuals and families either closer or farther away from their destinations. Indirect impacts would include reduced risk of damages from flooding events for population and housing. This risk reduction would lead to greater stability and sustainability of population and housing resources. However, if a residence is elevated, access to the elevated residences could be more difficult, especially for the elderly and physically handicapped, even if retrofitted with an elevator and other special access improvements. Additional indirect impacts would be the different visual appearance of neighborhoods and communities with a few elevated structures located within a community of nearby structures that are not elevated.

Employment, Business, and Industrial Activity (Including Agriculture)

There would be direct impacts associated with the flood proofing of businesses in the nonstructural plan. If commercial structures are flood proofed, businesses could potentially either shut down or relocate temporarily while the measure is being applied, which could lead to a loss of revenue, change in business clients to other more available businesses, as well as a loss of wages to employees. There is a potential that existing landscaping around businesses could be damaged and require restoration. Certain access points could be impeded during the construction of the levee and channel improvements, but access to public facilities would not likely be completely restricted. Indirect impacts of the levee, channel improvements, and nonstructural measures would include reduced risk of damage for employment, business, and industrial activity that would translate into greater stability of productivity in the region.

There would be direct impacts associated with the flood proofing of businesses in the nonstructural plan. If commercial structures are flood proofed, businesses could potentially either shut down or relocate temporarily while the measure is being applied, which could lead to a loss of revenue, change in business clients to other more available businesses, as well as a loss of wages to employees. There is a potential that existing landscaping around businesses could be damaged and require restoration. Indirect impacts would include reduced risk of damage for employment, business, and industrial activity that would translate into greater stability of productivity in the region.

Public Facilities and Services

Direct impacts associated with the levee and channel improvements would likely be negligible. Certain access points could be impeded during the construction of the levee and channel improvements, but access to public facilities would not likely be completely restricted. Direct impacts associated with flood proofing to public facilities in the area would be the interruption and temporary unavailability of public services if these facilities are forced to close or are relocated temporarily during implementation of the nonstructural risk reduction measures. Indirect impacts include reduced risk of flooding damages for public facilities and services in the area, thereby reducing the number of days a structure is unavailable for use and minimizing the inconvenience to the public.

Direct impacts associated with flood proofing to public facilities in the area would be the interruption and temporary unavailability of public services if these facilities are forced to close or are relocated temporarily during implementation of the nonstructural risk reduction measures. Indirect impacts include reduced risk of flooding damages for public facilities and services in the area, thereby reducing the number of days a structure is unavailable for use and minimizing the inconvenience to the public.

Transportation

Direct impacts associated with the construction of the levee, channel improvements, and the nonstructural measures for transportation would include temporary and intermittent delays, disruption of traffic movement, congestion of roads, and re-routing of vehicles and pedestrians during the construction of the various risk reduction measures. Local parking access to businesses could also be affected by construction vehicles and crews. Indirect impacts would include the additional wear and tear on roads, especially local roads. There would also be greater noise and dust generated by construction vehicles. However, best construction management practices would be utilized to limit dust emissions and to ensure the safety of construction workers, residents, and employees during construction of the levee, channel improvements, and nonstructural measures.

Direct impacts associated with the nonstructural plan for transportation would include temporary and intermittent delays, disruption of traffic movement, congestion of roads, and re-routing of vehicles and pedestrians during the construction of the various risk reduction measures. Local parking access to businesses could also be affected by construction vehicles and crews. Indirect impacts would include the additional wear and tear on roads, especially local roads. There would also be greater noise and dust generated by construction vehicles. However, best construction management practices would be utilized to limit dust emissions and to ensure the safety of construction workers, residents, and employees during construction of the nonstructural measures.

Community and Regional Growth

Direct impacts would include a temporary monetary stimulus to the region due to spending associated with the construction activities in the area. This stimulus would be an increase to the region's income for as long as the spending continued. Temporary relocations would likely take place within the overall study area during implementation of the nonstructural measures, resulting in little if any change. Indirect impacts would include reduced risk of flooding damages for low-lying structures, thus reducing overall social vulnerability and preserving growth opportunities for communities in the region and enhancing the potential for long-term growth and sustainability.

Tax Revenues and Property Values
Parish sales tax revenue would likely increase during the implementation of nonstructural measures due to an expected influx of workers and construction expenditures from outside of the area. Construction activities would provide jobs and could increase the level of spending, labor, and capital expenditures in the area.

Community Cohesion
Direct impacts that would disrupt community cohesion, temporarily, include the noise from construction activities, the temporary displacement and relocation of residents during construction, and disruption of businesses during construction. Furthermore, non-residential structures that serve as meeting places for the community could become temporarily unavailable during the implementation of nonstructural measures. Indirect impacts for the nonstructural plan would include reduced risk of flooding damages for structures within communities, thus preserving community cohesion in the region.

<u>*Levee Borrow Sources*</u> There would be temporary minor impacts to socioeconomic resources as result of borrow excavation, the action would add additional impact by obtaining material from existing operating pits or sites that have been previously cleared and are designated as borrow sites as described in 5.3 and above for Alternatives 2,4,5,7,8, and 9.

5.1.1.18 Navigation

Alternatives 1: No Action Plan and Alternative 2: Nonstructural Plan (within Optimized TSP)

There would be no impacts to navigation resulting from not implementing the proposed action or from implementing the Non-structural plan. Current trends would be expected to continue into the future.

Optimized TSP (Levees and Mile Branch Improvements)

There would be no impacts to navigation resulting from implementing the non-structural plan or from the proposed widening and deepening of the Mile Branch. Lake Pontchartrain and the tributaries that drain into it primarily serve recreational boating interests, and recreational fishing in the areas. Recreational boats would be able to continue to traverse Liberty Bayou and Bayou Bonfouca. There may be some temporary impacts to boating on Bayou Bonfouca during construction of the bypass channel and during transition times pre- and post-construction. There would also be temporary impacts to recreational boating during named storm events when proposed FG would be closed due to an impending storm. The gates are estimated to be closed for a few days until it is considered safe to reopen the gates. These impacts would be expected to be short term. Additional H&H modeling and project design would occur during PED to determine operating plans for the floodgate structures, open and closing triggers as well as durations. There are no major shipping corridors that would be impacted, affecting commerce in the study area. Impacts to navigation that affect recreational boating are described further in 5.3.11 Recreation.

Mitigation Sites: There would be no impact to navigation resources as a result of the proposed mitigation sites.

Levee Borrow Sources: There would be no impact to navigation resources as result of borrow excavation as described in 5.3.

5.1.1.19 Environmental Justice

An EJ assessment identifies areas of EJ concern and assesses impacts to these areas and mitigation strategies that avoid, reduce and minimize both direct, indirect impact and cumulative impacts. First areas of EJ concern are identified using minority and low-income criteria, which are discussed below. Figures are an excellent way to visually display the areas and for this EJ analysis, census block groups is the preferred geographic display. A Census Block Group (CBG) is a geographical unit used by the United States Census Bureau which is, in size, between the Census Tract and the Census Block. It is the smallest geographical unit for which the bureau publishes sample data, i.e., data which is only collected from a fraction of all households. This data is available for the years between the decennial census (taken every 10 years). Typically, Block Groups have a population of 600 to 3,000 people.

The second step is to identify the impacts to areas of EJ concern from the federal action, in this case, the impacts of constructing a flood risk reduction system. The third step is to determine If the impacts to areas of EJ concern are high, adverse disproportionate impacts. If they are, a mitigation plan is required and developed through EJ outreach and engagement with residents of Areas of EJ Concern to develop measures that would avoid, minimize and reduce the impacts. Regardless, if adverse impacts are disproportionate or not, this EJ assessment provides mitigation measures for the adverse impacts.

A key element of the EJ assessment is EJ Outreach and engagement throughout the planning process. Both of the Executive Orders mentioned earlier express the need to meet with residents who live in Areas of EJ Concern throughout the planning process. The goal of the outreach is to inform and engage with the hope of receiving comments about the project. EJ outreach is discussed at the end of this section.

Two different tools are used to identify areas of EJ concern. The National Historic Geographic Information System (NHGIS) tool enables the user to download 2020 U.S. Census Bureau demographic data for several different geographic levels. The NHGIS tool provides data (from the U.S. Census Bureau) and maps that identify areas of EJ concern.

Areas of EJ concern is the focus of the Executive Orders which state the importance of achieving Environmental Justice. A second source for this EJ analysis is EPA's EJSCREEN which lists demographic data and 12 environmental indicators and an area's percentile rank compared to the region and the USA. The environmental indicator report helps determine if any of the areas of EJ concern are overburdened with different types of environmental pollution or environmental vulnerability further reinforcing its identification as an area of EJ concern.

Identification of areas of EJ concern is based upon two thresholds recommended in the EPA's "Promising Practices for EJ Methodologies in NEPA Reviews" ("Promising Practices") document prepared by the Federal Interagency Working Group on EJ. A CBG is considered an EJ area of concern if it is comprised of 50 percent or more of residents identifying as a minority, or if the minority percentage is meaningfully greater than (15 percent) the reference area minority population (in this case the State of Louisiana) or if 18.6 percent or more of households live below poverty level. The poverty threshold uses the state of Louisiana poverty rate (18.6 percent).

The EJSCREEN tool also displays environmental indicators for CBGs to help identify environmental risks to communities. The indicators are another way of identifying an EJ community. Environmental Indicators are presented for St. Tammany Parish, Louisiana, in Table 2 of the Appendix C: Environmental Justice. An EJ Index that is above the 80th percentile in the State, the EPA Region or in the USA is, according to EPA, the percentile where one could expect environmental justice concerns. None of the environmental indicators are at the 80th percentile or higher in the State of Louisiana or in the USA. Much of the construction activities associated with the Optimized TSP or with any of the Final Array Alternatives would not exacerbate environmental concerns as identified by EPA's EJSCREEN tool. Nonetheless, best management practices would be utilized to avoid, reduce, and contain temporary impacts to human health and safety.

See Section 3.2.2.1.6 for discussion of Environmental Justice existing conditions.

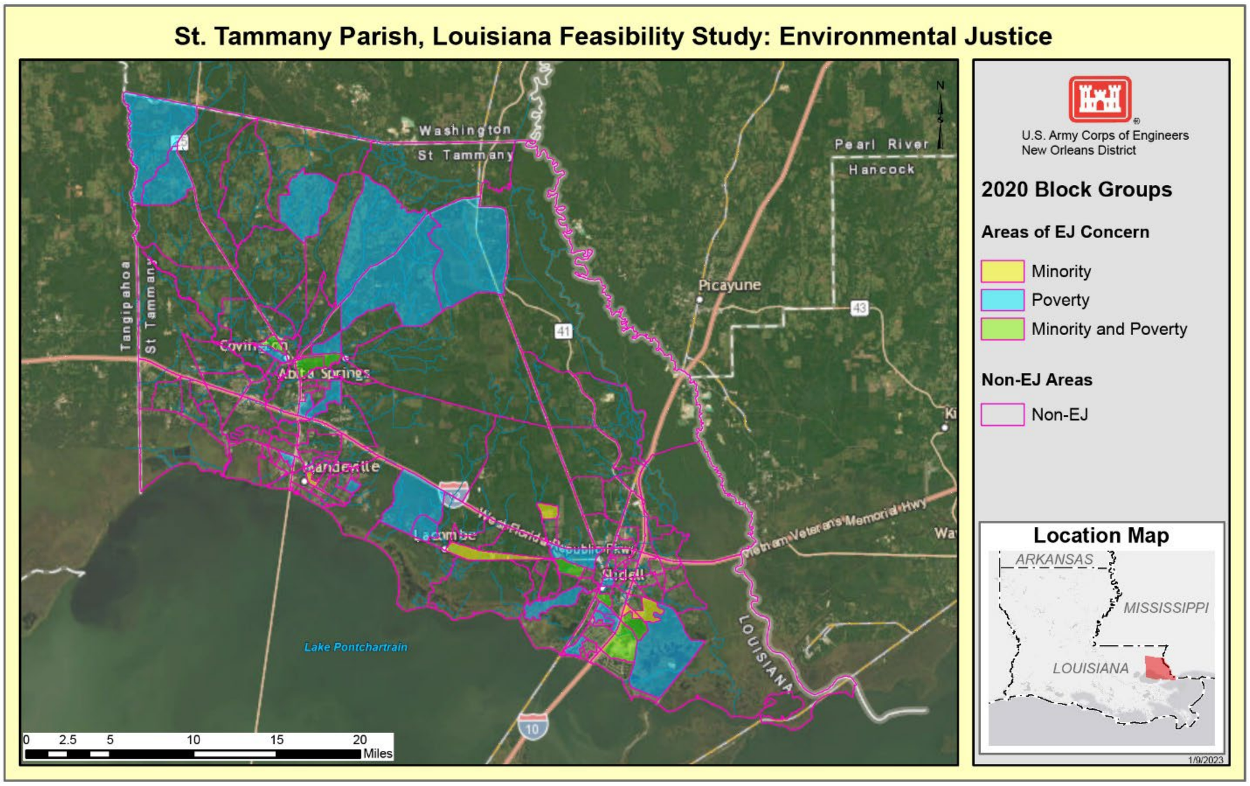


Figure 5-30. Areas of EJ concern at the Block Group Level, Study Area

Source: Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic

Alternative 1: No Action Plan

Without implementation of the proposed action, a federal flood risk reduction project would not be constructed. The area would continue to experience damages from rainfall and storm surge and housing and roads would continue to experience flooding during high water events. There would be no direct impact on minority and/or low-income population groups under this alternative. However, because this alternative fails to provide flood risk reduction, the actual and perceived risks to minority and/or low-income population groups under this alternative would be higher than under the alternatives. Low-income and minority populations would continue to be affected by and potentially adapt to changes in environmental conditions under the No Action Alternative in the short-term. Continued risk of flooding to EJ areas of concern in the study area could result in these communities suffering economic losses, loss of agricultural lands, impacts to urban structures and property, loss of crops, or damage to property, and reduction in land values.

Indirect impacts under the No Action Alternative would include a higher potential for permanent displacement of minority and/or low-income population groups as compared to the with-project alternatives as residents relocate to areas with higher levels of flood protection.

Cumulative impacts under the No Action Alternative would include the potential for a steady decline in minority and/or low-income population groups and other groups as residents move to areas with lower flood risks as well as continued financial and emotional strain placed on these groups as they prepare for and recover from flood events.

Alternative 2: Nonstructural Plan (within Optimized TSP)

The Nonstructural Plan may cause temporary impacts to housing, both within EJ and non EJ areas of concern while eligible residential structures are being elevated. How the implementation of the Nonstructural Plan might impact low-income and minority communities is not yet known at this point in the planning process. If voluntary resulting relocations are determined to be necessary, further evaluation of the impact to areas of environmental justice concerns would be assessed at that time.

For the nonstructural alternative in the Final Array, since the study area is subject to flooding from a variety of rivers, lakes, and bayous, as well as coastal flooding, aggregates were primarily grouped according to source of flooding. For the coastal aggregates, coastal Slidell yields positive net benefits through the 2 percent AEP event. The other coastal aggregates yield positive net benefits through the 1 percent AEP event. For the riverine aggregates, all yield positive net benefits through the 4 percent AEP event. All structures within economically justified aggregates would be potentially eligible for voluntarily flood-proofing or elevation if relevant standards are met; therefore, all residents within those reaches, irrespective of race, ethnicity, or income, would be able to participate in the plan. These nonstructural measures may provide sparsely populated areas of minority and low-income populations with beneficial flood risk reduction equivalent to that which would be provided by structural measures, which are not economically justified due to the sparse population scattered over a large area. Despite existing base flood elevations differing among individual structures, structure-raising would provide the same level of risk reduction benefits per structure at year 2082 (end of the period of analysis).

Only eligible residential structures could be elevated. An eligible structure is, among several criteria, one that is structurally-sound and capable of being elevated. Additionally, while the eligible structure is being elevated, residents of that structure are required to relocate to temporary quarters. Homeowners would be responsible for the costs to have their structure repaired so it can be elevated and the relocation housing costs during the elevation.

Low-income homeowners may not have sufficient resources to bear these costs. Homeowners of residential structures that do not meet the soundness criteria and who can’t afford the repairs and those who can’t afford to relocate during elevation would be unable to participate in the program. Their residences would remain at existing grade and would be exposed to higher risk for flooding than the homeowners who participate in the program. Although homeowners would be responsible for costs associated with repairs to ensure a structurally-sound home prior to elevation and would be responsible for temporary relocation costs during elevation, all other eligible costs of elevating structures, including the cost to elevate the structure, would not be borne by any single individual or the community; rather, these costs would be part of the proposed project costs. Minority and low-income tenants living in rental properties may experience benefits if the property owner chooses to participate in the plan. Under those circumstances, renters would not be responsible for temporary relocation costs.

The implementation plan for the nonstructural alternative may cause high, adverse disproportionate impacts to low-income residents who cannot afford the costs associated with elevation. A more refined assessment to identify high, adverse disproportionate impacts would be completed during PED when housing that is not engineeringly-sound would be identified. If necessary, a mitigation plan to address high and adverse impacts would be developed through public outreach to EJ areas of concern and public meetings. A whole-of-government approach may be applied to help resolve any disproportionate impacts to EJ areas of concern identified during PED. Whole-of-Government approach involves identifying other entities (such as other local, state, and federal governments) that may be able to provide financial assistance that bridges the financial gap of low-income owners to become eligible for structure elevation.

Optimized TSP (Levees and Mile Branch Improvements)

Positive and Adverse Impacts to EJ Areas of Concern: The Optimized TSP includes three measures, 1) the slightly modified South and West Slidell combined levee (Alternative 6c) referred to as West Slidell Levee, 2) the Mile Branch Channel Improvements measure from Alternative 8, and 3) the modified Nonstructural Alternative 2. The NS alternative includes only those structures in the future 4 percent, 2 percent, or 1 percent flood stage.. However, the impacts are the same as described for Alternative 2 but less since fewer structures are included in the economically justified reaches. As stated for Alternative 2, further evaluation of the nonstructural plan impact on communities with EJ concerns would be completed during (PED. This section discusses the Optimized TSP impacts, both positive and adverse to areas of EJ concern.

Benefits to Areas of EJ Concern

A comprehensive benefits analysis and its positive impact on disadvantaged communities is presented in Section 6.4. Disadvantaged communities are similar to areas of EJ concern and are shown at the census tract level using CEQ's Climate and Economic Justice Screening Tool (CEJST). However, the CEJST criteria used to identify the disadvantaged communities does not include minority data which is a criteria for identifying areas of EJ concern.

Positive impacts include a decrease in flood risk to minority or low-income populations. The alternatives would reduce the adverse impacts to EJ communities experienced under the no-action condition - flood damages, loss of life, reduced economic activity, and potential out-migration. These positive impacts would be long term and would be likely to sustain the socioeconomic vitality of the area, positively impacting EJ communities. Positive economic dollar benefits accrue to those in areas of EJ concern, which are described in the Section 6.4, comprehensive benefits analysis.

Mile Branch Channel Improvement: The proposed Mile Branch Channel alignment passes through two EJ areas of concern and two areas that are not an EJ concern. In total, the Mile Branch Channel improvement would benefit 297 residential and non-residential structures with the majority of these being in areas a of EJ concern. Benefits as discussed in this section are associated with a lowering flood stage and resulting decrease in flood damages to structures. The majority of the structures that would benefit from the improvements are residential (265). Of the 265 residential structures receiving some level of flood stage lowering, 162 or 61 percent are in areas of EJ concern, particularly Census Block Groups 405012 and 405013. This is a positive direct benefit to residents in areas of EJ concern.

- Overall = 297
    - Residential = 265
    - Non-Residential = 32

- In EJ Areas = 176
    - Residential = 162
    - Non-Residential = 14

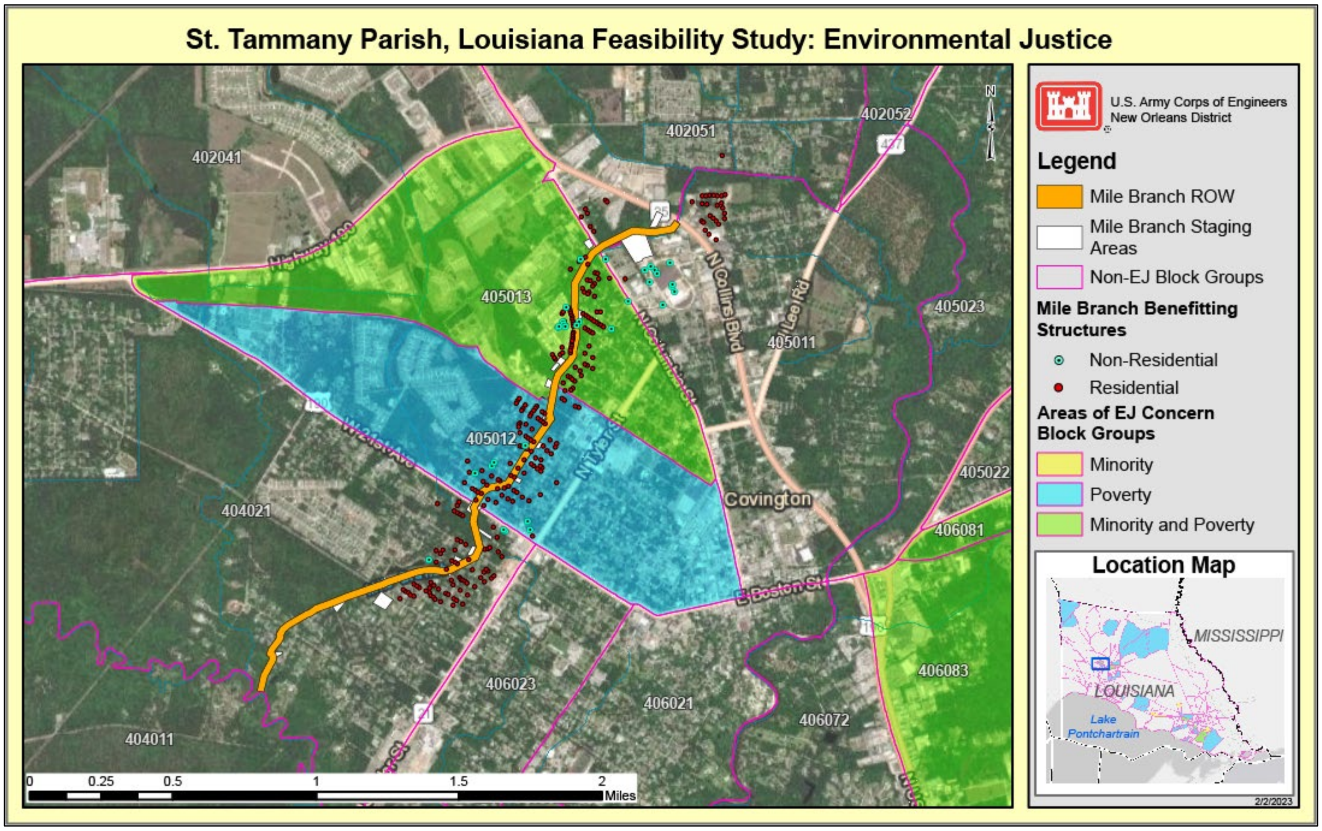


Figure 5-30. Mile Branch Channel Improvements, Areas of EJ concern and Structures Benefiting

Note: Polygon shapefiles shown on the maps in the EJ sections of the main report and attribute data used in the EJ analysis are from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 16.0 [dataset]. Minneapolis, MN: IPUMS. 2021. http://doi.org/10.18128/D050.V16.0

West Slidell Levee: Construction of the West Slidell Levee could benefit nearly 16,000 structures. A vast majority of these structures are residential (approximately 13,000). Of the 13,000 residential structures benefiting, about 40 percent are in EJ areas of concern. Figure 5-31 shows the location of the structures benefiting in relation to areas of EJ concern.

Slidell Levee INV

- Overall = 15,835
    - Residential = 13,111
    - Manufactured, modular and mobile homes = 818
    - Non-Residential = 1,906

- In EJ Areas = 6,342
    - Residential = 5,220
    - Manufactured, modular and mobile homes = 352
    - Non-Residential = 770

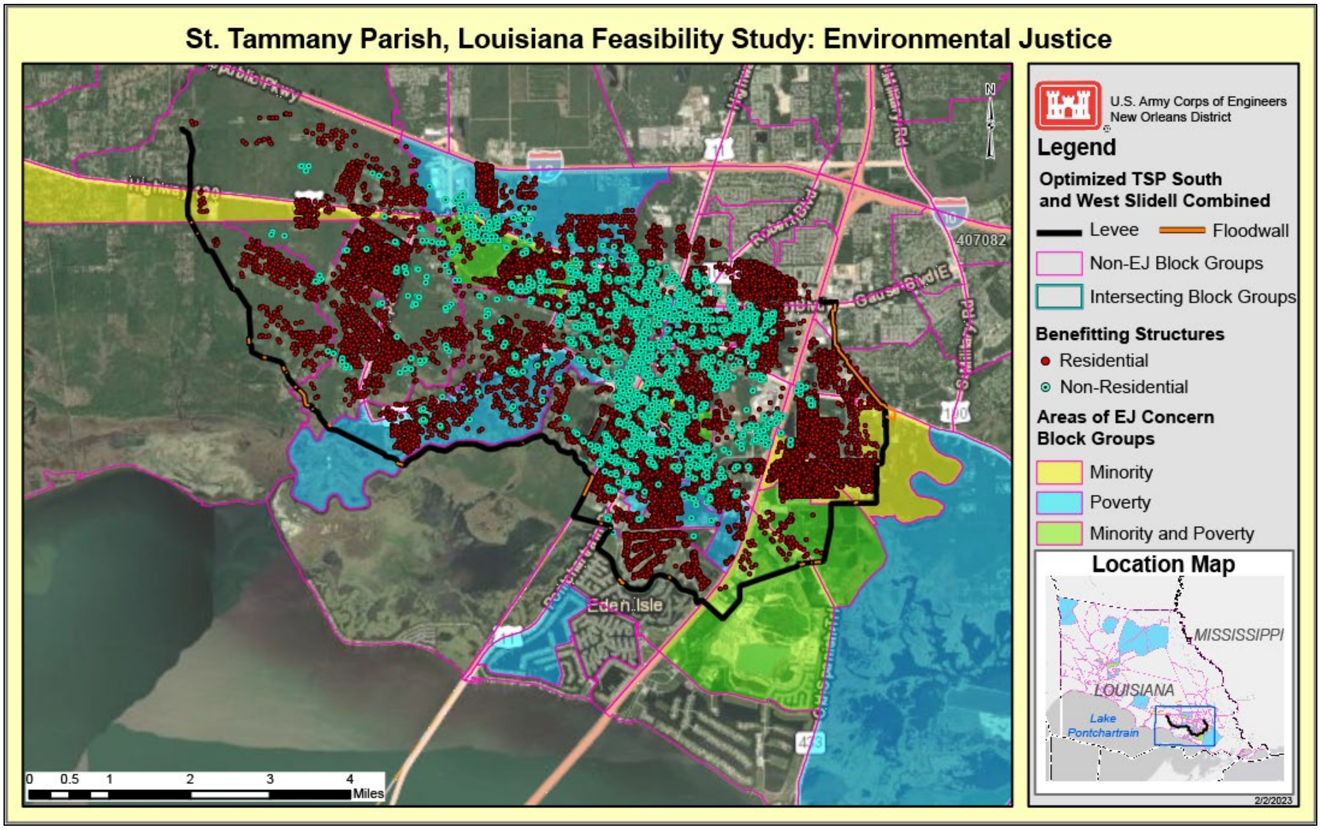


Figure 5-31. South and West Slidell Levee Alignment, Areas of EJ concern and Structures Benefiting

Note: Polygon shapefiles shown on the maps in the EJ sections of the main report and attribute data used in the EJ analysis are from Steven Manson, Jonathan **Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 16.0 [dataset]. Minneapolis, MN: IPUMS. 2021.** http://doi.org/10.18128/D050.V16.0

Nonstructural Plan: The nonstructural component of the Optimized TSP, which is a voluntary plan, involves elevating homes and for non-residential properties, offers the option to have businesses dry or wet floodproofed. The nonstructural plan includes 6,410 structures that would reduce flood risk and coastal storm damage to structures that are not included in the areas benefitted from the structural measures of the Optimized TSP. Approximately 5,583 eligible residential structures would be elevated to the future 4 percent, 2 percent, or 1 percent flood stage (up to 13 feet. Additionally, 827 eligible nonresidential structures would be floodproofed up to 3 feet. For more information on the nonstructural plan, refer to Appendix H: Nonstructural Implementation Plan.

Elevating or floodproofing structures offers the chance for property owners to reduce their flood risk from both storm surge and rainfall events. Overall, the nonstructural plan would offer the opportunity to elevate or floodproof about 6,410 structures, the vast majority being residential (approximately 5,583). Of these residential structures, only 10 percent are in areas of EJ concern. Of course one reason this figure is so low is that the entire parish is majority white and not low-income so there are fewer places spread throughout the parish that meet or exceed the minority and poverty thresholds for an area of EJ concern and the nonstructural plan is tailored to those structures in hydrologic areas that have a 1 percent Annual Exceedance Probability or flooding from a 100-year event. Figure 5-31 shows the general location of the structures in the nonstructural plan relative to EJ areas of concern.

STP Nonstructural INV Updated

- Overall = 6,410
    - Residential = 5,166
    - Manufactured, modular and mobile homes = 417
    - Non-Residential = 827

- In EJ Areas = 745
    - Residential = 505
    - Manufactured, modular and mobile homes = 85
    - Non-Residential = 155

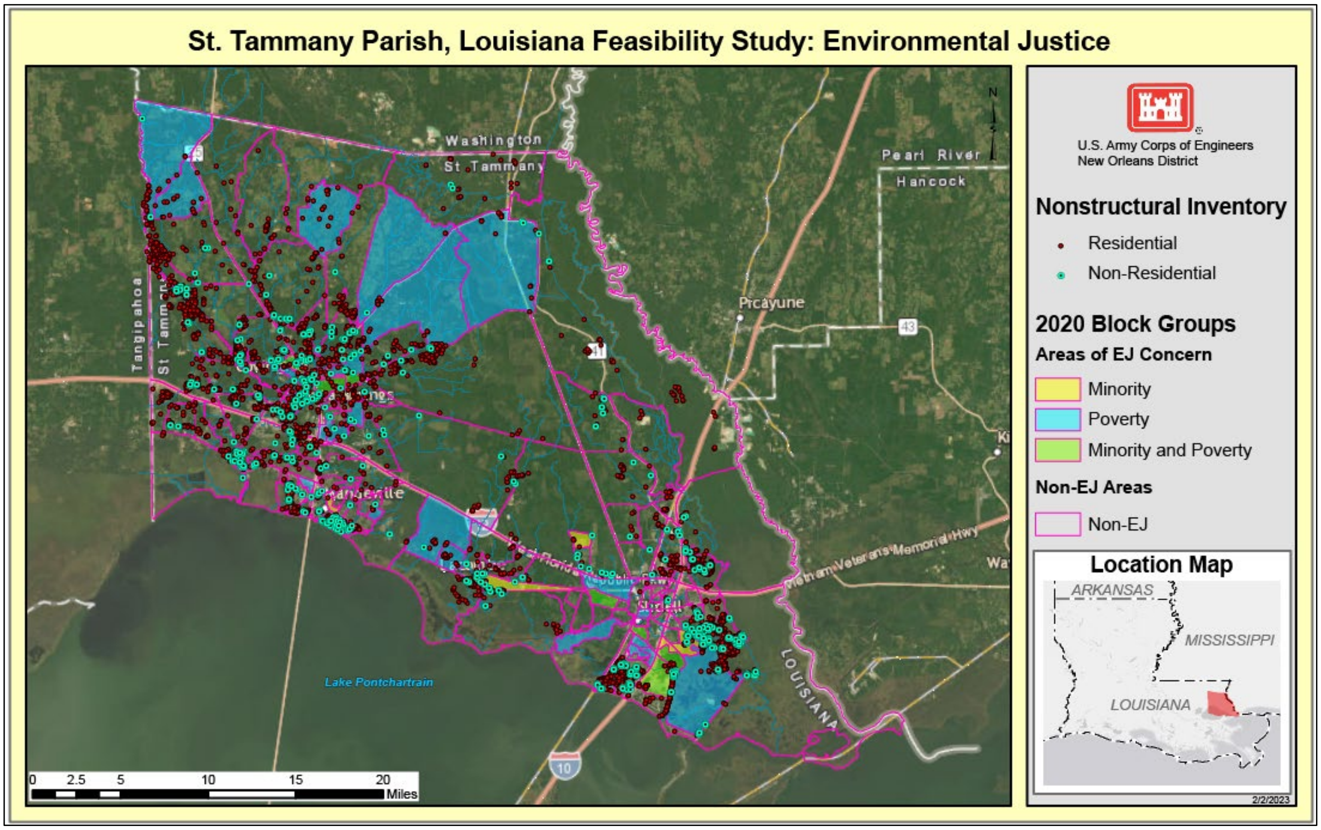


Figure 5-32. Nonstructural Plan Inventory and Areas of EJ Concern

Note: Polygon shapefiles shown on the maps in the EJ sections of the main report and attribute data used in the EJ analysis are from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS Na**tional Historical Geographic Information System: Version 16.0 [dataset]. Minneapolis, MN: IPUMS. 2021.** http://doi.org/10.18128/D050.V16.0

Adverse Direct Impacts to Areas of EJ Concern: Direct, adverse impacts from construction of the Optimized TSP include the acquisition of structures that are within the ROW needed for the channel improvements for Mile Branch or within the proposed footprint of the West Slidell Levee.

Twenty-three structures that are within the West Slidell Levee alignment may need to be acquired to construct the levee/floodwall; 18 of them are residential structures and 5 are non-residential structures. Along the Mile Branch channel improvement ROW, there are 31 structures, 28 residential and 3 non-residential structures, that may need to be acquired to construct the Mile Branch Channel Improvement. The number of structures that may need to be acquired are a worst case scenario and would be reassessed and possibly refined to minimize acquisitions during pre-engineering and design phase of the project.

There are no direct adverse disproportionate impacts resulting from the nonstructural plan, which is the elevation of residential homes and floodproofing of commercial structures.

Direct Adverse Impacts: Mile Branch Channel Improvement: Of the 28 residential structures that may be acquired due to the construction of the Mile Branch Channel improvement, 20 are located in areas of EJ concern while three of the five commercial structures are in areas of EJ concern as shown in Figure 5-33. The large number of structures located in areas of EJ concern borders on a disproportionate impact; therefore, mitigation strategies are described in the following section, notably Uniform Relocation Act (URA) funds. If the alternative impact is appreciably more severe or greater in magnitude on minority or low-income populations than the adverse effect suffered by the non-minority or non-low-income populations after taking offsetting benefits into account, then there may be a disproportionate finding.

To help inform the disproportionate impact determination, benefits must be compared to the level of impacts; and, the goal is to have a balance of adverse impacts and benefits therefore resulting in no disproportionate impacts. In total, the Mile Branch Channel improvement would benefit 297 residential and non-residential structures with the majority of these in areas of EJ concern. In this case, because there are substantial benefits to areas of EJ concern, the impact of acquisitions is not disproportionate.

Additionally, EJ outreach informed and engaged the communities about the impacts and the proposed mitigation. Additionally, the community would be engaged about their thoughts on how to mitigate the adverse direct impact of acquisition.

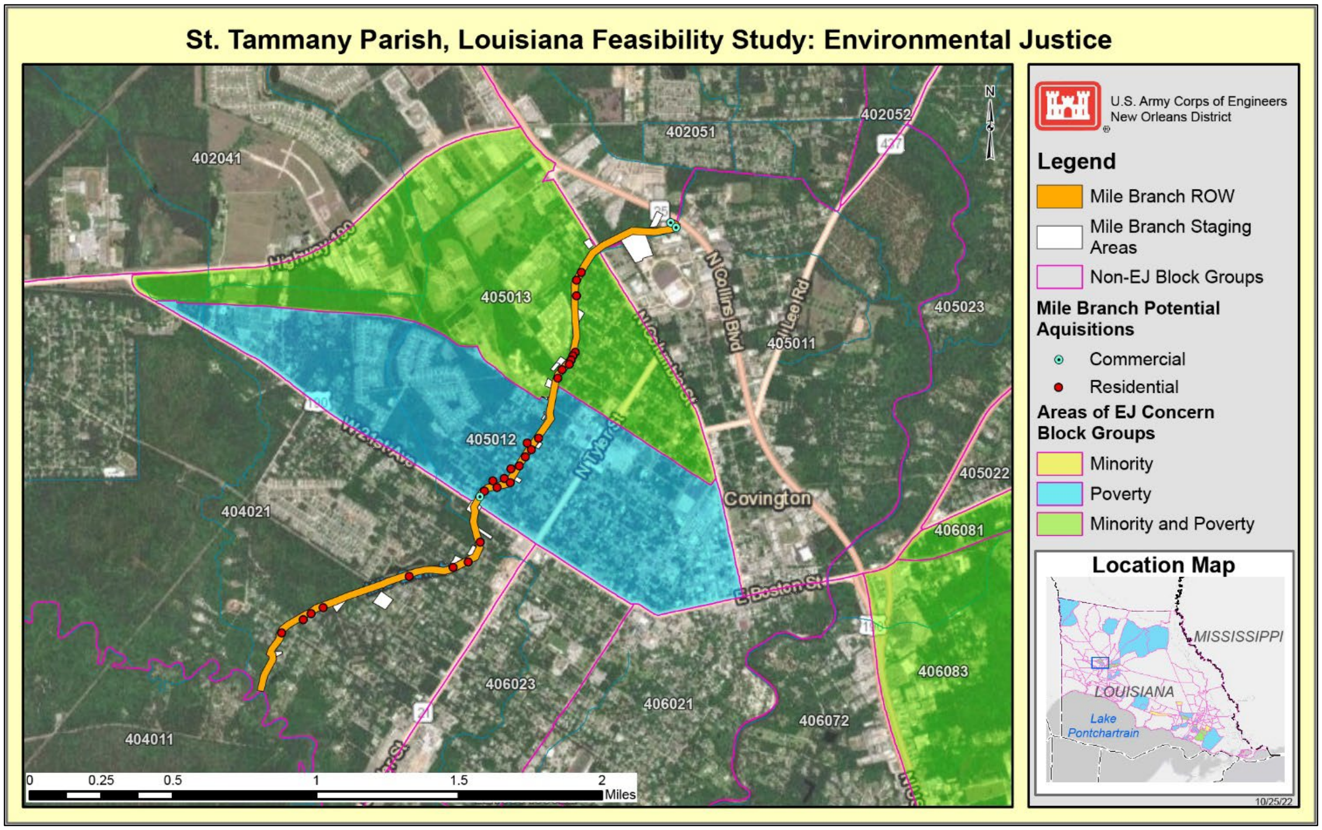


Figure 5-33. Mile Branch Channel Improvement Potential Structure Acquisitions

Note: Polygon shapefiles shown on the maps in the EJ sections of the main report and attribute data used in the EJ analysis are from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 16.0 [dataset]. Minneapolis, MN: IPUMS. 2021. http://doi.org/10.18128/D050.V16.0

<u>*Direct Adverse Impacts: South and West Slidell Levee:*</u> Of the 18 potentially affected (acquired) residential properties along the West Slidell levee/floodwall alignment, 4 are located in areas of EJ concern while 14 residential structures that may be acquired for construction of the levee/floodwall are NOT in areas of EJ concern. Additionally, when compared to who is receiving benefits from the levee, construction of the proposed West Slidell Levee could benefit nearly 16,000 structures. The high, adverse impact of residential acquisition for the West Slidell Levee does not cause a disproportion burden to areas of EJ concern. Mitigation measures would be offered to those households displaced because of the levee/floodwall construction. The mitigation measures include the use of the URA which is discussed in detail in the Appendix G: Real Estate Plan. Of the five commercial properties that could be acquired along the levee/floodwall alignment, three are in areas of EJ concern while two are NOT in areas of EJ concern. The high, adverse impact of commercial structure acquisition is not a disproportionate impact to areas of EJ concern the impact is proportionally distributed across both EJ and non-EJ areas of concern. EJ outreach would inform and engage the communities with and about the impacts and the proposed project.

Figure 5-34. shows the locations of the structures that may be acquired along the West Slidell Levee/floodwall alignment and the structures that are in areas of EJ concern.

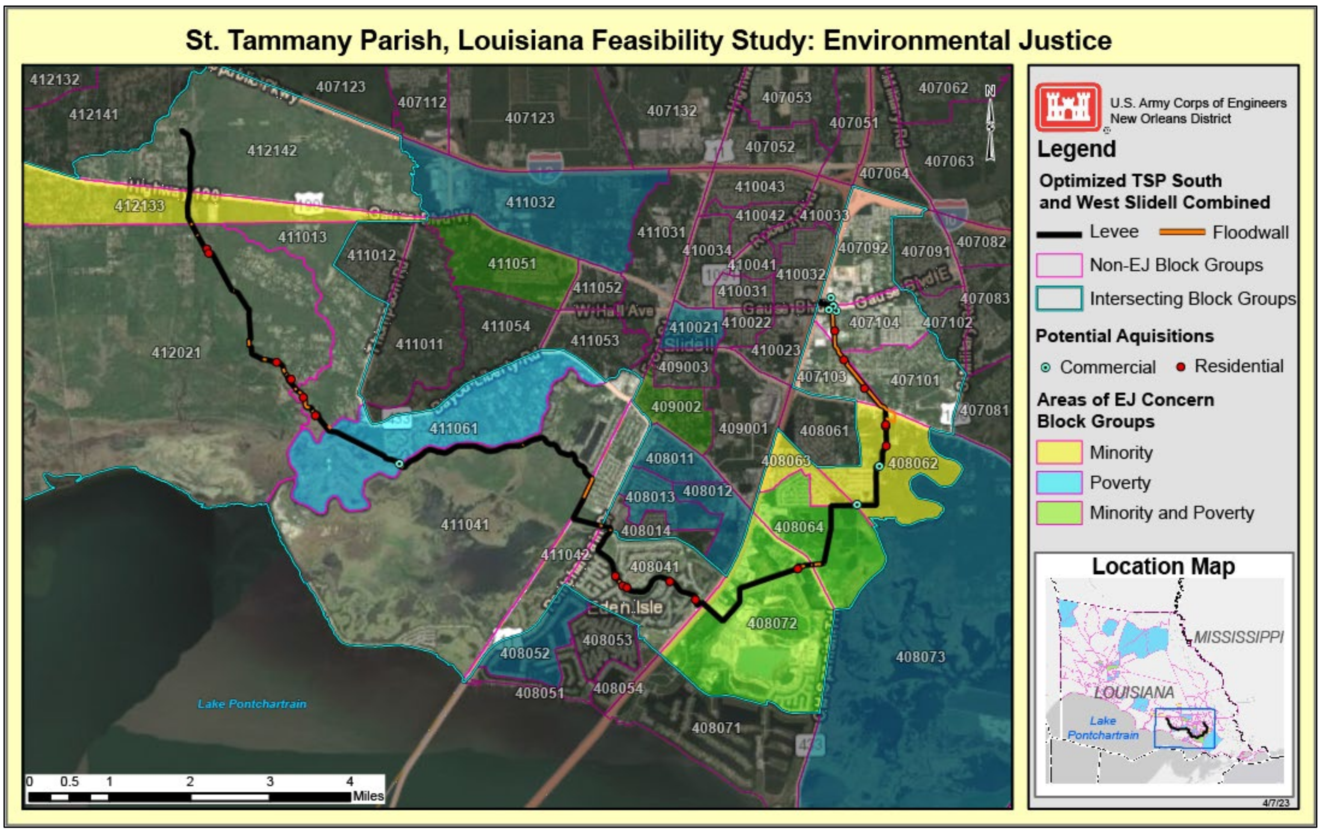


Figure 5-34. West Slidell Levee Potential Structure Acquisitions

Note: Polygon shapefiles shown on the maps in the EJ sections of the main report and attribute data used in the EJ analysis are from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 16.0 [dataset]. Minneapolis, MN: IPUMS. 2021. http://doi.org/10.18128/D050.V16.0

Adverse Indirect Impacts to Areas of EJ Concern: The indirect impacts from the construction of the Mile Branch Channel improvement and the West Slidell Levee construction are not expected to be high adverse impacts, would be temporary, and related to construction activities. Indirect adverse impacts due to the nonstructural plan and elevating of structures also are related to construction activities associated with the elevation of the structure.

Adverse, indirect impacts of construction of the structural measures may include the following: transportation and traffic delays, noise, and dust and air quality impacts. Approximately 130,000 cubic yards of material would be dredged from the Mile Branch Channel, resulting in about 9,000 truck trips over the course of the project. For the South and West Slidell Levee, approximately 7,239,000 cubic yards of borrow material would be required (including future levee lifts) to construct the levee system, resulting in approximately 499, 200 truck trips over a five-year period, or about 277 trucks trips per day traveling throughout the study area to the various segments of levee being constructed.

Adverse indirect impact of structure elevations include the temporary relocation of the household members while the structure is being elevated. However, these indirect impacts would not be considered high, adverse, or disproportionate, are temporary in nature and would be felt by those in EJ and non-EJ communities.

In general, the construction, operation, maintenance of the Optimized TSP, particularly the West Slidell Levee and Mile Branch Channel measures, may cause adverse temporary impacts on the road network near the Mile Branch Channel ROW and adjacent to the West Slidell Levee alignment due to increased congestion, accelerated roadway wear-and-tear, and traffic delays resulting from re-routing major and local access roads. Temporary impacts on transportation due to increased congestion may occur and is dependent on road closures required to construct the improvements and the levee. Road closures may not occur every day, and if closures are required, they would be for the short-term. On those segments of roads that must close and traffic re-routed, minor to moderate delays, particularly during peak hours, may occur especially in more congested areas.

Noise along all segments of the channel improvement and along and adjacent to the levee construction would increase due to the temporary operation of equipment and vehicles used during construction. While noise impacts may cause a temporary inconvenience to residents and facilities in the immediate area, noise levels associated with construction activities would be temporary and monitored to ensure acceptable standards are maintained. No permanent noise impacts are anticipated, and all noise emissions are expected to be short-term, lasting only as long as construction activities.

Dust and air quality impacts to EJ areas of concern are expected to be minor and short term. Temporary increases in air pollution could occur from the use of construction equipment (combustible emissions). Combustible emission calculations were made for standard construction equipment, such as bulldozers, excavators, dredgers, pumps, front end loaders, backhoes, cranes, and dump trucks.

Mitigation of Impacts to Areas of EJ Concern

Mitigation of Direct Impacts in Areas of EJ Concern

Uniform Relocation Act (URA) Benefits for those impacted under the Nonstructural Plan: Allowable relocation assistance funds for displaced tenants are allocated in accordance with the Uniform Relocation Assistance (URA) and Real Property Acquisition Policies for Federal and Federally Assisted Programs of 1970, Public Law 91-646, 84 Stat. 1984 (42 U.S.C. 4601), as amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV of Public Law 100-17, 101 Stat. 246-256. Relocation assistance for tenants may include, among other things, advisory services, eligible reasonable out-of-pocket expenses incurred during temporary displacement (e.g., moving and storage of household goods required to be removed during construction, temporary quarters, meals, etc.). Landowners whose properties are voluntarily elevated would not be eligible for benefits in accordance with URA; however, tenants of these structures may be eligible for these benefits.

Uniform Relocation Act (URA) Benefits for those impacted by Acquisition: Homeowners who are impacted by acquisition would also qualify for URA benefits, which are described in more detail in Appendix G:Real Estate Plan.

Mitigation of Indirect Construction-Related Impacts to Areas of EJ Concern: Best Management Practices include several impact avoidance features which are included as integral components of the proposed action to minimize impacts to vehicular transportation. Specific routes would be designated for construction-related traffic to minimize residential disturbance and traffic congestion. USACE contracts would designate specific routes for construction-related traffic to avoid residential areas, to the maximum extent practicable, and staging areas for construction equipment and personnel would be located away from heavily populated areas. Streets that would serve construction-related traffic would be resurfaced, if needed and as appropriate, prior to initiation of construction activities, and maintenance of those streets would be provided during the construction period. Appropriate detour signage would be placed in order to preserve access to local streets during construction activities. Off-street parking would be provided for construction workers, and shuttle vans would be used to transport construction workers to the work sites, if necessary. Streets that are damaged by any and all construction activities would be repaired.

Noise along all segments of levee construction would increase due to the temporary operation of equipment and vehicles used in the construction of the levee. Short-term noise impacts would be avoided, minimized or mitigated by use of the following best management practices:

- The contractor, as a best management practice and as practicable, would restrict work to regular business hours (approximately 0700-1900) on weekdays to reduce potential effects from noise and increased truck traffic to the identified existing EJ community and general public.
- Placement of temporary noise barriers adjacent to construction activities.
- If machinery causing vibrations is used, the following noise and vibration monitoring language would be included in the contract specifications for specific work items:

- Monitoring of noise levels to verify adherence to contract specifications
- Limit pile driving activities associated with pile founded T-walls to daylight hours
- Use vibration monitoring equipment that measures surface velocity waves caused by equipment and monitor vibration up to a threshold value established and approved in writing by USACE. Such measurements would only be taken near residences and occupied buildings that could be adversely affected by excessive ground vibrations.
- Construction equipment noise would be minimized during construction by muffling and shielding intakes and exhaust on construction equipment (per the manufacturer's specifications), and by shrouding or shielding impact tools.

All equipment, haul trucks, and worker vehicles would be turned off when not in use for more than 30 minutes.

Equipment warm-up areas, water tanks, equipment storage areas, and staging areas would be located as far from existing residences as is feasible.

According to EPA's EJSCREEN environmental indicators for St. Tammany Parish (EJ Appendix, Table 2), the Air Toxics Respiratory Hazard Index is low (any index above the 80 percentile is a high burden that would warrant further investigation and discussion) and any temporary effect of dust related to construction activities or use of construction equipment is not expected to alter this index.

Borrow Sources: Material obtained from borrow sources would be from four sites that would have no direct impact on EJ communities and one site that would impact an EJ community. Two sites in Mississippi (MS-1 and MS-2) are commercially-operating borrow pits. These two sites were previously evaluated in Individual Environmental Reports (IER) #19, 23, and 31 for the Hurricane and Storm Damage Risk Reduction System (HSDRRS) projects. That discussion is incorporated by reference. The remaining three sites are STP-5, STP-6, and STP-9. More information regarding the selection of borrow sources can be found in Appendix C: Environmental.

Borrow site STP-6 is in the Slidell area and is adjacent to a minority and low-income community, as identified using CBG data. Population groups residing near the borrow sites may experience minor, temporary, adverse indirect impacts. Potential impacts to these communities include an increase in truck traffic accessing and leaving the borrow sites, noise, and dust. Truck traffic and noise along roads, highways and streets during borrow site excavation would cease following completion of work activities. There may also be a degradation of the transportation infrastructure, primarily local roads and highways, as a result of the wear and tear from transporting earthen material. Best management practices would be utilized to avoid, reduce, and contain temporary impacts to human health and safety. During PED, the particulars of these impacts would be identified, including the approximate duration of activities involved in extracting material and the number of truck trips needed to deliver the material. Locations STP-5 and STP- 9 are located near communities that are predominately white and not low-income.

The two borrow sites in Mississippi, MS-01 and MS-02, are located on lands surrounded by undeveloped parcels and therefore impacts to minority and low-income residents would be either nonexistent or very minimal. Additionally, the areas around the borrow sites are vastly white and not low-income.

5.2 CUMULATIVE EFFECTS ANALYSIS

The Council on Environmental Quality (CEQ) Regulations define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR §Parts 1500-1508).

USACE recognizes that on July 16, 2020, CEQ published a Final Rule revising its NEPA-implementing regulations at 40 CFR Parts 1500 - 1508 (85 FR 43304). The revised regulations apply to NEPA processes begun after their effective date, 14 September 2020, although agencies may apply the revised regulations to ongoing NEPA evaluations begun before that date. 40 CFR 1506.13. USACE has chosen to proceed under the regulations in effect at the time the St. Tammany Parish EIS process began in early 2020 (The Notice of Intent was published on June 19, 2020 [85 FR 37075]).

Cumulative effects are not caused by a single project but include the effects of a particular project in conjunction with other projects (past, present, and future) on the particular resource. Cumulative effects are studied to enable the public, decision-makers, and project proponents to consider the "big picture" effects of a given project on the community and the environment. In a broad sense, all impacts on affected resources are probably cumulative; however, the role of the analyst is to narrow the focus of the cumulative effects analysis to important issues of national, regional, and local significance (CEQ, 1997).

The CEQ issued a manual entitled Cumulative Effects under NEPA (CEQ, 1997). This manual presents an 11-step procedure for addressing cumulative impact analysis. The cumulative effects analysis concentrates on whether the actions proposed for this study, combined with the impacts of other projects, would result in a significant cumulative impact, and if so, whether this study's contribution to this impact would be cumulatively considerable.

In Louisiana, the causes of coastal wetland degradation and loss have been researched extensively. Losses are expected to continue due to many different, and often interacting factors, including agriculture, nutrient enrichment, drainage, climate change, human development, pollution, invasive species, world-wide eustatic sea level rise, subsidence, navigation channels, oil and gas activities, saltwater intrusion, and tropical storms.

The gradual decline of marsh vegetation due to storm surge events, inundation, and saltwater intrusion eventually lead to complete loss of marsh vegetation. As this marsh vegetation is lost, underlying soils become more susceptible to erosion, leading to an increase in open water areas and preventing marsh regeneration. Without the accretion or deposition of sediments where erosion is occurring, it is not possible for marsh habitat to reestablish.

Rising sea levels in climate forecasting for the state of Louisiana are anticipated to expose additional shoreline areas to erosive forces. Levees, floodwalls, and other water resource management structures provide risk reduction to the human environment during flooding events from storm surge; aid in the reduction of flood risk and damages to residential, commercial, historic, cultural, and critical assets and infrastructure; limit economic damages and improve economic resiliency of the local economy and communities; convert flood zones to help minimize insurance expenses; and help reduce recovery time from high water events that make evacuation routes and other critical roadways impassable.

Regional Projects and Programs

Since the 2005 hurricane season, significant resources and efforts focused on rebuilding southeast Louisiana. To quantify these regional efforts, a wide array of resources were canvassed to try to bring the impacts of as much of this rebuilding effort as practicable under one overarching evaluation of cumulative impacts due to regional actions. For the cumulative impact analysis, regional projects conducted by others in southeastern LA were broadly addressed through the following subheadings:

- Storm Damage Reconstruction Projects - 29;
- Orleans Parish building permits 343,220 (2005-2011)
- Redevelopment Project – 500
- Coastal and Wetlands Restoration Projects – 240
- Flood Risk Reduction Projects – 125
- Transportation Projects – 339

Past, present, and reasonably foreseeable future regional projects including regulatory permits are listed in Appendix C, Annex N under the subheadings as indicated above. Coastal and restoration projects considered in the analysis include the State Master Plan measures in southeastern Louisiana. The analysis includes projects under the Final Comprehensive Environmental Document, Louisiana Coastal Impact Assistance Program (CIAP) and the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). As of October 2020, there are a total of 226 CWPPRA projects. Of those, 149 are active, six are inactive, 17 are complete, 96 are in long-term O&M, eight have been transferred, and 46 have been deauthorized. In addition, other regional projects include Section 408 permissions under Section 14 of the River and Harbors Act of 1899, codified at 33 USC Section 408. A total of 114 Section 408 permissions were issued between July 2016 and August 2020 by the CEMVN Operations Division. Of the issued permissions, 55 projects were in a five parish area including St. Tammany Parish, a majority of which were evaluated as Categorical Permissions or Categorical Exclusions.

Levee Systems:

The proposed project would construct approximately 18 miles of earthen levees. The impacts from construction of this project would be an additive impact to other similar projects constructed in the past, present and into the future. The proposed project would result in conversion of marsh and pine savanna habitat to earthen levees. The floodgates proposed for the waterways would be closed during named storm events and over time would be closed more frequently due to sea level rise.

Construction of levees, floodwalls and floodgates are, in a way, a way of life in coastal Louisiana and the coastal states along the Gulf Coast. These structures are necessary to provide flood risk reduction to the cities and communities in which they are constructed to protect. Billions of dollars have been spent in coastal Louisiana to construct flood risk reduction projects. Projects such as the Lake Pontchartrain & Vicinity and Westbank & Vicinity Hurricane Storm Damage Risk Reduction System have constructed approximately 213 miles of levees, floodwalls, closure structures, and pump station structures. The direct and indirect effects of implementing the HSDRRS projects, the significant environmental resources, ecosystems, and human communities that are affected, and the effects important from a cumulative impact’s perspective have been documented in the Comprehensive Environmental Document dated October 2021. The CED is a cumulative impact assessment of the HSRRS projects evaluated in 66 Individual Environmental Reports (IERs) supplemental IERs and EAs.

As a result of environmental conditions in coastal Louisiana such as subsidence and sea level rise, future levee lifts are necessary to maintain the 100-yr level of risk reduction. Initial rough order of magnitude estimates suggests that future levee lift of the HSDRRS would require 9 million cubic yards of additional borrow. The Non-Federal Sponsor can construct future lifts to sustain the design heights until 2025 with USACE 33 USC Section 408 permissions. Absent future construction of additional levee lifts by either the USACE or CPRAB and the local levee districts, risk associated with flooding from a tropical event in the metro New Orleans area would increase over time.

Borrow

In 2007, the USACE began an unprecedented search for suitable earthen material to rebuild and reinforce the HSDRRS in the Greater New Orleans metropolitan area. Approximately 72 borrow sites were evaluated in IERs. These borrow sites are located in twelve parishes in Louisiana and one county in Mississippi; these include, Jefferson, Orleans, St. Charles, Plaquemines, St. James, St John the Baptist, Iberville, St. Tammany parishes, and Hancock County, Mississippi.

Of those borrow sites investigated, only 21 borrow sites were excavated. All sites with wetlands were avoided. Two sites that were cleared by IERs are proposed borrow sites for this proposed project.

Farmland or pasture sites were primarily used as borrow areas for the HSDRRS construction. Two sites that were cleared by IERs and utilized as a borrow source for HSDRRS are proposed borrow sites for this proposed project. The other five borrow sites proposed are grasslands. Generally, agricultural fields and open grassland areas are ideal sources of borrow for construction of flood risk reduction projects. Over time, this results in significant loss of open grasslands and agricultural lands and leaves the landscape marked by open pits converted to essentially bodies of water such as ponds.

The currently known significant long term adverse cumulative effects expected from implementation of the proposed action would be associated with the conversion of existing marsh, and pine savanna habitats levee and the impacts to hydrology resulting from operation of floodgates during named storm events. Conversion of marsh, and forested habitats to grass-covered levee habitat would provide benefits for human development at the cost of lost habitat, including productive wetlands. Some loss of wetland habitat would occur even in the absence of the proposed project; current loss of wetlands throughout the area is the result of development, subsidence, erosion as well as sea level rise.

Longer term cumulative impacts of the project would include a reduction in existing habitat used by various terrestrial and aquatic organisms for shelter, nesting, feeding, roosting, cover, nursery, EFH and other life requirements.

Construction impacts associated with potential levee construction (i.e.. Southeast Louisiana Urban Flood Damage Reduction Projects (SELA)), ecosystem restoration (LPV Zydeco Ridge II), hydrologic restoration (Fritchie Marsh Restoration), development (Madison Bulkhead) could result in short term localized impacts such as increased turbidity, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels as well as providing some long-term benefits including flood risk reduction for communities, habitat restoration providing shelter, food and foraging opportunities for wildlife . Areas exposed to Lake Pontchartrain along the outside of the levee alignment are expected to receive an increased rate of erosion due to the reflection of storm surge against the levee. Indirect, longer term impacts include alterations to canals and their associated spoil banks, as hydrology changes within these wetland systems, often interfering with normal tidal flooding from Lake Pontchartrain, as well as overland water flow.

Section 6
Optimized Tentatively Selected Plan

The plan formulation process for this study identified potential solutions to rainfall, riverine and coastal storm related flooding across the study area. The study area has discrete hydrologic sub-basins, which allowed for measures and alternatives to be developed for each of these areas independently. Throughout the study, measures within the alternatives were independently evaluated and screened so that the justified measures to address flooding in each area could be identified. The measures that were determined to be incrementally justified and provide the greatest net benefits were combined to form the Optimized TSP.

The DIFR-EIS identifying the Draft TSP was released in June 2021 for concurrent ATR, IEPR Policy, and Public Review. Based on the feedback received and additional engineering, economic, and environmental investigations, the Draft TSP underwent final feasibility level of design and was optimized and reconfirmed.

The Optimized TSP is a comprehensive plan to address flooding parish-wide, which includes structural nonstructural measures that address both FRM and CSR and FRM flood risks. The structural component of the Optimized TSP consists of construction of a levee and floodwall system along an alignment in South and West Slidell, Louisiana, and channelization of a portion of the Mile Branch in Covington, Louisiana. The nonstructural component of the Optimized TSP spans the entire St. Tammany Parish and consists of elevation of 5,583 structures and floodproofing of 827 structures. Figure 6-1 illustrates the Optimized TSP and Table 6-1 details the Optimized TSP attributes.

A summary of the final feasibility level Optimized TSP is included in this Section. The full engineering project description and assumptions for the Structural Plan are included in Appendix D: Engineering. The Nonstructural Plan is further described in Appendix F: Economics and Appendix H: Nonstructural Implementation Plan.

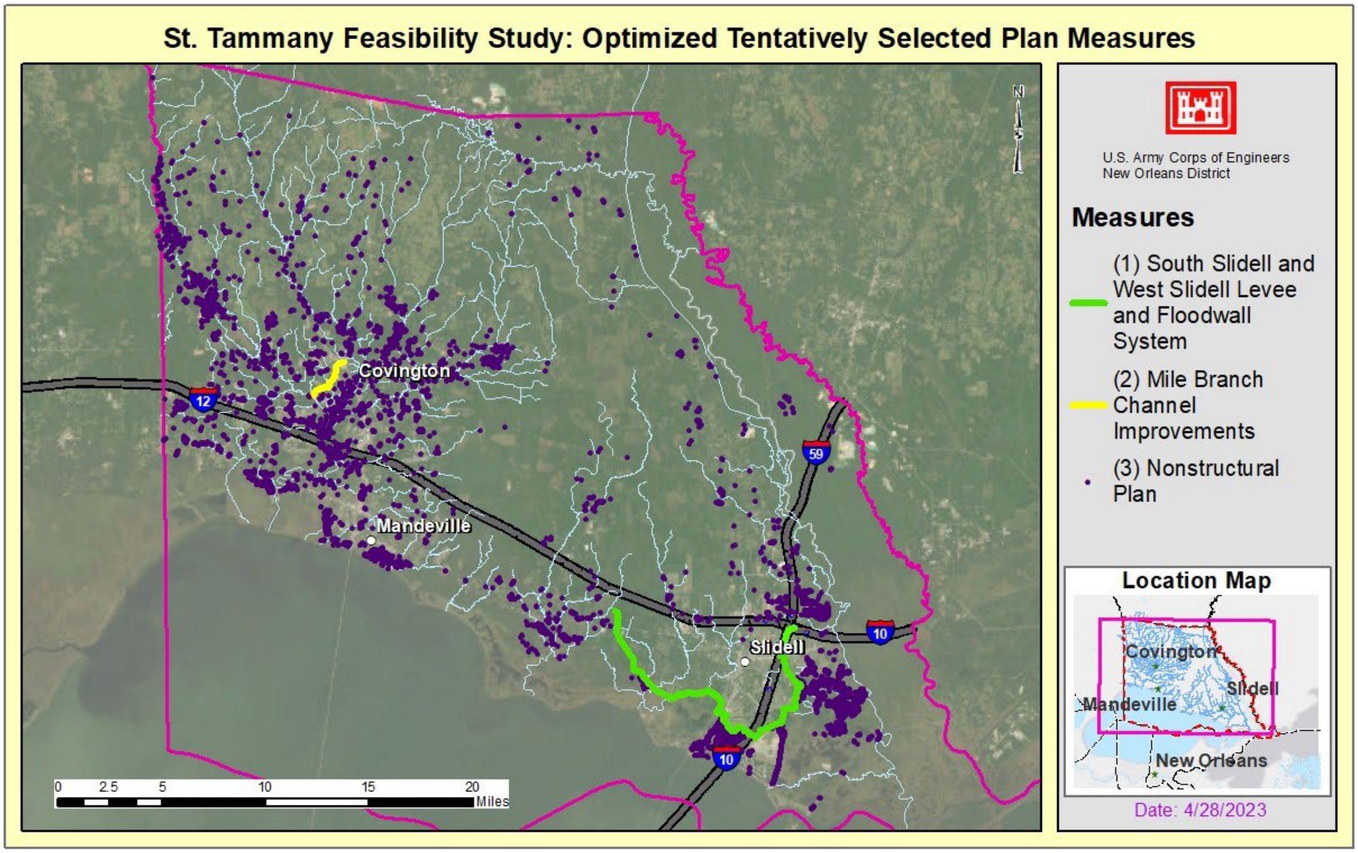


Figure 6-1. Optimized TSP/NED Plan

Table 6-1. Optimized TSP/NED Plan Attributes

Attribute	South Slidell and West Slidell Levee and Floodwall System	Mile Branch Channel Improvements	Nonstructural	Total
Total Length of alignment/improvements	18.5 miles (97,700 feet)	2.15 miles (11,341 feet)	-	-
Length of Floodwall	3.5 miles (18,200 feet)	-	-	-
Length of earthen Levee	15 miles (79,500 feet)	-	-	-
Hydraulic Design Elevation Range (Dependent on location)	13.5 to 16 (year 2032) 17.5 to 20 (year 2082) (depending on location)	-	-	-

Pump Stations	8	-	-	-
Culverts/ Sluice Gates/ Life Gates	13	-	-	-
Number of Vehicular Floodgates	18	-	-	-
Number of Pedestrian Floodgates	1	-	-	-
Number of Railroad Gates	1	-	-	-
Number of Road Ramps	6 (includes the I-10 near Oak Harbor)	-	-	-
Number of staging areas for clearing and grubbing and mechanical dredging and for bridge replacement	-	18 (7 for bridge replacements, 10 for clear and grubbing and mechanical dredging and one that becomes a backwater area)	-	-
Number of Bridge Replacements	-	7	-	-
Fill (Borrow Material) Required	7,079,000 cubic yards (initial construction plus future lifts) 3,000,000 cubic yards for initial construction only	-	-	-
Material to be Mechanically Dredged	-	130,000 cubic yards	-	-
Temporary Acres of Construction Impacts	238 acres (3.34 net acres)	7.3 acres (2.2 acres for bridge replacements and 5.1 acres for clear and grubbing and mechanical dredging)	-	-
Permanent Construction Impacts	352 acres (224 net acres)	38.8 acres (34 acres for clear and grubbing and mechanical dredging and 4.8 acres for one staging area that becomes a backwater area)	-	-

Number of structures benefitted	20,000	250	6,410	26,600
Mitigation Costs	$39,973,512.98	$6,828,1982.82	-	$46,801,711.80
Construction Costs	$2,440,973,000	$77,002,000	$1,934,084,000	$4,452,059,000
Net Benefits	$68,415,000	$368,000	$168,300,00	$237,083,000
B/C Ratio	1.7	1.1	3.5	2.4

6.1 TSP NONSTRUCTURAL MEASURES (CSRM AND FRM) ELEVATIONS AND FLOOD PROOFING (OPTIMIZED VERSION OF ALTERNATIVE 2)

The nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use of the floodplains, or by accommodating existing uses to the flood hazard. nonstructural measures differ from structural measures in that they focus on reducing the consequence of flooding for a specific structure rather than reducing the probability of flooding in that area.

Approximately 5,583 eligible residential structures would be elevated to the future 100-year flood stage up to 13 feet, and 827 eligible nonresidential structures in would be floodproofed up to 3 feet. Eligible structures must have a first-floor elevation (FFE) at or below the 25, 50 or 100 -year storm surge floodplain (depending on location within the study area), based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis). The analysis and aggregation of the nonstructural plan was refined from the Draft TSP which was based on the 50 year flood plain. This sub-aggregation based on combinations of structures that had the same source of flooding and community characteristics. This included consideration of underserved communities as identified by the Justice 40 criteria. An incremental floodplain or flood frequency analysis was conducted for each of the aggregates. The results showed in Table 4-21 that 16 of the 20 aggregates were economically justified up to the 4% (25 year) AEP Floodplain, coastal Slidell was economically justified up to the 2% (50 year) AEP Floodplain and coastal Lacombe, coastal Mandeville, and coastal Madisonville were economically justified up to the 1% (100 year) floodplain. A depiction of the structures included in the nonstructural plan are included in Figure 6-2.

In order to be preliminarily eligible for elevation, a residential structure must meet the following initial criteria:

- The structure must have a first-floor elevation at or below the applicable floodplain (which may be either a 25, 50 or 100 year floodplain depending on the location of the structure), based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis) at a specific location.

- The structure must be outside of the area of influence of the structural features recommended in the Optimized Tentatively Selected Plan (Optimized TSP) and not be receiving flood risk reduction benefits from the structural features (i.e., outside of the areas of influence (defined as the area that benefits from a given structural measure in the form of lowering stages) of the Optimized TSP.

- The elevation of the structure must be economically justified, meaning that the cost to implement the nonstructural measure of a certain structure does not exceed the total monetary cost of the flood damages that are anticipated to be avoided over the 50-year period of analysis (years 2032-2082).

- The structure must have a permanent foundation and be permanently immobilized and affixed or anchored to the ground as required by applicable law and must be legally classified as immoveable real property under state law. Notwithstanding the provisions of La. R.S. 9:1149.6, a manufactured, modular or mobile homeowner and any subsequent owner of an immobilized manufactured, modular or mobile home, may not deimmobilize the manufactured, modular or mobile home in the future, by detachment, removal, act of deimmobilization, or any other method. Manufactured, modular and mobile homes that do not meet these requirements are not eligible for elevation.

Additionally, 827 eligible nonresidential structures in would be floodproofed up to 3 feet. Dry floodproofing consists of sealing all areas of a structure up to a maximum of approximately 3 feet above ground level to reduce damage caused by coastal storm surge inundation by making walls, doors, windows and other openings resistant to penetration by water. Walls are coated with sealants, waterproofing compounds, or plastic sheeting. Back-flow from water and sewer lines is prevented by installing mechanisms such as drain plugs, standpipes, grinder pumps, and back-up valves. Openings, such as doors, windows, sewer lines, and vents, may also be closed temporarily with sandbags or removable closures, or permanently sealed.

The floodproofing of eligible nonresidential structures would protect structures that are not included in the areas benefitted from the structural measures of the Optimized TSP. To be considered preliminarily eligible for participation, a nonresidential structure must meet the following criteria:

- Have a first-floor elevation (FFE) at or below the 25, 50 or 100- year storm surge floodplain (depending on location within the study area), based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis) at a specific location.; and
- Structure must be outside of the area of influence of the structural features recommended in the Optimized TSP and not receiving flood risk reduction benefits from the structural features (i.e., outside of the area of influence (defined as the area that benefits from a given structural measure in the form of lowering stages) of the Optimized TSP.
- Elevation of the structure is deemed to be economically justified, meaning that the cost to implement the nonstructural measure of a certain structure does not exceed the total monetary cost of the flood damages that are anticipated to be avoided over the 50-year period of analysis (years 2032-2082).

The nonstructural elevations and floodproofing are voluntary, property owners who have preliminarily eligible structures that wish to participate in the flood proofing measures would be required submit an application and provide a right-of- entry for their structure to undergo site assessment, appraisal, and other inspections and evaluations to determine the final eligibility of the structure.

Further detail on the sub aggregation can be found in Section 4.4.2.7 Appendix F: Economics and Appendix H: Nonstructural Implementation Plan. Once the study is complete, detailed plans and specifications for implementing nonstructural measures would be developed as part of the PED phase. The PED phase occurs after Congress authorizes the recommended plan into law and appropriates funds for construction of the recommended plan. In concert with structural measures, nonstructural measures would be a key component to reducing long term FRM and CSRM to the study area.

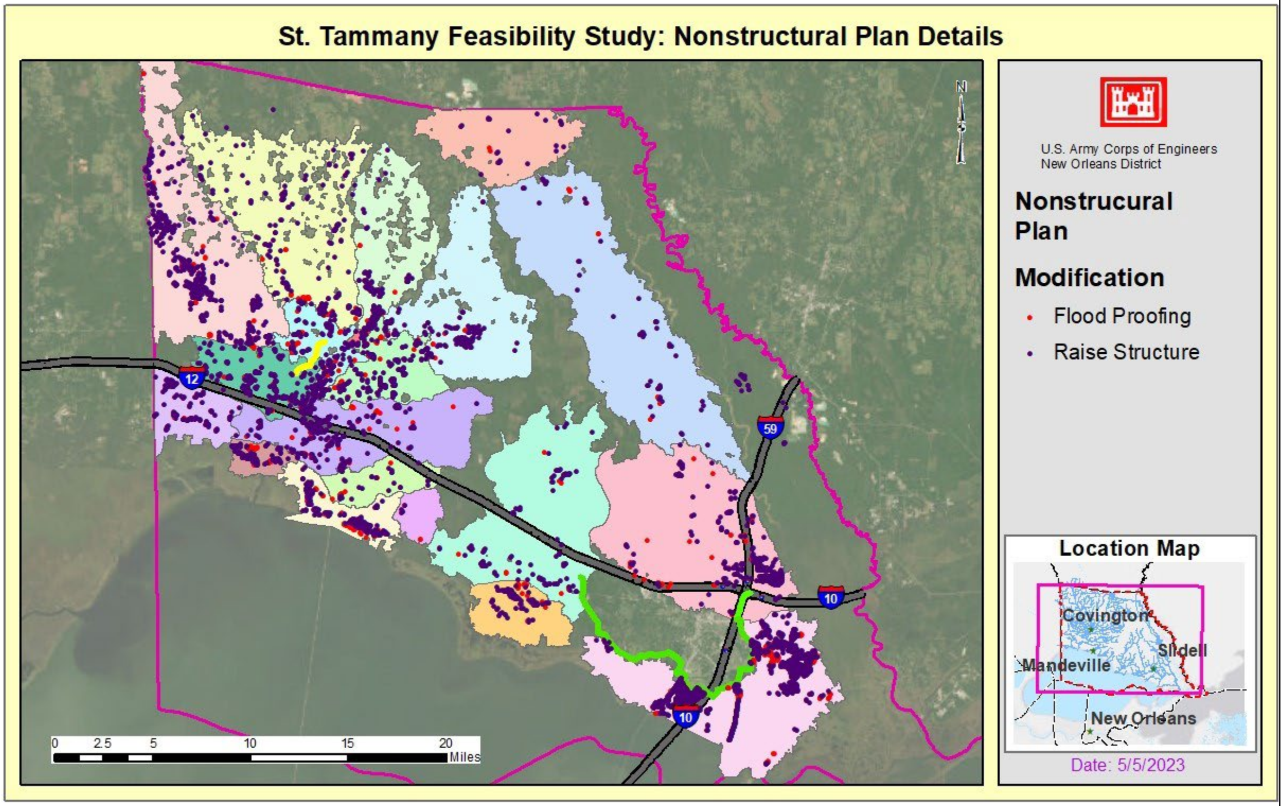


*Figure 6-2. Nonstructural Plan **Refer to Figure 4-18 for name of subaggregates identified*

6.2 OPTIMIZED TSP CRSM MEASURE-SOUTH SLIDELL AND WEST LEVEE AND FLOODWALL SYSTEM (OPTIMIZED VERSION OF ALTERNATIVE 6C)

The levee and floodwall system and associated structures would reduce risk of flooding for over 20,000 structures and 4 miles of evacuation routes and 1-10 would be located in the system. The levee and floodwall system (18.5 miles) consists of earthen levees (15 miles), floodwalls (3.5 miles of floodwalls), pump stations (8), sluice gates/lift gates (13), vehicular floodgates (18), pedestrian floodgate (1), railroad gate (1), and road ramps (6). Appendix D: Engineering provides levee, floodwall and structure dimension and typical segments) diagrams required to perform the impact analysis and develop cost estimates. For the 50-year period of analysis, the construction of the levee alignment would impact approximately 102 acres of staging area and 483 acres of permanent ROW. The levee alignment would require approximately 7,239,000 cubic yards of fill for construction (includes 30 percent contingency).

The construction of the floodwall and levee system, would be based on a 1% probability storm level of risk reduction and a 2032 intermediate RSLR condition. For the levee portions of the system, to maintain the levee crown at or above the future year (2082) design elevations while accounting for levee settlement and relative sea level rise, levees would be constructed in multiple lifts over the period of analysis. Both the design elevations and constructed "top of levee" elevations vary by location due to surge and wave differences due to storm path, wind speeds and direction, etc. Initial construction is estimated to take place in 2032. Four future levee lifts are projected to be needed subsequent to that initial construction. The assumed cross-section for these lifts would have a 10 feet wide levee crown and side slopes of 1V:3H. Existing berm sections from initial construction would be in place on both sides of the levee. Conversely, all floodwall segments, structures and the 1-10 crossing were designed and would be constructed to the future year condition (2082 condition) during the initial construction taking place in 2032. These features would not need additional lifts or construction after they are put in place beyond the planned OMRR&R.

The levee and floodwall system consists of a combination of portions of the West Slidell levee measure and the South Slidell floodwall measure from the Final Array of Alternatives. The two alignments would be connected by a new railroad gate across the existing Norfolk Southern Railway Corp. railroad tracks. Figure 6-3.

West Slidell Segment: Starting from the western segment of the levee and floodwall system, construction would commence on the south side of U.S. Highway 190 and South Tranquility Road, and on the eastern side of Pineridge Road. The alignment would run southward and would run on the west side of Tranquility Road (CC Road) and then it would turn in the southeast direction crossing Bayou Paquet Road and would stay on the east side of Bayou Paquet Channel to avoid impact to the BBMNWR. The alignment would cross Bayou Paquet and Bayou Liberty and would continue eastward on the northside of the BBMNWR. The alignment would cross Bayou Bonfouca and would continue on the south bank of the bayou (northern side of the refuge) until reaching the Norfolk Southern Railway Corp. railroad tracks west of U.S. Route 11 in the vicinity of Dellwood Pump Station in Slidell.

After initial construction, the western terminus of the levee and floodwall system would be extended north to account for future conditions (Year 2082) using the relative sea level change and subsidence. Updated modeling results, which included the intermediate scenario of sea level rise and subsidence, indicated a higher tie-in elevation would be needed through the period of analysis to continue to provide a 1% risk reduction.

To plan for the conditions expected throughout the 50-year period of analysis, the intermediate scenario of relative sea level change between years 2032 and 2082 was used to develop the 2082 hydraulic design elevations. Based on this information, an alignment extension with additional length of levee and additional structures was developed that would adapt the project while maintaining a 1% risk reduction.

The extended western segment would commence north of U.S. Highway 190 in the neighborhood near the intersection of North Tranquility Road and Shannon Drive between two properties. The alignment would be a berm with hydraulic design elevation of 17.5 feet for year 2082. The alignment would switch to levee (hydraulic design elevation of 17.5 feet (Year 2082)) and would continue south on the edge of the properties and cross U.S. Highway 190, the Tammany Trace Bike Trail and South Tranquility Road on the eastern side of Pineridge Road. The alignment would run south southeast an additional 890 feet past the intersection with South Tranquility Road and tie into the existing year 2032 alignment for West Slidell. The West Slidell levee would have a 10 feet wide levee crown and side slopes of 1V:3H. Berm sections would be needed on both sides of the levee. Floodside berm would have a slope of 1V:42H. The land side berm would have a slope of 1V:33H. The hydraulic design elevations of the new West Slidell levee would be 13.5 feet (year 2032) and the 17.5 feet (year 2082). Right of way for the levee was assumed to be 300 feet wide.

Within the West Slidell portion of the system there are three floodwalls as shown in Figure 6-3. The floodwall segments are located at the end of West Doucette (350 feet long with a design elevation of 17.5 feet), the North side of Bayou Paquet Drive (250 feet long with a design elevation of 16.5 feet) and at the east bank of Bayou Paquet/Mayer Drive (1400 feet long with a design elevation of 16 feet).

There are a total of eight sluice gates and lift gates that fall within the western portion of the alignment as listed below:

- Sluice gate # 7 near Tranquility Road/CC Road (control structure). The gate width is 25 feet and structural opening height is 8.9 feet.
- Sluice gate # 6 (control structure) at Bayou Paquet North Tributary. The gate width is 75 feet and structural opening height is 15.2 feet. Bayou Paquet North Tributary pump station with a pumping capacity of 300 cfs.
- 60 feet wide Bayou Paquet vehicular gate
- Lift gate at Bayou Paquet (navigable gate). The gate width is 90 feet and structural opening height is 16.5 feet. Bayou Paquet Pump station with a pumping capacity is 500 cfs.
- 20-ft wide Mayer Drive vehicular gate
- Lift gate at Bayou Liberty (navigable gate). The gate width is 80 feet and structural opening height is 22.8 feet. Bayou Liberty pump station with a pumping capacity of 1,800 cfs.
- Lift gate at Bayou Bonfouca (navigable gate). The gate width is 110 feet and structural opening height is 25 feet. Bayou Bonfouca pump station with a pumping capacity of 2,000 cfs.

- Sluice gate # 2 at Bayou Bonfouca (control structure). The gate width is 50 feet and opening height is 17.1feet.

The Western Segment includes two (2) ***pump stations*** with large pumping capacity at Bayou Liberty (1,800 cfs) and Bayou Bonfouca (2,000 cfs) and (2) pumpstations with small pumping capacity at sluice gate # 6 on the Bayou Paquet North Tributary (300 cfs) and Bayou Paquet lift gate (500 cfs).

The ***vehicular, pedestrian and railroad gates and road ramp***s for the western segment are included below and shown on Figure 6-3.

- 10 –foot Pedestrian Swing Gate at Tammany Trace with Lift Gate for Culvert on south side
- 20 –foot Vehicular Roller Gate at Tranquility Road
- 60 foot Vehicular Roller Floodgate at Bayou Paquet Road
- 20 foot Vehicular Gate at Mayer Road Roller
- 60 foot Floodgate for Railroad Swing
- 75 foot Roller Gate at Hwy 11 (Pontchartrain Drive Vehicle
- 500 Linear feet of floodwall for narrow section of Oak Harbor levee at Mariners Cove Blvd Roller Vehicle
- Floodwall and 20-foot Vehicular Gate for Oak Harbor Roller
- Floodwall and 20-foot Vehicular Gate for access to Oak Harbor Country Club Roller Vehicle
- 30 foot roller gate at Hwy 433 east crossing (Old Spanish Trail) Roller Vehicle
- 20 foot roller gate for access from Hardin Road to power substation Roller Vehicle
- 50 foot roller gate at Hwy 190-B east crossing (Fremaux Road) Roller Vehicle
- 20 foot roller gate at South Holiday Drive Roller Vehicle
- 20 foot roller gate at Jaguar Avenue Roller Vehicle
- 20 foot roller gate at Natchez Avenue Roller Vehicle
- 20 foot roller gate at Kisatchie Avenue Roller Vehicle
- 20 foot roller gate at Manzella Drive (Added to extend floodwall to 18.5 feet ground elevation south of Hwy 190) Roller Vehicle

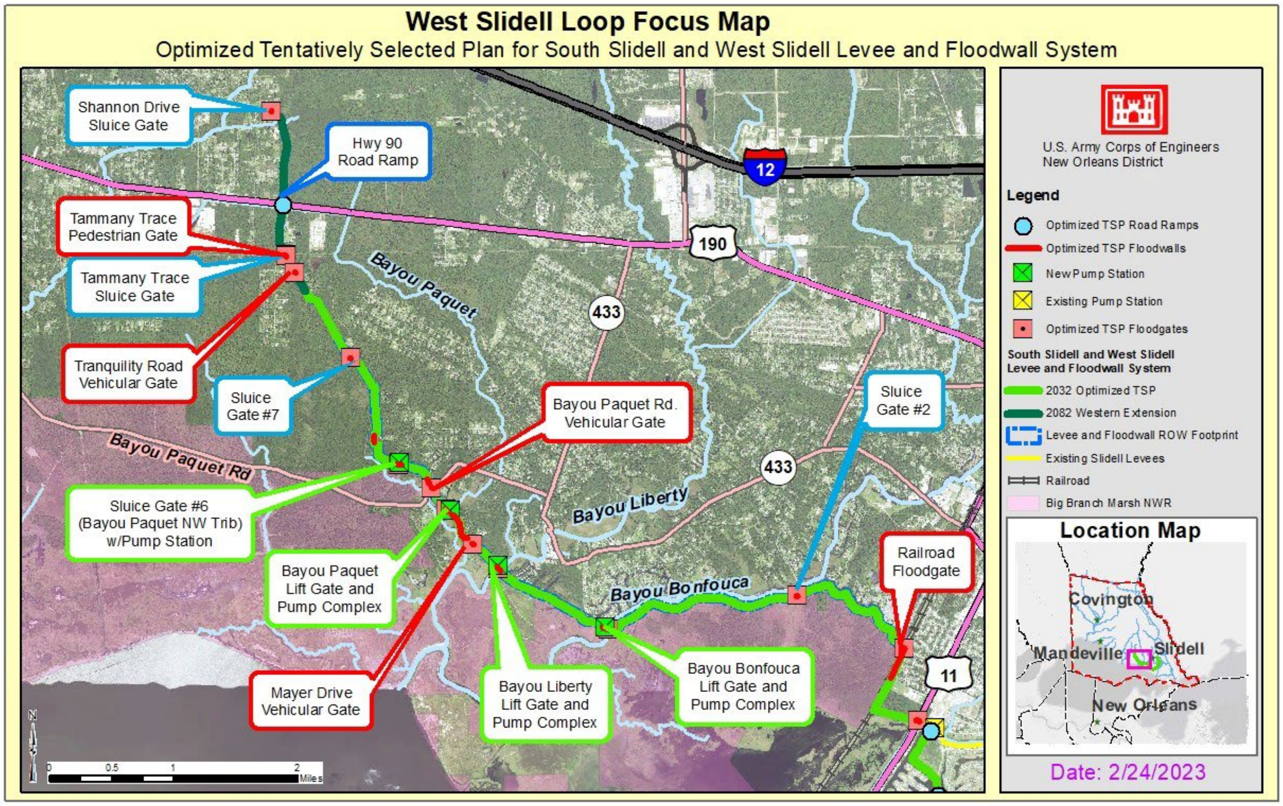


Figure 6-3. West Slidell Loop of the Levee and Floodwall System

South Slidell Segment: The levee and floodwall system alignment from West Slidell would continue to South Slidell. From the railroad gate connecting West Slidell with South Slidell, the alignment would transition to a floodwall parallel to the east side of the railroad tracks. The floodwall by the railroad tracks would have a hydraulic design elevation of 16.5 feet for year 2082. The alignment would transition to levee when it turned east toward U.S. Route 11. The alignment would cross U.S. Route 11 and would turn south in the vicinity of the existing Schneider Canal Pump Station and then turn east (on a portion of the existing Oak Harbor ring levee). The alignment would run on the south side of Oak Harbor Boulevard and would cross to the north side immediately past Mariners Cove Boulevard. The levee along the south side of the Oak Harbor would have a hydraulic design elevation of 14 feet for year 2032. The alignment would coincide with a portion of the existing Oak Harbor ring levee. The alignment would turn north and then east in the vicinity of the I-10. The I-10 would be raised to ramp over the new levee section (hydraulic design elevation of 18.5 feet for year 2082). The alignment would continue southeast and would tie to an existing portion of the Lakeshore Estates ring levee. The alignment then would turn north and then east and cross Old Spanish Trail/LA Highway 433. The alignment would continue north and tie to a portion of the existing King's Point west levee. The section of levee would have a hydraulic design elevation of 16 feet for year 2032.

The alignment would cross the W-14 Canal and would tie to a portion of the existing King's Point east levee and would turn north. The levee would have a hydraulic design elevation of 16 feet for year 2032. The levee would turn east and then north. Immediately south of U.S. Highway 190 Business the alignment would turn from levee to floodwall to provide risk reduction to the existing Hardin Road power substation. The floodwall would have a hydraulic design elevation of 18.5 feet for year 2082.

The alignment (floodwall) would cross U.S. Highway 190 Business and continue northwest on the west side of the existing CLECO Corporate Holdings, LLC utility corridor. The alignment would cross South Holiday Drive and continue north. The alignment would turn east on Manzella Drive and turn north in the middle of the block between Yaupon Drive and Malbrough Drive.

The alignment (floodwall) would cross Gause Boulevard and would turn west (hydraulic design elevation for floodwall of 18.5 feet for year 2082). There would be a vehicular gate across Gause Boulevard, a vehicular gate for access to a private road, and a vehicular gate for the I-10 Service Road. The floodwall would transition to a berm that would tie-in to the I-10 embankment. There would be a ramp for the on-ramp for the I-10 eastbound at Gause Boulevard.

For the berm, it was assumed a hydraulic design elevation of 16 feet for year 2032 and 19.5 feet for year 2082. The berm was assumed to be 1V:3H. This area of the alignment would be further developed during PED. The drainage on the grass area where the ramp merges to the I-10 would need to be reworked during PED.

The existing highway embankment would serve as the means of risk reduction in order for the project to form a continuous system up to the elevation required in 2082. There would be floodgates at Reine Canal and French Branch.

The new levee portions of the system in South Slidell would have a 10 ft wide levee crown and side slopes of 1V:3H. The hydraulic design elevation of the new South Slidell levee would vary between 14 feet and 16 feet during initial construction (year 2032) depending on the location; floodwalls, portions and structures would be built to the future condition (2082)

These floodwall segments would have a hydraulic design elevation of 16.5 feet (year 2082). Starting from the west, there would be the following floodwall reaches:

- 1375 feet of floodwall along the railroad between Dellwood Pump Station and Baptist Church (Front Street).
- 100 feet floodwall would cross downstream of existing Schneider Canal pump station. Minimal number of changes would be required.
- 500 feet of floodwall for narrow section of Oak Harbor levee at Mariners Cove Boulevard.
- 160 feet floodwall for the 20 feet vehicular gate for access to Oak Harbor Country Club.

The following floodwall reaches would have a hydraulic design elevation of 18.5 feet (year 2082 elevation). Refer to Figure 6-4 which shows the floodwall segments in red for South Slidell.

- 300 feet of floodwall near Old Spanish Trail.
- 450 feet of floodwall behind Esprit du Lac Street.
- 1,950 feet of floodwall to enclose power substation south of U.S. Highway 190 Business on east side of alignment.
- 430 feet of floodwall at U.S. Highway 190 Business (East Side).
- 3,530 feet of floodwall on western edge of the utility corridor.
- 3,700 feet of floodwall for northeast extension of alignment along the utility corridor and along east side of Yaupon Street.
- 650 feet of floodwall from Manzella Drive to Gause Boulevard
- 635 feet of floodwall north of Gause Boulevard to I-10, on the East Terminus

STRUCTURES AND RAMPS

Along the South Slidell portion of the alignment, the structures would have a hydraulic design elevation of 16.5 feet (Year 2082).

- 75 feet wide vehicular (roller) gate at U.S. Route 11 (Pontchartrain Drive)
- Oak Harbor Boulevard ramp
- Islander Drive ramp
- 50 feet wide Mariners Cove Boulevard vehicular gate
- 20 feet wide Oak Harbor vehicular gate (Mariners Cove and Oak Harbor gates would be in proximity of each other)
- 20 feet wide Oak Harbor Country Club vehicular gate
- Grand Champions Lane ramp

After crossing the I-10, the structures for the alignment would have a hydraulic design elevation of 18.5 feet (year 2082 elevation).

- 30 feet wide Old Spanish Trail vehicular gate (LA Highway 433)
- Sector gate at W-14 Canal (navigational gate). The gate width is 90 feet and opening height is 18.4 feet W-14 pump station with pumping capacity of 1,000 cfs.
- Sluice gate # 8 (control structure) at Kings Point East. The gate width is 90 feet and opening height is 14.1 feet Kings Point East pump station with a pumping capacity is 200 cfs.
- 20 feet wide Hardin Road Substation vehicular gate
- 50 feet wide Hwy 190 Business vehicular gate
- 20 feet wide South Holiday Drive vehicular gate
- 20 feet wide North Holiday Drive vehicular gate
- 20 feet wide Jaguar Drive vehicular gate
- Sluice gate # 10 near eastern terminus (control structure). The gate width is 20 feet and the structural opening height is 8 feet

- 20 feet wide Natchez Drive vehicular gate
- 20 feet wide Kisatchie Drive vehicular gate
- 20 feet wide Manzella Drive vehicular gate
- 80 feet wide Gause Boulevard vehicular gate near eastern terminus
- 65 feet wide vehicular gate for businesses on north side of Gause Boulevard
- 85 feet wide vehicular gate on the I-10 Service Road near Gause Boulevard
- Ramp for I-10 on-ramp at Gause Boulevard

On the eastern terminus, the Interstate 10 is consistently at high ground (hydraulic design elevation of 18.5 feet for year 2082). To use the I-10 embankment for risk reduction, any hydraulic openings past the tie-in point would need to be closed so that water does not have a path to flood the protected side of the alignment. There are hydraulic openings where Reine Canal and French Branch cross the I-10. The following structures (hydraulic design elevation of 18.5 feet for year 2082) would be needed north of the eastern terminus:

- Sluice gate at Reine Canal (control structure). The gate width is 30 feet and the structural opening height is 11 feet Reine Canal pump station (pumping capacity is 200 cfs).
- Sluice gate at French Branch at I-10. The navigable gate width is 25 feet and the structural opening height is 10.2 feet French Branch pump station (pumping capacity is 450 cfs).

<u>INTERSTATE 10 ELEVATION</u>

The I-10 road surface would be raised to construction elevation 22.0 feet to ramp over the new levee section to stay above the hydraulic design elevation for year 2082, to ensure the entire pavement section remains above the hydraulic design elevation across the interstate. The hydraulic design elevation at this location for year 2082 is 18.5 feet The pavement section was assumed to have a thickness of 2.5 feet, and 1 feet settlement was assumed.

The existing elevation of the I-10 at the proposed location is approximately 12.8 feet as per the terrain raster dataset. This proposed location is the highest elevation of the I-10 in the vicinity of the proposed alignment. The I-10 elevation is lower (approximately 10 feet) on the adjacent areas.

This feature would be fully designed during PED. The essential requirements to place a levee across an interstate corridor are listed below. The traffic control would be a complex item to be developed during PED to allow for uninterrupted interstate traffic while working on a total of 6 lanes of traffic.

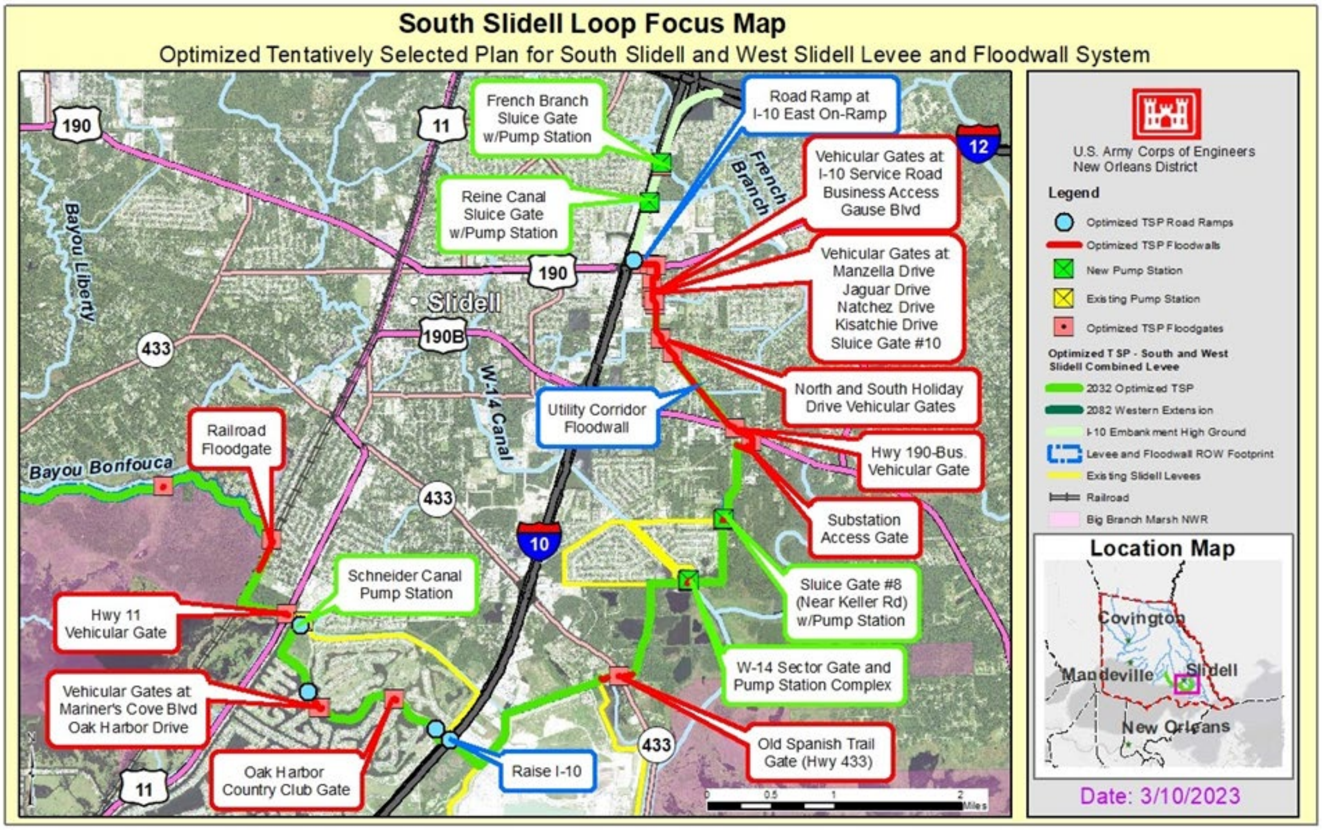


Figure 6-4. West Slidell Loop of the Levee and Floodwall System

Pump Stations: The Optimized TSP would include a total of eight (8) pump stations. These pump stations are divided into large pumping capacity and small pumping capacity. The Southern Segment of the Optimized TSP includes (4) pump stations with small pumping capacity at W-14 Canal (1,000 cfs), sluice gate # 8 at Kings Point (200 cfs), Reine Canal (200 cfs) and at French Branch at the I-10 (450 cfs). Additional detail on the optimized levee and floodwall system can be found in Section 10 Appendix D: Engineering.

6.3 OPTIMIZED TSP FRM MEASURE-MILE BRANCH CHANNEL IMPROVEMENTS (OPTIMIZED VERSION OF ALTERNATIVE 8)

This Optimized TSP feature (Figure 6-5) would consist of channel improvements on the lower 2.15 miles (11,341 foot channel) of Mile Branch in Covington, Louisiana. The proposed work at Mile Branch would be located in a heavily populated area. There are properties in close proximity of the Mile Branch. There are no surveys available for this area, and no surveys will be conducted during the study phase. The existing elevations used for the hydraulic analysis and design of the Optimized TSP were obtained from the terrain raster dataset. Designs are based on existing information gathered from reports provided by the

NFS as shown on Table 1.2 in the main RDIFR-EIS. Design refinements would occur during PED based on field data collections. Figure 6-6 provides the location of this work.

The Mile Branch channel improvements would start at the intersection of Mile Branch and U.S. Highway 190, crossing U.S. Highway 190 Business, and end at the intersection of Mile Branch and the Tchefuncte River. The preliminary design assumes an existing bank elevation of 1 foot, a 10 feet bottom width at elevation (-) 5 feet. The bank is at 1V:3H slope. The improvements include clearing and grubbing and mechanical dredging of the channel to deepen the channel. The channel bottom would be lowered by 5 feet. Refer to Figure 6-6 for typical cross-section. Approximately 21 acres of channel would be cleared and grubbed prior to mechanical dredging. Clearing and grubbing includes the removal trees, debris, and other obstructions within the channel. An assumed maximum of 130,000 cubic yards of material may be mechanically dredged from the channel. For the channel improvements, approximately 38.5 acres of permanent ROW would be needed. This area would include 25 ft on each side of the Mile Branch channel. Included in the 38.8 acres, there would be 4.8 acres for a staging area that would become a backwater area after construction is complete (as proposed by CEMVN). For the channel improvements, approximately 5.1 acres temporary ROW would be needed for the staging areas.

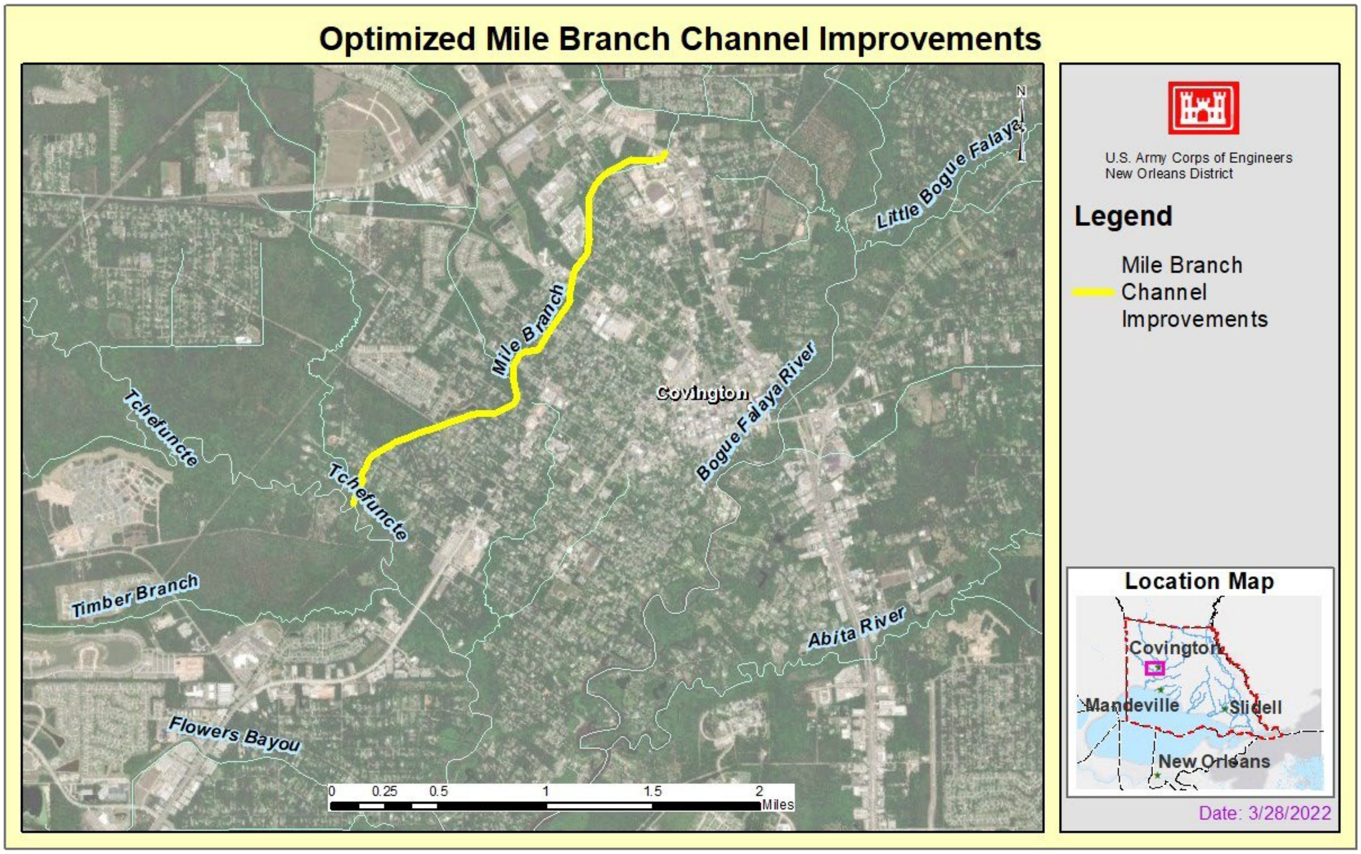


Figure 6-5. Optimized Mile Branch Channel Improvements

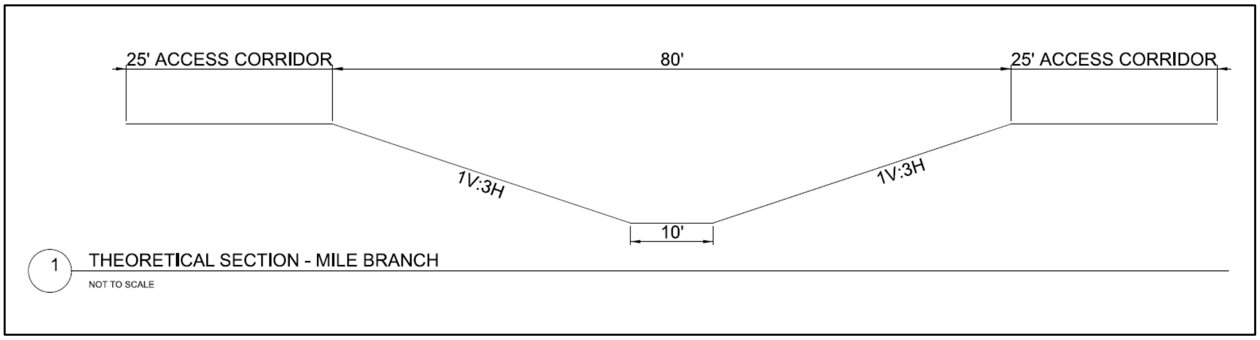


Figure 6-6. Mile Branch Improvements- Typical Cross-Section Riparian Zone bioengineering techniques and nature-based-solutions (NBS) would be considered as appropriate for Mile Branch FRM during PED in coordination with the NFS and resource agencies.

The Mile Branch channel improvements for the Optimized TSP would include seven (7) bridge replacements (starting from north to south) at vehicular bridges on W. 29th, W. 28th, W. 25th, W. 23rd, W. 21st, and W.19th Avenues and the pedestrian bridge at W. 27th Avenue (Figure 6-7). No work is anticipated at the W. 15th and W. 11th Avenue channel crossings as those bridges have been replaced prior to this study (and the new bridges were designed to safely pass higher flows on Mile Branch). During the Optimized TSP work, it was discovered that there is no existing bridge to connect both sides of Mile Branch on W. 18th Avenue. This location was eliminated from the list of bridge replacements that had been identified during alternative selection and the Draft TSP. During the Optimized TSP investigations, a pedestrian bridge (part of Tammany Trace Bike Trail) was identified on W. 27th Avenue that crosses the Mile Branch. The PDT decided to investigate this location as a potential bridge replacement. The hydraulic modeling and surveys that would be performed during PED would identify if this bridge needed to be replaced. Additional detail on the optimized Mile Branch channel improvements can be found in Section 10 Appendix D: Engineering.

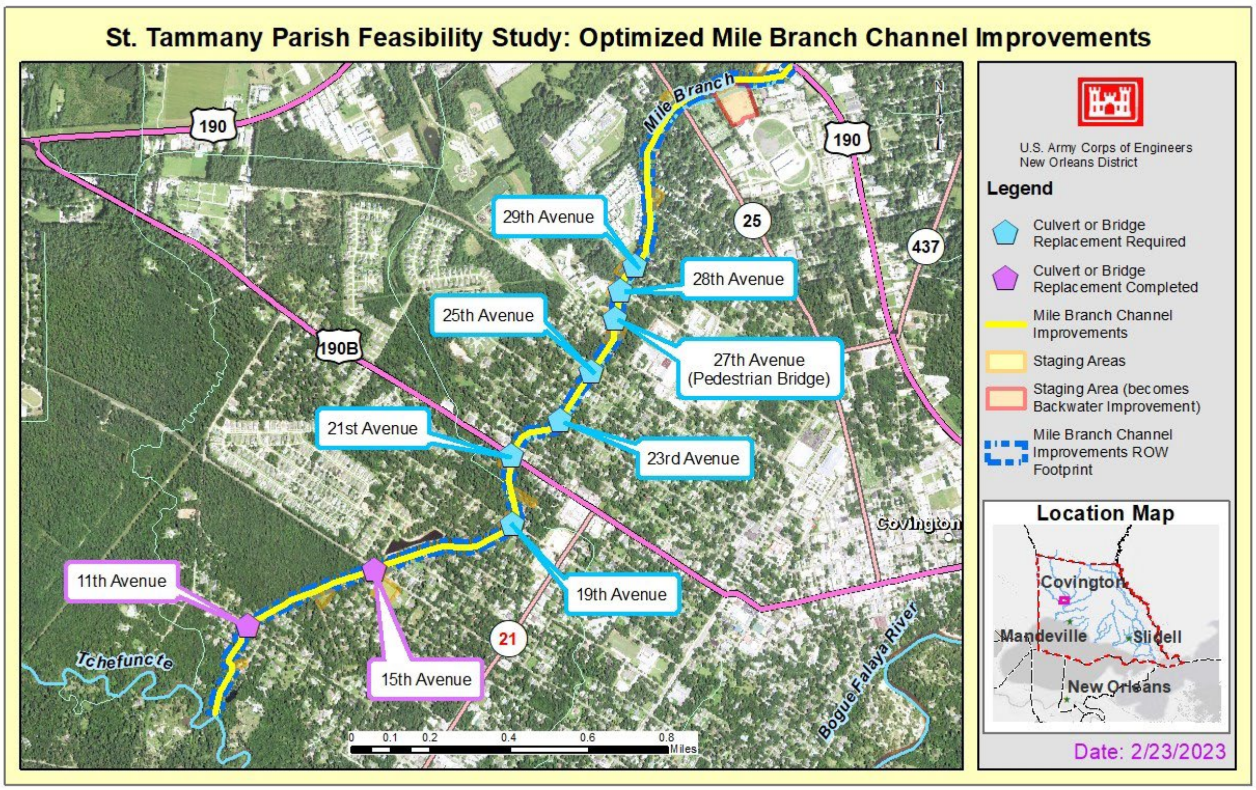


Figure 6-7. Mile Branch Region of the Tentatively Selected Plan (Mile Branch Channel Improvements) Table 6-2. Cost and Benefits Breakdown for each of the TSP/NED Plan Measures

	South Slidell and West Slidell Levee and Floodwall System	Mile Branch Channel Improvements	Rest of Parish Nonstructural 4%, 2% and 1% Annual Exceedance Probability (AEP)	Combined Plan-Structural & NS 4%, 2% and 1% AEP for Parish outside of structural influence
First Cost	2,440,973,000	77,002,000	1,934,084,000	4,452,059,000
Benefits	162,588,000	3,472,000	236,702,000	402,762,000
AA Cost	94,173,000	3,104,000	68,403,000	165,680,000
Net Benefits	68,415,000	368,000	168,300,000	237,083,000
B/C Ratio	1.7	1.1	3.5	2.4
Approx. # structures with flood risk reduction	20,000	250	6,410	26,600

* The nonstructural plan varies by location and then list the AEP for each area.

6.4 COMPREHENSIVE BENEFITS-NATIONAL SIGNIFICANCE OF THE PROJECT

USACE involvement in flood control construction is predicated on the project being in the national interest, which is determined by factors such as the likelihood of widespread and general benefits, the national savings achieved, precedent and law. The Optimized TSP reduces risk to life and safety, reduces the extent of property damage and property loss and reduces the risk of damage to critical infrastructure and transportation in the study area. The Optimized TSP is also the plan that maximizes NED benefits. The NED Account represents increases in the net value of the national output of goods and services, expressed in monetary units, and are the direct net benefits that accrue in the planning area, and the rest of the Nation. The benefits, average annual cost and total cost were based on the monetary costs or damages prevented and were ranked accordingly. The Optimized TSP is estimated to produce nearly $237,803,000 in net benefits with a BCR of 2.4. The Optimized TSP decreases expected annual damages from $547,701,000 under the without-out project condition to $162,887,000 under the with project condition.

Regional Economic Development (RED) -The Regional Economic Development (RED) account addresses the impacts that the USACE expenditures associated with the construction of a coastal storm risk management system will have on the levels of income, output, and employment throughout the region. This RED analysis employs input-output economic analysis, which measures the interdependence among industries and workers in an economy. This analysis uses a matrix representation of a regional economy to predict the effect that changes in one industry will have on other industries. The greater the interdependence among industry sectors, the larger the multiplier effect on the economy. Changes to government spending drive the input-output model to project new levels of sales (output), value added Gross Regional Product (GRP), employment, and income for each industry.

RECONS Version 2 was the specific input-output model used to estimate the regional economic development impacts of the Recommended Plan. The U.S. Army Corps of Engineers (USACE) Institute for Water Resources, Louis Berger, and Michigan State University developed the regional economic impact modeling tool, RECONS (Regional Economic System), that provides estimates of jobs and other economic measures such as labor income, value added, and sales that are supported by USACE programs, projects, and activities. This modeling tool automates calculations and generates estimates of jobs, labor income, value added, and sales using IMPLAN®'s multipliers and ratios, customized impact areas for USACE project locations, and customized spending profiles for USACE projects, business lines, and work activities. RECONS allows the USACE to evaluate the regional economic impact and contribution associated with USACE expenditures, activities, and infrastructure. Tables 6-3 through 6-5 summarize the RED results. Additional information can also be found in Appendix F: Economics.

Table 6-3 RED Summary for the Slidell Levee and Floodwall system

Area	Output	Jobs*	Labor Income	Value Added
Local				
Direct Impact	$2,219,412,264	505	$1,606,683,533	$1,462,181,013
Secondary Impact	$1,893,120,238	235	$626,059,375	$1,061,856,953
Total Impact	$4,112,532,502	740	$2,232,742,907	$2,524,037,966
State				
Direct Impact	$2,331,560,812	576	$1,826,483,378	$1,602,061,631
Secondary Impact	$2,367,881,842	278	$754,458,665	$1,320,902,540
Total Impact	$4,699,442,654	853	$2,580,942,043	$2,922,964,171
US				
Direct Impact	$2,415,105,510	599	$1,901,147,647	$1,701,368,649
Secondary Impact	$4,391,611,291	422	$1,409,043,954	$2,402,920,452
Total Impact	$6,806,716,800	1020	$3,310,191,601	$4,104,289,101

Table 6-4 RED Summary for the Mile Branch Channel Improvements

Area	Output	Jobs*	Labor Income	Value Added

Local				
Direct Impact	$67,413,497	15	$47,880,317	$42,275,475
Secondary Impact	$57,376,609	7	$18,274,211	$31,928,227
Total Impact	$124,790,106	22	$66,154,528	$74,203,702
State				
Direct Impact	$70,862,292	17	$54,965,773	$46,301,703
Secondary Impact	$73,027,149	8	$22,402,738	$40,424,843
Total Impact	$143,889,441	26	$77,368,512	$86,726,546
US				
Direct Impact	$75,703,707	18	$57,724,072	$50,907,527
Secondary Impact	$140,827,007	13	$44,356,343	$76,656,673
Total Impact	$216,530,715	31	$102,080,415	$127,564,200

Table 6-5 RED Summary for the Nonstructural Plan

Area	Output	Jobs*	Labor Income	Value Added
Local				
Direct Impact	$1,531,085,009	276	$996,857,892	$957,565,145
Secondary Impact	$1,228,406,804	154	$390,645,169	$675,553,628
Total Impact	$2,759,491,813	430	$1,387,503,061	$1,633,118,773
State				
Direct Impact	$1,651,881,781	312	$1,191,054,939	$1,107,210,463
Secondary Impact	$1,559,809,227	183	$482,082,740	$861,277,124
Total Impact	$3,211,691,008	495	$1,673,137,679	$1,968,487,587
US				
Direct Impact	$1,861,922,843	350	$1,353,887,980	$1,266,033,975
Secondary Impact	$3,338,857,796	313	$1,070,990,779	$1,831,033,991
Total Impact	$5,200,780,639	664	$2,424,878,759	$3,097,067,965

Environmental Quality (EQ)

The Environmental Quality (EQ) account is an assessment of favorable or unfavorable ecological, aesthetic and cultural or natural resources changes. Environmental Impacts of the Optimized TSP are described in detail in Section 5. The analysis was conducted with the participation of agencies, local governments, and stakeholders through an on-going and engaging series of scoping meetings, public input meetings, agency and stakeholder meetings, and on-site meetings, and will continue through the Preconstruction Engineering and Design (PED) study phase and coordination of the project through State and Agency reviews.

EQ impacts related to the construction of Mile Branch are expected to be temporary and non- significant related to terrestrial habitat with some additional impacts to aquatic waterbottom habitat during construction, which are being compensated for with creation of a backwater area off of Mile Branch. Riparian habitat impacts are included in the developed mitigation plan.

The West Slidell levee is expected to result in EQ impacts on Big Branch Wildlife Refuge and Bayou Liberty Louisiana Scenic Waterway but they would be offset by the anticipated land swap and nature based designs for the floodgate at Bayou Liberty. Compensatory mitigation is incorporated into the Optimized TSP for the impacts to marsh and pine savanna habitat. The nonstructural portion of the Optimized TSP is expected to have minimal and temporary EQ impacts.

Other Social Effects (OSE)

The South and West Slidell levee and floodwall system is one of the alternatives from the Final Array that provided the most direct benefits by reducing flooding on LA Hwy 433, U.S. Highway 190. These highways are critical evacuation routes and provide access to 1-10 and 1-12 which are transportation corridors and evacuation routes. The Nonstructural Plan and Mile Branch channel improvements are expected to indirectly reduce roadway flooding and impacts to smaller roadways, and benefit overall evacuation in the area.

The Federal Government has made it a goal that 40 percent of the overall benefits of certain Federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution. This goal has been designated the Justice 40 Initiative. There are nine census tracks in St. Tammany Parish that have been identified as disadvantaged communities according to the Justice 40 criteria. Each of these communities qualify due to their low-income designation and the economic loss to building value resulting from natural hazards each year. Additionally, categories shared by some but not all these communities include barriers to transportation, unemployment, percent of adults with less than a high school diploma, high rates of heart disease, and projected flood risk. Forty-six percent of the benefits provided by the Slidell levee and floodwall system and sixty-eight percent of the benefits provided by the channel improvements in Mile Branch accrue to these disadvantaged communities. Four percent of the benefits provided by the nonstructural plan accrue to disadvantaged communities. The low percent of benefits under the non-structural plan is primarily due to community locations. Most of these communities are located either in northern areas of the parish that are not subject to frequent flooding or they are located in the parts of the parish that would benefit from the levee system in Slidell. The disadvantaged communities where nonstructural measures would be applied are in largely rural areas that are more sparsely developed and have lower flood risk. Overall, approximately 20 percent of the benefits provided by the Optimized TSP accrue to disadvantaged communities. Table 6-6 shows the Justice40 benefit analysis for the Optimized TSP.

Table 6-6. Justice40 Benefit Analysis for the Optimized TSP (in $1,000s)

Measures	OSE	
	Justice40 Benefits	Justice40 Benefit %
South Slidell and West Slidell Levee and Floodwall System	$75,826	46%
Mile Branch	$2,367	68%
Nonstructural	$10,526	4%

Life Safety Risk Indicator

For the RDIFR-EIS, the Slidell levee was modeled using the LSRI software. https://www.usace.army.mil/missions/civil-works/budget/https://team.usace.army.mil/sites/HQ-CW/PDT/budget/Manual/Forms/AllItems.aspx?View={A42833E2-B04E-42BE-A0A2-A01F662A2C1E}

The results of which show an LSRI value of 6.682 meaning if this project were not built, then this area would experience an average annual life loss of 6.682 people per year. Additionally, the cost per statistical life saved (CSSL) for St. Tammany is $10,623,109 annually. Further detail on the Life Safety Analysis can be found in Appendix F: Economics.

6.5 IMPLEMENTING THE OPTIMIZED TSP

Implementation strategies would be a shared responsibility conducted in coordination with the non-federal sponsor, and FEMA to cost effectively reduce flood risk from coastal storms. The implementation strategy for the NED plan would reduce the risk through a series of risk reduction increments that either could be implemented simultaneously, where the entire project is implemented in an expedited manner or implemented sequentially, where measures are implemented on a rolling incremental basis. The Optimized TSP includes a risk informed strategy that utilizes best practices to reduce risk to the most vulnerable areas and critical infrastructure first with the most cost-effective measures.

Detailed design for the Optimized TSP would be cost-shared between the NFS and the USACE contingent upon the execution of a Design Agreement and approval of Work in Kind in accordance with the provisions of ER 1165-2208. All detailed design would be in accordance with USACE regulations and standards. Subject to project authorization and funding, and full environmental compliance, the construction of the structural features of the Optimized TSP is scheduled to begin in 2025. A continuous funding stream is needed to complete this project within the anticipated timeline, which requires continuing appropriations from Congress and the State of Louisiana to fund the detailed design phase, PED, and fully fund construction contracts. Once construction funds are appropriated, the NFS, and the Department of the Army would enter into a PPA. After the signing of a PPA, the NFS would acquire the necessary land, easements and ROW to construct the project. Because project features cannot be advertised for construction until the appropriate real estate interests have been acquired, obtaining the necessary real estate in a timely fashion is critical to meeting the project schedule.

A revised construction schedule was developed for the Optimized TSP. For the nonstructural component, construction would occur from 2025-2032. See Appendix H: Nonstructural Implementation Plan for additional information regarding implementation of the nonstructural component of the Optimized TSP. For the levee and floodwall system, construction would occur from 2025-2076. Additional levee lifts would occur three times post initial construction at 5-7 years, 15-20 years, and 30 years. For the Mile Branch Channel Improvements, construction would occur from 2025-2032. See Appendix D: Engineering for additional information regarding implementation of the structural components of the Optimized TSP. At the completion of construction of the project, or functional portions thereof, the NFS would be fully responsible for OMRR&R.

6.5.1 Real Estate required for construction of the structural measures of the Optimized TSP

A real estate plan (REP) was prepared to conform with the requirements of ER 405-1-12, dated 1 May 1998. The REP describing the real estate requirements and costs for the TSP is contained in Appendix G: Real Estate Plan. The REP was prepared with estimated ROW requirements based on available information. The structural measures will impact an estimated 294 private landowners. The nonstructural measures will include 5,583 residential elevations and 827 non-residential floodproofing measures. Descriptions of the estates required for implementation of the structural measures of the TSP are included in Appendix G Real Estate Plan. The total estimated real estate cost for structural features including contingencies, borrow sites and mitigation sites, is estimated as $81,476,240. The total estimated real estate cost for nonstructural measures including contingencies is $170,763,762. The REP and real estate cost estimates may require revisions during PED if the project is approved.

6.5.2 Real Estate required for implementation of the nonstructural measures of the Optimized TSP

The dry floodproofing of eligible structures would require that the NFS acquire a Right of Entry for Survey and Exploratory Work, Right of Entry for Construction, and a permanent easement with restrictive covenants (for OMRR&R). A standard Temporary Work Area Easement will be acquired for the duration of construction on any improvements. For non-residential flood proofing of structures, a separate non-standard easement would be required, which provides the necessary rights and restrictions to protect the federal investment. The draft easement language would be submitted through CEMVD to USACE CEMP-CR as a request for approval of a Non-Standard Estate.

The elevation of eligible residential structures will require the NFS to acquire a standard right of entry for survey and exploratory work and a standard right of entry for construction. A standard temporary work area easement will be acquired for the duration of construction on any improvements. Also, the NFS will be required to obtain subordinations and releases for all rights required for project implementation, including the temporary ROW easements. In addition, a non-standard estate in the form of a permanent easement for restrictions and access (permanent easement), will likely be proposed by CEMVN and submitted in accordance with USACE regulations with a request for approval later in the study process. It is anticipated that such an easement will be imposed in, on, over, and across the land on which the residential structure(s) has been or will be elevated in connection with this project. The contemplated easement will perpetually prohibit the grantors, heirs, successors, assigns, and all others from: (1) using any portion of the ground level of the elevated structure for human habitation; (2) constructing or placing any enclosure or permanent obstruction that would impair the flow of water on the ground level of the elevated structure; and (3) engaging in other uses of the elevated structure or the land that would impair, contravene, or interfere with the integrity of the elevated structure. There would be a reservation of rights and privileges in favor of the grantors, heirs, successors, and assigns to use the land in such a manner so as not to interfere with, or abridge, the rights, easement, prohibitions, and restrictions contained in the easement. The easement would also include a right of ingress and egress over and across the land by the Coastal Protection and Restoration Authority Board of Louisiana, its representatives, agents, contractors, and assigns, for the purpose of inspecting and monitoring the elevated residential structures and land in order to enforce the rights and prohibitions contained in the easement. A similar nonstandard estate (permanent easement) to that described above, may also be required for manufactured, modular and mobile homes that are to be elevated as part of the Nonstructural Plan. The draft easement language would be submitted through CEMVD to USACE CEMP-CR as a request for approval of a Non-Standard Estate.

Additionally, the NFS would obtain subordination agreements for any outstanding encumbrances that would interfere with the rights obtained in the permanent easement or that would interfere with the project.

6.5.3 Borrow required for construction of the structural components of the TSP

The construction of the TSP is estimated to require approximately 7 million cubic yards of fill or borrow material. The only features of the TSP that require borrow material are West and South Slidell levees and floodwalls. Borrow material for construction will come from sites estimated to be within no more than 17 miles of the levee and floodwall system. A total of 3,000,000 cubic yards of soil is needed for initial construction and a grand total of 7,239,000 cubic yards is needed over the entire authorized 50-year period to sustain the 1 percent AEP design elevations out to year 2082.

Existing Government borrow sites were not available within the designated distance. Feasibility level borrow site investigations were conducted to confirm there were available borrow quantities within the vicinity to support the TSP decision and evaluate the anticipated impacts associated with the potential borrow sites. A total of 34 potential sites were identified and evaluated and narrowed down to five borrow sites in the vicinity STP-5, STP-6, STP-9, MS-1, and MS-2. It was assumed that between 200,000-17,000,000 cubic yards of usable material could be found in these sites. The borrow pit needed for the quantity of soil would be approximately 500 acres. See Appendix B: Plan Formulation for additional information regarding the borrow site investigation and Section 5 for environmental resource analysis for the five borrow sites. Final selection of the borrow source would be conducted prior to acquisition of the site by the NFS.

6.5.4 Relocations

6.5.4.1 Relocations West Slidell and South Slidell Levee and Floodwall System

Based on the research and investigations conducted as part of the project effort, multiple facilities or utilities are located within the project area of the STPFS alignment. The STPFS levee and floodwall system crosses the Norfolk Southern Railroad. A floodgate in this area would affect the railroad itself and a transmission corridor running parallel to the eastern side of the railroad tracks. USACE would have to meet criteria around these transmission lines to provide necessary clearance for pile driving activity associated with construction of the floodgate and adjacent floodwall. Possible underground utilities servicing the railroad (i.e., communication lines) would be impacted as well.

Entergy Louisiana, LLC has right-of-way use requirements pertaining to USACE work around their existing transmission lines, electrical distribution lines and power poles within the project area, that would have to be met to provide clearance for construction activities (i.e., pile driving).

6.5.4.2 Relocations Mile Branch

Based on the research and investigations conducted as part of the study effort, multiple facilities or utilities are located within the project area of the Mile Branch Waterway. See Appendix D: Engineering for additional information regarding relocations.

6.5.5 Operations, Maintenance, Repair, Rehabilitation, and Replacement- Obligations of the NFS

The NFS’s obligation to OMRR&R the project at no cost to the Government shall be set forth in an OMRR&R manual prepared and issued by USACE in accordance with ER 1110-2-401 “*Operation, Maintenance, Repair, Replacement and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors*” dated 30 September 1994, the executed PPA, and applicable USACE regulations. The NFS shall conduct its OMRR&R responsibilities in a manner compatible with the authorized purpose of the project and in accordance with applicable Federal laws and specific directions prescribed by the Government in the OMRR&R manual. The purpose of OMRR&R is to sustain the constructed project. The assumed OMRR&R included items such as routine maintenance, routine clearing and snagging, periodic inspection, machinery and gate replacements, and minor and major repairs. The estimated costs were annualized and included in the economic analysis to determine the BCR. The project specific OMRR&R activities and associated costs were estimated for the levee and channel improvements and will be done further refined in PED.

6.2.5 Cost Sharing Requirements under the PPA

It is anticipated the cost share for the design and construction of the project would be 65 percent Federal and 35 percent non-Federal. However, Public Law 115-123 provides that a project that is studied using Supplemental Investigations funds is eligible for implementation using Construction funds provided in that Act if the Secretary determines that the project is technically feasible, economically justified, and environmentally acceptable. Final, specific cost share requirements would be identified in the Project Partnership Agreement. Among other responsibilities, the NFS must provide all project LERRDs required for the project. The OMRR&R cost is a 100 percent NFS responsibility. The estimated total project cost for the NED TSP is $4,452,058,000 at a FY 23 price level.

Table 6-7. Optimized TSP Project First Costs, (FY23 Price Level, 2.5% Discount Rate)

Levee and Floodwall + Dry Floodproofing	Federal	Non-Federal	Total
Lands, easements, rights-of-way, relocations, and disposal areas (LERRD) 100%			
Lands and Damages	-	$296,359,000	$296,359,000
Relocation	-	$24,779,000	$24,779,000
LERRDs Subtotal		*$321,138,000*	*$321,138,000*
Construction First Cost (65 Fed/ 35 Non-Fed)			
Fish and Wildlife Relocations	$52,576,550	$28,310,450	$80,887,000
Roads, Railroads, and Bridges	$13,115,050	$7,061,950	$20,177,000
Buildings, Grounds, and Utilities	$811,217,550	$436,809,450	$1,248,027,000
Cultural Resource Preservation	$12,060,100	$6,493,900	$18,554,000
Levees and Floodwalls	$560,229,880	$301,662,200	$861,892,000
Pumping Plan	$482,771,250	$259,953,750	$742,725,000
Channels and Canals	$8,605,350	$4,665,150	$13,239,000
Floodway Control and Diversion Structure	$75,797,150	$40,813,850	$116,611,000
Construction First Cost Subtotal	$2,016,372,880	$1,161,567,850	$3,177,940,730
Administrative Cost (65 Fed/ 35 Non-Fed)			
Planning Engineering and Design	$155,645,000	$289,054,000	$444,699,000
Construction Management	$149,480,000	$80,489,000	$229,969,000

Administrative Subtotal	*$305,125,000*	*$369,543,000*	*$674,668,000*
Optimized Tentatively Selected Plan Total Cost			
	$2,321,497,880	***$1,852,248,850***	***$4,173,746,730***

6.5.6 Federal Responsibilities under the PPA

The Federal government would be responsible for PED and construction of the project in accordance with the applicable provisions of Public Law 99-662 (WRDA of 1986), as amended. The Government, subject to Congressional authorization, the availability of funds, and the execution of a binding agreement with the NFS in accordance with Section 221 of the Flood Control Act of 1970, as amended, and using those funds provided by the NFS, shall expeditiously construct the project, applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

6.5.7 Non-Federal Responsibilities under the PPA

The project, if approved, consists of structural and nonstructural measures in St. Tammany Parish, to reduce the risk of damages from riverine and rainfall flooding and coastal storm surge. The project includes construction (and operation) of approximately 18.5 miles of a levee and floodwall system from West Slidell to South Slidell, to include 8 pump stations, 13 culverts/sluice gates/lift gates, 18 vehicular floodgates, 1 pedestrian floodgate, 1 railroad floodgate, 6 road ramps, 2.15 miles of channel improvements to Mile Branch in Covington. The I-10 road surface would be raised to construction elevation 22.0 to ramp over the new levee section to stay above the hydraulic design elevation for year 2082, to ensure the entire pavement section remains above the hydraulic design elevation across the interstate by constructing ramps to the preliminary design elevation of 15 feet. Approximately 5,583 eligible residential structures would be elevated to the future 100-year flood stage up to 13 feet, and 827 eligible nonresidential structures in would be floodproofed up to 3 feet. Eligible structures must have a first-floor elevation (FFE) at or below the 25, 50 or 100 -year storm surge floodplain (depending on location within the study area), based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis).

As a shared responsibility, the Optimized TSP is inclusive of the NFS's additional floodplain management responsibilities and emergency response actions in conjunction with state and Federal Emergency Management Agency (FEMA) related programs to mitigate the Optimized TSP's residual risk, including potential life loss and damages to critical infrastructure. Federal implementation of the project would be subject to the NFS agreeing in a binding written agreement to comply with applicable Federal laws and policies, and to perform the following non-Federal obligations, including, but not limited, to the following:

a. Provide 35 percent of total project costs as further specified below:

1. Provide the non-Federal share of design costs allocated by the Government in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total project costs;

b. Do not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the project;

c. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

d. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project‘s authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

g. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as would properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

h. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

i. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

j. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

l. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that would not cause liability to arise under CERCLA.

m. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

n. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

o. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

p. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal sponsor to prepare a floodplain management plan within one year after the date of signing a project partnership agreement, and to implement such plan not later than one year after completion of construction of the project;

q. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

r. Shall not use any project features or lands, easements, and rights-of-way required for such features as a wetlands bank or mitigation credit for any other project;

s. Pay all costs due to any project betterments or any additional work requested by the non-Federal sponsor, subject to the non-Federal sponsor's identification and request that the Government accomplish such betterments or additional work, and acknowledgement that if the Government in its sole discretion elects to accomplish the requires to so notify the non-Federal sponsor in writing that sets forth any applicable terms and conditions.

6.6 RISK AND UNCERTAINTY

Risk and uncertainty are intrinsic in water resources planning and design. Risk is a measure of the probability and consequence of uncertain future events. It is the chance of an undesirable outcome. Uncertainty refers to the likelihood an outcome results from a lack of knowledge about critical elements or processes contributing to risk or natural variability in the same elements or processes. Throughout the planning process, the PDT identified risk and uncertainty using collaboration with the NFS and stakeholders and in accordance with USACE policies related to risk such as USACE ER 1105-2-100. Risk informed decisions were made regarding the reliability of estimated benefits and the costs of alternative plans.

Measures were developed to manage risk by expanding on and referencing successful similar completed projects along the Louisiana coast, as well as nationwide. Experience from previous projects helped in the identification of possible risks and decrease uncertainty in plan formulation. No measure or alternative in the TSP is burdened by significant risk or uncertainty regarding its eventual success. Significant risks were avoided by using proper design, appropriate selection, and correct seasonal timing of applications. Risks were also managed through extensive coordination with other agencies and experts. The dynamic and complex nature of coastal environmental processes is a principal source of uncertainty. This section described various categories of risk and uncertainties pertinent to the study. See Section 4 for information regarding how the PDT incorporated risk-informed decision making into the planning process.

USACE decision documents recognize cost risk and uncertainty surrounding implementation. All cost estimates will carry a degree of uncertainty. The estimated total project first cost for the CSRM measure of the Optimized TSP is $ $2,448,516,000 at a Class 3 level of technical information which represents preliminary design. For this CSRM measures, the currently known major uncertainty drivers are the following:

1) Limited survey and Geotech data may result in quantity changes;

2) inflation estimates may be lower than actual inflation;

3) Construction modification.

As the project moves into the next phases, USACE will focus risk management and mitigation on the primary cost and other significant risk drivers to the extent within USACE control. However, there still exists the potential for other unanticipated and uncontrollable changes in environmental or economic conditions that could further increase the total project first cost beyond the current estimate and/or necessitate changes in the project's design.

Because natural systems are complex and consist of an intricate web of variables that influence the existence and condition of other variables within the system, all projects (e.g., flood risk management, restoration, etc.) contain inherent uncertainties. The effects of tropical storms, increased sea level rise, and climate change on each project's performance are uncertain and are addressed through future projections based on existing information

The study evaluated potential impacts of sea level change in formulating and engineering the Optimized TSP. To address this uncertainty, project performance was assessed at the intermediate rate of sea level rise as it offered the best balance between equally likely scenarios (i.e., the historic rate of sea level rise continuing indefinitely and the high rate including accelerated rates of change caused by warming temperatures and accelerated ice melt). In recognition of the uncertainty presented by sea level rise, adaptation capacity has been incorporated into the final feasibility-level design to maximize the overall usefulness of the system over the life of the project by including redundancy and robustness in the design, so they are adaptable to future conditions including the high rate sea level change. CEMVN will continue to monitor local conditions and determine if the intermediate scenario of sea level change is reasonably representative of observed conditions. If observed conditions significantly exceeding the intermediate projection are identified during design or construction, reevaluation of the NED plan will be required.

The PDT identified the following environmental factors that inherently carry uncertainty and could impact the accrual of benefits within the 50-year period of analysis. These environmental risks to implementation would be managed by gathering data and making changes to the project, if necessary, based on this data, through adaptive management.

- Potential climate change issues, such as SLR, in addition to regional subsidence rates are significant scientific uncertainties. These issues have been incorporated in the alternative evaluation process.
- Future climate change trajectories or projections affect habitat conditions (e.g., subsidence, sea level rise, flood events, drought, growing season lengths, etc.).
- The mitigation area, project infrastructure and/or project operations could be impacted by severe weather events (flooding, structural damage from wind, etc.).
- River conditions could change.
- Impacts and risk of pollution or oil/contaminant spills could occur in the river or in the vicinity of the mitigation area. There would be a system in place at the diversion intake structure in the Mississippi River to automatically close the structure if a spill is detected at a nearby industrial facility; this would lessen the impact of a spill reaching the mitigation area.
- Unknown variability in topography or bathymetry within the benefit areas and vicinity could alter diversion flow and change environmental impacts.

Engineering factors that carry uncertainty include:

- Final construction design;
- Modeling analysis and assumptions;
- Existing or future projects cause unexpected effects on the TSP;
- Design changes could affect the mitigation need.

Section 6 and Appendix I: Mitigation Plan Marsh, Pine Savanna and Riparian Monitoring, Success Criteria, and Adaptive Management Plans identify the numerous adaptive management activities in the life cycle of the project that could be used to address and or manage these risks and uncertainties with respect to the new habitats constructed as compensatory mitigation for unavoidable losses to existing habitats.

Uncertainties in Analysis

Future conditions are inherently uncertain. The forecast of future conditions is limited by existing science and technology. Future conditions described in this RDIFR-EIS are based on an analysis of historic trends and the best available information. Some variation between forecast conditions and reality is certain. Mitigation features were developed in a risk-aware framework to minimize the degree to which these variations would affect planning decisions.

However, errors in analysis or discrepancies between forecast and actual conditions could affect plan effectiveness.

All the models used to inform the RDIFR-EIS are mathematical representations of reality. Models simulate complex systems by simplifying real processes into expressions of their most basic variables. These tools assist with finding optimal solutions to problems, testing hypothetical situations, and forecasting future conditions based on observed data. No model can account for all relevant variables in a system. The interpretation of model outputs must consider the limitations, strengths, weaknesses, and assumptions inherent in model inputs and framework. Inaccurate assumptions or input errors could change benefits predicted by models used in this evaluation. The potential for significant changes due to errors has been reduced through technical review, sensitivity analyses, and quality assurance procedures. However, there is inherent risk in reducing complex natural systems into the results of mathematic expressions driven by the simplified interaction of key variables.

Impact Assessment

The mitigation sites have been assessed through review of existing information, reports and projects as well as data sources. Project designs would be further developed and refined during PED should the study receive approval and funding. A reassessment of impacts would conducted once designs are finalized in PED to ensure all impacts from construction of the TSP are fully identified and mitigated. If additional impacts are identified beyond what has been assessed in this RDIFR-EIS, then a supplemental NEPA document would be prepared analyzing those project changes and mitigation needs and released to the public for comment. If the identified mitigation sites incur, through construction, additional impacts to habitat, those impacts must also be mitigated.

Wetland Value Assessment Model Uncertainties

Some of the remotely sensed data used to classify habitat type used older data. Satellite imagery data used to classify habitat types may be as old as 2005. There is a risk that these data may not accurately represent the existing conditions. There are many general risks associated with using mathematical models and projecting future conditions in a dynamic environment. These risks are covered in other parts of this section.

Habitat Evaluation Procedures (HEPs)

Impacts to pine savanna fish and wildlife resources was limited to using species specific HEPs in lieu of a pine savanna community model. The HEP approach are species-based models and only quantify habitat quality associated with a single species instead of measuring the overall health of the ecosystem and its ability to support a diversity of fish and wildlife resources. There are a limited number of species with published HEP models that are good indicators of pine savanna forest quality. Some of the best indicator species for this habitat type do not have HEPs developed (e.g., gopher tortoise, eastern indigo snake, eastern diamond-backed rattlesnake, flatwoods salamander, etc.). Species HEPs that are available are often dated and do not include new species information collected since the time of publication.

Elevation of Manufactured, Modular and Mobile homes as part of the Nonstructural Plan

For purposes of this RDIFR-EIS, the terms “manufactured home”, “modular home” and “mobile home” shall have the meanings ascribed to those terms below.

"*Modular home*" and "*modular housing*" mean a factory-built, residential dwelling unit built to the International Residential Code as adopted by the Louisiana State Uniform Construction Code Council. See La. R.S. 51:911.22 as amended from time to time. To be eligible for elevation, a modular home must be permanently affixed to the ground, and must meet the anchoring, construction, installation, and other requirements of La. R.S. 912, ART XIV-B. MINIMUM STANDARDS FOR INSTALLATION OF MANUFACTURED AND MODULAR HOMES AND TRANSPORTATION REQUIREMENTS.

"*Manufactured home*" and "*manufactured housing*" mean a factory-built, residential dwelling unit constructed to standards and codes, as promulgated by the United States Department of Housing and Urban Development (HUD), under the National Manufactured Housing Construction and Safety Standards Act of 1974, 42 U.S.C. 5401 et seq., as amended. Further, the terms "manufactured home" and "manufactured housing" may be used interchangeably and apply to structures bearing the permanently affixed seal of the United States Department of Housing and Urban Development. See La. R.S. 51:911.22 as amended from time to time. To be eligible for elevation, a manufactured home must be permanently affixed to the ground, and must meet the anchoring, construction, installation and other requirements of La. R.S. 912, ART XIV-B. MINIMUM STANDARDS FOR INSTALLATION OF MANUFACTURED AND MODULAR HOMES AND TRANSPORTATION REQUIREMENTS.

"*Mobile home*" means a factory-built, residential dwelling unit built to voluntary standards prior to the passage of the National Manufactured Housing Construction and Safety Standards Act of 1974. This term includes and is interchangeable with the term "house trailer" but does not include the term "manufactured home", as only manufactured homes are built to federal construction standards. See La. R.S. 51:911.22 as amended from time to time. To be eligible for elevation, a mobile home must be permanently immobilized in accordance with the requirements of La. R.S. 9:1149.4 as amended from time to time. A mobile home placed upon a lot or tract of land shall be an immovable when there is recorded in the appropriate conveyance or mortgage records of the parish where the said lot or tract of land is situated an authentic act or a validly executed and acknowledged sale or mortgage or sale with mortgage which contains a description of the manufactured home as described in the certificate of title or manufacturer's certificate of origin and a description of the lot or tract of land upon which the manufactured home is placed, and contains a declaration by the owner of the manufactured home and, when applicable, the holder of a mortgage or security interest under Chapter 9 of the Louisiana Commercial Laws on the manufactured home, that it shall remain permanently attached to the lot or tract of land described in the instrument. Notwithstanding the provisions of La. R.S. 9;1149.6, the original mobile home owner and any subsequent owner of a immobilized mobile home, may not deimmobilize the mobile home in the future by detachment, removal or any other method.

The state of Louisiana classifies property as either immoveable or moveable. Immoveable property refers to things like land and everything permanently attached to the land such as a house or buildings. Moveable property consists of things that physically exist and can be moved from one place to another. If the home is a manufactured, modular or mobile home, it is classified as *moveable personal property* under state law unless it has been permanently immobilized in accordance with the requirements of state law. Immobilizing means the manufactured, modular or mobile home is made a part of the land, both physically and legally. In order for a manufactured, modular, or mobile home to be legally classified as immoveable real property, the structure owner must comply with the requirements of La. R.S. 9:1149.4 (2022), which include the execution of an act or declaration of demobilization stating that the structure shall remain permanently attached to the lot or tract of land described in the act or declaration. The act or declaration of immobilization must contain the written consent of all owners of the structure and all holders of a mortgage or security interest. Upon recordation of the act of immobilization in the public records, the structure is subject to all laws concerning immoveable property.

Although an act of immobilization must state that the manufactured, modular, or mobile home shall remain permanently attached to the land, the act of immobilization can be “undone”. Even if a manufactured, modular, or mobile home has been immobilized in accordance with state law, another state statute authorizes the owner (and subsequent owners) to thereafter deimmobilize the manufactured, modular and mobile home. This process effectively transforms the immobilized corporeal immoveable manufactured, modular or mobile home back to the legal status of a corporeal moveable thing and personal as opposed to real property. La. R.S. 9:1149.6 (2022), provides that an owner may deimmobilize a manufactured, modular or mobile home by detachment or removal. To be effective against third person, the owner must comply with statutory provisions requiring the execution of an act of deimmobilzation, recording of the act in the public records, and the submission of application to the Department of Public Safety, Office of Motor Vehicles, for a new certificate of title. Upon issuance of a new certificate of title, the deimmobilization process is complete, and the manufactured, modular or mobile home shall be deemed moveable and subject to all laws concerning moveable personal property.

At this time, there are approximately 417 homes that are either manufactured, modular or mobile homes included in the total number of 5,583 residential structures that are preliminarily eligible for elevation. The PDT has not researched how many of the 417 structures in this count are manufactured homes, or modular homes, or mobile homes. Further investigation into the legal classification of these 417 structures will be conducted by the PDT before PED. The PDT is continuing to work with the vertical team, the Offices of Counsel, the USACE National Nonstructural Committee and others, to reach consensus on the propriety of including these types of structures for elevation in the Nonstructural Plan. This collaboration will continue to evaluate how to best protect the federal investment and enforce requirements to ensure that these kind of homes remain immoveable real property and permanently affixed to the ground in perpetuity.

FEASIBILITY LEVEL DESIGN RISK AND UNCERTAINTY

6.6.1 Environmental Factors

Sea Level Change:

Outlined in ER 1100-2-8162, USACE is to incorporate “the direct and indirect physical effects of projected future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of project.” ER 1100-2-8162 was developed by USACE with the assistance of coastal scientists from the National Oceanic and Atmospheric Administration (NOAA) and the USGS to allow scientific data to be embedded into engineering guidance. Possible future rates of sea level change are divided into three scenarios: 1) Low, 2) Intermediate, and 3) High Sea Level Change. Based on the data the three scenarios are broken down into the following:

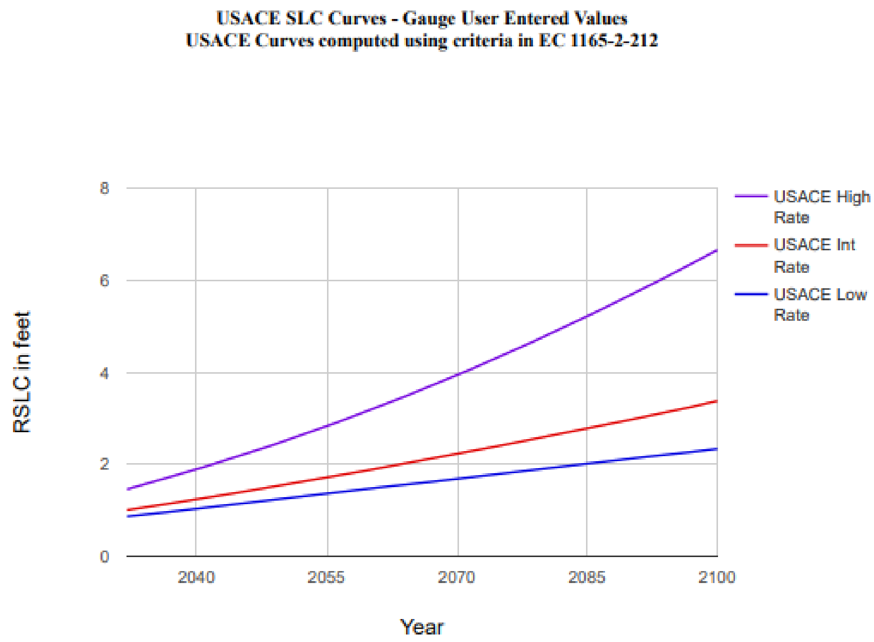
> LOW: Based on historic rates of sea-level change (ETL 1100-2-1, Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaption).
>
> INTERMEDIATE: Calculated from the modified NRC Curve I considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added.
>
> HIGH: Computed from the modified NRC Curve III considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added.

The ER directs to use the USACE Sea Level Change Curve Calculator online tool to develop the three rates. For the high-subsidence area of coastal Louisiana, the Sea-Level Calculator for Non-NOAA Long-Term Tide Gauges was used specifically, results may be seen in Figure 6-8. A base year of 2032 is used in the tool as that is the selected base year of the project and the selected location for computation of the Sea Level Change Curve Calculator is Mandeville, Louisiana. Each rate of SLC and the impact these rates pose on proposed projects performance in the Optimized TSP is evaluated and discussed in Section 14 of Appendix E: Hydrologic & Hydraulics.

USACE Curves computed using criteria in USACE EC 1165-2-212

>

Gauge User Entered Values All values are in feet			
Year	USACE Low	USACE Int	USACE High
2032	0.87	1.01	1.46
2037	0.97	1.15	1.73
2042	1.08	1.30	2.01
2047	1.19	1.46	2.31
2052	1.30	1.62	2.63
2057	1.41	1.78	2.97
2062	1.52	1.95	3.33
2067	1.62	2.12	3.71
2072	1.73	2.30	4.10
2077	1.84	2.48	4.52
2082	1.95	2.67	4.95
2087	2.06	2.86	5.40
2092	2.17	3.05	5.87
2097	2.27	3.25	6.36
2100	2.34	3.38	6.66



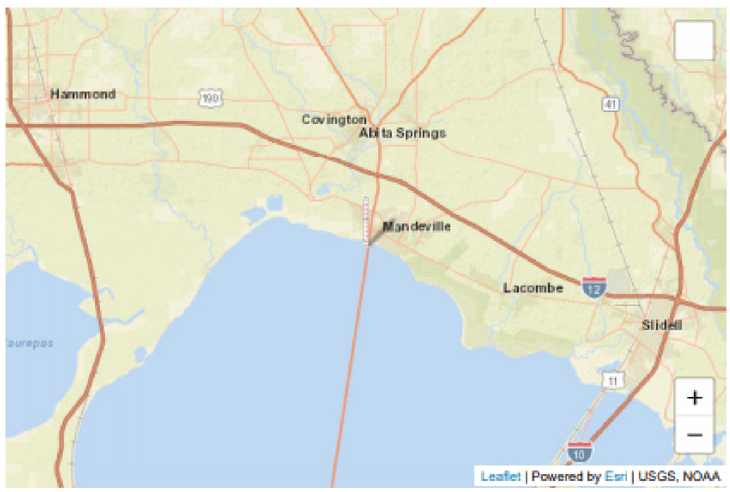


Figure 6-8. USACE Relative Sea Level Change Results for St. Tammany Parish Feasibility Study (Gage – Lake Pontchartrain at Mandeville – USGS Gage ID 85575)

Storms: Risks associated with the TSP are primarily related to the possibility of extreme weather events. The uncertainty of the size or frequency of storms and other meteorological events, such as El Nino and La Nina, cannot be predicted over a set period of time. The storm record is constantly being updated and a large storm, such as Hurricane Katrina, or a slow moving storm, such as Hurricane Isaac, can alter the expected return period for other storms.

6.6.2 Engineering Factors

Levee/Structure Failure: The risk associated with the levee/structure system is stability. Analysis of the earthen levee and associated T-walls and gates was evaluated during feasibility-level design, and included in the RDIFR-EIS and Appendix D: Engineering. PED should follow an extensive geotechnical exploration program. The levee and other TSP features would be constructed to USACE standards.

Modeling Factors: Detailed information regarding model analysis, assumptions, and factors may be reviewed in Appendix E: Hydrologic & Hydraulics. To summarize the modeling effort, HEC-RAS modeling was utilized for FRM alternative analysis. Processing of previously-run existing conditions ADCIRC modeling results was conducted for CSRM alternative analysis. The Draft TSP was modeled directly in ADCIRC to inform feasibility level of design. This modeling approach was utilized to model the impacts of three sources of flood risk within the parish: local rainfall, Pearl River Basin flooding, and coastal storm surge and waves. Uncertainties, risks, and assumptions made in this modeling effort may be reviewed in Appendix E Hydrologic & Hydraulics.

6.6.3 Economic Factors

The HEC-FDA Version 1.4.2 USACE-certified model was used to calculate the damages and benefits for the study. The economic and engineering inputs necessary for the model to calculate damages and benefits include structure inventory, contents-to-structure value ratios, vehicles, first floor elevations, and depth-damage relationships, ground elevations, and without-project stage probability relationships.

The uncertainty surrounding each of the economic and engineering variables was also entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for study area reaches to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships. Uncertainty surrounding variables such as population growth, first floor elevations, structure value, depth damage relationships and additional inputs are consistent with typically accepted uncertainty.

6.6.4 Residual Damages and Residual Risks

The RDIFR-EIS fully describes flood risk to structures and life safety associated with riverine, rainfall, and coastal storm flood events. The measures of the Optimized TSP were formulated to reduce the risk of flood damages to key infrastructure and structures . The Optimized TSP would greatly reduce, but not eliminate future damages and residual risk would remain. The structural measures of the Optimized TSP reduces expected annual damages by approximately 30 percent relative to the without project conditions. The nonstructural plan of the Optimized TSP reduces annual damages by approximately 40 percent relative to the without project condition. The residual risk, along with the potential consequences, has been communicated to the Non-federal Sponsor and will become a requirement of any communication and evacuation plan.

Of the $573 million in the without project estimated annual damages (EAD) in the study area, about $383 million in estimated annual damages is due to coastal flooding and $190 million in estimated annual damages is due to rainfall and riverine flooding. The TSP is currently estimated to reduce the EAD caused by coastal flooding by about 80 percent and reduce the EAD caused by rainfall and riverine flooding by about 60 percent.

6.6.5 Potential Induced Flooding

The flood risk that remains in the floodplain after the Optimized TSP is implemented is known as the residual flood risk. Measures included in the Riverine Modeling are the Bayou Patassat channel improvements, the South and West Slidell levee and floodwall system, and the Mile Branch channel improvements. The measures in the Optimized TSP were modeled in HEC-RAS. The South and West Slidell levee and floodwall system was the only measure from the Optimized TSP modeled in ADCIRC. Riverine modeling was performed for the 2, 5, 10, 25, 50, 100, 200, and 500-year rainfall events for existing conditions, with-project base (year 2032), and future conditions (year 2082).

Coastal storm surge and wave modeling was completed for existing conditions, with-project base (year 2032), and future conditions (year 2082). The South and West Slidell levee and floodwall system is the sole measure included in the ADCIRC coastal modeling. Water surface elevation results for the Coastal storm surge and wave modeling were statistically computed and provided to the PDT for use in economic, environmental, and engineering analyses for the following return periods: 10, 20, 50, 100, 200, 500, and 1000-year events. ADCIRC modeling of the Optimized TSP alignment for the 1 percent AEP water levels on the floodside of the alignment indicated less than 6 inches of inducement. The structural measures of the TSP are not expected to cause significant changes to storm surge levels for that would be experienced by the USACE Lake Pontchartrain and Vicinity system (part of the post--Katrina Hurricane Storm Damage Risk Reduction System for the New Orleans Metro area) or the USACE West Shore Lake Pontchartrain system on the western end of Lakes Pontchartrain and Maurepas.

Section 7
Mitigation Assessment

A compensatory mitigation plan for the study was developed. Efforts taken to avoid, minimize, rectify and or reduce habitat impacts still resulted in unavoidable impacts to fish and wildlife resources that required development of a compensatory habitat mitigation plan. An initial draft of the habitat mitigation plan was provided in the June 2021 DIFR and DEIS. During Feasibility level of design the original draft mitigation plan was refined. The revised mitigation plan updates the quantities and types of habitat impacts based on field survey and provides a selected plan to compensate for these impacts. The second draft of the mitigation plan is released as part of this report for concurrent public, agency, technical and policy review in July 2023. Comments received will be considered in development of the recommended plan. The full mitigation plan (Appendix I: Mitigation Plan) documents and details the mitigation assessment performed, including coordination, plan formulation, and environmental compliance, to develop the compensatory habitat mitigation plan.

The authority and requirements for compensatory habitat mitigation are found in Federal laws and regulations. The legal foundation for habitat mitigation to offset unavoidable habitat losses cause by USACE water resources projects includes the Clean Water Act, the Water Resources Development Act (WRDA) of 1986, Section 906, as amended by subsequent WRDAs, the Fish and Wildlife Coordination Act and other environmental laws. The specific procedures followed to develop this compensatory habitat mitigation plan are found in Engineer Regulation 1105-2-100, Appendix C: Environmental. Mitigation for other types of impacts, such as for cultural resources, or noise may also be part of a project. Efforts to avoid, minimize, rectify, or reduce impacts, not directly related to fish and wildlife habitat impacts are not covered in this Mitigation Plan and are found elsewhere in the report and appendices.

Compensatory habitat mitigation is defined as “the restoration (re-establishment or rehabilitation), establishment, enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved” (see 40 CFR 230.92). Implementation guidance for Section 1163 of the WRDA of 2016 requires functional assessments be performed to define habitat impacts and to set mitigation requirements for impacted habitats.

The goal of the developed mitigation plan is to fully compensate for the unavoidable impacts to significant fish and wildlife habitat resources that would occur with the implementation of the CSRM and FRM plan developed in the study. The objectives of the mitigation plan are defined by the results of the habitat impact assessment model using quantified units. The same habitat assessment model was used to estimate potential study impacts and potential mitigation project outputs.

- Compensate for the loss of 48 average annual habitat units of fresh and intermediate marsh wetland habitat in the Mississippi Alluvial Plain, Deltaic Coastal Marshes and Barrier Islands ecoregion within Louisiana.
- Compensate for the loss of 55 average annual habitat units (10 red-cockaded woodpecker AAHU; 45 pine warbler AAHU) of Pine Savanna habitat in the Lake Pontchartrain Watershed.
- Compensate for the loss of 23 average annual habitat units of Riparian habitat in the Lake Pontchartrain Watershed.
- Compensate for the loss of 9 average annual habitat units (7 red-cockaded woodpecker AAHU; 2 pine warbler AAHU) of Pine Savanna habitat on refuge land within BBMNWR or on within other USFWS within the Lake Pontchartrain Watershed.
- Compensate for the loss of 3 acres of Stream water bottoms within the Mile Branch impact area.

Development of this plan involved extensive coordination and collaboration with the NFS, state and federal agencies. An interagency team comprised of state and federal resource agencies contributed expertise and information toward the identification of habitat impacts and the development of a comprehensive compensatory mitigation plan. CEMVN will continue to coordinate and seek input from these organizations during the design and implementation phases in executing the mitigation plan upon authorization and funding of the study.

Mitigation measures and alternatives were developed and evaluated separately for the following impact types:

- Fresh and intermediate marsh non-refuge
- Pine Savanna non-refuge
- Pine Savanna refuge
- Riparian Habitat non-refuge
- Stream Habitat non-refuge

The identification and evaluation of mitigation measures, sites and the Final Array of mitigation alternatives for each habitat type are detailed in Appendix I: Mitigation Plan. Factors considered include compliance with laws, regulations and policies, watershed and ecological site considerations, implementation timing, risk and reliability, environmental impacts, and cost effectiveness.

The proposed action would be a combination of mitigation bank credit purchases and USACE constructed projects. Constructed projects are proposed for marsh, stream and refuge pine savanna impacts and mitigation banks are proposed for riparian and non-refuge pine savanna impacts. The proposed ecological success criteria, monitoring and adaptive management for the mitigation plan is including in Appendix I: Mitigation Plan.

<u>Marsh - Constructed</u>

MA 2-3. Non-refuge Fresh and Intermediate Marsh - East Fontainebleau (Site M2), This alternative includes a 221 acre restoration site in St Tammany Parish. The site is within the acquisition boundary of the BBMNWR but is currently under private ownership. There is a proposed CWPPRA project (Bayou Cane Marsh Creation) #PO181 adjacent to this site. Measures include: perimeter retention dikes, dredged material placement, interior terraces, pump and fill dredged material to required elevation, allow to dewater for 1 year, 1 year after dewatering degrade perimeter dikes, should naturally vegetate, use external borrow from identified site along north shore of Lake Pontchartrain. if possible (Management Measure #3 and #10). There are 299 acres available. This constructed site to provide 47 AAHUS.

<u>Riparian - Mitigation Bank</u>

MA 3-1. Non-refuge Riparian BLH – Purchase mitigation bank credits ((Riparian Site-MB). Mitigation bank credits would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for the particular habitat type (Management Measure #1). This measure to provide 24 AAHUS.

<u>Pine Savanna - Mitigation Bank</u>

MA 4-1. Non-refuge Pine Savanna – Purchase mitigation bank credits (PS-MB). Mitigation bank credits would be selected through a solicitation process, through which any mitigation bank meeting eligibility requirements and having the appropriate resource type of credits could submit a proposal to sell credits. If appropriate and cost-effective, the Corps may choose to purchase mitigation bank credits from more than one bank to fulfill the compensatory mitigation requirements for the particular habitat type (Management Measure #1). This measure to provide 67 AAHUS.

<u>Refuge Pine Savanna- Constructed</u>

PSR –1. - The proposed project involves the restoration of up to (~)70 acres of degraded wet Long-leaf Pine Savanna Forest as compensatory mitigation for coastal zone Pine Savanna impacts resulting from construction of the West and South Slidell levee and floodwall alignment. The restoration area is located entirely within the Big Branch National Wildlife Refuge, St Tammany Parish, LA (reference Figure 7-1 below). The site is located south and east of Bayou Bonfouca, west of the Norfolk Southern railroad and Pontchartrain Drive (U.S. Route 11) and north of the Lake Pontchartrain, Louisiana.

The project includes: eradication of invasive species such as Tallow, removal of undesirable hardwood species, and reintroduction of fire across the entire site. Removal of undesirable hardwood species coupled with the reintroduction of frequent fires are effective tools in removing brush and mid-story species and restoring appropriate ground cover in remnant longleaf pine savannas. Longleaf pine forests are fire dependent systems, and if left unchecked, can eventually develop into a mixed pine-hardwood forest. Controlled burns conducted on a regular basis would impede forest succession to promote a diverse herbaceous ground cover. This is done by inhibiting the growth of invading hardwood trees that are not adapted to fire while encouraging the growth and development pine forests and herbaceous vegetation that are fire-adapted, such as pines, grasses, herbs and forbs typical of a pine savanna ecosystem. Planting would not be required unless triggered by the adaptive management plan.

Stream - Constructed

M12a Create a backwater area off of Mile Branch that provides 3 acres of mud bottom as a project feature. A free exchange of water between Mile Branch and the backwater area would be preferred; however, if pedestrian access to Mile Branch must be provided along the full length of Mile Branch, then culverts (4-60”; 2 inflow; 2 outflow) would be required to allow inflow and outflow exchange between the two areas. The culverts should be placed at an elevation that allows frequent water exchange between Mile Branch and the backwater area to avoid stagnation. The site would need to be excavated 3-5-feet deep below the average stage to Mile Branch to achieve both deep-water and shallow water habitat. A 40-feet buffer would be planted with bottomland hardwoods around the east, south, and west perimeter of the site. The 40-feet buffer should not be higher than the existing elevation to allow run-off from adjacent areas to flow into the backwater area. The deep-water area would be excavated at a 3:1 slope away from the buffer to achieve the required depth of the site. Finger islands would be created within the site and planted with BLH. Excavated material from within the site would be hauled off-site. The internal tree "fingers" would be at a lower elevation than the perimeter forested buffer. The fingers should be at the former natural ground elevation or maybe a foot or two lower but would be sufficient to support BLH species. Deep water "channels" would extend through the southern end of the tract to encourage circulation throughout the site. Some shallow areas should be provided for marsh or swamp vegetation growth. The TSP Mitigation Plan is outlined in Table 7-1. See Figure 7-1 for mitigation site locations.

Table 7-1. Summary of TSP for Habitat Mitigation of the St. Tammany Parish Feasibility Study

Habitat Type	St Tammany Project Feature Impacts	Mitigation Site	AAHUs/ Acres	Cost*
Non-Refuge Marsh	Levee and Floodwall System	M2 – East Fontainebleau	48 AAHUs	$25,566,938.00
Non-Refuge Riparian	Mile Branch Channel Improvements	Mitigation Bank	24 AAHUs	$2,766,198.82
Non-Refuge Pine Savanna	Levee and Floodwall System	Mitigation Bank	67 AAHUs	$11,687,041.00
Refuge Pine Savanna	Levee and Floodwall System	Pine Savanna BBMNWR PSR-1	8 AAHUs	$2,719,532.98
Stream	Mile Branch Beneficial	Mile Branch	3 Acres	$4,062,000

	Use of Staging Area M12a			
Total Mitigation Cost				**$46,801,711.80**

*Constructed project costs include construction, monitoring and adaptive management and any necessary OMRR&R.

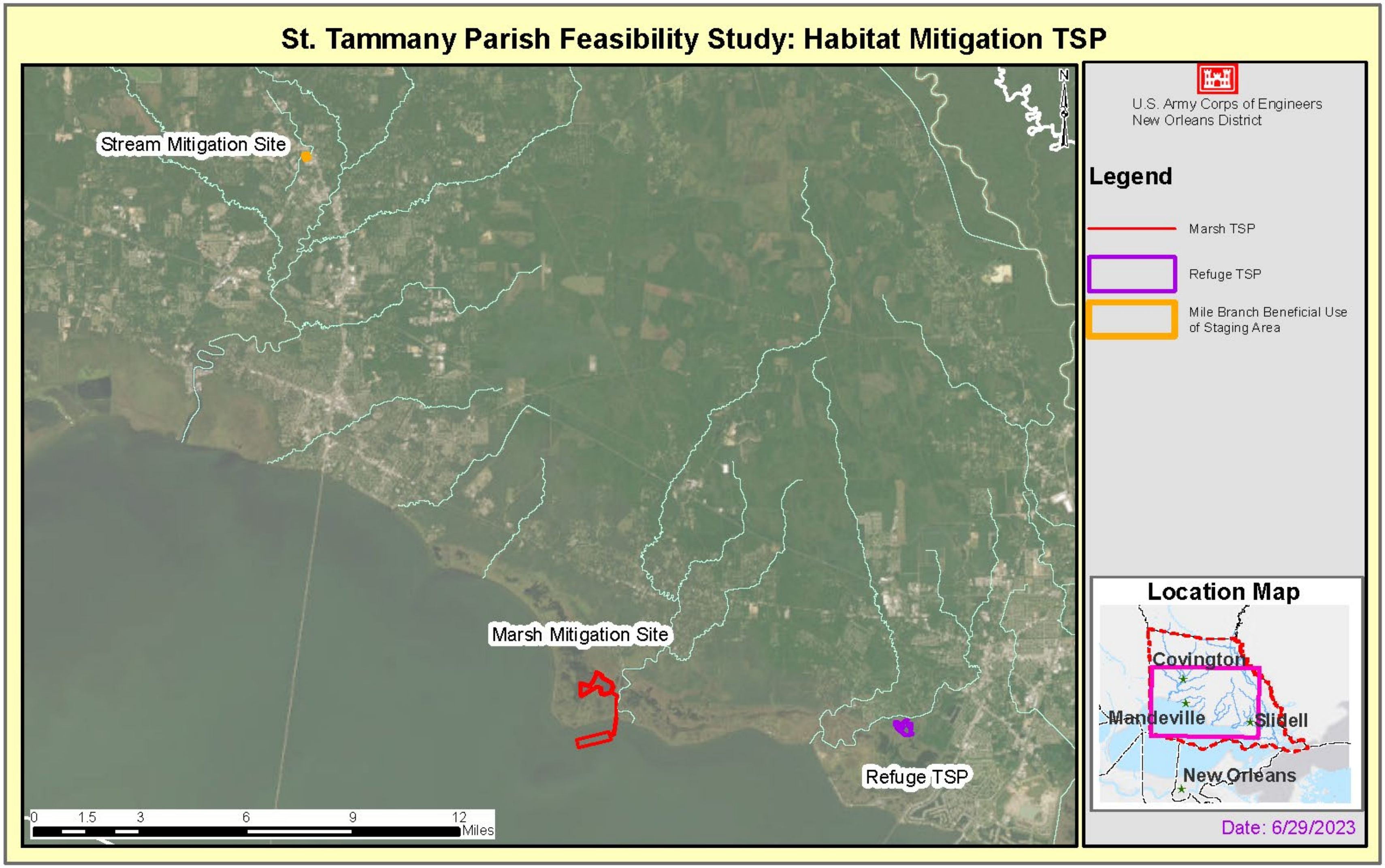


Figure 7-1. Summary of TSP for Habitat Mitigation of the St. Tammany Parish Feasibility Study

Section 8
Environmental Laws and Regulations

8.1 EXECUTIVE ORDER 12898, FEDERAL ACTIONS TO ADDRESS ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW-INCOME POPULATIONS DATED FEBRUARY 11, 1994;

Executive Order 12898 directs federal agencies to: identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations to the greatest extent practicable and permitted by law. No high adverse disproportionate impacts were identified. However, mitigation of high, adverse impacts is provided.

8.2 EXECUTIVE ORDER 14008, TACKLING THE CLIMATE CRISIS AT HOME AND ABROAD DATED 27 JANUARY 2021, SEC 219: SECURING ENVIRONMENTAL JUSTICE AND SPURRING ECONOMIC OPPORTUNITY; OFFICE OF MANAGEMENT AND BUDGET MEMORANDUM M-21-28;

Executive Order 14008, Sec 219, states that agencies shall make achieving environmental justice part of their missions by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental and climate-related impacts as well as the accompanying economic challenges of such impacts. An EJ assessment identified high, adverse human impacts and determined that these impacts are not disproportionate to minority or low-income residents. Additionally, areas of EJ concern are shown to benefit from floor risk reduction measures recommended in the TSP.

8.3 EXECUTIVE ORDER 14096: REVITALIZING OUR NATION'S COMMITMENT TO ENVIRONMENTAL JUSTICE FOR ALL

Executive Order 14096 states that advancing environmental justice will require investing in and supporting culturally vibrant, sustainable, and resilient communities. The Flood Risk Management system, recommended as the TSP, benefits areas of EJ concern by reducing flood risk to those living in vulnerable communities.

8.4 EXECUTIVE ORDER 11988: FLOODPLAIN MANAGEMENT

Executive Order 11988 directs Federal agencies to reduce flood loss risk; minimize flood impacts on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by flood plains. Agencies must consider alternatives to avoid adverse and incompatible development in the flood plain. If the only practical alternative requires action in the floodplain, agencies must design or modify their action to minimize adverse impacts. Some project features would extend into floodplains; however, the TSP would not promote future development within the floodplain that otherwise would not occur. The study is compliant with the order.

8.5 EXECUTIVE ORDER 11990: PROTECTION OF WETLANDS

Executive Order 11990 directs Federal agencies to assess the likely impacts to wetlands associated with any proposed action, This is met through the following: (a) avoid long and short term adverse impacts associated with the destruction or modification of wetlands; (b) avoid direct or indirect support of new construction in wetlands; (c) minimize the destruction, loss or degradation of wetlands; (d) preserve and enhance the natural and beneficial values served by wetlands; and (e) involve the public throughout the wetlands protection decision-making process. The TSP was developed to avoid and minimize impacts to wetlands where practicable. All unavoidable impacts would be mitigated as described in Chapter 7.

8.6 CLEAN AIR ACT OF 1970, AS AMENDED

The Clean Air Act (CAA) sets goals and standards for the quality and purity of air and requires the EPA to set national ambient air quality standards (NAAQS) for pollutants considered harmful to public health and the environment. The study area is currently in attainment of NAAQS. No general conformity determination is required.

8.7 CLEAN WATER ACT OF 1972, AS AMENDED – SECTIONS 401 AND 404

The Clean Water Act (CWA) sets and maintains goals and standards for water quality and purity. Section 401 requires a Water Quality Certification from the LDEQ that a proposed project does not violate established effluent limitations and water quality standards. A Section 401 Water Quality Certificate application was submitted to LDEQ on 13 March 2023. Water Quality Certification would be obtained prior to the release of the Final EIS.

As required by Section 404b)(1) of the CWA, an evaluation to assess the short- and long-term impacts associated with the placement of fill materials into waters of the United States resulting from implementation of the TSP is occurring simultaneously with the release of the RDEIS for public comment. A draft Section 404(b)(1) evaluation may be found in Appendix C, Environmental. Comments received on the draft Section 404(b)(1) would be incorporated into the FEIS.

8.8 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act (CZMA) requires that "each federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." In accordance with Section 307, CEMVN submitted a Consistency Determination to LDNR on 30 June 2023. The Coastal Zone Consistency Determination would be incorporated into the Final EIS.

8.9 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The Magnuson-Stevens Fishery Conservation and Management Act, as amended, addresses the protection of Essential Fish Habitat (EFH) by NMFS in association with regional Fishery Management Councils. The NMFS has a “findings” with the CEMVN on the fulfillment of coordination requirements under provisions of the Magnuson-Stevens Fishery Conservation and Management Act. In those findings, the CEMVN and NMFS have agreed to complete EFH coordination requirements for federal civil works projects through the review and comment on National Environmental Policy Act documents prepared for those projects. See 50 CFR 600.920(f) (allowing use of existing environmental review procedures). The initial DEIS was provided to NMFS 3 March 2021. Comments received from NMFS were significant and required further analysis and revisions to the EIS, which are addressed in this RDEIS. EFH conservation recommendations received on the initial DEIS were incorporated into this RDEIS. CEMVN will provide a written response to NMFS’ Conservation Recommendations in the FEIS. Consultation with NMFS is on-going and would be concluded prior to the signing of a ROD.

8.10 ENDANGERED SPECIES ACT OF 1973

The ESA helps to protect and recover T&E species of fish, wildlife, and plants. A biological assessment was prepared and submitted NOAA on 1 May 2023 and USFWS on 3 July 2023, as part of on-going coordination with USFWS and NMFS for listed T&E species, including the Gulf sturgeon and Gulf sturgeon critical habitat, West Indian manatee, Gopher tortoise, Ringed map turtle, Red-cockaded woodpecker, Louisiana quillwort, Eastern black rail, migratory shorebirds, and species of management concern (i.e. rare and very rare species) that are known to occur or are believed to occur within the area. The biological assessment and coordination documents are included in Appendix C: Environmental. USFWS and NMFS will provide their Biological Opinions regarding effects to ESA species prior to the Final EIS.

The implementation of the TSP would include Standard Manatee Conditions for In-Water Activities, Protected Species Construction Conditions, and Vessel Strike Avoidance Measures. In summary, the contractor will be responsible for instructing all personnel regarding the potential presence of protected species in the area and the need to avoid collisions with these animals. If protected species are sighted within 150 feet of the construction area, all operations of moving equipment must cease until the species has departed the area on its own volition. There also would be reporting requirements, restrictions on vessel operation, and restrictions on the use of siltation barriers. Construction guidelines can be found in Environmental Appendix C.

8.11 FARMLAND PROTECTION POLICY ACT

The Farmland Protection Policy Act of 1981 is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to non-agricultural uses. The USDA-NRCS is responsible for designating prime or unique farmland protected by the act. Prime farmland is land with the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops that is available for these uses. It can be cultivated land, pastureland, forestland, or other land, but is not urban or built-up land or water areas. Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops, such as citrus, tree nuts, olives, and vegetables. Forty-four percent of the lands within the TSP footprint are prime and unique farmlands. Construction of the TSP features associated borrow areas would impact prime farmland. The overall potential impact to prime and unique farmland is not considered significant due to the overall benefits the TSP would provide to remaining farmlands. Potential impacts to prime and unique farmland as a result of any project feature, including compensatory mitigation activities would be coordinated with NRCS.

8.12 FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act (FWCA) provides authority for the USFWS and NMFS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license, or permit water resource development projects to first consult with the USFWS, NMFS, and state resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts. Section 2(b) requires the USFWS to produce a Coordination Act Report (CAR) that details existing fish and wildlife resources in a study area, potential impacts due to a proposed project and recommendations for a project. Draft CAR recommendations on the initial DEIS were received 28 April 2021. Revised draft CAR recommendations on the Optimized TSP were received on 15 May 2023 and CEMVN responses are set forth below. USFWS correspondence and the draft CAR are included in Appendix C: Environmental.

The Service requests the following recommendations are implemented concurrently with project construction:

1. The Service recommends that the levee alignment be moved off the BBMNWR. If the alignment cannot be altered, lands would need to be purchased and exchanged with the refuge to construct flood control features. These exchanged lands must be within the approved refuge acquisition boundary. The USACE or the non-federal sponsor would then own the lands needed to build and maintain flood control features.

    CEMVN Response: Concur. Following release of the initial draft IFR-EIS, the TSP was optimized. Meetings were held with the resource agencies including personnel from the BBNMWR to identify ways to avoid and minimize impacts to the refuge. The Optimized TSP reflects those efforts. CEMVN understand that lands directly impacted by the levee alignment are to be exchanged with USFWS for approved lands within the refuge acquisition boundary. CEMVN and the Refuge have been in close communication, and it is understood that the required NWR conformity determination and land exchange would be handled during PED if the project is authorized and funded.

2. Indirect impacts to pine savannah habitat (-6.62 AAHUs) on the BBMNWR are required

to be mitigation for on refuge lands.

CEMVN Response: Concur. A mitigation site (PSR-01) has been selected on the BBMNWR to offset indirect impacts (-6.62 AAHUs) on the refuge. The mitigation plan and project description for the mitigation site are located in Appendix I: Mitigation Plan.

3. Species of vegetation, planted and maintained on levees or levee slopes on Big Branch Marsh NWR, should be closely coordinated with the Service.

   CEMVN Response: Concur. CEMVN will coordinate closely with the refuge and Service regarding construction plans and specifications and species of vegetation planted on the levee/levee slopes.

4. All project related activities on the refuge must be coordinated with Refuge Project Leader Neil Lalonde (985-882-2000).

   CEMVN Response: Concur. CEMVN will coordinate and work closely with the Refuge Project Leader.

5. The Service and other natural resource agencies should be coordinated with throughout the engineering and design of project features including levees, floodgates, water control structures, and clearing and snagging at Mile Branch to ensure that those features are designed, constructed, and operated consistent with wetland restoration and associated fish and wildlife resource needs as required by the FWCA. In addition, the Service recommends these actions and plans, as they are further developed, be provided to the Service and other resource agencies for review, comment, and input.

   CEMVN Response: Concur. CEMVN will maintain close coordination with the Service and natural resource agencies during PED should the project become authorized and funded. The Service, natural resource agencies and Refuge will be provided opportunities to review and comment on project plans and specifications as well as operation manuals as they are developed.

6. Water control structure operation manuals or plans should be developed in coordination with the Service and other natural resource agencies. All drainage features through the levee system should be sized to match the existing drainage system and mimic the existing drainage patterns when the system is not closed. The operation plan should maintain hydrologic connectivity through water control structures except during closure for hurricanes or tropical storms.

   CEMVN Response: Concur. CEMVN will maintain close coordination with the Service and natural resource agencies during PED should the project become authorized and funded. The Service, natural resource agencies and Refuge will be provided opportunities to review and comment on project plans and specifications as well as operation manuals as they are developed.

7. To minimize impacts to fisheries, flood protection water control structures in any watercourse should maintain pre-project cross section in width and depth to the maximum extent practicable. Water control structures within a waterway should include shoreline baffles and/or ramps (e.g., rock rubble, articulated concrete mat) that slope up to the structure invert to enhance organism passage. Various ramp designs should be considered. Please coordinate with the NMFS, Alexis Rixner (alexis.rixner@noaa.gov) on this issue.

   CEMVN Response: CEMVN will maintain close coordination with the Service, Refuge and natural resource agencies during PED should the project become authorized and funded. The natural resource agencies would be provided opportunities to review and comment on project plans and specifications as they are developed. Design features for water control structures would consider shoreline baffles and/or ramps (e.g., rock rubble, articulated concrete mat) that slope up to the structure invert to enhance organism passage to the extent feasible. CEMVN will consider various ramp designs.

8. To offset fish and wildlife impacts to the Mile Branch stream bottom, the Service recommends the USACE develop a backwater area project feature to account for stream bottom impacts as proposed during the planning phase of the STPFS.

   CEMVN Response: Concur. CEMVN has identified plans to establish a backwater area adjacent to Mile Branch once the area is no longer necessary for staging equipment and materials. The design of the backwater area would be closely coordinated with the Service.

9. To minimize impacts to Mile Branch, the USACE should assess whether the existing culverts are of sufficient size to allow for adequate drainage or if larger size culverts are needed. If larger culverts are being installed, the USACE should assess whether these larger structures would preclude the need to widen and deepen the channel. In addition, the USACE should assess whether debris build-up at bridges and/or culverts is blocking/limiting conveyance of floodwaters. If obstructions in the waterway are present and removal would allow for adequate flow during flood events, then the less damaging snagging and clearing should be conducted in place of widening and deepening the canal. Should snagging and clearing be included as a feature of the project, those activities should follow the techniques described within the Stream Obstruction Removal Guidelines (see attached) or nature-based engineering techniques should be used to accomplish the work in the least damaging manner possible.

   CEMVN Response: Noted. During PED, further modeling and design would inform whether the drainage problems identified within the Mile Branch could be addressed via adequate sizing of culverts and bridge embankments as well as debris removal from the channel. If during PED clearing and snagging is determined necessary, the techniques described within the Stream Obstruction Removal Guidelines or nature-based engineering techniques would be considered.

10. Mile Branch is a Louisiana designated Natural and Scenic River. LDWF should review the project and determine if Mile Branch a Scenic Stream Permit would be required. The USACE should initiate consultation with the LDWF Scenic Rivers Program prior to conducting any activities within or adjacent to the banks of that bayou. Scenic Rivers Coordinator Chris Davis can be contacted at (225) 765-2642.

CEMVN Response: Noted, however Federal supremacy has not been waived with respect to the Louisiana Natural and Scenic Rivers Act. CEMVN has coordinated with the LDWF regarding its concerns for the Scenic Stream to determine how to address its concerns and to provide additional information as warranted. Plans and specifications for the scenic streams will be shared with LDWF for input and comment during PED.

11. Full, in-kind compensation (quantified as Average Annual Habitat Units) is recommended for unavoidable direct impacts to 146 acres (-9.7 RCW AAHUs; -45 pine warbler AAHUs) of pine savannah; 39.9 acres (-48 AAHUs) of fresh/intermediate marsh; and 34.9 acres (-22.9 AAHUs) of riparian habitat. Unavoidable indirect impacts to 3.3 acres (-6.6 RCW AAHUs; -13.8 pine warbler AAHUs) of pine savannah. should be mitigated. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.

a. If applicable, a General Plan should be developed by the USACE, LDWF, and the Service in accordance with Section 3(b) of the Fish and Wildlife Coordination Act for mitigation lands.

b. Mitigation measures should be constructed concurrently with the flood damage reduction features that they are mitigating (i.e., mitigation construction should be initiated no later than 18 months after levee construction has begun).

c. If mitigation is not implemented concurrent with levee construction, the amount of mitigation needed should be reassessed and adjusted to offset temporal losses.

d. The USACE should remain responsible for the required mitigation until the mitigation is demonstrated to be fully compliant with interim success and performance criteria. At a minimum, this should include compliance with the requisite vegetation, elevation, acreage, and dike gapping criteria.

e. The acreage restored and/or managed for mitigation purposes and adjacent affected wetlands should be monitored over the project life. This monitoring should be used to evaluate mitigation project impacts, the effectiveness of the compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.

CEMVN Response: Concur in part. USACE has developed a mitigation plan in coordination with USACE and LDWF; compensatory mitigation would be implemented concurrent with levee construction; USACE is responsible for the mitigation until initial success criteria are met, at which time the NFS would be responsible for monitoring and maintenance; the mitigation sites would be monitored over the project life.

12. The Service recommends the development of a Pine Savannah Community Model and a Stream/Riparian Community Model, including ECO PCX approval. These tools would be used for evaluating mitigation credits and refining project impacts during later project phases. The Service is currently using FWS Habitat Evaluation Procedures (HEP) for pine savanna habitat evaluations and bottomland hardwood WVAs because there are no user-friendly ECO PCX approved evaluation tools for Pine Savannah and stream/riparian habitats. These more appropriate tools would be community models based on the habitat's ecology and important indicator species. Without these models, the analysis of impacts and mitigation may be inaccurately estimated.

    CEMVN Response: Noted. The CEMVN will pursue opportunities to develop a Pine Savanna community model whether it be outside a particular CW study or during PED for this study if it is authorized and funded.

13. The construction of levees can result in temporary and/or permanent impacts to migratory birds and the habitats upon which they depend for various life requisites. The Service has concerns regarding the direct and cumulative impacts resulting from the loss and fragmentation of forest and grassland habitats, and the direct and indirect impacts that these losses would have upon breeding migratory birds of conservation concern within the West Gulf Coast Plain Bird Conservation Region. The Service recommends avoiding impacts to forested areas to the maximum extent practicable.

    CEMVN Response: Concur. CEMVN has worked closely with the Service and natural resource agencies to find ways to avoid and minimize impacts to habitats to the extent possible. Any changes to the proposed project resulting from further engineering and design during PED would be closely coordinated with the Service and natural resource agencies.

14. Due to the importance of the project area as nesting habitat for bird species of conservation concern, the Service recommends that the project be constructed in a manner that would minimize bird impacts. The Migratory Bird Treaty Act prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the U.S. Department of the Interior. While the Act has no provision for allowing unauthorized take, the Service realizes that some birds may be harmed or killed as a result of project-related activities even when reasonable measures to protect birds are implemented. The Service's Office of Law Enforcement (LE) carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries that have taken effective steps to minimize their impacts on migratory birds, and by encouraging others to enact such programs. As such, LE focuses its resources on investigating and prosecuting individuals and

entities that take migratory birds without regard for their actions or without effort to implement Service recommendations or conservation measures. In this case, we recommend that no habitat alteration work be performed during the nesting period (March 1 to July 31).

CEMVN Response: Noted. Reference Section 8.11 which includes language that captures this requirement.

15. To aid in water quality improvements, any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate nutrients being discharged.

    CEMVN Response: Noted. during PED should the proposed project become authorized and funded, consideration would be given to designing pump stations such that the discharge would not flow directly into open water bodies. CEMVN will closely coordinate design activities during PED with the Service.

16. If it becomes necessary to use borrow sources other than the previously proposed environmentally cleared sites, the Service recommends USACE begin investigating potential borrow sources in coordination with the Service. Borrow sites to be considered should have minimal impacts to fish and wildlife resources.

    CEMVN Response: Concur. CEMVN will continue to work closely with the Service regarding the proposed project and any changes that may occur during PED should the project become authorized and funded.

17. To avoid adverse impacts to bald eagles and their nesting activities the Service and LDWF recommend that a qualified biologist inspect the construction site for the presence of new or undocumented bald eagle nest within 1,500 feet of the levee construction area.

    CEMVN Response: Concur. Reference Section 8.11 which includes language that captures this requirement.

18. To avoid adverse impacts to nesting wading bird colonies the Service and LDWF recommend that a qualified biologist inspect the construction site for the presence of undocumented nesting colonies during the nesting season (i.e., September 1 through February 15).

    CEMVN Response: Concur. Reference Section 8.11, which includes language that captures this requirement.

19. West Indian manatees occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., through September). During in-water work in areas that potentially support manatees

all personnel associated with the project should be instructed about the potential presence of manatees, manatee speed zones, and the need to avoid collisions with and injury to manatees. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Additionally, personnel should be instructed not to attempt to feed or otherwise interact with the animal, although passively taking pictures or video would be acceptable. For more detail on avoiding contact with manatees contact this office.

CEMVN Response: Concur. Manatee protection language is a part of our contract specifications and contractors are trained in the necessary requirements and best management practices to avoid adverse impacts to Manatee.

20. Consideration should be given to minimize adverse impacts to species currently designated as “at-risk” that may occur within St. Tammany Parish. Those species include the: golden winged warbler, frecklebelly madtom, saltmarsh topminnow, monarch butterfly, Southern snaketail butterfly, Eastern beard grass skipper, tri-colored bat, Alabama hickory nut, Correll’s false dragon-head, alligator snapping turtle, Eastern diamondback rattlesnake and Pearl River map turtle.

    CEMVN Response: Noted. CEMVN will continue to work closely with the Service during development of plans and specifications as well as project implementation regarding species at risk and opportunities to avoid or minimize adverse impacts.

21. A Biological Assessment should be prepared to identify potential direct and indirect impacts to federally listed threatened and endangered species that occur within the project impact area. Those species include the: West Indian manatee, Gulf sturgeon, gopher tortoise, and red-cockaded woodpecker. The Corps should determine if the potential impacts identified would “likely (or not likely) adversely affect” those species.

    CEMVN Response: A Biological Assessment has been developed and submitted to NOAA Protected Species Division May 4, 2023 and FWS XX July 2023.

22. The Service recommends that the USACE contact the Service for additional consultation if: 1) the scope or location of the proposed project is changed significantly, 2) new information reveals that the action may affect listed species or designated critical habitat; 3) the action is modified in a manner that causes effects to listed species or designated critical habitat; or 4) a new species is listed or critical habitat designated. Additional consultation as a result of any of the above conditions or for changes not covered in this consultation should occur before changes are made and or finalized.

    CEMVN Response: Concur. Coordination with the Service will continue throughout the preconstruction, engineering, design and implementation phases should the project become authorized and funded.

The NMFS reviewed the USFWS draft CAR and submitted a letter to the USFWS on June 5, 2023. The NMFS agrees with the 22 recommendations in the CAR related to direct and indirect impacts, recommendations for in-kind compensation, and recommendations requesting USACE provide extensive additional project information. To ensure the conservation of EFH and associated marine fishery resources, NMFS requests expanding the CAR recommendations to include:

1. As required by the Magnuson-Stevens Act, a revised complete EFH assessment should be provided to NMFS to conclude EFH consultation with USACE. The revised assessment should clarify, delineate, and quantify direct and indirect impacts to EFH by habitat type differentiating between the flood side and the protected side of all structures. All activities associated with this project including a description of measures to avoid, minimize, mitigate, or offset the adverse impacts of the proposed activities on EFH should be incorporated.

CEMVN Response: Concur. This RDIFR-EIS includes an updated section on essential fish habitat existing conditions (Section 3.2.17) and impact assessment (Section 5.1.1.5). Impacts to EFH resulting from the Optimized TSP have been more fully described to clarify, delineate and quantify direct and indirect impacts. Impacts are described for both the protected side and floodside of the proposed structures. The mitigation plan summarized in Section 7 and included in Appendix I: Mitigation Plan, describe measures to avoid, minimize and mitigate for the adverse impacts of the proposed plan.

2. Sufficient information should be provided to assess impacts to fisheries access and water exchanges in the Lake Pontchartrain Basin from construction of levees and water control structures. All structures (e.g., roller floodgate and culverts with sluice gates) should remain open under normal conditions. An operational plan for these structures should be provided that includes triggers for gate closures (e.g., named storm events in the Gulf of Mexico, fixed water level elevations, crest setting, estimated frequency of closures, etc.,). The USACE should also provide a reference to the specific flood protection authorization and hydrological modeling results for all structures justifying: (1) how particular locations were selected for each structure, (2) why each structure is needed, and (3) how the size and type of each structure was determined.

CEMVN Response: Concur. Potential impacts to fisheries resulting from proposed structures is included within this draft report. A conceptual operating plan is included in Appendix C for operations of the water control structures. This operating plan will be further defined during PED following additional H&H modeling and engineering design. USACE will continue to closely coordinate with USFWS and NMFS in the development of plans and specifications.

3. The USACE should develop, in coordination with NMFS, a mitigation and monitoring plan which fully compensates for all direct and indirect EFH impacts. To avoid additional mitigation for temporal impacts, the NMFS recommends implementation of the mitigation

plan concurrent with the construction of the development. The quantity of EFH to be impacted should be clarified to inform determination of mitigation. Specifically, a functional assessment should be used to evaluate the compensatory mitigation requirements for unavoidable impacts to wetlands and water bottoms. Water column and estuarine mud/sand bottoms EFH impacts should also be included among the habitat types requiring mitigation. The USACE should: (1) refine the final assessment of EFH impacts by habitat type, (2) provide the information required to conduct a final Wetland Value Assessment (WVA), (3) provide the types of mitigation required, and (4) provide the final mitigation plans. Estimates of all direct and indirect project related impacts to tidally influenced habitat should be refined for inclusion in the project's final CAR.

CEMVN Response: Concur. The USACE has developed a draft mitigation plan in close coordination with USFWS and NMFS, The impact assessment for EFH has been updated to include an impact assessment by habitat type, a wetland value assessment has been conducted and coordinated with NFS and the mitigation plan has been developed with input from NMFS.

8.13 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Pursuant to USACE policy, potential Hazardous, Toxic, and Radioactive Waste concerns are to be identified early and construction in HTRW-contaminated areas is to be avoided to the extent practicable. A Phase I ESA site reconnaissance was conducted on October 1-22, 2021 to assess the potential for HTRW materials within the footprints for each of the alternatives in the Final Array of Alternatives. An American Society for Testing and Materials (ASTM) E 1527-13 Phase I Environmental Site Assessment (ESA) was completed on 8 March 2023, on the Optimized TSP and is on file within the CEMVN-PDC database. Within the Optimized TSP footprint, Mile Branch alignment, South and West Slidell alignment, ST 5 Borrow Site, ST 6 Borrow Site, ST 9 Borrow Site, MS-1 & MS-2 Borrow Site, East Fontainebleau Mitigation Site, and PSR-1 Mitigation Site, it was found that there is a low probability of encountering HTRW during construction. Prior to construction, an ASTM E 1527-13 Phase I ESA would be completed due to the current lack of right of entry provided for the projected TSP right of way required. Reference Appendix C: Environmental.

8.14 MIGRATORY BIRD TREATY ACT, AS AMENDED

The MBTA is the primary legislation in the United States established to conserve migratory birds. The MBTA prohibits taking, killing, or possessing of migratory birds unless permitted by regulations promulgated by the Secretary of the Interior. The USFWS and the Department of Justice are the federal agencies responsible for administering and enforcing the statute. The study area is known to support colonial nesting wading/water birds (e.g., herons, egrets, ibis, night-herons and roseate spoonbills) and shorebirds (terns and gulls). USFWS and USACE biologists would survey the proposed action areas before construction to confirm no nesting activity as suitable habitat and the potential for nesting exist within the area. If active nesting exists within 1,000 feet (water birds) or 1,300 feet (shorebirds) of construction activities then USACE, in coordination with USFWS, would develop specific measures to avoid adverse impacts to those species. A detailed nesting prevention plan may be necessary in order to deter birds from nesting within the aforementioned buffer zones of the area footprints in order to avoid adverse impacts to these species. If a nesting prevention plan is necessary, it would be prepared in coordination with USFWS.

The bald eagle is protected under the Bald and Golden Eagle Protection Act (BGEPA) and the MBTA. USFWS developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at:
https://www.fws.gov/northeast/ecologicalservices/pdf/NationalBaldEagleManagementGuidelines.pdf

These guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. During construction of the Optimized TSP, on-site personnel should be informed of the possible presence of nesting bald eagles in the vicinity of the project boundary, and should identify, avoid, and immediately report any such nests to the USACE. If a bald eagle nest occurs or is discovered within 660 feet of the TSP footprint, then an evaluation must be performed to determine whether the construction and/or operation of the project is likely to disturb nesting bald eagles. An evaluation would be conducted in accordance with the procedures outlined by the USFWS at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, a determination would be made as to whether additional consultation is necessary or not. During nesting season, construction must take place outside of FWS/LDWF buffer zones. A USACE Biologist and an USFWS Biologist would survey for nesting birds prior to the start of construction.

8.15 EXECUTIVE ORDER 12898 AND 14008: ENVIRONMENTAL JUSTICE

Federal agencies are to assess Environmental Justice pursuant to Executive Order #12898: Environmental Justice (1994) and EO #14008, Tackling the Climate Crisis at Home and Abroad (2021). For USACE, compliance with these Executive Orders is mandatory pursuant to Section 112(b)(1) of WRDA 2020 (Public Law 116-260). ("In the formulation of water development resources projects, the Secretary shall comply with any existing Executive Order regarding environmental justice . . . to address any disproportionate and adverse human health or environmental effects on minority communities, low-income communities, and Indian Tribes.") Pursuant to P.L. 116-260, E.O. 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995 USACE identifies and addresses any disproportionately high and adverse human health or environmental effects of its actions to minority and/or low-income populations.

Areas of EJ concern are identified to help inform planners as to the location of those areas needing a particular focus and attention when determining the impacts of the Federal action, as described in Executive Orders #12898 and #14008.

Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, Pacific Islander, or some other race or a combination of two or more races. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population.

Low-income populations are those whose income is at or below the state of Louisiana's statistical poverty threshold for a family of four. The percent of residents living at or below poverty in Louisiana in 2020 is 18.6 percent. Therefore, any census block group in the study area with 18.6 percent or more of its residents below the poverty threshold level is identified as a low-income or poverty area. Poverty is defined by the U.S. Census Bureau as having an annual household income of $26,500 or less for a family of four.

Direct impacts to EJ areas of concern from the structural plans are high and adverse due to the need for residence acquisitions in those areas to accommodate the project footprint. The acquisitions of private residences, however, is not expected to disproportionately impact areas of EJ concern. The NS plan is unlikely to cause high, adverse disproportionate impacts, but further analysis would be completed during the PED phase.

8.16 NATIONAL HISTORIC PRESERVATION ACT OF 1966, AS AMENDED

The CEMVN, as a federal agency, is required, pursuant to Executive Order 13175, NEPA, as amended (42 U.S.C. Sections 4321 et seq), Section 106 of the NHPA, as amended, (54 U.S.C. Section 306108) and its implementing regulations, (38 CFR Part 800) and Section 110 of the NHPA, to assume responsibility for the preservation of historic properties or resources that fall under USACE jurisdiction and that such properties are maintained and managed in a way that considers the preservation of the historic, archeological, architectural, and cultural values.

The NHPA Section 106 process, implemented by regulations of the Advisory Council on Historic Preservation, 36 CFR § 800, requires agencies to define a project's APE, identify historic properties in that area that may be directly or indirectly affected by the project, assess the potential for adverse effects, resolve those adverse effects, and provide the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking.

The consideration of impacts to historic and cultural resources is mandated under § 101(b)(4) of NEPA as implemented by 40 C.F.R. Parts 1501-1508. NEPA calls for the consideration of a broad range of historic and cultural resources, including sites of religious and cultural importance to federally-recognized Tribal governments. Cultural resources include historic properties, archeological resources, and Native American resources including sacred sites and traditional cultural properties. Common cultural resource sites include prehistoric Native American archeological sites, historic archeological sites, shipwrecks, and structures such as bridges and buildings. Historic properties have a narrower meaning and are defined in § 101(a)(1)(A) of the NHPA; they include districts, sites (archaeological and religious/cultural), buildings, structures, and objects that are listed in or determined eligible for listing in the NRHP. Historic properties are identified by qualified agency representatives in consultation with LA SHPO, Tribes, and other consulting parties.

In compliance with NHPA Section 106, CEMVN has initiated Section 106 consultation for the Proposed Action (Proposed Undertaking) as described in the CEVMN correspondence dated 20 August 2020 to the LA SHPO. CEMVN is developing a Programmatic Agreement (PA) that would establish procedures to satisfy the CEMVN's Section 106 responsibilities pursuant to 36 CFR Part 800.14(b). The final PA would be contained in the FIFR-EIS and be executed before the ROD is signed.

The PA allows the CEMVN to coordinate Section 106 reviews with its evaluation of the TSP/proposed action's potential for significant impacts to the human and natural environment required by NEPA, as amended (42 U.S.C. § 4321 et seq.). The PA would address the potential to affect historic properties that are eligible for or listed in the NRHP, including archaeological sites, districts, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and/or sites of religious and cultural significance on or off Tribal Lands (as defined in 36 CFR § 800.16(x)) that may be affected by this undertaking. USACE would continue to develop a project-specific PA in furtherance of the CEMVN's Section 106 responsibilities for this undertaking. The PA would then govern the CEMVN's subsequent NHPA compliance efforts.

In partial fulfillment of the CEMVN's Section 106 responsibilities, CEMVN submitted a NOI to develop a project-specific PA to the LA SHPO, ACHP, and the following tribes on 26 August 2020: (the Alabama-Coushatta Tribe of Texas (ACTT), the Choctaw Nation of Oklahoma (CNO), the Coushatta Tribe of Louisiana (CT), the Jena Band of Choctaw Indians (JBCI), the Mississippi Band of Choctaw Indians (MBCI), and the Tunica-Biloxi Tribe of Louisiana (TBTL)) (Appendix C: Environmental).

On 25 September 2020, the CNO submitted written correspondence stating that: "St. Tammany Parish lies in our area of historic interest. The Choctaw Nation has sites of significance, including village locations, located in St. Tammany Parish. We request to be a consulting party on the project PA."

On 10 September 2020, the CEMVN received a written response from the ACHP stating that "Based upon the information you provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases*, of our regulations, "Protection of Historic Properties" (36 CFR Part 800), does not apply to this undertaking. Accordingly, we do not believe that our participation in the consultation to resolve adverse effects is needed." No other responses to this letter were received from any of the other potential stakeholders consulted. Additionally, on 31 August 2020, the CEMVN posted a NHPA/NEPA Public Notice to the designated project website (https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/St-Tammany/) for a 30-day comment period requesting the public's input concerning the proposed undertaking and its potential to significantly affect historic properties, assistance in identifying any relevant parties who may have an interest in participating in this consultation, and the CEMVN's proposal to develop a project-specific PA pursuant to 36 CFR § 800.14(b). No comments were received by CEMVN.

On 21 May 2021, CEMVN submitted a continued consultation to develop a project-specific PA to the LA SHPO, CPRAB, and tribes (ACTT, CNO, CT, JBCI, MBCI, and TBTL) (Appendix C: Environmental). The letter provided information regarding the Tentatively Selected Plan (TSP) for the Project and requested consulting parties' input regarding CEMVN's proposal to develop a project-specific PA that establishes procedures to satisfy CEMVN's Section 106 (NHPA) responsibilities for this undertaking and potential consulting parties' interest in participating in the development of this PA. On 24 May 2021, CEMVN received a written response from the NFS who concurred with CEMVN's proposal to develop a project-specific PA and requested to be a consulting party in the PA. On 17 June 2021, the CNO requested to be a consulting party to the PA. On 21 June 2021, the LA SHPO also accepted CEMVN's plan to develop and adopt a PA pursuant to 36 CFR § 800.14(b) and confirmed they would participate in the development of this agreement.

On 13 October 2021, CEMVN held an initial Section 106 (NHPA) consultation meeting to develop the PA for the St. Tammany Parish, Louisiana Feasibility Study. Subsequent Section 106 PA development meetings were held on 17 November 2021, 8 December 2021, 12 January 2022, and 28 June 2022. As of June 2023, consulting parties to the PA include the CEMVN (Signatory), LA SHPO, (Signatory), USFWS (Signatory), CPRA (Invited Signatory), Choctaw Nation of Oklahoma (Invited Signatory), and the Certified Local Government (CLG) of Slidell (Concurring Party).

8.17 WILD AND SCENIC RIVERS ACT (16 U.S.C. §1271)

There are no federally designated Wild and Scenic Rivers under the Federal Wild and Scenic Rivers Act, 16 U.S.C. §1271, *et seq* within the study area.

However, there are natural and scenic streams designated by the Louisiana Scenic Rivers Act of 1988 within the study area. The LDWF is the lead state agency in the Scenic Rivers Program. There are approximately 3,000 miles of water that are currently designated as Scenic Rivers in Louisiana. The Mile Branch, a tributary to the Tchefuncte river and the Liberty Bayou are located within the study area. Archaeological resources within scenic river corridors are protected by law under the Louisiana Scenic Rivers Act of 1988 (LSRA).

The LDWF has expressed concerns for the potential impacts caused to the scenic streams and has stated that channelizing a stream does not comply with the Louisiana Scenic Rivers Act. CEMVN will continue to coordinate and work through the issues with the LDWF. As the project moves forward through authorization and funding for PED, CEMVN will endeavor to address LDWF concerns regarding impacts to scenic streams.

Section 9

Public and Agency Coordination

9.1 OVERVIEW OF PUBLIC AND AGENCY COORDINATION

Initial coordination with the resource agencies began on 15 January 2020 with the NFS, CPRA, USFWS, NMFS, and various state and local officials attending a planning charette conducted by CEMVN. This charette was a collaborative workshop in which an overview of the study's authority, purpose, study area and timeline were presented; the attendees discussed planning objectives, initial solutions, concepts to reduce flooding, and other relevant studies and data that could be used to inform the study process. From that point, individuals from each of those agencies were invited to attend the bi-weekly PDT meetings and contribute to alternative development. GIS files and information from past studies performed by state and local officials were assessed by CEMVN to determine what work had previously been studied and what could be used for this study. Information exchange between CEMVN, the state, and local partners is ongoing and would continue throughout the study.

As part of early coordination, two general public information meetings were held: (1) 11 February 2020, at the Mandeville Community Center, and (2) 12 February 2020, in the Slidell Civic Auditorium. PowerPoint presentations presented information about the study and PDT members were available to discuss alternative development and issues of local concern that would factor into the planning process and analysis. Both public meetings were well attended by municipal and parish officials, along with a large contingent of local residents. Information received from the public was incorporated into the planning process. Information was distributed regarding how to submit comments via letter, email, and telephone.

A public website page was created in June 2020 to aide interested parties in obtaining study information and provide feedback. https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/St-Tammany/

A Notice of Intent was published on 19 June 2020 (FR vol 85 No. 119) notifying the public of the USACE intent to prepare an IFR–EIS and to conduct scoping for a study to evaluate potential CSRM and FRM measures in the study area. Public scoping meetings were held virtually on 14–15 July 2020. The virtual meetings were broadcast from the CEMVN office and the public was notified about the meetings through publication of the NOI, as well as through multiple social media channels and local newspaper. Recorded presentations of the scoping meetings were uploaded to the study website for those who could not attend. Questions were answered live by the PDT during both meetings.

- The meeting videos are available on the CEMVN YouTube Channel, Facebook, & study website. Scoping comments were received through 3 August 2020, which was established as the last day to provide comments to inform the study planning process.

Input received from public meetings assisted the PDT in refining study problems and opportunities, goals, objectives, potential measures, and alternative plans.

Themes of common concern include, but are not limited to:

- Local drainage issues throughout the Parish;
- Concern for potential adverse impacts/induced flooding resulting from the construction of the USACE West Shore Lake Pontchartrain Levee (which is a separate CEMVN flood risk reduction project) to Eden Isle neighborhood;
- Resource agency concerns for potential impacts to Gulf sturgeon, red cockaded woodpecker, and gopher tortoise habitats from the any proposed construction.

See Appendix C: Environmental for the public notices, coordination letters, Scoping Report, and public comments received to date.

Cooperating agencies include the USFWS, NMFS, LDWF, the city of Slidell and the City of Mandeville. As cooperating agencies they were invited to participate in the study planning and in the PDT meetings. The following Federally recognized tribes that have historic interest in Louisiana and the study area were also invited to participate in the planning process: Alabama-Coushatta Tribe of Texas (ACTT), the Choctaw Nation of Oklahoma (CNO), the Coushatta Tribe of Louisiana (CT), the Jena Band of Choctaw Indians (JBCI), Mississippi Band of Choctaw Indians (MBCI), and Tunica-Biloxi Tribe of Louisiana (TBTL).

9.2 PUBLIC COMMENT PERIOD

A Notice of Availability (NOA) was published in the Federal Register (Vol 86, No 111) on 11 June 11 2021 kicking off the 45-day public comment period for the earlier draft report. A public notice was published in the Baton Rouge and New Orleans Advocate on 11 June 2021. Two virtual public meetings were held on 28 June and 29 June 2021 (held virtually due to USACE policies during the covid pandemic). Approximately 725 people were reached during the first meeting and approximately 746 people were reached during the second meeting. One hundred fifty-nine comments from 88 individuals and 11 agencies/NGOs were received. The top reoccurring themes were regarding modeling (20 percent), plan formulation (30 percent), non-structural plan (16 percent), potential impacts or insufficient discussion of impacts (14 percent) and induced flooding (8 percent). Nine percent of the comments expressed opposition to the Draft TSP. One petition was received that was signed by 36 individuals. Comments received are described below:

9.2.1 NFS and Federal Agency Comments

Comments received from the resource agencies expressed concerns regarding potential impacts of the proposed levee alignment to the BBNWR and implementation of avoidance and minimization measures to reduce impacts to wetlands. Agencies requested greater engineering detail such as cross sections and plan views, H&H modeling, and operating guidelines for flood control structures. At the time of the release of the draft IFR-EIS, impacts had not been assessed utilizing a certified habitat evaluation model and the compensatory mitigation plan was incomplete. Additional time and project details were necessary to complete the field work and data collection critical to conducting a wetland value assessment, and the development of an adequate compensatory mitigation plan. The resource agencies requested a revision of the draft IFR-EIS and a second 45-day public comment period due to the lack of project information, resource impact analysis, wetland value assessment and mitigation plan.

The NFS expressed concerns with the alignment and the costs associated with the alignments.

9.2.2 Public Comments

Many of the comments received from the general public were related to concerns for induced flooding, the nonstructural plan, inadequate or insufficient H&H modeling, and the TSP alignment. The public questioned the alignment along the Military Road and Old Spanish Trail areas. The residents of the communities in and around Military Road criticized the lack of inclusion of their community within the levee alignment and they requested reconsideration of the levee alignment. Eden Isle residents, in Eastern Slidell, expressed concerns regarding the lack of protection the TSP provided to Eden Isle. Comments received highlighted the previous work by the State/Parish regarding possible benefits of the Rigolets Barrier measure that was screened out due to the cost outweighing the benefits.

Additional information was requested regarding the implementation of the nonstructural plan such as which homes would be raised and the cost burden of elevations. In addition, concern was expressed for induced flooding impacts to structures outside of the structural protection.

A recurring theme in the comments was in regard to localized flooding, floodplain development and permitting. Many comments received described areas prone to flooding and the effects of flooding caused by Hurricane Katrina as well other rain events. Many individuals commented on real estate development within the parish floodplain and critiqued the permitting process.

9.2.3 EJ Outreach and Meetings

EJ Outreach was conducted after the draft IFR-EIS was released to the public in June 2021 to gain insight from residents in areas of EJ concern regarding the Final Array and potential positive and adverse impacts. The outreach and meeting coincided with the general public meeting that took place in July 2020, after the draft IFR-EIS was released. Project information sheets were sent to church pastors in the vicinity of the Mile Branch Channel Improvement and the West Slidell Levee alignment who were asked to inform their congregation of the meeting taking place concerning the draft IFR-EIS.

On 4 April 2023 and 5 April 2023, EJ outreach meetings were conducted regarding the Optimized TSP. Public outreach focused on civic and environmental organizations that serve residents in areas of EJ concern, which included local churches, libraries, and non-profits. Initial and follow up calls were made to 45 churches, 13 public libraries, and 12 civic and environmental organizations. Of all community entities contacted 6 churches, 8 public libraries, and 11 civic and environmental organizations agreed to disseminate a one-page summary to residents and their contacts. The Good Samaritan Ministries organization specifically agreed to help disseminate our 1-pager to 30 additional local churches.

9.2.4 Second Release and Public Comment Period

Due to the significance of the comments received on the initial draft IFR-EIS, the initial draft report has been revised, additional modeling and evaluation were performed and the TSP was optimized. Wetland value assessment were conducted based on the Optimized TSP alignment. Impacts resulting from the alignment were further developed including identification of mitigation sites and development of the mitigation plan.

This revised report is being released as a second Draft report for a second public comment period beginning 21 July 2023.

The NOA for the RDIFR-EIS for a second 45-day public comment period will be published in the Federal Register on 21 July 2023. Another round of public comment meetings will be scheduled during the 1public comment period. Preparation of this RDIFR-EIS has been coordinated with appropriate Congressional, Federal, tribal, state, and local interests, as well as environmental groups and other interested parties.

This RDIFR-EIS is available for public review and comment beginning 21 July 2023. The official closing date for comments is 6 September 2023. Comments may be mailed or emailed to:

U.S. Army Corps of Engineers
Attention: Ch, Environmental Branch
CEMVN–PDS, Room 136,
7400 Leake Avenue New Orleans, LA 70118
Email: sttammanyfs@usace.army.mil

Section 10
Conclusion

10.1 RECOMMENDATION

The recommendations contained herein reflect the information available at this time and current USACE policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the non-federal sponsor, interested federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

The Optimized TSP for this study includes a nonstructural plan for eligible properties within the study area that will not be benefited by the structural features (the levee and floodwall system) of the TSP in south and west Slidell and the channel improvements in Mile Branch. The Optimized TSP as detailed in this RDIFR-EIS has been identified by CEMVN for future recommendation for authorization as a Federal project, with such modifications thereof as in the discretion of the Commander, Headquarters, U.S. Army Corps of Engineers, may be advisable. The USACE recognizes that the NFS, supports the current identification of the Optimized TSP, but the NFS will support also concurrently review the RDIFR-EIS.

The Draft TSP was first released for review in June 2021 and has since undergone additional analysis and optimization. The second review of this RDIFR-EIS includes additional concurrent ATR, public and policy reviews. The PDT, CEMVN management, and USACE vertical team representatives throughout the agency would consider comments provided during the public/concurrent review period prior to providing feedback to a USACE Headquarters Senior Leaders Panel. This panel would consider significant public, technical, legal, policy and IEPR comments on the TSP and other alternatives in conjunction with a decision to endorse the Optimized TSP and propose a way forward to complete feasibility-level design and the FIFR-EIS.

The FIFR-EIS will be submitted in 2024 to USACE headquarters after which a Chief's Report will be developed. Once the Chief of Engineers approves and signs the Report, the Chief of Staff will sign the notification letters forwarding the Report to the chairpersons of the Senate Committee on Environmental and Public Works and the House of Representatives Committee on Transportation and Infrastructure. The signed Chief's Report will also be provided to the Office of the Assistant Secretary of the Army for Civil Works for review by the Administration.

The RDIFR-EIS fully describes flood risk to structures and life safety associated with riverine, rainfall, and coastal storm flood events. The measures of the Optimized TSP were formulated to reduce the risk of flood damages to key infrastructure and structures. The Optimized TSP would greatly reduce, but not eliminate future damages and residual risk would remain. The structural measures of the Optimized TSP reduces expected annual damages by approximately 30 percent relative to the without project conditions. The nonstructural plan of the Optimized TSP reduces annual damages by approximately 40 percent relative to the without project condition. The residual risk, along with the potential consequences, has been communicated to the Non-federal Sponsor and will become a requirement of any communication and evacuation plan.

10.2 VIEW OF THE NON-FEDERAL SPONSOR

The CPRAB supports and recognizes the importance for flood risk reduction and coastal storm risk reduction in St. Tammany Parish. Similar projects to reduce risk to the study area are included in the 2017 Master Plan projects, including the Slidell Ring Levee project (Project No. 001. HP.13), and the St. Tammany Nonstructural Risk Reduction project (Project No. STT.01N). The St. Tammany Parish Coastal Protection Study (PO-167), funded by CPRAB, identified the West Slidell Levee, South Slidell Levee as structural alternatives and nonstructural risk reduction as alternatives warranting further investigation.

Section 11
List of Preparers

Title/Topic	Team Member
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Distribution of the Revised DIFR-EIS

Electronic copies of the Notice of Availability of the RDIFR-EIS were sent to Federal, state, and local agencies, federally recognized Tribal Nations, newspapers, NGOs, and other interested parties (See Section 9). An electronic file of the complete distribution list is available by request.

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List of Acronyms and Abbreviations

AAHU	Average Annual Habitat Unit
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ACTT	Alabama-Coushatta Tribe of Texas
ADCIRC	Advanced Circulation Model
AEP	Annual Exceedance Probability
AMM	Alternatives Milestone Meeting
APE	Area of Potential Effects
AQCR	Air Quality Control Region
ASA(CW)	Assistant Secretary of the Army for Civil Works
ASCII	American Standard Code for Information Exchange
ASTM	American Society for Testing Materials
BBA	Bipartisan Budget Act
BCR	Benefit to Cost Ratio
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practice
BLH	Bottomland Hardwood
CAA	Clean Air Act
CAR	Coordination Act Report
CDP	Census Designated Place
CEMVN	USACE New Orleans District
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFS	Cubic Feet Per Second
CNO	Choctaw Nation of Oklahoma
CO	Carbon Monoxide
CPRA	Coastal Protection and Restoration Authority
CPRAB	Coastal Protection and Restoration Authority Board
CSRM	Coastal Storm Risk Management
CSRA	Cost Schedule Risk Analysis
CT	Coushatta Tribe of Louisiana
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DIFR	Draft Integrated Feasibility Report
EAD	Estimated Annual Damages
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice

EO	Executive Order
EPA	Environmental Protection Agency
EQ	Environmental Quality
ER	Engineer Regulation
ESA	Endangered Species Act
FCSA	Federal Cost Share Agreement
FDR	Federal Discount Rate
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIFR	Final Integrated Feasibility Report
FLOAT	Flood Loss Outreach and Awareness Taskforce
FRM	Flood Risk Management
FWCA	Fish and Wildlife Coordination Act
FWCAR	Coordination Act Report
FWS	Fish and Wildlife Services
FWOP	Future With Out Project
GIS	Geographic Information System
GOMESA	Gulf of Mexico Energy Security Act
H&H	Hydraulics and Hydrology
HEC-FDA	The Flood Damage Reduction Analysis
HEC-RAS	Hydrologic Engineering Center- River Analysis System
HMGP	Hazard Mitigation Grant Program
HSDRRS	Hurricane & Storm Damage Risk Reduction System
HTRW	Hazardous, Toxic, and Radioactive Waste
HQUSACE	Headquarters United States Army Corps of Engineers
IER	Individual Environmental Report
IFR	Integrated Feasibility Report
IUCN	International Union for Conservation of Nature
JBCI	Jena Band of Choctaw Indians
LACPR	Louisiana Coastal Protection and Restoration
LADOTD	Louisiana Department of Transportation and Development
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDOA	Louisiana Division of Archaeology
LDRIPs	Long Term Disaster Recovery Investment Plans
LDWF	Louisiana Department of Wildlife and Fisheries
LERRD	Lands, Easements, Rights-of-way, Relocations and Disposal Areas
LIDAR	Light Detection and Ranging
LPP	Locally Preferred Plan
LSRA	Louisiana Scenic Rivers Act
LWCF	Land and Water Conservation Fund

LWFMP	Louisiana Statewide Comprehensive Water Based Floodplain Management Program
MAV	Mississippi Alluvial Valley
MBCI	Mississippi Band of Choctaw Indians
MBTA	Migratory Bird Treaty Act
MCACES	Micro-Computer Aided Cost Estimating System
MDAH	Mississippi Division of Archives and History
MSA	Metropolitan Statistical Area
MSC	Major Subordinate Command
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MVD	Mississippi Valley Division
NAAQS	National Ambient Air Quality Standards
NAWMP	North American Waterfowl Management Plan
NB	Nature Based
NBEM	National Bald Eagle Management
NCDC	National Climatic Data Center
NED	National Economic Development
NEPA	National Environmental Policy Act
NFS	Non- Federal Sponsor
NGVD	National Geographic Vertical Datum
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NLAA	Not Likely to Adversely Affect
NO2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRHD	National Register of Historic District
NRHP	National Register of Historic Places
NS	Nonstructural
O&M	Operation and Maintenance
OCD	Office of Community of Development
OMRR&R	Operations, Maintenance, Repair, Rehabilitation, and Replacement
OSE	Other Social Effects
O3	Ozone
PA	Public Assistance
PA	Programmatic Agreement
Pb	Lead
PPA	Project Partnership Agreement

PBF	Physical Biological Features
P&G	Principles and Guidelines
PED	Pre-Construction Engineering and Design
PDT	Project Delivery Team
Phase 1 ESA	Phase 1 Environmental Site Assessment
PM	Particulate Matter
PMP	Project Management Plan
PPA	Project Partnership Agreement
PPT	Parts Per Thousand
RCRA	Resource Conservation and Recovery Sites
REC	Recognized Environmental Condition
RED	Regional Economic Development
REP	Real Estate Plan
ROD	Record of Decision
RMP	Risk Management Plan
ROE	Right of Entry
ROM	Rough Order of Magnitude
ROW	Right Of Way
RPEDS	Regional Planning and Environment Division South
RSLC	Relative Sea Level Change
RSLR	Relative Sea Level Rise
S	Structural
SELA	Southeast Louisiana Urban Flood Control Project
SHPO	State Historic Preservation Officer
SLC	Sea Level Change
SMART	Specific Measurable Attainable Risk Informed Timely
SO2	Sulfur Dioxide
STLDCD	St. Tammany Levee, Drainage and Conservation District
STPG	St. Tammany Parish Government
SWPPP	Stormwater Pollution Prevention Plan
T&E	Threatened and Endangered
TBTL	Tunica-Biloxi Tribe of Louisiana
TCP	Traditional Cultural Property
TIF	Tag Image File Format
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSP	Tentatively Selected Plan
URA	Uniform Relocation Assistance Act
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

VOC	Volatile Organic Compound
VRAP	Visual Resources Assessment Procedure
WBDHU12	U.S. Geological Survey Watershed Boundary Dataset Hydrologic Unit 12
WIIN	Water Infrastructure Improvement Act for the Nation
WSE	Water Surface Elevation
WMA	Wildlife Management Area
WQC	Water Quality Certification
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act
WVA	Wetland Value Assessment