Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Draft Integrated Feasibility Report with Draft Environmental Impact Statement

June 2021

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Cover Page

St. Tammany Parish, Louisiana Feasibility Study

Draft Integrated Feasibility Report with Draft 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 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 Draft Integrated Feasibility Report with Draft 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 Tentatively Selected Plan (proposed action). The proposed action includes the construction (and operation) of a total of approximately 16.3 miles of a hurricane and storm damage risk reduction levee and floodwall from west Slidell to south Slidell, five pump stations, 5 floodgates, ramps, channel improvements to Bayou Patassat in Slidell, channel improvements to Mile Branch in Covington, and nonstructural home elevations and floodproofing for eligible structures in the Parish. The proposed action would reduce flood risk to approximately 15,800 structures in the study area.

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

New Orleans District, U.S. Army Corps of Engineers
Attention: Project Management, CEMVN–PMR, Room 331
7400 Leake Avenue New Orleans, LA 70118
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Executive Summary

St. Tammany Parish, Louisiana Feasibility Study (study) investigates flood risk management (FRM) and coastal storm risk management (CSRM) solutions to reduce flood damages caused by rainfall and coastal storm flooding in St. Tammany Parish (study area). The Non-Federal Sponsor (NFS) is the State of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB). A Feasibility Cost Share Agreement (FCSA) was executed between the Department of the Army and the NFS on 14 January 2020. Shortly thereafter, this study was commenced. This study was 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.

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 draft Integrated Feasibility Report (DIFR) with Draft Environmental Impact Statement (DEIS). The DIFR and DEIS (collectively the "report") reflects the collaboration of the NFS, cooperating agencies, stakeholders, and members of the public in this study. The report recommends the approval of a Tentatively Selected Plan (TSP) a/k/a Proposed Action, which is supported by the NFS.

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 258,110 residents and 2,500 businesses. The parish is uniquely located at the crossroads of three interstates, I-10, I-12, and I-59, and transportation waterways to the Gulf of Mexico. The study 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 Pearl River runs along the Mississippi-Louisiana state border 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 to the north. The study area includes 36 sub-basins, as defined by the United States Geological Survey (USGS) 12-digit hydrologic unit delineations (WBDHUC12). See Figure ES-1.

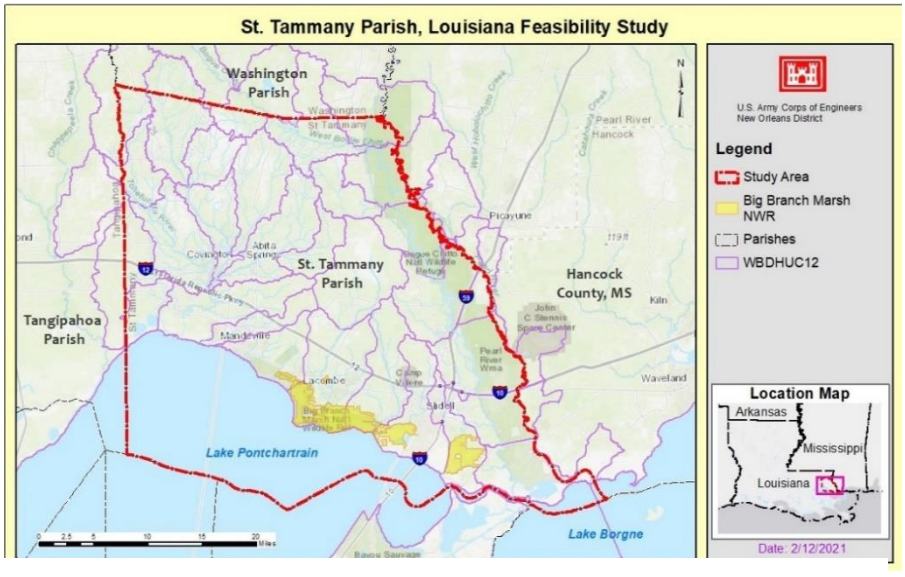

Figure ES-1. St. Tammany Parish, Louisiana Study Area

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

- Public Safety - Decrease risk to public safety during flood events;
- Flood Damages - Convey and redirect water to reduce the flood risks and damage to public, commercial, and residential property, real estate, and infrastructure;
- Community Resilience - Improve the communities' ability to prepare, mitigate, and recover from flood events;
- Evacuation - Increase the reliability of the national transportation corridors (I-10, I-12, and I-59) by providing alternatives that will potentially lessen damages to roads and interstates;
- 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.

- 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 events.
- Increase resiliency of coastal and riparian habitats as natural resources to reduce flood damages.

A *planning constraint* is a restriction that limits plan formulation or that formulation must work around. It is a statement of things the alternative plans avoid. 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 promoting development within the floodplain (in accordance with Executive Order (EO) 11988), to the maximum extent practicable, which contributes to increased life safety risk;
- 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: This report describes how the project delivery team (PDT) followed the USACE's planning process, 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 and 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. Additional measures were added throughout the iterative planning process leading to a total of 208 measures that were ultimately evaluated. The measures were evaluated by the PDT using a screening process, which is detailed in Appendix B: Plan Formulation, based on the planning objectives, existing data, professional judgment, avoiding constraints, and addressing the opportunities and problems within the study area. See Figure 4-1 in Section 4.

After screening the initial 195 measures, the PDT developed the Initial Array of 13 Alternatives with 61 site-specific management measures. The Initial Array were developed by grouping measures based on hydrologic sub-basins for different areas into alternatives. The PDT then evaluated, screened and compared measures within the geographic alternatives, including the No Action Alternative. Further screening by the PDT during the planning process led to the development of the Focused Array of 11 Alternatives with 43 measures. The screening of the Focused Array was informed by preliminary economic modeling (Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA)), hydrologic and hydraulic (H&H) modeling (AD-CIRC and Hydrologic Engineering Center – River Analysis System (HEC-RAS)) and updated cost estimates. Next, the PDT identified the Final Array consisting of 8 alternatives and 27 measures. The screening, evaluation and comparison of the Final Array of alternatives was informed by economic modeling (HEC-FDA)), 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. In early iterations of this process, the PDT narrowed the focus from many alternatives and management measures to a smaller array of alternatives and measures (Measures, Initial Array, Focused Array, Final Array to TSP). In the final iteration, the PDT selected a TSP.

Throughout the planning process, the geographic based alternatives which were created around the subbasins and hydrologic units were evaluated separately to determine the measures within an alternative that were incrementally justified. In areas where multiple causes for flooding are documented, measures to reduce the risk from the multiple sources were included in an alternative. After the evaluation of the Final Array, the justified measures within the alternatives were combined into a comprehensive parish-wide alternative that reduces flood risk to multiple subbasins within the study area as the study moved toward the selection of a TSP. The levees and floodwalls for all alternatives of the Final Array are designed following the Hurricane and Storm Damage Risk Reduction System (HSDRRS) standards, as applicable and appropriate for this level of design and using engineering judgement.

The Final Array of Alternatives is summarized below. Please see Section 4 of the report 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 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. Alternative 1 does not address study objectives and was screened based on completeness since it would not alleviate problems or provide flood risk reduction benefits.

Alternative 2. Nonstructural: Alternative 2 included standalone comprehensive nonstructural measures, which 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 including floodproofing, structure raising, buyouts, and relocations to reduce damages from the flood hazard were considered for the entire parish in areas of documented flood damage. 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 (for example elevating a structure in an area that is flooded to reduce damages rather than reducing the flooding source). The standalone comprehensive nonstructural alternative was screened out in favor of the combined structural and nonstructural alternative which will provide more net benefits. The combined structural and nonstructural measure based on the 50 year floodplain aggregation was carried forward and included in the TSP.

[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 flooding in Lacombe, LA (Variations 4a and 4a.1). A longer levee extending from Lacombe to the West Slidell area was also considered (4b). Alternative 4 was not carried forward to the TSP. Although it met study objectives and was determined to be complete and effective, all of the Lacombe levee variations (Variations 4a, 4a.1 and 4b) were screened based on efficiency due to a negative benefit-cost ratio (BCR).

Alternative 5. Bayou Liberty/ Bayou Vincent/Bayou Bonfouca: Alternative 5 included measures to address riverine, rainfall and coastal storm flooding to the areas of Bayou Liberty, Bayou Vincent, and Bayou Bonfouca. To address riverine flooding, the Bayou Bonfouca Regional Detention Pond and channels improvements were considered on Bayou Liberty and Bayou Patassat. A West Slidell levee with floodgates and pump stations was also considered to reduce storm surge impacts to the area. The West Slidell Levee and channel improvements on Bayou Patassat were carried forward to the TSP.

Alternative 6. South Slidell Storm Surge: Alternative 6 included a combination of levees and pump stations proposed to reduce damages from coastal storm events, including a levee and floodwall system in South Slidell (6a). Variation (6b) incorporated Eden Isle into the South Slidell levee system. A combination of the measures in Alternative Variation 6a and the West Slidell levee from Alternative 5 was created to form Alternative Variation 6c. Alternative Variation 6c was moved forward to the TSP.

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. Alternative 7 was not carried forward to the TSP. 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.

Alternative 8. Upper Tchefuncte/Covington: Alternative 8 includes channel modifications on Mile Branch River in Covington to reduce riverine flood damage risks. The evaluation also included enlarging the lower 2 miles of Mile Branch and enlargement of Lateral "A." The Mile Branch Channel Improvement measure of Alternative 8 was moved forward to the TSP. The Lateral A channel improvements was screened based on efficiency resulting in a negative BCR, and because the improvements would be ineffective in reducing flooding (the H&H modeling only showed minor reductions in water surface elevations).

Alternative 9. Mandeville Lakefront: Alternative 9 considered three variations of replacing and raising the existing seawall and providing additional improvements, such as floodwalls, floodgates and or pumps to address tidal and storm surge flooding in Mandeville. This alternative investigated both variations with forced drainage and pump station and passive (gravity) drainage systems at Little Bayou Castine and Ravine aux Coquille. Alternative 9 was not carried forward to the TSP. All structural measures that made up alternative 9 were screened based on efficiency due to a negative BCR.

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

Per USACE Guidance, the study evaluated 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) plan, 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 specific measures from some of the Alternatives in the Final Array to form the TSP, that has a combination of structural and nonstructural measures for both FRM and CSRM.

Table ES-1. Summary of Measures in the TSP

	South Slidell and West Slidell Levee	**Bayou Patassat Channel Improvements**	**Mile Branch Channel Improvements**	**Rest of Parish Nonstructural 50 year**	**Combined Plan- Structural & NS 2% AEP for Parish outside of structural influence**
First Cost	1,732,901,000	956,630	26,337,000	2,241,108,370	4,001,303,000
Benefits	118,160,000	133,000	2,221,000	157,421,000	277,935,000
AA Cost	70,985,000	45,900	1,115,100	79,263,000	151,409,000
Net Benefits	47,175,000	87,000	1,106,000	78,158,000	126,526,000
B/C Ratio	1.7	2.9	2.0	1.9	1.8
Approx. # structures with flood risk reduction	7,000	30	250	8,500	15,800

Table ES-1 provides a breakdown of the average annual benefits, average annual cost, net benefits, and the BCR for the measures in the TSP. The TSP is a comprehensive plan to address flooding parish-wide. The TSP includes both FRM and CSRM measures with approximately 16 miles of a levee and floodwall alignment from west Slidell to south Slidell; channel improvements (clearing and snagging) in Bayou Patassat in Slidell; channel improvements in Mile Branch in Covington; and nonstructural home elevations and floodproofing for eligible structures in the parish based on the 50-year floodplain. The combined structural and nonstructural TSP would reduce flood risk to approximately 15,800 structures in the study area. The TSP is also the NED Plan.

The TSP is estimated to produce nearly $126,526,000 in net benefits with a BCR of 1.8 (greatest economic net 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 following is a discussion of the measures that were selected to form the TSP:

- Nonstructural Elevations and Floodproofing (from Alternative 2)

  Approximately 6,643 eligible residential structures would be elevated to the future 100-year flood stage up to 13 feet, and 1,855 eligible nonresidential structures in the 50 year floodplain would be floodproofed up to 3 feet. The floodproofing of eligible nonresidential structures will protect structures that are not included in the areas benefitted from the structural measures of the TSP. These structure counts are preliminary and will continue to be evaluated and refined and are not absolute at this time. To be considered preliminarily eligible for participation, a structure must meet the following criteria:

  1. Have a first-floor elevation (FFE) at or below the 0-50-year storm surge floodplain, based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis)
  2. Structure must be outside of the area of influence of the structural features recommended in the Tentatively Selected Plan (TSP) and not receiving flood risk reduction benefits from the structural features (i.e. outside of the area of influence of the West Slidell, South Slidell Levees, Bayou Patassat clearing and snagging and Mile Branch Channel Improvements).
  3. Must be economically justified meaning that the cost of the flood-proofing measure for the structure must not cost more than the total monetary value of the flood damages anticipated to be avoided over the 50-year period of analysis.

  The nonstructural elevations and floodproofing are voluntary; property owners who have preliminarily eligible structures that wish to participate in the flood proofing measures will 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.

- Bayou Patassat Channel Improvements - Clearing and Snagging (from Alternative 5)

  Bayou Patassat is a small tributary of Bayou Bonfouca in Slidell. The work will be located between Bayou Vincent pump station and Highway 11. Approximately 0.17 miles (900 feet) will be cleared and snagged, which includes the removal trees, vegetation, debris, trash, or other obstructions within the channel.

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

  The system is 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 by constructing ramps to the preliminary design elevation of 15 feet. The construction of the levee alignment would impact approximately 169 acres. The levee alignment would require approximately 1,528,000 cubic yards of fill (includes 30 percent contingency). There would be five pump stations and five floodgates. There would also be a total of three sluicegates, eight pedestrian and vehicular floodgates, one railroad gate along the Norfolk Southern Railroad, and seven ramps.

- Mile Branch Channel Improvements (from Alternative 8)

  The Mile Branch channel improvements start at the intersection of Mile Branch and Highway 190, crossing Highway 190 Business, and end at the intersection of Mile Branch and the Tchefuncte River. The channel improvements would be 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 the channel. The channel bottom will be lowered by 5 feet. Approximately 20 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.

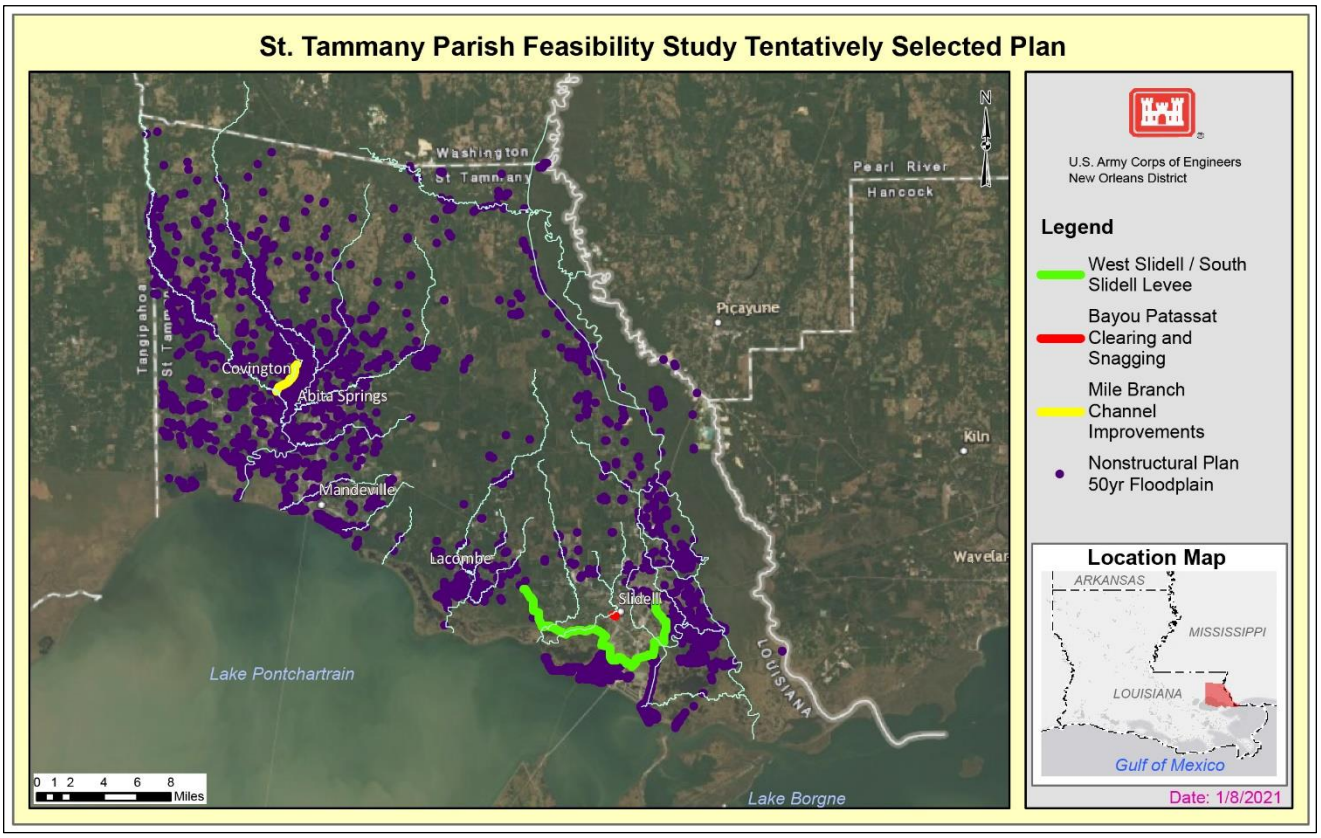

Figure ES-2. TSP/NED Plan

Environmental Summary: The CEMVN issued a Notice of Intent (NOI) to prepare the DEIS for the study in the Federal Register (Vol. 85, No. 119) on 19 June 2020 and included a 45-day public comment period. The CEMVN held two public scoping meetings on 14 July 2020 and 15 July 2020. Input received from public meetings assisted the PDT in refining the study's problems and opportunities, goals, objectives, potential measures, and alternative plans. 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. 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, LA; City of Slidell, LA; and the Choctaw Nation of Oklahoma (CNO) responded that they would like to be cooperating agencies and were invited to participate in the PDT meetings. See Appendix C: Environmental.

Resources evaluated within the study area were identified through agency and public scoping include, but are not limited to: migratory birds; T&E and protected species; wetlands; aquatic resources; 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 this 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) is being performed by CEMVN in coordination with USFWS to refine initial mitigation acreage estimates which will be included in the final EIS. Impacted acreages described in this draft report may change pending additional evaluation and will be updated in the final report. Consultation and coordination with resource agencies has been initiated by CEMVN and will be concluded prior to the Record of Decision.

Timeline: This DIFR and DEIS is available for public review beginning 11 June 2021. 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: Project Management
CEMVN–PMR, 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 draft Integrated Feasibility Report (DIFR) with Draft Environmental Impact Statement (DEIS) (collectively the "report") for the St. Tammany Parish Feasibility, Louisiana Feasibility Study. This report documents the technical and other 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 report 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 report also documents the plan formulation process and recommends a 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. The TSP is considered "tentatively selected" unless and until a Recommended Plan from the final report is approved by USACE Headquarters (HQUSACE). Plan approval follows several USACE internal, external peer, legal, policy, state, other federal agency, and public review processes.

1.1 STUDY SCOPE

The study is authorized to investigate both CSRM and FRM 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 report was prepared in accordance with the USACE Planning Guidance Notebook (1105-2-100); ER 1105-2-101 "Risk Assessment for Flood Risk Management Studies" dated 15 July 2019; NEPA, and all other applicable laws, regulations and policies. The study followed the typical specific, measurable, attainable, risk-informed, timely (SMART) planning process and schedule. The outcome of the planning process, as performed up to the date of the draft report, is the identification of the NED plan, and designation of the TSP.

The study was conducted by a PDT. This multi-disciplinary study team includes professionals with expertise matched to the identified water resources problem to be solved and the information needed to make a recommendation to reduce flooding in St. Tammany Parish. The NFS and cooperating agencies were an integral part of the PDT. The feasibility process also coordinated with, and integrated input from, the USACE vertical team, which includes MVD, or Major Subordinate Command (MSC), and 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.

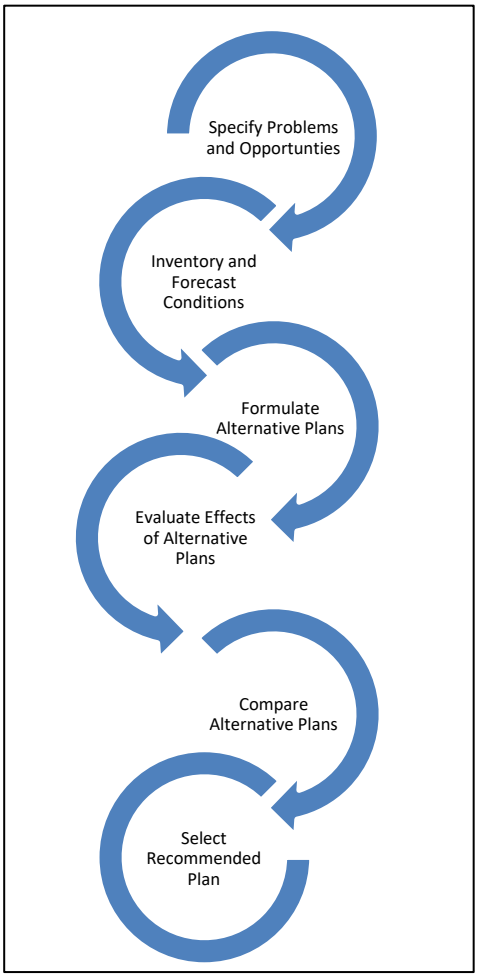

Figure 1-1. Six Step USACE Planning Process adapted from ER 1105-2-100

1.2 STUDY AUTHORITY

This study in St. Tammany Parish, Louisiana 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, (BBA 2018) 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 was 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 reflected 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 FSCA 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) FSCA package (with no deviations) for review and approval to the MVD, together with a request that the signature authority for the FSCA 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 Feasibility Cost Share Agreement (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 will be conducted for not more than $3 million and will be 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 will be cost shared and the Federal portion of those remaining costs will compete for funding from annual investigations funding. If additional cost sharing is required, the FCSA will need to be amended.

Except as otherwise noted, studies funded by BBA 2018 will be undertaken in accordance with existing civil works policies and guidance and incorporate SMART planning principles. This study has been undertaken in accordance with Sections 1001 and 1002 of Water Resources Reform and Development Act of 2014 (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 258,110 residents and 2,500 businesses. The study 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 State of Mississippi with the Pearl River creates the eastern boundary of the study area. Lake Pontchartrain serves as the southern boundary and is one of the largest estuaries in the United States. Tangipahoa Parish is located along the western boundary and Washington Parish is located to the north. The study area includes 36 sub-basins, as defined by the United States Geological Survey (USGS) 12- digit hydrologic unit delineations (WBDHUC12).

Most of the population resides along the 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 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, and finance, and insurance.

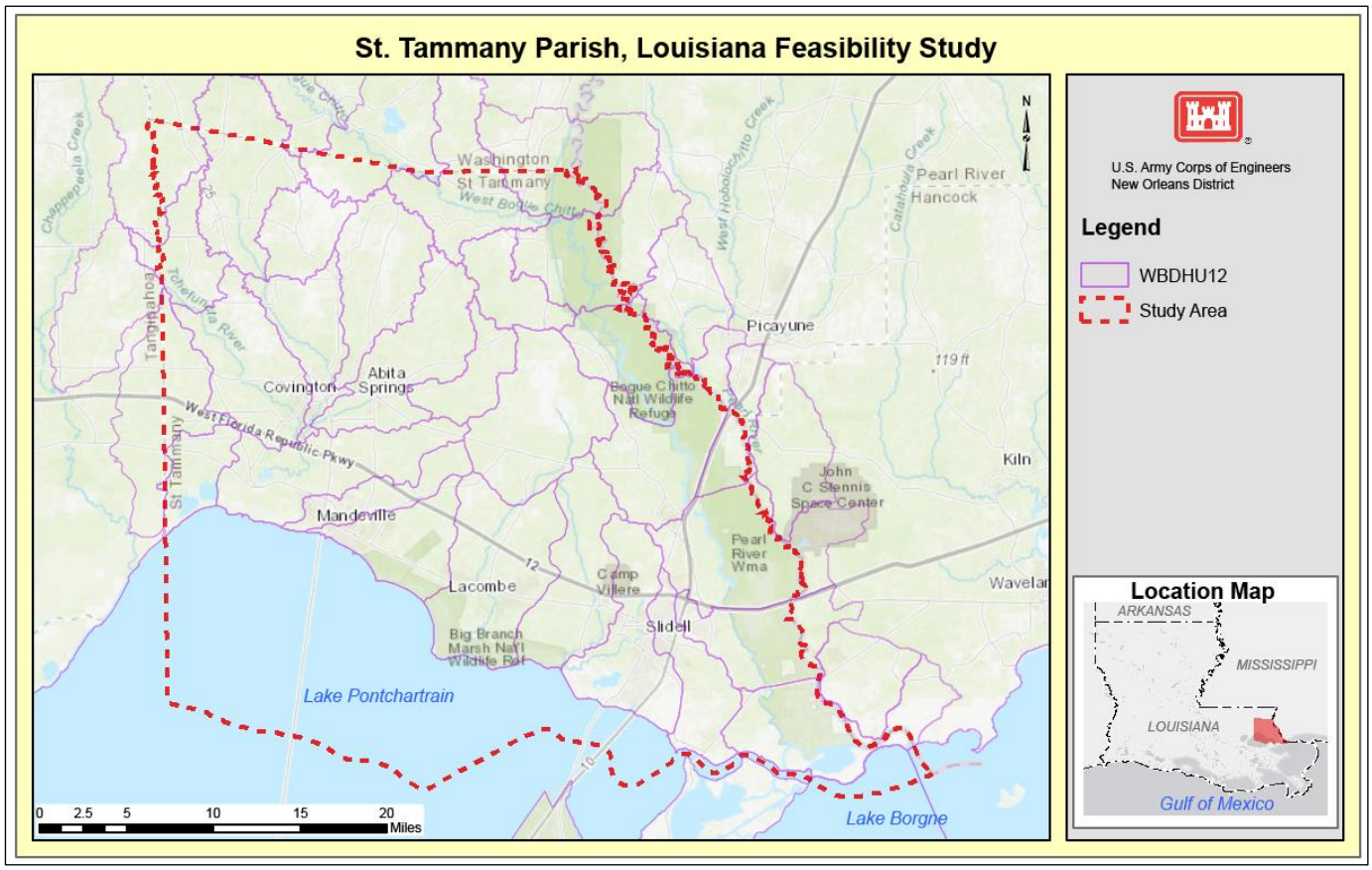

Figure 1-2. St. Tammany Parish, Louisiana Feasibility Study Area.
Note: The U.S. Geological Survey Watershed Boundary Dataset (WBDHU12) was used to delineate the hydrologic sub basins with study area.

1.5 PROJECT AREA

The study area includes 36 sub-basins, as defined by the USGS 12-digit hydrologic unit delineations (Table 1-1). Figure 1-3 highlights the 18 areas in the parish with documented flooding, whether from coastal or riverine, and repetitive flood loss. These 18 areas (bolded in Table 1-1) comprise the project area. The project area is the area that was further examined and where the measures and alternatives for the study were located.

Table 1-1. St. Tammany Parish, Louisiana Feasibility Study Hydrologic Sub Basins

	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**	**Coastal/ Rainfall**
15	Warner Creek-Bogue Chitto	Rainfall
16	Lacombe Bayou	Rainfall (headwater flooding)
17	**Middle River-Pearl River**	**Coastal/ Rainfall**
18	**Big Branch Bayou-Lacombe Bayou**	**Coastal (storm surge)/ Rainfall**
19	Simalusa Creek	Rainfall
20	Bull Branch-Tchefuncte River	Rainfall
21	Pearl River Canal-Pearl River	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**
27	Bedico Creek	Rainfall
28	Berrys Creek-Bogue Chitto	Rainfall
30	**Bayou Chinchuba**	**Coastal/ Rainfall (headwater flooding)**
31	**Lower Bogue Falaya River**	**Coastal/ Rainfall**
32	Second Alligator Branch-Pearl River	Rainfall
34	Wilson Slough-Pearl River	Rainfall
35	**Liberty Bayou-Bayou Bonfouca**	**Coastal/ Rainfall, (headwater and backwater flooding)**
36	**Little Bogue Falaya River**	**Rainfall**

1.6 PRIOR REPORTS, EXISTING WATER PROJECTS, AND ONGOING PROGRAMS

A number of studies and reports on water resources development for the Parish have been prepared by USACE, and other Federal, state, Parish, and local agencies. The PDT collected this existing information and data during the plan formulation process, and relevant portions of existing data 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 the documents listed in Table 1-2 were considered the most significant to identifying problems and formulating plans. Table 1-2 presents the document title, along with the date of the effort. The table also indicates how the report or study was used during this study, including whether this study used the information as a source of data for analysis, modeling, the FWOP condition or whether it provided recommendations to inform the development of management measures for FRM and CSRM in the study area. Studies and reports were also reviewed to ensure consistency between the plan formulation under this study and other existing plans and reports for the study area.

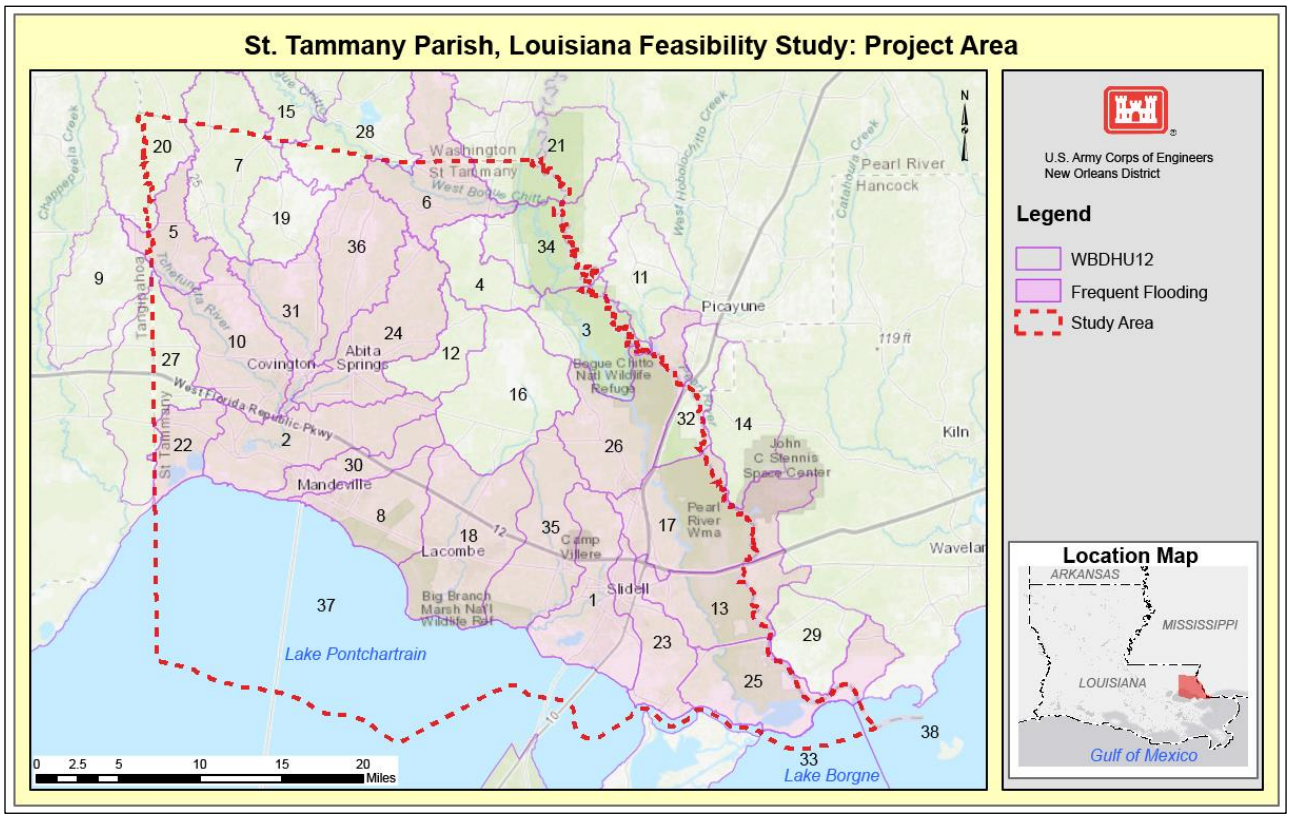

Figure 1-3. St. Tammany Parish, Louisiana Feasibility Project Area

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.

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				×	
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	×	×			

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 included in Figure 1-4. (Note: The only existing Federally certified levee is the Lakeshore Levee, Slidell, Louisiana.)

- 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)

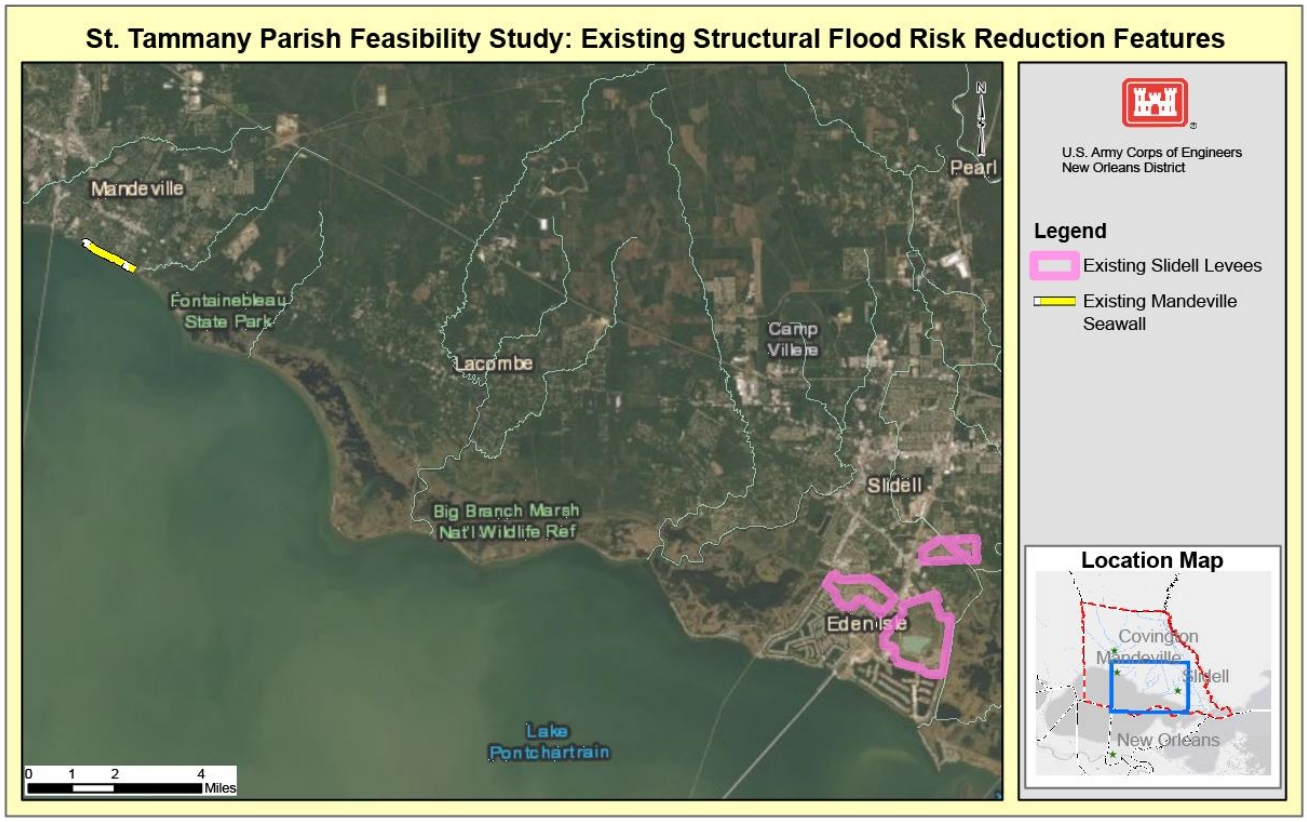

Figure 1-4. St. Tammany Parish Existing Structural Features

St. Tammany Parish Government (STPG) projects related to drainage in the Parish that have the potential to further reduce flood risk in the study area include:

- 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. Highway 11 near North Boulevard

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 study modeling can be found in Appendix E.

1.6.3 Ongoing Programs and Projects

Major ongoing programs and/or projects are described below.

Louisiana Watershed Initiative: 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, EO 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 Department of Wildlife and Fisheries.

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.

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

The USACE (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 will be incorporated into the final report. On 23 March 2021, Governor Edwards announced that $10 million in Community Development Block Grant Mitigation funding from the LWI will be allocated toward nonstructural projects in St. Tammany Parish. The PDT is in coordination with CPRAB 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. 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.

Only the W-14 SELA Project in Slidell has an approved report from March 2012 confirming it is technically sound, environmentally acceptable, and economically justifiable (533d report). Because the W-14 project had 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 subsequently funded. 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 study is much more limited in scope and study area. The SELA Schneider Canal PDT is evaluating 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 is ongoing and will continue to determine the linkages between the two studies.

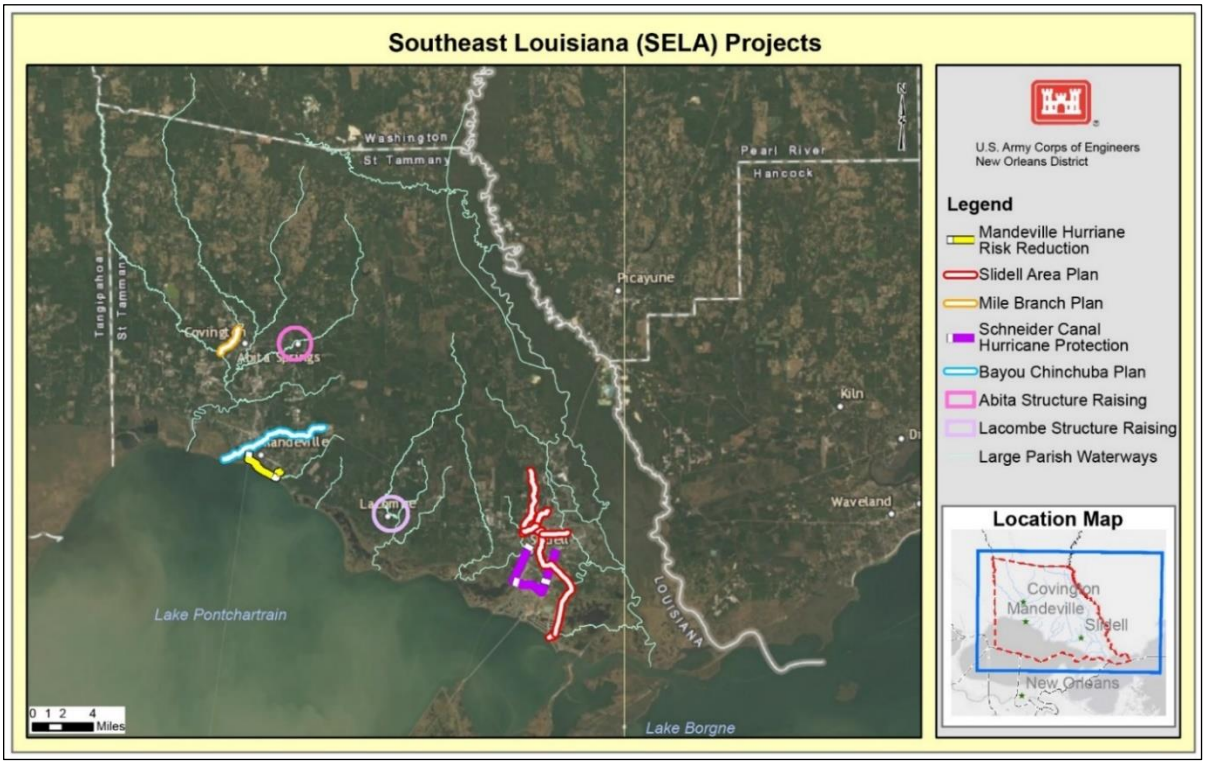

Figure 1-5- SELA Projects Map

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) was updated in 2017. The 2017 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 2017 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 2017 Master Plan and the draft 2023 Master Plan under development.

Structural and nonstructural projects contained in the 2017 Master Plan that are in the study area and were included in the development of management measures and alternatives are listed below.

- 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 of a levee to an elevation of 16 feet NAVD 88 for storm surge risk reduction around Slidell.
- 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.

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)

Section 2
Problems and Opportunities
(Purpose and Need)

2.1 SPECIFIC PROBLEMS AND OPPORTUNITIES

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

Step 1 of the planning process focused on identifying the problems and opportunities in the study area. The PDT needed to understand the issues within the study area and what was driving the issues. The PDT then was able to define the objectives of the study, or what the PDT hopes to achieve with a project and identify any constraints that limit potential solutions.

St. Tammany Parish has experienced repeated, widespread flooding (Figure 2-1) from rainfall and riverine bank overtopping, waves, and storm surge, including historic impacts during Hurricane Katrina in August of 2005 and recently with the flood of August of 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 of 2016, in St. Tammany Parish, caused flood impacts 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

Through Step 1 of the planning process, the PDT identified both FRM and CSRM types of flood damages 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 also accounts for different sources of 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 3.2.2provides 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 (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		
Jun-01	Heavy Rainfall		
Jun-01	Tropical Storm Allison		

2.1.1 Problems

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

Different locations within the study area experience different flood damages since the sources of flooding vary across the Parish and drainage subbains. 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 that the PDT 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 - Convey and redirect water to reduce the flood risks and damage to public, commercial, and residential property, real estate, and infrastructure;
- Community Resilience - Improve the communities' ability to prepare, mitigate, and recover from flood events;
- Evacuation - Increase the reliability of the national transportation corridors (I-10, I-12, and I-59) by providing alternatives that will potentially lessen damages to roads and interstates;
- 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 NED in a manner that is consistent with protecting the Nation's environment, and in compliance with environmental laws and regulations, applicable EOs, 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 study objectives.

Study Objectives:

- Reduce the risk to public health and safety by reducing flood impacts to structures, evacuation routes, and critical infrastructure in St. Tammany Parish.
    - Metric to evaluate objective: water surface elevation (WSE), structure impacts, impacts to population
- Reduce flood damage to structures (i.e. businesses, residential, commercial, and public structures) from flooding in St. Tammany Parish.
    - Metric to evaluate objective: WSE, annualized damages, structure impacts
- Reduce interruption to the maximum extent practicable to the Nation's transportation corridor, e.g. the I-10, I-12, and the I-10 interchange in St. Tammany Parish.
    - Metric to evaluate objective: road inundation
- Increase community resiliency, the sustained ability of a community to use available resources, before, during and after significant rainfall and or coastal events.
    - Metric to evaluate objective: reduce or adapt risk to known flooding hazards
- Increase resiliency of coastal and riparian habitats as natural resources to reduce flood damages.
    - Metric to evaluate objective: wave attention, water surface elevations (WSE)

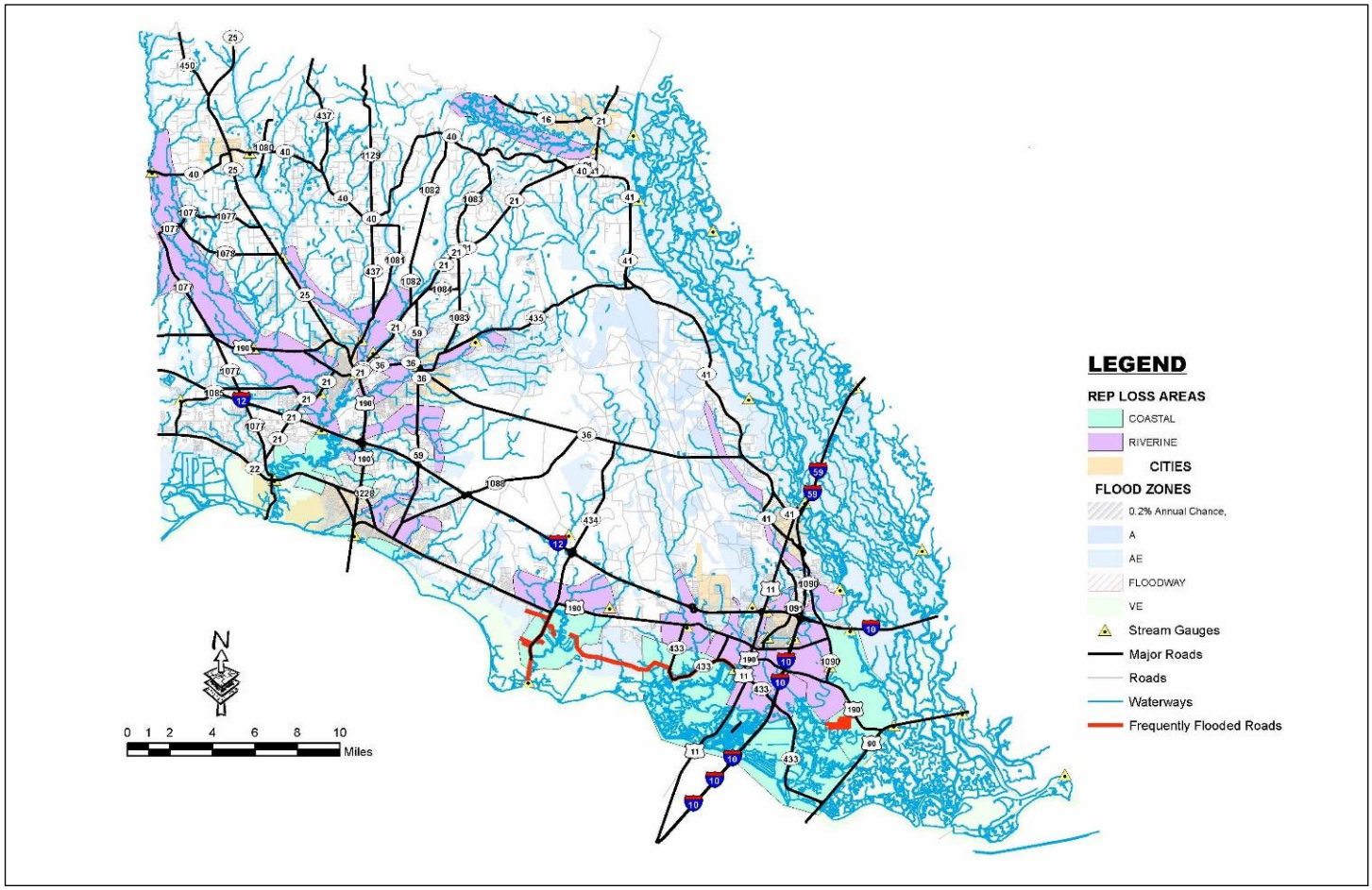

Figure 2-2. St. Tammany Parish- Repetitive Loss Areas, Flood Zones, and Frequently Flooded Roads. (Source STPG 2020)

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 .25% change of annual flooding, those in a designated A zone with hazards from erosion and waves >3ft 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 >3ft. For additional information on the elevation of surface water and the flood zones please see www.FEMA.gov.

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 promoting development within the floodplain (in accordance with EO 11988), to the maximum extent practicable, which contributes to increased life safety risk.
- 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 AGENCY INPUT TO 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 needed, developing and refining the study purpose, goals, objectives, constraints, the range of alternatives to consider, impacts to resources, possible mitigation measures, and opportunities for environmental enhancement as well as in identifying the NEPA and permit requirements of other agencies.

Under this study a NEPA formal scoping process was followed which was intended to get the lead and cooperating agencies and other interested groups together early in the project development process to determine the scope of the issues to be addressed, and identify any important issues related to the study. By properly using the early coordination process, agencies could avoid conflicts later, and could assure the full input from the various interests.

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 for additional details regarding the scoping and coordination process and activities.

- During the early phases of project planning, CEMVN held two public information meetings within 90 days after the commencement of the study: (1) 11 February 2020, at the Mandeville Community Center, and (2) 12 February 2020, in the Slidell Civic Auditorium.

- Two public NEPA scoping meetings were conducted by CEMVN 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 of these meetings were to present the stakeholders and the public with the alternative plans that had been developed and being considered under the study and obtain feedback to ensure that the study area problems were being addressed by the alternatives being considered. Both meetings were recorded and shared on the study website, below, where multiple options to provide feedback were available.

  https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/St-Tammany/

  The period for public comments to inform the scoping period ended on 3 August 2020. Input received from public meetings assisted the PDT in refining study problems and opportunities, goals, objectives, potential measures, and alternative plans to consider in the planning process. See Appendix C for the Scoping Report, NOI, NOA, and other documentation regarding public scoping, participation, and coordination.

- There is ongoing coordination between CEMVN and the NFS and key stakeholders, such as STPG, the St. Tammany Levee, Drainage, and Conservation District (STLDCD), CPRA, city of Slidell, city of Covington, town of Mandeville, community of Lacombe, other local municipalities and the State of Louisiana Congressional Delegation. Quarterly meetings with key stakeholders are held to ensure they are informed of the progress of the study, as well as multiple municipal entities at the local level.

- Bi-weekly meetings are held between the PDT, NFS, and official cooperating 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. The cooperating agencies for this study are the USFWS, NMFS, LASHPO, LDWF, the City of Mandeville, LA; City of Slidell, LA; Choctaw Nation of Oklahoma.

- This draft report is being provided to the public and stakeholder for review and comment on the analysis of the alternative plans and the selection of the TSP. The input and feedback received during this review period will be incorporated into the final report. This DIFR and DEIS is available for public review beginning 11 June 2021. 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: Project Management, CEMVN–PMR, Room 331, 7400 Leake Avenue New Orleans, LA 70118
  Email: sttammanyfs@usace.army.mil.

Section 3
Inventory and Forecast Conditions

In Step 2 of the Six Step Planning Process, the PDT documented the existing conditions relevant to the identified problems by looking at historic trends and potential changes to the existing conditions, and forecasting what would likely happen in the future if no federal action was taken. The data from the inventory and forecasting was used to define the future without-project (FWOP) condition or the "No Action" Alternative. The future without-project condition is the default baseline to which all other alternatives are compared. The without-project condition is the same as the NEPA "no action" condition and it assumes that no action would be taken to solve the problem.

3.1 EXISTING CONDITIONS (AFFECTED ENVIRONMENT) STUDY AREA

3.1.1 Land Use

The study area consists of the entire parish including but not limited to, the communities of Slidell, Mandeville, Covington, Abita Springs, Lacombe, and Madisonville. The Bogue Chitto and Pearl River have the biggest flooding impacts to communities in the eastern and northeastern portion of the parish. Critical infrastructure in the parish 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 City of Mandeville directly with the greater New Orleans area in Metairie (Jefferson Parish).

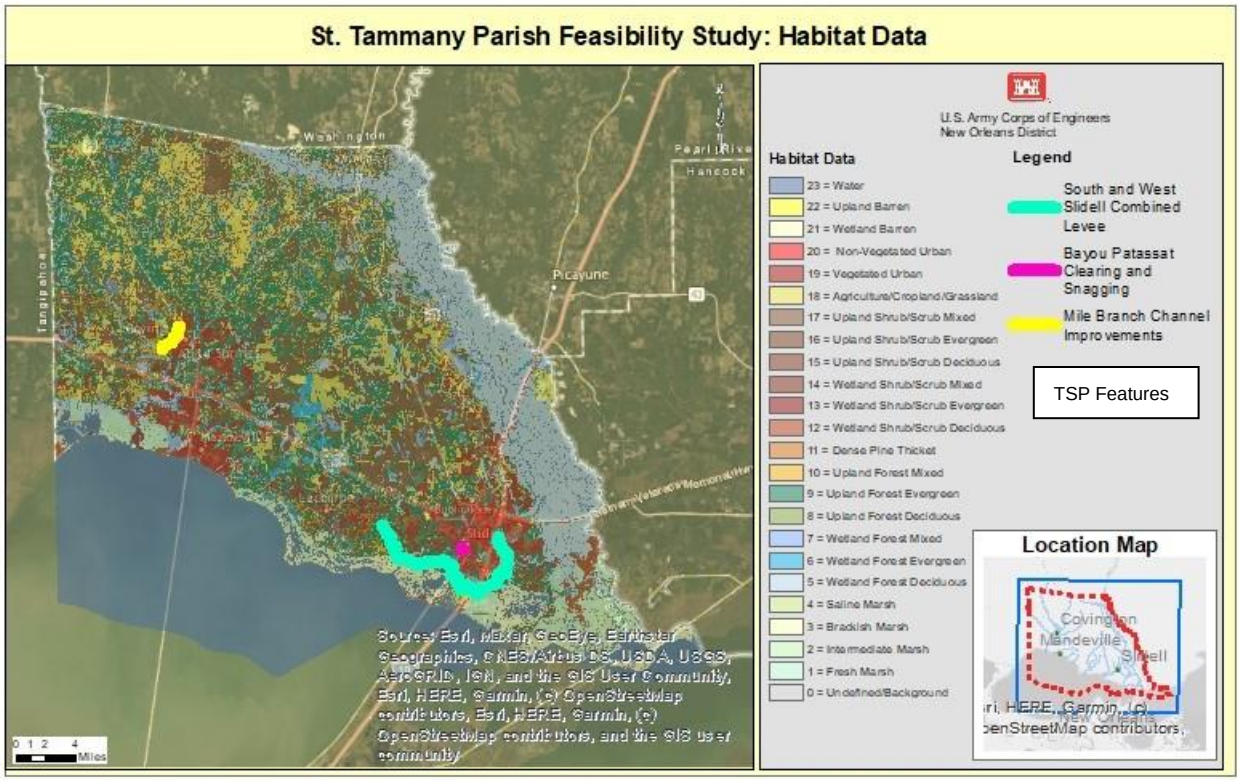

Figure 3-1. TSP Habitat Data within St. Tammany Parish

3.1.2 Geomorphic and Physiographic Setting

Multiple waterways run through the parish, with major rivers and streams including but not limited to: the Pearl River, Tchefuncte River, Bayou Castine, and the Bogue Chitto. Each of these serves an important role in sediment transport from the upper portions of the parish into Lake Pontchartrain, enriching the estuary with nutrients in a manner that is highly favorable to numerous species. 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.

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.

3.1.3 Climate, Weather Patterns, and Climate Change

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 June 2015 USACE Climate Adaptation Plan update 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.

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.

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).

The study area is humid, reflecting the subtropical nature typical for the region, and heavily influenced by the amount of water surface in the immediate area and the proximity to the Gulf of Mexico. Prevailing winds from the Gulf of Mexico reduce extreme summer heat, shorten the duration of infrequent winter polar air masses, and provide abundant rain in all seasons. Available data from the National Climatic Data Center show seasonal averages in St Tammany Parish, including both temperature and precipitation, are included in Table 3-1.

Table 3-1. St. Tammany Parish, LA Average Temperature and Precipitation

Climate Variable Averages (1981-2010)												
Slidell Station	J	F	M	A	M	J	J	A	S	O	N	D
Temperature (°F)	50.7	53.9	60.5	67.0	74.9	80.2	82.0	81.9	78.2	69.1	60.4	52.9
Precipitation (Inches)	5.65	4.95	5.28	4.36	5.16	5.57	6.83	6.92	4.99	3.82	4.47	4.89
Source: National Climatic Data Center, NOAA												

Projections of storm frequencies from the 2017 Master Plan anticipate increased frequencies for hurricanes and decreased frequencies for tropical storms. Table 3-2 presents the average annual number of North Atlantic Basin tropical storms and major hurricanes (CPRA 2017).

Table 3-2. 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%

3.2 RELEVANT RESOURCES

This section contains a description of relevant resources that could be impacted by implementation of the Proposed Action or TSP (these terms may be used interchangeability in this Section). 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. Table 3-3 provides a summary of the institutional, technical, and public importance of these resources.

Table 3-3. Relevant Resources and their Institutional, Technical, and Public Importance

Resource	Institutionally Important	Technically Important	Publicly Important
Wetlands	Clean Water Act of 1977, as amended; Executive Order 11990 of 1977, Protection of Wetlands; Coastal Zone Management Act of 1972, as amended; and the Estuary Protection Act of 1968., EO 11988, and Fish and Wildlife Coordination Act.	They provide necessary habitat for various species of plants, fish, and wildlife; they serve as ground water recharge areas; they provide storage areas for storm and flood waters; they serve as natural water filtration areas; they provide protection from wave action, erosion, and storm damage; and they provide various consumptive and non-consumptive recreational opportunities.	The high value the public places on the functions and values that wetlands provide. Environmental organizations and the public support the preservation of these areas.
Uplands (including scrub shrub)	Food Security Act of 1985, as amended; the Farmland Protection Policy Act of 1981; and the Fish and Wildlife Coordination Act of 1958, as amended.	They provide habitat for both open and forest-dwelling wildlife, and the provision or potential for provision of forest products and human and livestock food products.	The high value the public places on their present value or potential for future economic value.
Prime and Unique Farmlands	Farmland Protection Policy Act, Food Act of 1981	State and Federal agencies recognize the value of farmland for the production of food, feed, and forage. Public places a high value on food and feed production.	Public places a high value on food and feed production.
Wildlife	Fish and Wildlife Coordination Act of 1958, as amended and the Migratory Bird Treaty Act of 1918	They are a critical element of many valuable aquatic and terrestrial habitats; they are an indicator of the health of various aquatic and terrestrial habitats; and many species are important commercial resources.	The high priority that the public places on their esthetic, recreational, and commercial value.
Threatened and Endangered Species	The Endangered Species Act of 1973, as amended; the Marine Mammal Protection Act of 1972; and the Bald Eagle Protection Act of 1940.	USACE, USFWS, NMFS, NRCS, EPA, LDWF, and LDNR cooperate to protect these species. The status of such species provides an indication of the overall health of an ecosystem.	The public supports the preservation of rare or declining species and their habitats.
Aquatic / Fisheries Resources	Fish and Wildlife Coordination Act of 1958, as amended; Clean Water Act of 1977, as amended; Coastal Zone Management Act of 1972, as amended; and the Estuary Protection Act of 1968.	They are a critical element of many valuable freshwater and marine habitats; they are an indicator of the health of the various freshwater and marine habitats; and many species are important commercial resources. USACE, USFWS, NMFS, NRCS, EPA, and State DNR and wildlife/fishery offices recognize value of fisheries.	The high priority that the public places on their esthetic, recreational, and commercial value. Environmental organizations and the public support the preservation of fishery resources.
Essential Fish Habitat (EFH)	Magnuson-Stevens Fishery Conservation and Management Act of 1996, Public Law 104-297	Federal and state agencies recognize the value of EFH. The Act states, EFH is “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”	Public places a high value on seafood and the recreational and commercial opportunities EFH provides.

Resource	Institutionally Important	Technically Important	Publicly Important
Air Quality	Clean Air Act of 1963, Louisiana Environmental Quality Act of 1983.	State and Federal agencies recognize the status of ambient air quality in relation to the NAAQS.	Virtually all citizens express a desire for clean air.
Noise and Vibration	USACE ER 1105-2-100, and National Environmental Policy Act of 1969, Noise Control Act of 1972, Quiet Communities Act of 1978	Unwanted noise has an adverse effect on human beings and their environment, including land, structures, and domestic animals and can also disturb natural wildlife and ecological systems.	The EPA must promote an environment for all Americans free from noise that jeopardizes their health and welfare.
Water Quality	Clean Water Act of 1977, Fish and Wildlife Coordination Act, Coastal Zone Mgt Act of 1972, and Louisiana State & Local Coastal Resources Act of 1978.	USACE, USFWS, NMFS, NRCS, EPA, and State DNR and wildlife/fishery offices recognize value of good water quality and the national and state standards established to assess water quality.	Environmental organizations and the public support the preservation of water quality and the desire for clean drinking water.
Socioeconomics	River and Harbor Flood Control Act of 1970 (PL 91-611), USACE ER 1105-2-100, and National Environmental Policy Act of 1969.	When an environmental document is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental document will discuss all of these effects on the human environment.	Government programs, policies and projects can cause potentially significant changes in many features of the socioeconomic environment. Social concerns and items affecting area economy are of significant interest to community.
Cultural Resources	National Historic Preservation Act of 1966, as amended; the Native American Graves Protection and Repatriation Act of 1990; and the Archeological Resources Protection Act of 1979	State and Federal agencies document and protect sites. Their association or linkage to past events, to historically important persons, and to design and construction values; and for their ability to yield important information about prehistory and history.	Preservation groups and private individuals support protection and enhancement of historical resources.
Aesthetics	USACE ER 1105-2-100, and National Environmental Policy Act of 1969, the Coastal Barrier Resources Act of 1990, Louisiana's National and Scenic Rivers Act of 1988, and the National and Local Scenic Byway Program.	Visual accessibility to unique combinations of geological, botanical, and cultural features that may be an asset to a Study Area. State and Federal agencies recognize the value of beaches and shore dunes.	Environmental organizations and the public support the preservation of natural pleasing vistas.
Recreation Resources	Federal Water Project Recreation Act of 1965 as amended, and Land and Water Conservation Fund Act of 1965 as amended	Provide high economic value of the local, state, and national economies.	Public makes high demands on recreational areas. There is a high value that the public places on fishing, hunting, and boating, as measured by the large number of fishing and hunting licenses sold in Louisiana; and the large per-capita number of recreational boat registrations in Louisiana.

Resource	Institutionally Important	Technically Important	Publicly Important
Navigation	Rivers and Harbors Act of 1899 and River and Harbor Flood Control Act of 1970 (PL 91-611).	The Corps provides safe, reliable, efficient, and environmentally sustainable waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation.	Navigation concerns affect area economy and are of significant interest to community.

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.

3.2.1.1 Wetlands Resources

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. Trend analyses from 1985 to 2010 shows a wetland loss rate of about 16.57 square miles per year in areas around the study area. USGS (2017) “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.

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 will 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 Louisiana and 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 before saltmarsh 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 much 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 Uplands

Uplands in the central portions of the parish are dry with an open canopy and generally consist of a scrub understory and longleaf pines. The lack of a mid-story is a characteristic that helps define the habitat and is found primarily in the northern portion of the parish, away from the main water bodies that this study is analyzing for flood risk reduction and coastal storm damage. Water bodies run throughout the parish; however, drainage ultimately runs into Lake Pontchartrain and the Pearl River. Species found throughout the uplands rely on these bodies of water and drainages to them 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.

3.2.1.2 Prime and Unique Farmlands

A review of prime and unique farmland in the TSP footprints and borrow sources was conducted by CEMVN using the web soil survey service provided by the Natural Resource Conservation Service (NRCS), and the results can be found in Appendix C. 44% of the lands within the survey report of the TSP footprint are prime and unique farmlands.

Prime and unique 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.

3.2.1.3 Aquatic Resources

Primary fresh and intermediate water bodies in the parish of importance for this study 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.

Wetlands throughout the study 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.

3.2.1.4 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. Please see Appendix C for more information.

Brown shrimp and white shrimp 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.

Red drum 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).

Bull sharks 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.

3.2.1.5 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 in the study area 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 in the study area 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 found in St. Tammany Parish.

3.2.1.6 Threatened, Endangered and Protected Species

To aid the CEMVN in complying with proactive consultation responsibilities under the Endangered Species Act (ESA), the USFWS provided a planning aid letter list of threatened and endangered (T&E) species and their critical habitats within the study area in a letter dated 31 January 2020. Species addressed as being of concern are:

Gulf sturgeon

The gulf sturgeon is federally listed as a threatened species, and the NMFS has designated Lake Pontchartrain extending out through the Rigolets, the Pearl River, and the Bogue Chitto as critical habitat for the species in 2003. The species spawns in coastal freshwater rivers in the late winter through spring (March-May) but spend the majority of the year in marine and estuarine waters (NOAA). Young sturgeon spend their first 2 years in the estuarine and coastal freshwater rivers before migrating into the marine environment of the Gulf of Mexico.

The USFWS has authority over the Gulf sturgeon when the species is within its riverine habitat during spawning and its first two years. After the species moves into the marine habitat as an adult, it falls under the authority of the NMFS. In estuarine areas, responsibility is divided between USFWS and NMFS based on the action agency involved.

On 19 March 2003, USFWS and 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. In Louisiana, the designation includes portions of the Pearl and Bogue Chitto Rivers and Lake Pontchartrain east of the Lake Pontchartrain Causeway, as well as Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne in their entirety. The physical biological features (PBF) for the conservation of Gulf sturgeon, which should be considered when determining potential project impacts, are those habitat components that support feeding, resting, sheltering, reproduction, migration, and physical features necessary for maintaining the natural processes that support those habitat components. The PBF for gulf sturgeon critical habitat include:

- abundant prey items within riverine habitats for larval and juvenile life stages, and within estuarine and marine habitats for juvenile, sub-adult, and adult life stages,
- riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay,
- riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, sub-adult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions,
- a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging, and necessary for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larvae staging,

- 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,
- sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by a permanent structure, or a dammed river that still allows for passage).

Alabama heelsplitter mussel

The Alabama heelsplitter mussel is a federally listed threatened freshwater mollusk that is known to occur in Louisiana in the lower Amite River and two dead specimens were found in the Pearl River in 1996. Little is understood about the lifecycle of the species, other than it is heavily impacted by poor water quality associated with dredging, channel modifications, and mining activities. They are typically found in areas with a soft, sandy substrate that experiences lower flow rates and along riverbanks and point bars.

Louisiana quillwort

A semi-aquatic, federally-listed endangered plant species, the Louisiana quillwort grows in riparian areas throughout the study area along streams associated with springs. Activities that disturb hydrologic regimes in these habitats would negatively impact the species as it is sensitive to changes in water quality.

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, preferring longleaf pine uplands, 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.

The preference for the upland pine habitat has resulted in the species becoming increasingly impacted by commercial and residential development in the southeast, and land that is converted for agricultural purposes. Remaining gopher tortoises are often found in areas under power lines, golf course edges, and fence rows. These are considered marginal habitats that occur typically as the result of their preferred adjacent habitat becoming unsuitable as the result of development.

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.

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.

West Indian manatee

The West Indian manatee is one of the largest coastal mammals in North America. This unusual marine mammal, with its massive, seal-like body, has been able to adapt well to its marine environment but prefers warmer temperatures. Manatees migrate seasonally to adapt to water temperatures dropping below 68°F every winter. Manatees range widely in between fresh, brackish, and marine waters throughout the Gulf of Mexico, Caribbean, and South America. They are known to occur in Lake Pontchartrain and signage warning the public of their presence is posted by the LDWF at most boat launch sites. Encounters with recreational and commercial watercraft significantly reduced the population levels of manatees along the gulf coast, and they are known to sometimes congregate in and around water control structures. In 2017, the manatee was reclassified from endangered to threatened in response to a rebound in population. Manatees are also protected under the Marine Mammal Protection Act, which prohibits the take (i.e., harass, hunt, capture, or kill) of all marine mammals.

Red-cockaded woodpecker

The red-cockaded woodpecker is a federally listed endangered bird species that prefers open longleaf pine uplands throughout the southeast. It roosts in the cavities of pine trees, particularly ones that have heart fungus as this makes the wood softer and easier to excavate for nest construction. The species seeks out habitats where there is little mid-story and the pines are less dense, allowing for buffer zone of multiple pines with cavities that are sticky with resin to evade predators. 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.

Bald Eagle

Some of the measures in the TSP may affect habitats that provide nesting habitat for the bald eagle, which 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, willow, 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.

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, 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 this office. 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. The evaluation that would be conducted in such event, may be found online at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, this website will provide a determination of whether additional consultation is necessary.

On 11 September 2009, two Federal regulations were published establishing 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. 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 will 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 Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703, et seq.) 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.

3.2.1.7 "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 will become ESA listed species, their potentially reduced populations warrant additional consideration during plan formulation and design to avoid and minimize impacts. Please see Appendix C for a list of "At-Risk" Species from USFWS.

3.2.1.8 Water Quality

Water quality throughout the study area is heavily influenced by tidal action from the Gulf of Mexico and its effects on Lake Pontchartrain. Water quality can also be 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.

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 EPA synthesizes into a report to Congress. The Louisiana Department of Environmental Quality (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 will 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.

3.2.1.9 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. 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.

3.2.1.10 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 3-2 shows the National Structure Inventory and the study area boundary.

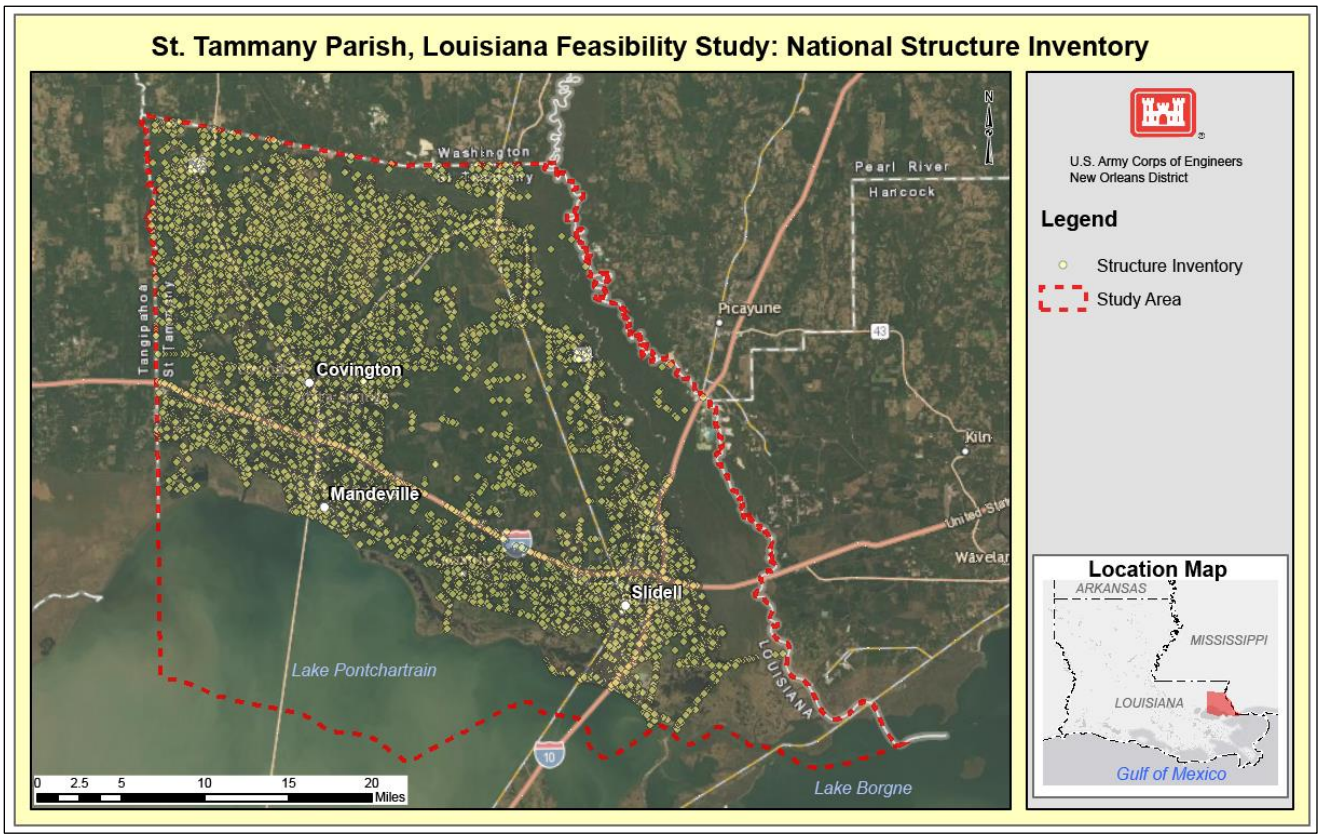

Figure 3-2. Study Area Boundary and National Structure Inventory (2018)

3.2.2.1.2 Population, Number of Households, and Employment

Tables 3-4, 3-5, and 3-6 display the population, number of households, and the employment (number of jobs) for the years 2000, 2010, 2019, and projections for 2025 and 2045.

Table 3-4. Historical and Projected Population by Parish

Parish	2000	2010	2019	2025	2045
St. Tammany	192,131	234,567	255,376	262,054	275,133
Sources: 2000 and 2010 from U.S. Census Bureau; 2019, 2025, 2045 from Moody's Analytics (ECCA) Forecast					

Table 3-5. Historical and Projected Households by Parish

Parish	2000	2010	2019	2025	2045
St. Tammany	69,714	87,915	100,343	105,906	119,757

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

Table 3-6. Historical and Projected Employment by Parish

Parish	2000	2010	2019	2025	2045
St. Tammany	59,560	78,379	92,919	96,699	110,549

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

3.2.2.1.3 Income

Table 3-7 shows the actual and projected per capita personal income levels for St. Tammany Parish from 2000 to 2025.

Table 3-7. Actual and Projected Per Capita Personal Income Levels from 2000 to 2025

Parish	2000	2010	2019	2025
St. Tammany	29,945	46,995	68,904	96,474

Sources: 2000, 2010 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 3-8. 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 will 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 3-8. FEMA Loss Statistics for St. Tammany Parish, Louisiana from 7/2018 and 7/2019

Location	Number of Claims	Total Payments
ABITA SPRINGS, TOWN OF	89	$ 662,788.17
COVINGTON, CITY OF	718	$ 15,104,969
FOLSOM, VILLAGE OF	15	$ 270,232.20
MADISONVILLE, TOWN OF	391	$ 13,401,206

MANDEVILLE, CITY OF	1,762	$ 44,099,776
PEARL RIVER, TOWN OF	46	$ 439,053
SLIDELL, CITY OF	9,479	$ 456,248,588.53
ST. TAMMANY PARISH*	22,267	$ 1,141,962,561

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

3.2.2.1.5 Environmental Justice

The largest city in the parish is Slidell, which is home to about 11 percent of the parish population. The majority of the parish is white with 83 percent identifying as white and 17 percent identifying as minority. The largest minority in the parish is Black/African American. Hispanic ethnicity is between 3 and 7 percent of the parish's population. The Federal Interagency Working Group's "Promising Practices for EJ" document recommends using a 50 percent threshold to identify EJ communities. None of the communities shown in Table 3-9 meet the minority threshold of 50 percent. However, there may be pockets of EJ neighborhoods within these larger communities and those will be identified once the project alternatives are assessed later in the report.

Table 3-9 Census Information

Location	Total Population	White	Black	Native American	Asian	Native Hawaiian	Some Other Race1	Two or more Races	Minority	Hispanic
St. Tammany	249,201	207,710	29,050	1,279	3,875	90	2,435	4,762	17%	5%
Slidell (city)	27,755	21,655	4,779	166	453	10	242	450	22%	7%
Lacombe CDP*	8,519	6,017	2,205	36	0	0	131	130	29%	3%
Mandeville (city)	12,215	11,116	622	0	241	0	93	143	9%	4%
Madisonville	820	789	12	0	15	0	0	4	4%	2%
Covington (city)	9,925	7,467	1,984	0	149	0	79	246	25%	4%
Abita Springs	2,487	2,477	10	0	0	0	0	0	0.4%	7%

[1] includes some other race alone and two or more races

*Census Designated Place

Source: U.S. Census Bureau, American Fact Finder, ACS 2013-2017.

The majority of the population lives above the poverty threshold, as shown in Table 3-10. In 2017, eleven percent of parish residents had a poverty status below the poverty threshold of $25,094 for a family of four. As detailed in the "Promising Practices" document, 20 percent or more of residents with incomes below poverty is a threshold used to identify EJ communities. None of the places shown in Table 3-10 meet this EJ threshold; however, there may be neighborhoods, near project alternatives, within these communities that may be EJ communities.

Table 3-10. Communities within Study Area Below Poverty

Place	Total Population*	Population having Income below Poverty	Percent of Population Below Poverty
St. Tammany Parish	246,484	26,554	11%
Slidell (city)	27,263	3,958	15%
Lacombe CDP	8,438	1,296	15%
Mandeville (city)	11,970	907	8%
Madisonville	820	61	7%
Covington (city)	8,794	1,146	13%
Abita Springs	2,487	202	8%

*For Whom Poverty Status is Known

Source: U.S. Census Bureau ACS 2013-2017

3.2.2.2 Navigation

Bayou Lacombe and the Pearl, Tchefuncte, and the Bogue Chitto Rivers 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 (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 43 historic properties listed in the NRHP are located within St. Tammany Parish. These include 5 historic districts, 35 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.

The remaining two historic districts are 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.

Three sites in St. Tammany Parish include the Williams Cemetery in Lacombe, and the Pottery Hill and Tchefuncte sites in Mandeville. The Williams 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 Sites

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. A list of archaeological sites within 0.5 miles of the TSP's multiple footprints is found in Appendix C.

3.2.2.3.2 Tribal Trust Resources

There are six federally-recognized Tribes that have current and/or ancestral interest within St. Tammany Parish:

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 Louisiana 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 Tribal lands [as defined in 36 CFR § 800.16(x)].

3.2.2.4 Louisiana Natural and Scenic Rivers

Archaeological resources within scenic river corridors are protected by state law under the Louisiana Scenic Rivers Act (LSRA), La. Rev. Stat 56:1847. The following Louisiana natural and scenic rivers occur within the parish: 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, Tchefuncte River (excluding any tributaries), West Pearl River, and Wilson Slough. The LDWF is the lead State agency in the Scenic Rivers Program.

None of these rivers are designated under the federal Wild and Scenic Rivers Act, 16 U.S.C. §1271, *et seq*. No waterbodies in St. Tammany Parish are designated under the federal Act.

3.2.2.5 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, USEPA 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.

3.2.2.6 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:

- important urban landscapes, including visual corridors, monuments, sculptures, landscape plantings, and greenspace,
- 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 area's economy,
- 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. Specific examples include:

- City 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, Abita Springs, Madisonville and Slidell,
- 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.

3.2.2.7 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 Table C:3-1*).* See photo of the Tammany Trace in Fig 3-3 below.

Figure 3-3. 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 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 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.

3.3 FUTURE WITHOUT PROJECT CONDITIONS

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 gains (e.g. flood risk reduction) would not be achieved. The FWOP condition includes increased flood risk and coastal storm damage associated with high precipitation and tropical storm events and rapid change in floodplain hydrology from development activities. Continued flooding from the Pearl River, Tchefuncte, Bogue Chitto, and other waterways would continue to negatively impact communities within the parish. Effects from sea level rise, continued subsidence, and climate change are anticipated. This would result in higher and more frequent storm damages and higher average annual damages. The FWOP conditions would include lower tax revenues as property values decline due to higher risk of damage from flooding events over time. Higher risk of damage from flooding could manifest itself in higher premiums for flood insurance under FEMA’s National Flood Insurance Program. Higher premiums are expected to increase the cost of property ownership and result in correspondingly lower market values.

Without implementation of the TSP, other Federal, state, local, and private efforts may still occur within or near the TSP footprints. 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. Due to heavy development along the coast, there are few existing wetlands along Lake Pontchartrain to absorb storm surge events. Flooding from the Pearl River is commonplace in Slidell and would only worsen based on current conditions.

Marshes 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 slowly decline as marshes are slowly lost. The threat of continued damage from flooding is likely to continue as the result of sea level rise and continued subsidence throughout southeastern Louisiana.

Section 1.6 of this report discusses ongoing programs and potential projects in the study area for floodplain related activities such as the projects listed in the 2017 Master Plan.

Section 4
Formulation of Alternative Plans

Plan formulation is the process of building alternative plans that meet planning objectives, address identified problems, and avoid planning constraints. A systematic and repeatable planning approach was 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 report describes the iterative process of identifying measures, creating alternative plans and continually reevaluating the measures within the alternatives and screening measures all the way through selection of the Final Array of Alternatives and TSP. Plan formulation was consistent with protecting the Nation's environment, pursuant to national environmental statues, applicable EOs, and other Federal planning requirements. Plan formulation also considers all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (P&G) (1983), which are: NED, EQ, RED, and OSE.

Plan formulation was a data driven process, building upon previous data and work and developing more detail and including more refinement of alternatives and measures as the PDT moved toward identifying the TSP. Each iteration identified additional information necessary to inform make further 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 alternatives and measures. Throughout the study, the PDT incorporated risk-informed decision into the planning process to balance the level of study detail necessary to make decisions at that phase, along with balancing uncertainty in accordance with USACE policy, such as ER 1105-2-101.

Early iterations of alternatives and measures were devoted to understanding the problem while identifying possible measures (solutions to reduce flood risk) and critical uncertainties. In subsequent iterations, information was developed to reduce uncertainties that affected the choices on hand. While it was not possible to eliminate all uncertainty, the PDT prioritized which uncertainties posed the greatest risk to decisions. The PDT used existing information to make reasonable comparisons between alternatives where possible and determined when to accept the risk of using existing data over the cost and time of new analyses.

When the PDT lacked information about a critical aspect of the alternatives, it was determined how much analysis was needed to make an informed decision and where possible any additional analyses (and costs) were delayed until later in the study, after the TSP selection. Using these principles, the PDT was able to manage risk by balancing the level of uncertainty with the tolerance for risk. Figure 4-1 shows the planning process and a summary of the information that was available and used 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. As discussed in Section 3, in Step 2 of the planning process, the PDT documented the relevant existing conditions related to FRM and CSRM and the affected environment by looking at historic trends and potential changes that would likely happen in the future if no USACE actions were taken. The data compiled by the PDT was used to define the FWOP condition 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 study 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 report, 30 different types of structural, nonstructural, and engineering with nature-based actions to reduce flood risk were identified. The PDT initially developed a total of 195 measures within the structural, nonstructural, and nature-based categories/actions. 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. The measures were subsequently evaluated and screened, and the remaining 61 measures were combined to form alternative plans. See Appendix B: Plan Formulation for more details on the Initial Array of Alternatives.

The separate alternatives were developed by combining all 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. Once the cost-effective actions from within an alternative were identified, the justified

measures from the alternatives were then combined into a comprehensive alternative that reduced flood risk to multiple parts of the study area. A comprehensive nonstructural plan was also evaluated for the entire parish, along with combined structural and nonstructural plans for the separate geographic areas.

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. The screening for the Initial Array of Alternatives was informed by preliminary economic modeling (HEC-FDA), H&H modeling (HEC-RAS and analysis of ADCIRC results), and cost estimates from previous studies in the area. The screening led to a Focused Array of 11 alternatives and 43 measures, which was further informed by preliminary economic modeling (HEC-FDA), H&H modeling (HEC-RAS and analysis of ADCIRC results) and updated cost estimates. 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 the TSP from the Final Array of Alternatives was informed by among other things, economic modeling (HEC-FDA), 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.

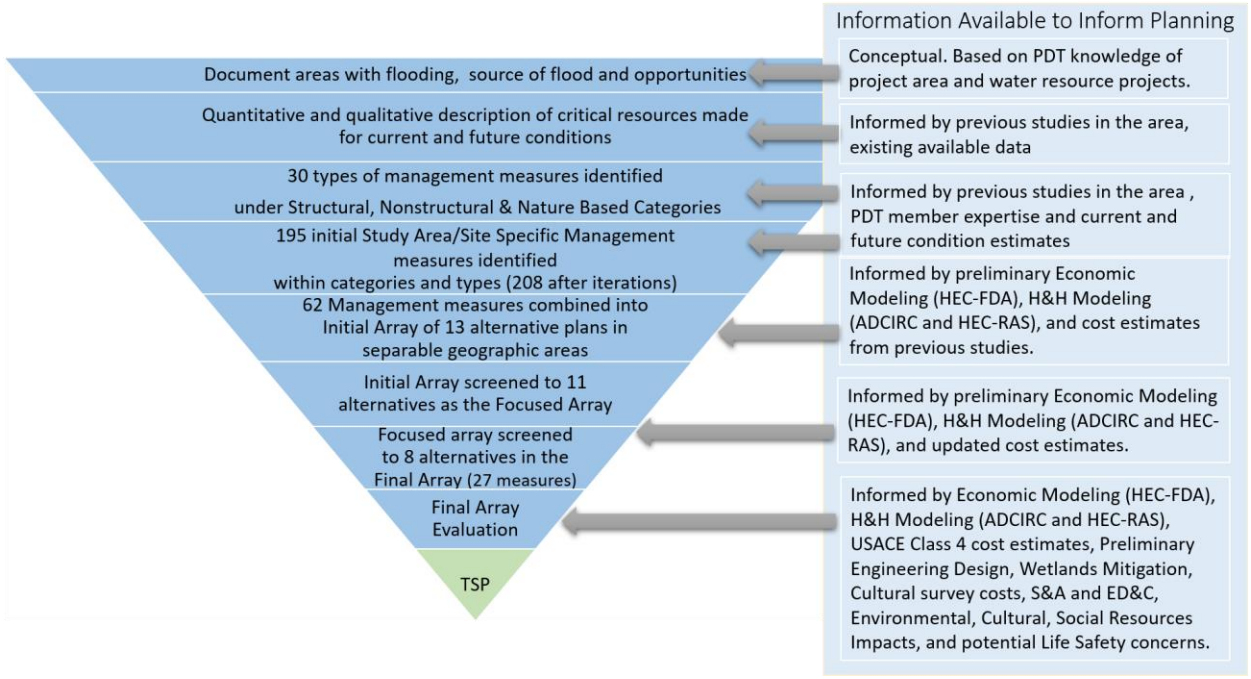

Figure 4-1. Summary of St. Tammany Parish, Louisiana Feasibility Study Plan Formulation Process

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 TSP. The measures, alternatives, and screening and evaluation process that lead to the selection of the Final Array of Alternatives are further detailed in Appendix B: Plan Formulation. During the final phase, called the feasibility level design phase, and in pre-construction engineering and design (PED), additional analyses will be completed to refine and optimize the design and cost estimates of the measures included in the TSP. The revised design and costs will be incorporated into the numerical modeling (Hydraulics and Economics) to develop refined assessments of the performance and cost-effectiveness of the TSP, which will be included in the final Integrated Feasibility Report (FIFR) and final Environmental Impact Statement (FEIS) as the Recommended Plan. The final report will fully describe the Recommended Action, as well as its costs, benefits, and consequences. Because uncertainty cannot be eliminated, the final report will further document the levels of certainty and the associated risks that are inherent in the assumptions and analyses.

The measures within the Final Array of Alternatives underwent H&H modeling, preliminary engineering and design, development of full cost estimates, and environmental resource analysis. The Final Array of Alternatives included eight 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)
- 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 ft (S-046, S-048 S-118, S-122)

During the evaluation of the Final Array (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 Combined with West Slidell Levee was added as a potential variation to evaluate a complete levee/floodwall system from Slidell to Lacombe. Measure S-122 Mandeville Lakefront-18 ft was added to evaluate a 100 year level of protection in Mandeville after the 7.3 ft system proposed being evaluated was shown to have limited flood reduction benefits.

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

The levees in the Final Array are designed following the HSDRRS standards as applicable and appropriate for this level of design and using engineering judgement. Throughout this document, they will be 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 this section and the report, flood events are referred to by their annual exceedance probability (AEP), which is the probability that of 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. In the past, this has often been referred to as a 100-year event (return period) or having a 1 percent annual chance of exceedance. Table 4-1 provides a list of AEP events with their equivalent “return period.”

Table 4-1. Comparison of AEP and Return Period Terminology AEP Return Period.

AEP	20%	10%	4%	2%	1%	0.5%	0.2%	0.1%
Return	5-	10-	20-	50-	100-	200-	500-	1000-

Table 4-2. 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-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
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 18ft Seawall with Pump Stations	Structural	Flood Wall 18 ft 100 year	Mandeville	CSRM

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

For the structural measures, CEMVN Engineering Division developed the estimated levee lengths, quantities, borrow quantities, etc. of the Final Array, by 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. Existing ground elevations were obtained from light detection and ranging (LIDAR) raster dataset. Potential borrow sites were investigated using the data that is currently available. Anticipated impacts associated with five potential borrow sites are evaluated for this study.(See Appendix B and Appendix D for additional information on borrow).

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.

Table 4-3. Final Array of Alternatives

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

								NS-010, NS-011
6	6a South Slidell				S-074, S-075, S-077	S-075, S-076	S-075, S-076	NS-008, NS-009, NS-010, NS-011
	6b South Slidell with Eden Isle				S-74, S-075, S-077	S-70, S-075, S-076	S-70, S-075, S-076	NS-008, NS-009, NS-010, NS-011
	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	NS-008, NS-009, NS-010, NS-011
7	Eastern Slidell	Pearl River Levee			S-060	S-060	S-060	NS-008, NS-009, NS-010, NS-011
		Doubloon Bayou Channel Improvements		S-069,				NS-008, NS-009, NS-010, NS-011
		Poor Boy Canal Channel Improvements		S-073				NS-008, NS-009, NS-010, NS-011
		Gum Bayou Diversion-Channel Improvements		S-072				NS-008, NS-009, NS-010, NS-011
8	Upper Tchefuncte/Covington	Mile Branch		S-057,				NS-008, NS-009, NS-010, NS-011
		Lateral A		S-121				NS-008, NS-009, NS-010, NS-011
9	Mandeville Lakefront	9a. Mandeville Lakefront-Seawall Passive Drainage				S-046, S-118,	S-047	NS-008, NS-009,

								NS-010, NS-011
		9b. Mandeville Lakefront-Seawall and Pump Stations			S-048	S-046, S-118,		NS-008, NS-009, NS-010, NS-011
		9c. Mandeville Lakefront-18 ft			S-048	S-046, S-118, S-122		NS-008, NS-009, NS-010, NS-011

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

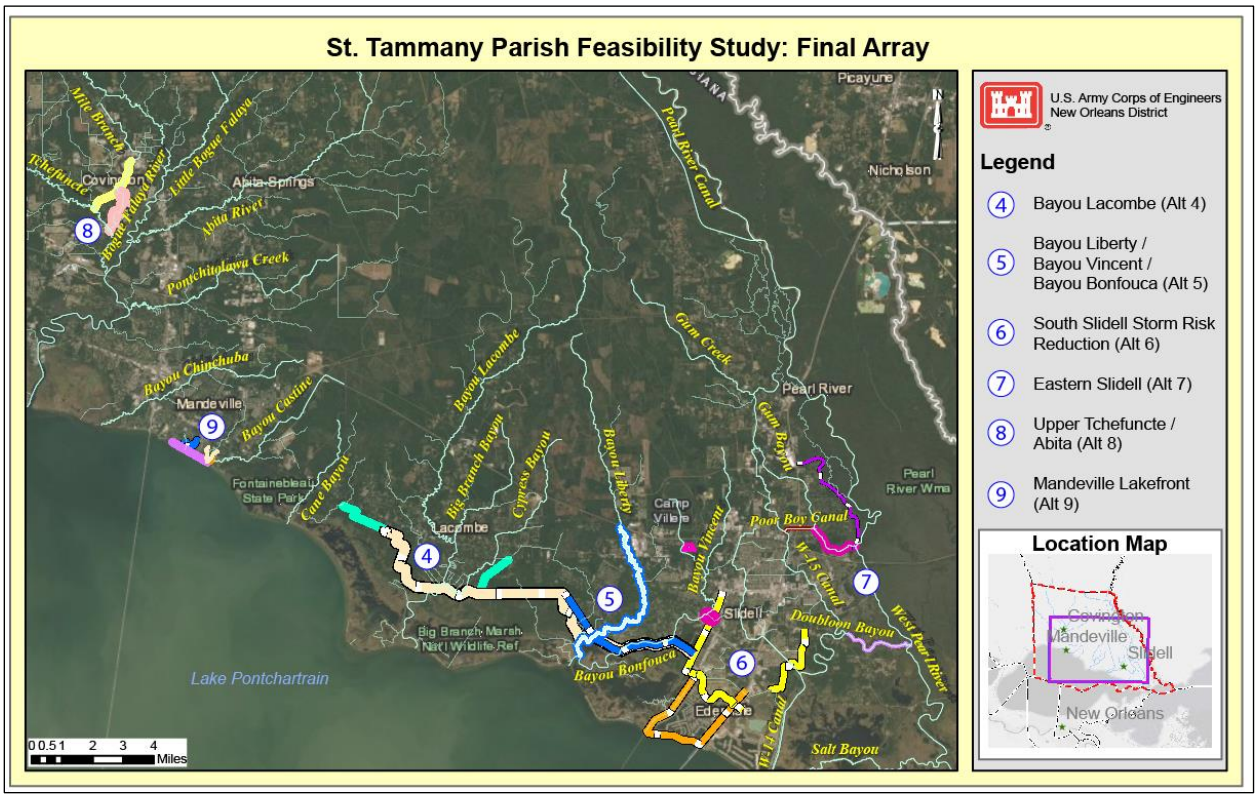

Figure 4-2. Structural Alternatives in the Final Array of Alternatives.

Alternative 1. No Action (FWOP condition)

Alternative 1 is the FWOP condition if no plan is authorized. Under the No Action Alternative, no risk reduction would occur. The area would continue to experience damages from riverine, rainfall, storm surge, and coastal storm related flooding.

Alternative 2. Nonstructural

Alternative 2 considers nonstructural actions parish wide in areas of flood damages (FRM and CSRM) to structures. This alternative was aimed at reducing flood damages

without altering the nature or extent of the flooding by changing existing structure or structure usages. Nonstructural measures include modifying homes, businesses, and other facilities to reduce flood damages by elevating structures or removing them from the floodplain. Measures considered included flood proofing, structure raising, buyouts, and relocations to reduce damages to the flood hazard. Nonstructural measures differ from structural alternatives in that they focus on reducing the consequence of flooding for a specific structure rather than reducing the probability of flooding in that area (i.e. move what gets damaged from flood waters rather than moving the water).

The parish-wide nonstructural alternative was developed for implementing nonstructural measures using structure elevations and flood proofing and anticipated to be voluntary (see Economics Appendix F for additional information). For evaluation purposes, the cost of raising 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; raising and/or floodproofing structures were determined as being more cost effective than other nonstructural measures such as buyouts or relocations. Residential structures were assumed to be raised up to the future 100-year stage up to 13 feet, and nonresidential structures floodproofed up to 3 feet. Further assessments will be performed on the nonstructural component during the next phase of the study as the engineering modeling is refined, which will include further assessment of the buyout and relocation measures. The nonstructural analysis was based on an inventory of residential and non-residential structures and was developed using NSI version 2.0 for the portions of the study area impacted by CSRM and FRM associated with the future without project condition. An assessment of all structures located in the 10, 20, 50 and 100-year (10 percent, 4 percent, 2 percent, and 1 percent AEP) floodplains was performed. Beyond the comprehensive parish-wide nonstructural alternative, 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 a combined alternative with a nonstructural component combined with structural measures.

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

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

Alternative 4. Lacombe

Alternative 4 includes three variations of Alternative 4 (Alternative 4a, 4a.1, and 4b) of a new 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) 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 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 cubic feet per second (cfs) and 300-foot long pump station complex across Bayou Lacombe. This complex includes a 20-foot navigable floodgate. This alternative includes 10 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 4b consists of a combination of levee that includes the shorter version of the Lacombe Levee from Alternative 4a.1 and the West Slidell Levee from Alternative 5. The intent was to evaluate a levee from Lacombe to Slidell. The combined levee is approximately 13.7 miles (72,000 feet) long. The footprint includes 2,133 acres. This levee alignment is estimated to need approximately 1,205,000 cubic yards of fill/ borrow (includes 30 percent contingency) and includes 0.07 mile (350 feet) floodwall segment. In addition to the levee and floodwall section, there are a series of pump stations (4 with navigable gates) and three sluicegates that are part of this alternative. There are also five road ramps and two vehicular floodgates.

The Measure ID included in this Alternative is 120.

Engineering Appendix D contains additional engineering details for this alternative.

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 justified.

The *West Slidell Levee* measure includes 6.5 miles of levee and floodwall alignment to reduce flooding. 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 have 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. Highway 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 acres.

The Measure ID included in this Alternative is S-080.

Alternative 5 includes the *Bayou Liberty Channel Improvements* (channel improvements work) which would begin from north-south, starting immediately south of the I-12, crossing US 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 Bayou Liberty channel improvements would run north-south to address rainfall and riverine flooding. 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.

Engineering Appendix D contains additional engineering details for this alternative.

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.

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 two pump stations, two floodgates, eight vehicular ramps over the levee, 14 vehicular floodgates, and the raising of Interstate 10 roadway over the new levee section to 15 ft NAVD 88.

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 levees (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, two pump stations, five vehicular floodgates, four 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 levee is 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 NAVD 88. 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. There would also be a total of three sluicegates, eight vehicular floodgates, one railroad floodgate across the Norfolk Southern, and seven ramps. The I-10 would be raised to ramp over the new levee section. Further refinement will be needed to determine preliminary assumptions of any relocation of utilities.

The Measure IDs included in this Alternative 6c are S-074, 075, 076, 077, and S-081.

Engineering Appendix D contains additional engineering details for this alternative.

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 new proposed 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 bankline 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.

Engineering Appendix D contains additional engineering details for this alternative.

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.

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.

The Measure ID included in this alternative is S-121.

Engineering Appendix D contains additional engineering details for this alternative.

Alternative 9. Mandeville Lakefront

Alternative 9 consists of variations for replacing and raising the existing seawall and such as 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 NAVD88. 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 NAVD88 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, 2 pump stations, and floodgates. For elevation 7.3 feet NAVD88, 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 NAVD 88 and 0.3 miles (1,740 feet) long. The new floodwall at

Little Bayou Castine would be at elevation 7.3 feet NAVD 88 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 2 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 NAVD88, the new seawall is approximately 1.8 miles long (9,600 feet). The new floodwall in Galvez Canal would be at elevation 18 feet NAVD 88 and would be 0.5 miles (2,700 feet) long. The new floodwall at Little Bayou Castine would be at Elevation 18 feet NAVD 88 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 and was not evaluated in the Initial or Focused Array of Alternatives.

Engineering Appendix D 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 and screened against the following criteria: physical performance, costs, economic benefits, impacts to life, impact to environmental resources, societal impacts, study objectives and constraints, P&G alternative criteria, and contributions to Federal objectives and accounts. The environmental and social benefits and impacts for the Final Array are presented in Section 5 and the remainder of the analysis is presented within this Section 4.2 and Appendix B: Plan Formulation. Where available, references are made to other sections of this report or the appendices for additional information.

4.2.1 Performance Analysis of Structural Measures

To assess the benefits of the structural measures of the Final Array of Alternatives, H&H modeling along with a coastal modeling analysis were performed to quantitatively measure the reductions in WSEs for the Final Array of Alternatives This is referred to as the With Project modeling. See Appendix E for additional details.

Each FRM measure within an alternative was analyzed using 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 to be processed for analysis. Hydraulic model results were provided for analysis of flood damages in the form of geographic information science (GIS) rasters showing the maximum 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 protected by the proposed levees were determined using a Louisiana statewide LIDAR dataset. Design elevations, described in Section **Error! Reference source not found.** of Appendix E, 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 alignment.

Because the 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, modeling of the TSP will be performed during the feasibility level of design phase of the study and will be included in the final report.

HEC-RAS with-project modeling results and the SRM 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 4-4 and difference grids displaying with-project difference may be seen in Appendix E. The analysis of the nonstructural measures is included in Section 4.2.4.

Table 4-4. 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 ft. Small inducements are caused at the upstream end.
5	Bayou Liberty Channel Improvements	Reductions range from 0-1 ft. along the Bayou Liberty floodplain.
5	Bayou Patassat Channel Improvements- Clearing and Snagging	Reductions range from 0-1 ft. 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 ft. along the dredged channel. Lowerings 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 ft. 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 ft. on protected side of levee alignment for 200yr. frequency event. Inducements of up to 1ft. in certain areas outside the levee alignment.
8	Mile Branch Channel Improvements	Reductions of approximately 0-1ft. for the 10yr. event upstream and in the floodplain of Mile Branch channel deepening location.
8	Lateral A Channel Improvements	Reductions of approximately 0-1ft. 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 inputted into the HEC-FDA Economics Model described in Section 4.2.3.The hydraulic model results (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 in Appendix E.

4.2.2 Structural Measure Cost Estimates

Total cost and estimated annual costs for the structural alternatives and measures include planning, engineering and design, construction, construction management, real estate, and environmental and cultural mitigation costs, all of which include contingencies. See Table 4-5. For the purposes of this study, 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 due to sinking and subsidence) were assumed to occur at three times post initial construction 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. 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, which do not include berms. During future design for the TSP, the TSP will be updated, and it may include stability or seepage berms, geotextile reinforcement, and/or ground improvement, which may need additional real estate procurement.

Mitigation costs due to unavoidable habitat impacts were calculated for each alternative and measure. Programmatic 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 estimate details are described in Section 7 and Appendix C.

See Section 4.2.5 regarding the cost estimates for the nonstructural measures. There is no cost for implementing Alternative 1, No-Action.

4.2.3 Economics Analysis for Structural Alternatives

The HEC-FDA Version 1.4.2 USACE-certified model was used to calculate the damages and benefits. 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 4-6 and 4-7 show the total construction costs, average annual costs, average annual benefits, and BCR for each of the structural measures in the Final Array. The economic analysis yielded several structural measure that had a positive BCR. Twelve measures within the structural alternatives were screened due to negative net benefits. The measures that were screened and were carried forward for consideration in the TSP are summarized in Section 4.2.11.

Table 4-5. 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	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 (7.3ft) 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 (7.3ft) 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 (18ft) (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 4-6. Structural CSRM Measures in the Final Array of Alternatives. Net Benefit Summary, CSRM, 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 (7.3ft) (S-46, S-47, S-048, S-118)**	**Alt 9c: Mandeville Seawall (18ft) (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 Investment Costs	$39,108,100	$63,119,000	$33,345,000	$65,029,000	$17,335	$50,580	$6,460	$19,498
AA 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 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 4-7. Structural FRM Measures in the 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 Nonstructural Alternative 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.

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, 4 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 will continue to be evaluated and refined. Incorporating the source of flooding into the floodplain aggregation will result in a larger number of smaller aggregates to be assessed.

Raising 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, raising, and floodproofing were determined as being more cost effective than other nonstructural measures, such as buyouts or relocations. Further assessments will be performed on the nonstructural component once additional ADCIRC and HEC-RAS have been completed, which will include further assessment of acquisitions and relocations measures and other targeted evaluations. For the analysis, residential structures were to be raised 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.

4.2.5 Nonstructural Implementation 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 (the 100-year future-without project stage) 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 the 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

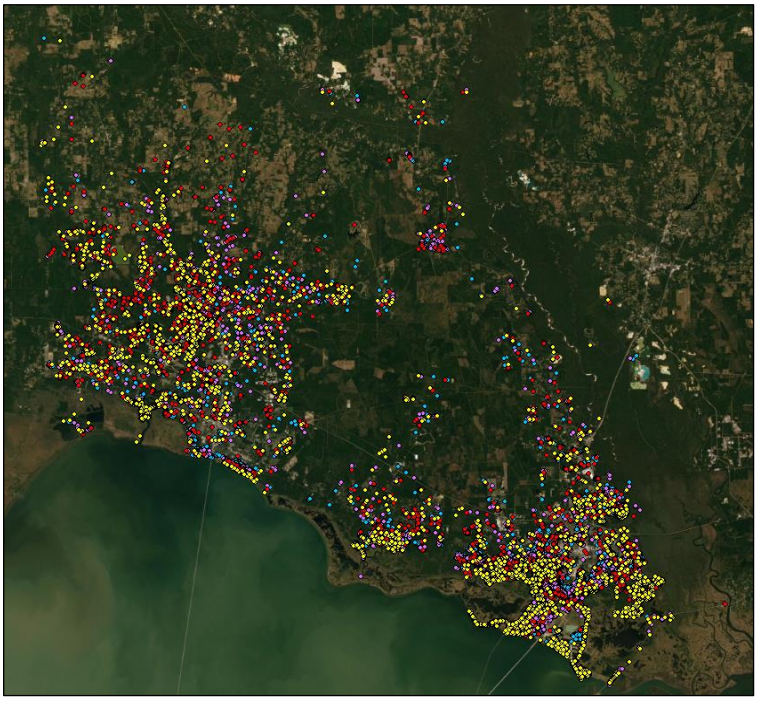

Figure 4-3. Structures Identified by Incremental Floodplain

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.

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 for additional details regarding the development of cost estimates for the nonstructural alternative and Appendix H for implementation of nonstructural features of the TSP.

4.2.5.1 Nonstructural Benefits

4.2.5.1.1 Standalone Nonstructural Plan

The flood damages reduced by combining the cumulative CSRM and FRM floodplain results are displayed in Table 4-8. All floodplains have 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 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. Appendix F contains additional data regarding the incremental floodplain analysis.

Table 4-8. Comprehensive Nonstructural Plan for the study area- Standalone Plan

FY 2021 Price Level, FY 21 Discount Rate

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
25 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

4.2.5.1.2 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 South Slidell/West 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 subsections were not included in the broader nonstructural portion of the combined structural and nonstructural plan considered for the TSP.

In areas where there were economically justified structural measures, the subsections of the comprehensive nonstructural alternative that correspond to justified structural areas were parsed out. The resulting reduced nonstructural plan was brought forward to be combined

with the justified structural measures into a combined structural and nonstructural plan. Benefits in the combined plan were attributed to either risk reduction from structural measures or nonstructural measures, not both.

The combined coastal and rainfall/riverine nonstructural results by cumulative floodplain for the portions of the parish located outside of the areas benefitting from the structural measures included in the TSP are displayed in Table 4-9. The results show the damages reduced, project cost, net benefits, and BCR for the combined cumulative floodplains across the entire study area except for the areas occurring within the estimated boundary of risk reduction provided by the justified structural measures.

All of the cumulative floodplains have positive BCR in the combined FRM and CSRM analysis. The results were further analyzed incrementally to determine and verify which floodplains were incrementally justified. The incremental floodplains were determined to be economically justified up to the 2 percent AEP floodplain and the structures in the 0-50 year floodplain were in the nonstructural portion of the combined structural and nonstructural plan. This cumulative 2 percent AEP floodplain nonstructural plan consists of elevating 6,643 residential structures and dry floodproofing 1,855 nonresidential structures. Additional information regarding the incremental floodplain analysis results is presented in Appendix F.

Table 4-9. Cumulative CSRM and FRM Nonstructural Benefits for all Areas of the Parish (rest of parish) not Covered by the Economically Justified Structural Measures

	(10 year/10%AEP)	**(25 year/5% AEP)**	**(50 year/2% AEP)**	**(100 year/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

4.2.6 Evaluation and Comparison against Study Objectives and Constraints

Cost effective measures in the Final Array were compared to the study objectives and constraints, presented and discussed in Section 2.2 and Section 2.3 of this report. Table 4-10 summarizes the results based on the degree to which they satisfy planning objectives without violating planning constraints.

Objective 1 and Objective 2 are related to reducing the risk to public health and safety, and reducing flood damages were evaluated through the performance analysis described in Section 4.2.1 to quantitively measure the reductions in WSEs for the Final Array and the subsequent economic analysis to determine the change in the number and frequency of flooded structures with the action alternative compared to without the No Action Alternative. Public infrastructure such as hospitals are included under the nonstructural analysis. The No Action Alternative does not decrease the risk to public safety.

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 reducing the annual damages compared to the No Action Alternative. The relative comparative values between measures are included in Table 4-10.

Table 4-10. Summary of Evaluation and Comparison again Study Objectives.

	Alt 1: No Action	**Alt 2: 50 Year Nonstructural (NS-09 & NS-11)**	**Alt 5: West Slidell Levee (S-081)**	**Alt 5: Bayou Patassat Channel Improvements (S-080)**	**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 8: Mile Branch Channel Improvements (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 (2,513 structures)	Yes: reduces population impacted by flood risk (30 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 (78 structures)
Obj 2 Flood Damage	Does not meet	Yes: EAD reduction $244,563,000	Yes: EAD reduction $ 42,455,000	Yes: EAD reduction $ 133,000	Yes: EAD reduction $ 75,706,000	Yes: EAD reduction $93,114,000	Yes: EAD reduction $118,160,000	Yes: EAD reduction $ 2,221,000
Obj 3 Interruption Transportation	Does not meet	Indirect benefits	Directly reduces flooding to Hwy 433 along with Indirect benefits	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	Indirect Benefits

Obj 4 Community Resiliency	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
Obj 5 Natural Resource Resiliency	Meets objective by not impacting current natural resources but does not increase habitat	Meets objective by not impacting current natural resources but does not increase habitat	Yes, Potential to increase habitat outside of levee	No opportunities to increase habitat identified	No opportunities to increase habitat identified	Yes, Potential to increase habitat outside of levee	Yes, Potential to increase habitat outside of levee	No opportunities to increase habitat identified
Constraints	Does not violate constraints	Does not violate constraints	Does not violate constraints	A low risk HTRW site is within 1 mile and will 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	Does not violate constraints

Objective 3 measures the interruption to transportation. The PDT conducted an analysis on frequently flooded roadways to determine where alternatives were expected to 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. Alternatives and measures where flooded roadways were directly expected to be reduced are shown in Table 4-10.

Beyond the measures identified as directly reducing flooding to roadways, others were documented to have indirect benefits and are expected reduce impacts to roadway overall evacuation route and closure time following an event.

Objective 4 is building community resiliency as 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, Section 3.

Objective 5 is where the PDT evaluated for potential opportunities to increase resiliency of coastal and riparian habitats to reduce flood damages, both through standalone nature-based measures and through the exploration of potential nature-based features to be incorporated into structural options during TSP optimization. Through the plan formulation process, standalone nature-based measures were screened out based on completeness and efficiency. The evaluation of the nature-based measures ability to reduce water surface levels and surge attenuation that were used to support the screening are included in Appendix B. Although the nature-based measures were screened out as standalone project measure, the PDT will continue to look at incorporating nature-based measure, where possible, into the TSP. The measures in the Final Array were evaluated for their potential to allow for future incorporation of nature-based measures into the final design. Examples include incorporation of vegetative plantings in areas to reduce or eliminate the need for mowing, incorporation of tree and marsh plantings to increase levee protection and or reduce additional operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) costs etc. A specific example that will be further evaluated is the use of forested buffers to reduce floodwater velocities to protect adjacent levees from erosive water flows (2020 USFWS recommendation based on use of buffers in river systems and Klimas 1987, Dwyer et al 1997, Allen et al 2003, and USACE EM 1110-2-1913). These options will continue to be evaluated and incorporated into the TSP where possible.

4.2.7 Evaluation and Comparison against Principle and Guidelines Criteria

The cost effective measure in the Final Array were also evaluated against the four P&G evaluation criteria 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. Summary of the Evaluation Against the P&G Criteria

	Alt 1: No Action	**Alt 2: 50 Year Nonstructural (NS-09 & NS-11)**	**Alt 5: West Slidell Levee (S-081)**	**Alt 5: Bayou Patassat Channel Improvements (S-080)**	**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)**	**Mile Branch Channel Improvements (S-057)**
Completeness	Does not meet objectives to reduce flood risk	Can be implemented and contributes to addressing f 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 related to flooding around Bayou Patassat	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 f identified problems or opportunities in Covington
Effectiveness	Will 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.
Efficiency	Is cost effective since it does not require a Federal investment	Effective at meeting the t objectives	Effective at meeting the objectives for the West Slidell area. BCR 1.2	Effective at meeting objectives BCR 2.9	Effective at meeting the objectives for the South Slidell Area BCR 1.8	Eden Isle portion is not cost effective. South Slidell alone or West Slidell South Slidell combo more effective BCR 1.4	More efficient at objectives than South Slidell or West Slidell alone BCR 1.7	Effective at meeting objectives BCR 2.0

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; will 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	Acceptable in meeting required laws and policies; West Slidell portion will require further coordination with LDWF regarding Scenic Rivers where the levee crosses over a scenic river	Acceptable in meeting required laws and policies; will require further coordination with LDWF regarding Scenic Rivers

4.2.8 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 plan, RED, OSE, and EQ.

- NED: 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.
- RED: When the economic activity lost in the flooded region can be transferred to another area or region in the national economy, these losses cannot be included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the RED account. The RED does not influence plan selection; however, the results can be useful for the sponsor and local stakeholders. 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.
- EQ: A separate EQ analysis was not conducted, as the EQ account did not drive the plan selection. However, the environmental benefits and impacts are discussed in detail as part of the NEPA evaluation in this report. Environmental consequences of alternatives for each key human and natural resource are described in Section 5.
- OSE: The OSE account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic and manmade and natural resources. OSE effects are discussed in detail as part of

the NEPA evaluation in this report. Environmental consequences of the Final Array of Alternative for each key human and natural resource are described in Section 5.

Table 4-12. Evaluation and Comparison of Systems of Accounts

System of Accounts	Alt 1: No Action	Alt 2: 50 Year Parish Wide Nonstructural Only (NS-09 & NS-11)	Alt 5: West Slidell Levee (S-081)	Alt 5: Bayou Patassat Channel Improvements (S-080)	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 8: Mile Branch Channel Improvements (S-057)
NED	Does not provide NED benefits	$244,563,150- Avg. Annual Benefits Highest damage reduction for nonstructural	$42,455,000- Avg. Annual Benefits	$13,000- Avg. Annual Benefits	$75,706,000- Avg. Annual Benefits	$93,114,000- Avg. Annual Benefits	$118,160,000- Avg. Annual Benefits Highest damage reduction for structural measure	$2,221,000- Avg. Annual Benefits
		$136,095,426- Avg. Annual Costs	$36,036,000- Avg. Annual Costs	$45,900- Avg. Annual Costs Lowest Average AAC	$42,372,000- Avg. Annual Costs	$66,432,000- Avg. Annual Costs	$70,985,000- Avg. Annual Costs	$1,115,100- Avg. Annual Costs
		$108,467,724- in Net Benefits. Highest net benefits of nonstructural	$6,419,000- in Net Benefits	$87,000- in Net Benefits. 2.9 BCR	$33,334,000- in Net Benefits	$26,682,000- in Net Benefits	$47,175,000- in Net Benefits. Highest net benefits for structural measure	$1,106,000 - in Net Benefits. 2.0 BCR
		1.8 BCR	1.2 BCR	BCR 2.9 High Ranking BCR	1.8 BCR	1.4 BCR	1.7 BCR	BCR 2.0 High Ranking BCR
EQ	No impacts	Environmental benefits and impacts were included as part of the NEPA evaluation. Environmental consequences of alternatives for each key human and natural resource are described in section 5.						
RED	Continued impacts on regional economics due to continued	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. The RED is under development and will be included in the final report; however, regional impacts are expected to include an increase in local, state, and national employment statistics as a result of the labor required for project construction. Local and regional sales industries including temporary housing, are expected to increase as a result of temporary laborers coming into the area for project construction. These impacts are not included in the NED analysis and may be used by decision makers as part of their investment decision process. The TSP 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						

	flood damages.	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.
OSE	Continued impacts due to continued flooding and risk to life, safety and community impacts	The OSE account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic, and man-made and natural resources. The TSP has more opportunity for improvement in these areas than any other plans since it addresses flood damages and life safety risks to several communities in the study area. It also represents the greatest net economic benefit of all plans evaluated. Implementation of the TSP will help preserve community cohesion should a significant flood event occur and risks from future floods and loss of life will be greatly reduced in the areas at high risk from structure and property damages. Under the no action alternative, it is 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. The TSP reduces the risk of flooding impacts to roads within the Study Area. 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.

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. A qualitative life safety assessment was completed on the Final Array of Alternatives. The 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 ft and a velocity of 1-2 ft/s at Bayou Bonfouca
- The City of Mandeville had an average depth of 2 -3ft with a velocity of 1 -2ft/s at Bayou Castine
- The City of Madisonville had an average depth of 4 - 5ft with a velocity of 4 -5ft/s on the Tchefuncte River
- The City of Covington had an average depth of 2 - 3ft 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 STPG to determine their protocol. 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 will be incorporated during the feasibility level of design and PED phases of the study.

The results of the assessment of the Final Array are shown in Figure 4-4. 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.

This qualitative assessment was conducted in the beginning phases of this study and will continue to be refined during the feasibility study and into PED. A semi-quantitative life safety risk assessment will be conducted on the TSP. LifeSim will be used to estimate the potential life loss under various overtopping and failure scenarios in PED. Appendix D contains additional information.

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 4-4 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, as described in Sections 4.2.1-4.2.9, and screened them based on their ability to meet the study objectives, avoid constraints, environmental impacts, and to maximize benefits provided over the 50-year period of analysis from 2032-2082. The Final Array were also evaluated against the P&G criteria and their contributions to Federal objectives and accounts. Table 4-13 summarizes the screening and evaluation of the measures in the Final Array. Table 4-14 provides a summary of the cost-effective measures evaluated in the Final Array. 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, which was compared to the standalone nonstructural plan for the entire parish to determine the TSP.

- Alternative 1 - No Action - was not carried forward to the combined structural and nonstructural plan. It does not address study 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 study 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 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. The alternative ranked medium flood velocity risk for life safety.

  Screened: The 10, 25, 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) - was not carried forward to the combined structural and nonstructural plan. Although it met study 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 carried forward to the combined structural and nonstructural plan. The measure is complete, effective, efficient, and acceptable. The measure met study 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 will 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 minimal EQ impacts.

  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. Coordination is ongoing regarding T&E and managed habitat impacts. The measure is expected to have positive NED, RED and OSE benefits. The West Slidell levee is expected to have minimal EQ impacts on Big Branch Wildlife Refuge and Bayou Liberty Scenic Waterway. 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 - was carried forward to the combined structural and nonstructural plan. For the combined structural and nonstructural plan, the South Slidell levee was combined with the West Slidell levee, as it was determined that these two measures combined produced the greatest net benefits. The combination was determined to be complete, effective, efficient, and acceptable, meeting study objectives and avoiding study constraints. The measure is expected to have positive NED, RED and OSE benefits. Coordination is ongoing regarding EQ including T&E and managed habitat impacts and the West Slidell levee impacts on Big Branch Wildlife Refuge and Bayou Liberty 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 carried forward to 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. 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 - moved forward to the combined structural and nonstructural plan. Coordination is ongoing regarding T&E and managed habitat impacts and actions on Mile Branch since it is designated as a scenic waterway. The combination was determined to be complete, effective, efficient, and acceptable, meeting study 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-signification related to terrestrial habitat, with some additional impacts to aquatic habitat during construction.

  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 carried forward to 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 4-13. Summary Evaluation and Comparison Final Array of Alternatives. The measures in bold were moved forward to the TSP (combined structural and nonstructural plan).

	Meet Study 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	Increase Natural Resource Resiliency		Wetlands	Farmlands	Aquatics	EFH	Wildlife	T&E	WQ	Air Quality	HTRW	Cultural	Noise	Aesthetics	Recreation	Socioeconomic	Navigation	EJ
1-No Action	No					Yes																Risk to minority and low income population groups
2-Non Structural (Standalone Parish wide) 100 year	Y	Y	I	Y	I	Yes								Short-term		Potential effect on known and undocumented archeological resources and historic built resources, modifications to viewshed and visual landscape		Viewshed		Temporary		Temporary, further investigation needed
2-Non Structural (Standalone Parish wide) 50 year	**Y**	**Y**	**I**	**Y**	**I**	**Yes**																
2-Non Structural (Standalone Parish wide) 25 year	Y	Y	I	Y	I	Yes																
2-Non Structural (Standalone Parish wide) 10 year	Y	Y	I	Y	I	Yes																
4a-Lacombe Levee (S-028)	Y	Y	I	Y	Y	Yes	BLH, Swamp, Marsh	Yes	Migration, Spawning	Yes	Habitat shift, Mortality, Displacement	Gulf Sturgeon, Indian Manatee, Bald Eagle, Red-Cockaded	Water Quality Certification (WQC) from LDEQ required, SWPPP required,				Short-term	Viewshed, Louisiana Natural and Scenic Rivers System	Big Branch Marsh NWR, Louisiana Natural and Scenic Rivers System		Recreational boating	Temporary, positive long-term impacts
4a.1-Lacombe Levee Short (S-028)	Y	Y	I	Y	Y	Y	BLH, Swamp															

4b-Lacombe Levee combined with West Slidell Levee (S-120)	Y	Y	I	Y	Y	Y	BLH, Swamp, Marsh				Woodpecker potential	and Louisiana Pollutant Discharge Elimination System General Permit required								
5-West Slidell Levee	Y	Y	Y	Y	Y	Y														
5-Bayou Bonfouca Detention Pond	Y	Y	N	Y	Y	Y	BLH									Viewshed				
5-Bayou Liberty Channel Improvements	Y	Y	N	Y	Y	Y										Viewshed, Louisiana Natural and Scenic Rivers System	Louisiana Natural and Scenic Rivers System		Recreational boating	
5-Bayou Patassat Channel Improvements-Clearing and Snagging	**Y**	**Y**	**I**	**Y**	**N**	**Low risk HTRW site**														
6a-South Slidell (S-075 & S-076)	Y	Y	I	Y	N	Low risk HTRW site								(1) NPL site, (1) TSCA site, (2) ACRES sites, (6) TRI sites found within a 1 mile radius		Viewshed				
6b-South Slidell with Eden Isle (S-070, S-075 & S-076)	Y	Y	Y	Y	Y	Critical habitat sturgeon; Low Risk HTRW											Big Branch Marsh NWR		Recreational boating	
6c-South Slidell with West Slidell Levee (S-081, S-075 & S-076)	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**		Yes	Migration, Spawning	Yes										
7-Pearl River Levee	Y	Y	Y	Y	Y	Y	BLH, Swamp, Marsh									Viewshed, Louisiana Natural and Scenic Rivers System	Pearl River WMA, Louisiana Natural and Scenic Rivers System		Recreational boating	
7-Gum Bayou Channel Improvements-Diversion(S-072)	Y	N	N	Y	Y	Y														
7-Poor Boy Canal Channel Improvements-Dredging (S-073)	N	M	N	I	N	Y											Louisiana Natural and Scenic Rivers System			
7-Doubloon Bayou Channel Improvements-Dredging (S-069)	N	N	N	N	N	Y														

8-Mile Branch Channel Improvements (S-057)	**Y**	**Y**	**I**	**Y**	**N**	**Y**	BLH, Swamp				Habitat loss				(1) ACRES site							
8- Lateral A Channel Improvements (S-121)	N	M	I	Y	N	Y																
9a-Mandeville Seawall (7.3ft) Passive Drainage (S-046, 118, S-047)	Y	Y	I	Y	Y	Y	BLH, Swamp, Marsh	Yes									Viewshed	Mandeville Lakefront Park, East Lakefront Children's Park				
9b-Mandeville Seawall (7.3ft) Pump Stations (S-046, S-118, S-048)	Y	Y	I	Y	Y	Y																
9c- Mandeville Seawall (18ft) (S-122)	Y	Y	I	Y	Y	Y																
Borrow																						Temporary

	NED (Sec. 4.2.6)	RED (Sec 4.2.6)	EQ (Sect 4.2.6)	OSE (Sec. 4.2.6)	Life Safety (Section 4.2.9)	P&G Criteria (Section 4.2.8)				BCR (Table 4-6, 4-7, 4-8)	Estimated Number of Structures Benefitted	Total Cost (Table 4-5 & Table 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	Min	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	Min	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	Min	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	Min	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	N	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	N	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	N	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	N	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	N	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	N	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	min	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	N	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	N	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	N	Y	**high**	**Y**	**Y**	**Y**	**Y**	**1.7**	**7,000**	**$1,732,902,000**	**Most effective variation**	**Yes**
7-Pearl River Levee	N	Y	N	Y	med	Y	N	N	Y	0.4	400	$216,511,535	Screened- Efficiency; negative B/C ratio; did not meet study objectives or P&G criteria	No
7-Gum Bayou Channel Improvements-Diversion(S-072)	N	Y	N	Y	N/A	N	N	N	N	0	0	$22,174,443	Screened- Efficiency; negative B/C ratio; did not meet study objectives or P&G criteria	No
7-Poor Boy Canal Channel Improvements-Dredging (S-073)	N	Y	N	Y	N/A	N	N	N	Y	0	0	$15,307,082	Screened- Efficiency; negative B/C ratio; did not meet study objectives or P&G criteria	No

7-Doubloon Bayou Channel Improvements-Dredging (S-069)	N	Y	N	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	N	Y	**low**	**Y**	**Y**	**Y**	**Y**	**2**	**250**	**26,337,000**		**Yes**
8- Lateral A Channel Improvements (S-121)	N	Y	N	Y	low	Y	Y	N	Y	0.3	30	25,600,000	Screened- Efficiency; negative B/C ratio	No
9a-Mandeville Seawall (7.3ft) Passive Drainage (S-046, 118, S-047)	N	Y	N	Y	high	Y	Y	N	Y	0.2	400	$172,144,000	Screened- Efficiency; negative B/C ratio	No
9b-Mandeville Seawall (7.3ft) Pump Stations (S-046, S-118, S-048)	N	Y	N	Y	high	Y	Y	N	Y	0.2	400	$186,409,000	Screened- Efficiency; negative B/C ratio	No
9c- Mandeville Seawall (18ft) (S-122)	N	Y	N	Y	high	Y	Y	N	Y	0.4	400	$519,596,000	Screened- Efficiency; negative B/C ratio	No
Borrow														

Table 4-14. 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 (TSP)

4.2.11 TSP Selection

Based on evaluations in Sections 4.2.1 - 4.2.9 and summarized in Section 4.2.10 and Table 4-13, the independent, combinable, cost-effective measures with a BCR of value greater than 1 were moved forward for inclusion as part of the comprehensive combined structural and nonstructural plan (Table 4-14). 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 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 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 4-14). 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 4-14). The combined structural and nonstructural plan was moved forward as the NED plan and the TSP. The individual measures that make up the TSP were previously described in Section 4.1 are summarized below. Additional details on the TSP measures beyond what is provided in Section 4.1 are included in the Engineering Appendix D.

The TSP is 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 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.*

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

- 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, four gate complexes, and one channel floodgate. There would also be a total of three sluicegates, seven vehicular gates, one railroad gate along the Norfolk Southern Railroad, and seven 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*

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

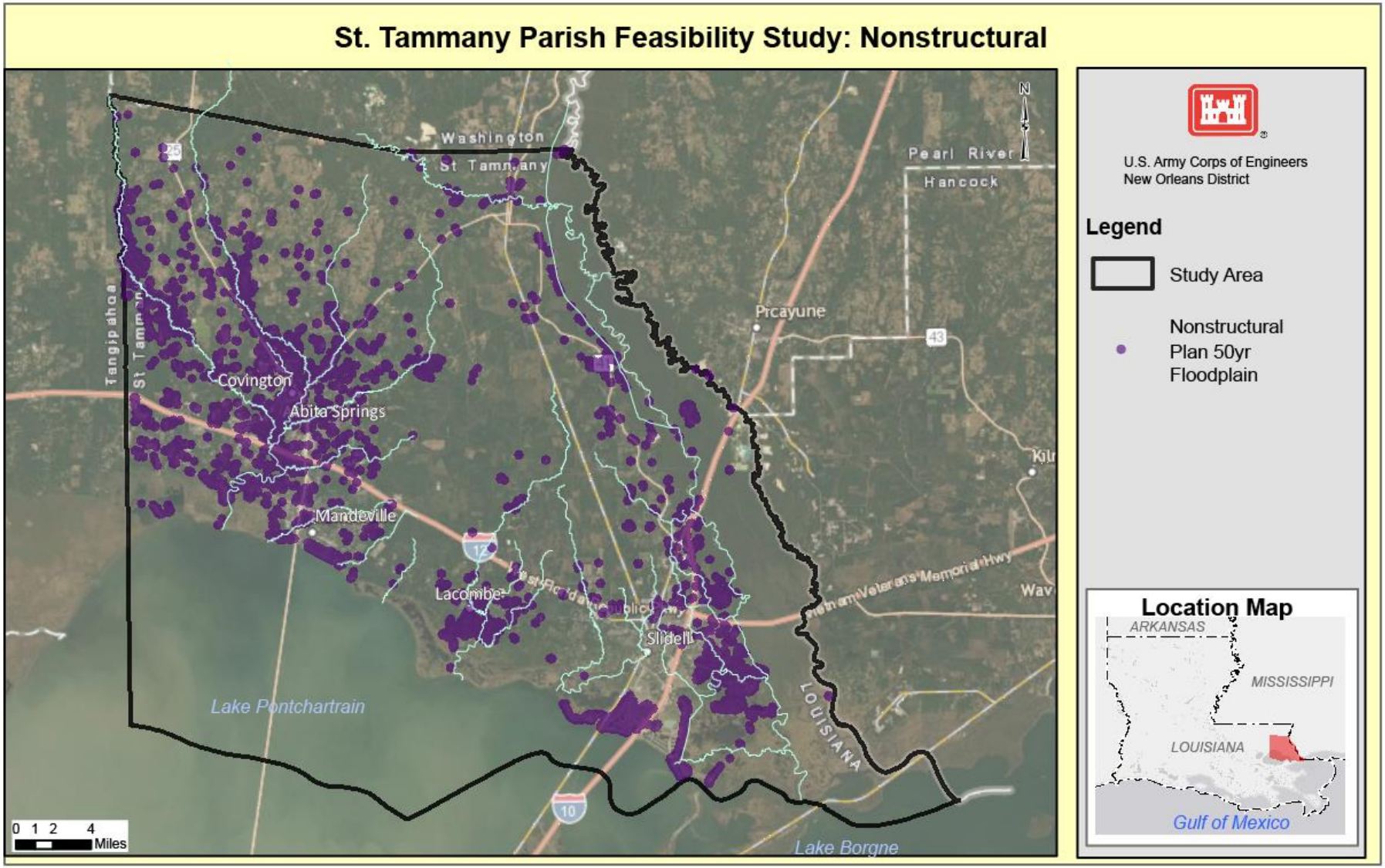

Figure 4-5: Nonstructural Component of the TSP

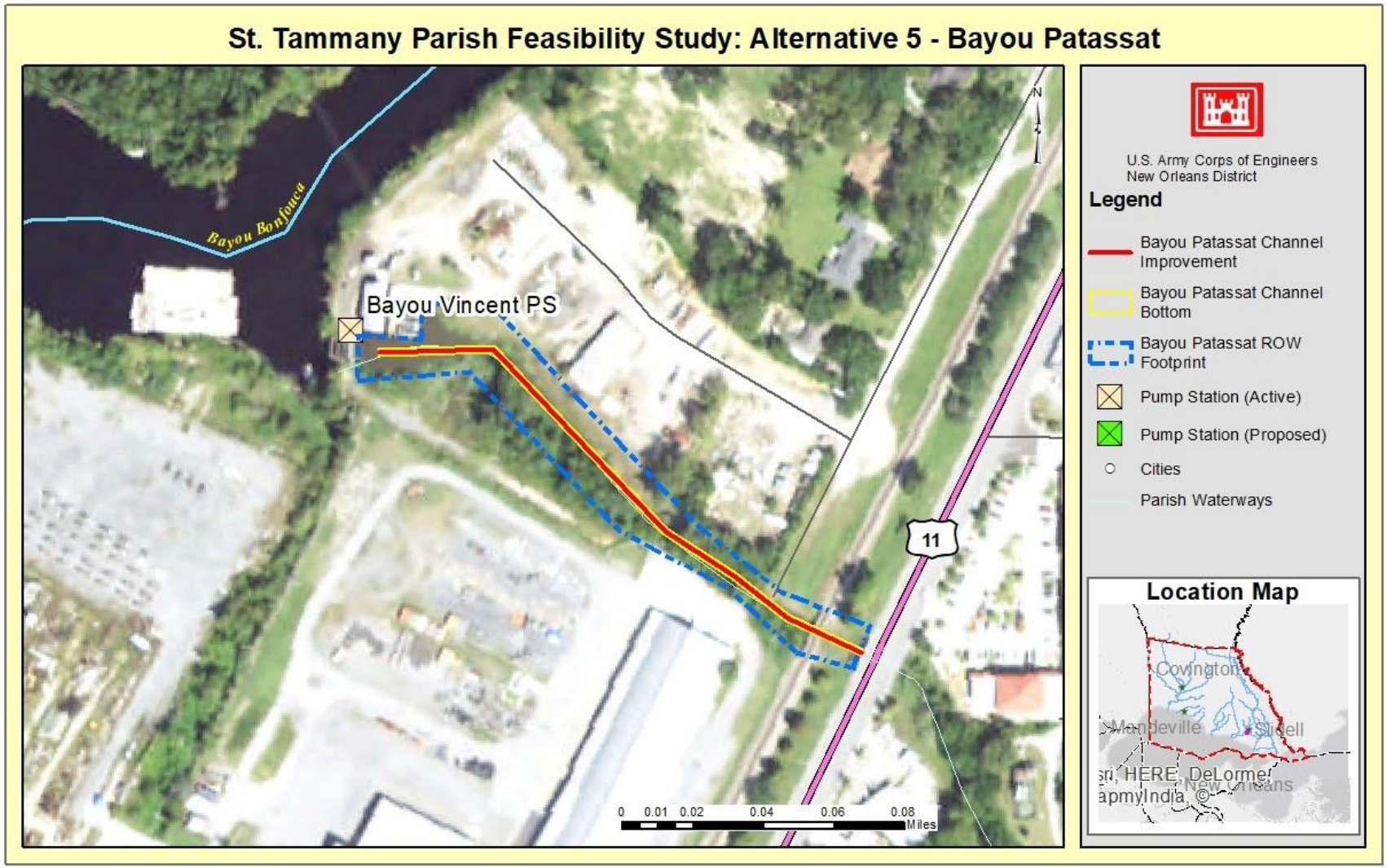

Figure 4-6: Bayou Patassat Channel Improvements (Alternative 5)

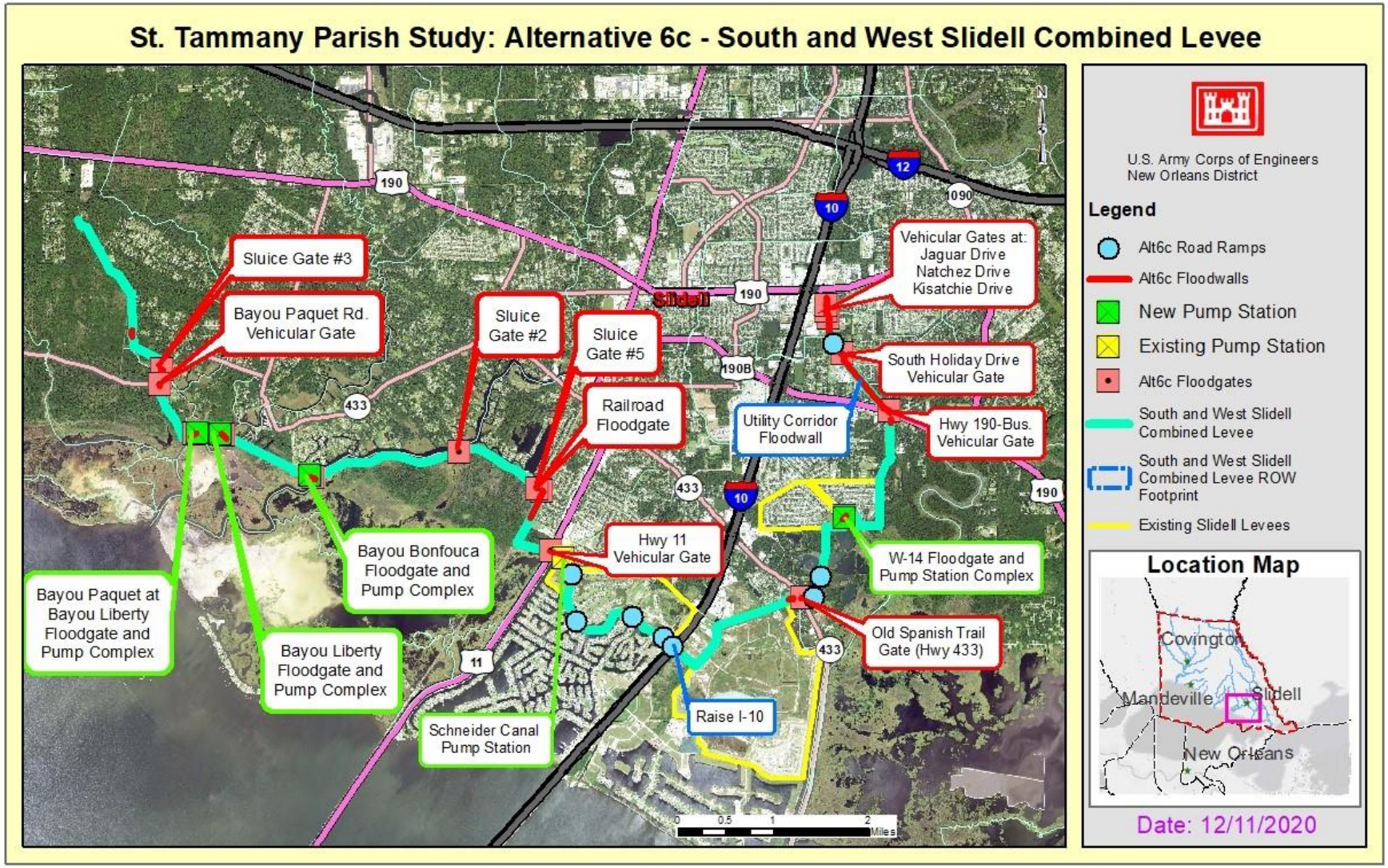

Figure 4-7. South and West Slidell Combined Levee (Alternative 6c)

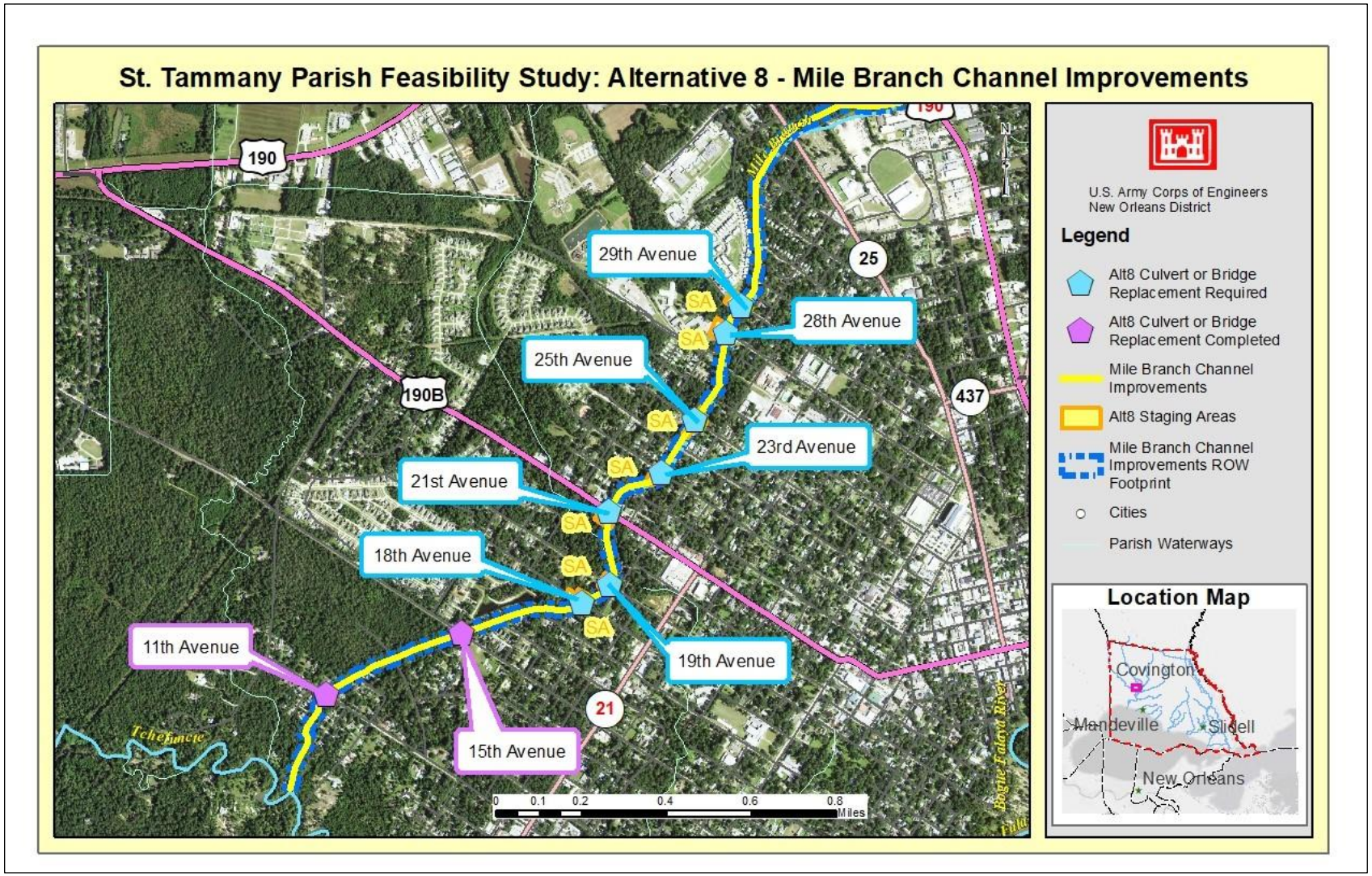

Figure 4-8: Mile Branch Channel Improvements (Alternative 8)

4.2.12 Further Investigation and Reevaluation of FRM/CSRM Measures for the Eden Isle Community in Slidell, La.

The Final Array of Alternatives included Alternative 6b, which consisted of CSRM measures that would provide flood risk reduction to the Eden Isle community in Slidell, Louisiana. Alternative 6b included, but was not limited to, a series of levees, floodwalls, pump stations and floodgates along the eastern, southern and western boundaries of the Eden Isle community. However, the final economic and cost-benefit analysis conducted by USACE demonstrated that Alternative 6b was not the most cost-effective alternative for a structural protection. Therefore, the TSP did not incorporate the structural measures (S-070) of Alternative 6b, but does include nonstructural measures (from Alternative 2) that will protect approximately 400 homes and businesses within Eden Isle.

Subsequent to the selection of the TSP, 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 develop additional measures. A total of 14 structural measures (variations of levee and floodwall segments) were reevaluated by USACE. The USACE reevaluation included Alternative 6b, Measure S-070 (with its three floodwall components) and 11 new structural measures. See Table 4-15 and 4-16.

The significant distinguishing factors between the variations in the 14 structural measures included differences in the costs of construction, real estate acquisition challenges, environmental resource impacts, constructability concerns, LaDOTD and other requirements for the I-10 crossing features, and general safety concerns.

During USACE's supplemental reevaluation of the 14 structural measures (S-070 from Alternative 6b and S-123-S-133), a new measure (S-132) was identified as a viable alignment for the western segment of Eden Isle. USACE determined that Measure S-132 was cost effective and efficient, and had (potential) lower construction costs and real estate impacts when compared to the original western segment in Measure S-070 from Alternative 6b. Measure S-132 would provide additional benefits to reduce damages to the Norfolk Southern Railroad, which passes through Slidell, Louisiana, but had potential impacts related to environmental that would need to be avoided, reduced, mitigated and/or minimized.

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, including the new western segment (comparing S-070 and S-132), would result in the selection of a different TSP. Taking into consideration the existing conditions and the required USACE design criteria, the sensitivity analysis showed that the estimated changes in benefits, impacts and/or costs associated with any of the reevaluated structural measures (including the new Measure S-132) were not significant enough to result in the selection of a different TSP. Consequently, the TSP originally identified by USACE remains as the NED Plan. Although the TSP does not include structural protection for the Eden Isle community, the nonstructural portion of the TSP does include approximately 400 homes and businesses within Eden Isle.

If the NFS wants alternative actions to the NED Plan, a locally preferred plan (LPP) can be developed. An LPP would include changes to plan component(s) to address local interests. An LPP would be evaluated in the same way as the NED Plan was analyzed, including a full environmental assessment to identify the impacts as required by NEPA. An LPP has to be approved by the Assistant Secretary of the Army for Civil Works (ASA(CW)). The LPP components can be presented to Congress by USACE as alternatives to the study findings. If the LPP is smaller in scale and cost than the NED Plan, the Federal cost share will be 65 percent of total project costs, as long as the LPP changes are consistent with the objectives of the study. An LPP that costs more than the NED Plan is eligible for ASA(CW) consideration if the following conditions are met: (a) The LPP must produce as many or more benefits as the NED Plan; (b) The NFS must pay all increased costs of the LPP over the NED Plan. The Federal cost share of a higher-cost LPP is established as 65 percent of the NED Plan for flood/coastal risk management on projects. The NFS has not expressed the desire to pursue a LPP at this time.

The measures of the TSP will continue to be refined as the level of design increases and additional modeling is conducted. This additional analysis will include investigations to determine whether the TSP might induce any potential flooding or residual risk for Eden Isle. In such case, the TSP would be adjusted as necessary to minimize and or mitigate those risks to Eden Isle, (See Section 6.3.1.4 “Residual Damages and Risk”; 6.3.1.5 “Potential Induced Flooding”).

Table 4-15. Reevaluation of Eden Isle Measures. Measures in bold were part of the Final Array of Alternatives.

Measure ID	Measure Type		Location/Segment	Source
NS-08	nonstructural	Buyouts	Parish wide	Final Array
NS-09	nonstructural	flood proofing	Parish wide	Final Array
NS-10	nonstructural	Relocations	Parish wide	Final Array
NS-11	nonstructural	Structure Raising	Parish wide	Final Array
S-070	Floodwall	Floodwall West 1-10	Slidell, Eden Isle, Eastern	Final Array (STPG)
	Floodwall	Floodwall T-Wall Median Lakeview Dr	Slidell, Eden Isle, Southern	Final Array (STPG)
	Floodwall	Highway 11 Floodwall	Slidell, Eden Isle, Western	Final Array (STPG)
S-123	Levee	Levee West of I-10	Slidell, Eden Isle, Eastern	St Tammany Parish
S-124	Levee	Levee East of I-10	Slidell, Eden Isle, Eastern	St Tammany Parish
S-125	Floodwall	I-10 Median	Slidell, Eden Isle, Eastern	St Tammany Parish
S-126	Floodwall	Floodwall East of I-10	Slidell, Eden Isle, Eastern	PDT

S-127	Floodwall	Eastern Lakefront Floodwall	Slidell, Eden Isle, Eastern	PDT
S-128	Surge Barrier	Levee Berm North Lakeview Drive	Slidell, Eden Isle, Southern	St Tammany Parish
S-129	Seawall	Lake Surge Barrier	Slidell, Eden Isle, Southern	St Tammany Parish
S-130	Floodwall	Eden Isle Seawall with Backfill	Slidell, Eden Isle, Southern	PDT
S-131	Levee	Highway 11 T-wall Median	Slidell, Eden Isle, Western	St Tammany Parish
S-132	Levee	Levee West of Railroad to Lake	Slidell, Eden Isle, Western	St Tammany Parish
S-133	Levee	Levee East of Hwy 11	Slidell, Eden Isle, Western	St Tammany Parish

Table 4-16. Summary of Eden Isle Measures Screening

Measure ID	**Eden Isle Measures**	**Location/Segment**	**Screening Notes**
NS-08-NS-11	Nonstructural	Eden Isle	Nonstructural risk reduction is included in the NED Plan for Eden Isle.
S-070	Floodwall West 1-10	Slidell, Eden Isle, Eastern	Original concept from St. Tammany Parish early in the planning process, modified by PDT and fully evaluated during the final array. Most cost effective of all Eastern alignments considered in the reevaluation. Optimal location for I-10 crossing and highest location.
	Floodwall T-Wall Median Lakeview Dr	Slidell, Eden Isle, Southern	Original concept from St. Tammany Parish and CPRA early in the planning process, modified by PDT and fully evaluated during the final array analysis. Most cost effective of all Southern alignments considered in the reevaluation. Existing 60 foot ROW for road confirmed with St Tammany Parish; some additional RE acquisitions are expected to be needed for construction and maintenance
	Highway 11 Floodwall	Slidell, Eden Isle, Western	Original concept from St. Tammany Parish early in the planning process, modified by PDT and fully evaluated during the final array analysis. Will require some RE acquisitions
S-123	Levee West of I-10	Slidell, Eden Isle Eastern	Screened-lacks necessary space for levee; floodwall version included in final array
S-124	Levee East of I-10	Slidell, Eden Isle Eastern	Screened-lacks necessary space for levee the entire route; PDT-necessary space for levee; PDT considered floodwall variation in S-126; more substantial 1-10 crossing is needed at a higher elevation
S-125	I-10 Median	Slidell, Eden Isle Eastern	Screened by St Tammany Parish and PDT confirmed; concern over lack of space for floodwall in median and potential construction and maintenance accessibility and feasibility
S-126	Floodwall East of I-10	Slidell, Eden Isle Eastern	Provides minimal benefits to I-10; I-10 in New Orleans East is underwater during storm events; location of I-10 crossing is a substantial concern and construction feature; measure not as cost effective as S-070a; has environmental impacts to habitat and recreation depending on the needed I-10 crossing

S-127	Eastern Lakefront Floodwall	Slidell, Eden Isle Eastern	Screened- Efficiency-Documented damages in the area do not exceed estimates construction cost
S-128	Levee Berm North Lakeview Drive	Slidell, Eden Isle southern	Screened- Efficiency- would requires buy out of houses on north and south of Lakeview Drive; levee would be entire width of remaining land
S-129	Lake Surge Barrier	Slidell, Eden Isle Southern	Screened- Efficiency-Documented damages in the area do not exceed estimates construction cost
S-130	Eden Isle Seawall with Backfill	Slidell, Eden Isle Southern	Screened- Efficiency-Documented damages in the area do not exceed estimates construction cost
S-131	Highway 11 T-wall Median	Slidell, Eden Isle Western	Screened by STPG and confirmed by PDT as less effective than other measures along the western segment to meet study goals
S-132	Levee West of Railroad to Lake	Slidell, Eden Isle Western	Most cost effective of all Eastern alignments considered in the reevaluation. Add additional benefits for the railroad. Will require habitat mitigation and impacts to sturgeon and Refuge land.
S-133	Levee West of Hwy 11	Slidell, Eden Isle Western	More efficient than Hwy 11 floodwall but with less impacts to Refuge and habitat. Is considered and optimization of either the S-132 or S-70c.

Section 5
Environmental Consequences

5.1 ENVIRONMENTAL CONSEQUENCES

In accordance with NEPA, this section includes the scientific and analytic basis for comparison of the considered alternatives identified in Section 4 – Formulate Alternative Plans. The discussion includes the environmental impacts of the considered alternatives, any adverse environmental effects that cannot be avoided, the cumulative effects of proposed actions, the relationship between short-term uses and long-term productivity, and any irreversible or irretrievable commitments of resources involved in the proposed action should one be implemented. This section assesses the TSP a/k/a the proposed action's potential environmental impact on those resources identified in Section 3, Inventory and Forecast Conditions. The terms "TSP" and "proposed action" are used interchangeably in this section (and elsewhere in this report).

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, 1515-1518).

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, September 14, 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.

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, swamp, and BLH habitats as hydrology across the landscape shifts due to construction. Conversion of marsh, swamp and BLH habitats to grass-covered levee habitat in the study area would provide benefits to human development at the cost of lost wildlife 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 and erosion. 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 the development of levee systems such as dredging and temporary roads are localized and include: increased turbidity, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels. Following construction, these temporary and localized effects would return to pre-construction levels. Long-term positive cumulative impacts are expected to occur as the proposed measures would help protect the area on the protected side of the alignments. 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.

5.3 SUMMARY OF ENVIRONMENTAL CONSEQUENCES BY EACH ALTERNATIVE

This section describes the environmental consequences associated with implementing the measures in the Final Array of Alternatives and the TSP and compares the effects of the alternatives and their associated measures. **Bolded measures are included in the TSP.** See Section 4.2.11 for selection of TSP and Figure ES-1 and Figure 3-1. Maps of Louisiana habitat data from 1956 to Present are plotted with structural alternatives 4-9 (See Figure 5-1 through 5-6). Figures 3-1, 5-7, 5-8, 5-9, 5-10, and 5-11 for more habitat data.

- Alternative 1: No Action Alternative
- **Alternative 2: Nonstructural**
- Alternative 4: Lacombe
  - 4a Lacombe Levee
  - 4a.1 Lacombe Levee Short
  - 4b Lacombe Levee Combined with West Slidell Levee
- Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca
  - West Slidell
  - Bayou Bonfouca Detention Pond
  - Bayou Liberty Channel Improvements
  - **Bayou Patassat Channel Improvements- Clearing and Snagging**
- Alternative 6: South Slidell
  - 6a South Slidell Levee
  - 6b South Slidell and Eden Isle Levee
  - **6c South Slidell and West Slidell Levee**
- Alternative 7: Eastern Slidell
  - Pearl River Levee
  - Doubloon Bayou Channel Improvements-Dredging
  - Poor Boy Canal Channel Improvements- Dredging
  - Gum Bayou Diversion- Channel Improvements
- Alternative 8: Upper Tchefuncte/Covington
  - **Mile Branch Channel Improvements**
  - Lateral A Channel Improvements
- Alternative 9: Mandeville Lakefront
  - 9a Mandeville Lakefront-Seawall Passive Drainage
  - 9b Mandeville Lakefront-Seawall and Pump Stations
  - 9c Mandeville Lakefront-18 ft

- **TSP-The TSP is a comprehensive plan to address flooding parish-wide, which includes CSRM, FRM, and nonstructural measures.**

- **South Slidell and West Slidell Levee (6c)**
- **Bayou Patassat Channel Improvements- Clearing and Snagging**
- **Mile Branch Channel Improvements**
- **Nonstructural for the rest of St Tammany Parish not covered by the structural measure of the TSP, see Figure 3-1**

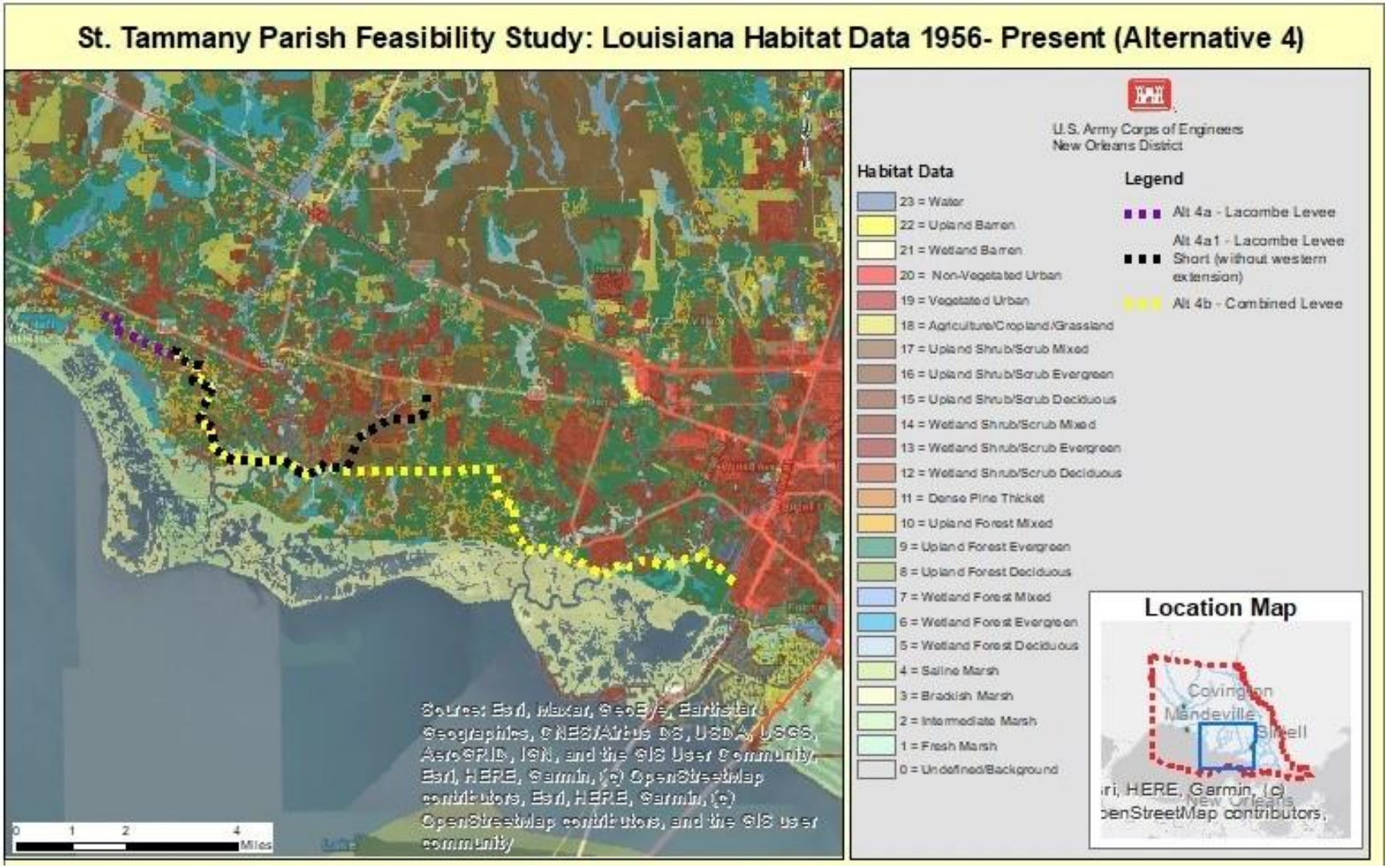

Figure 5-1: Louisiana Habitat Data 1956 – Present (Alternative 4)

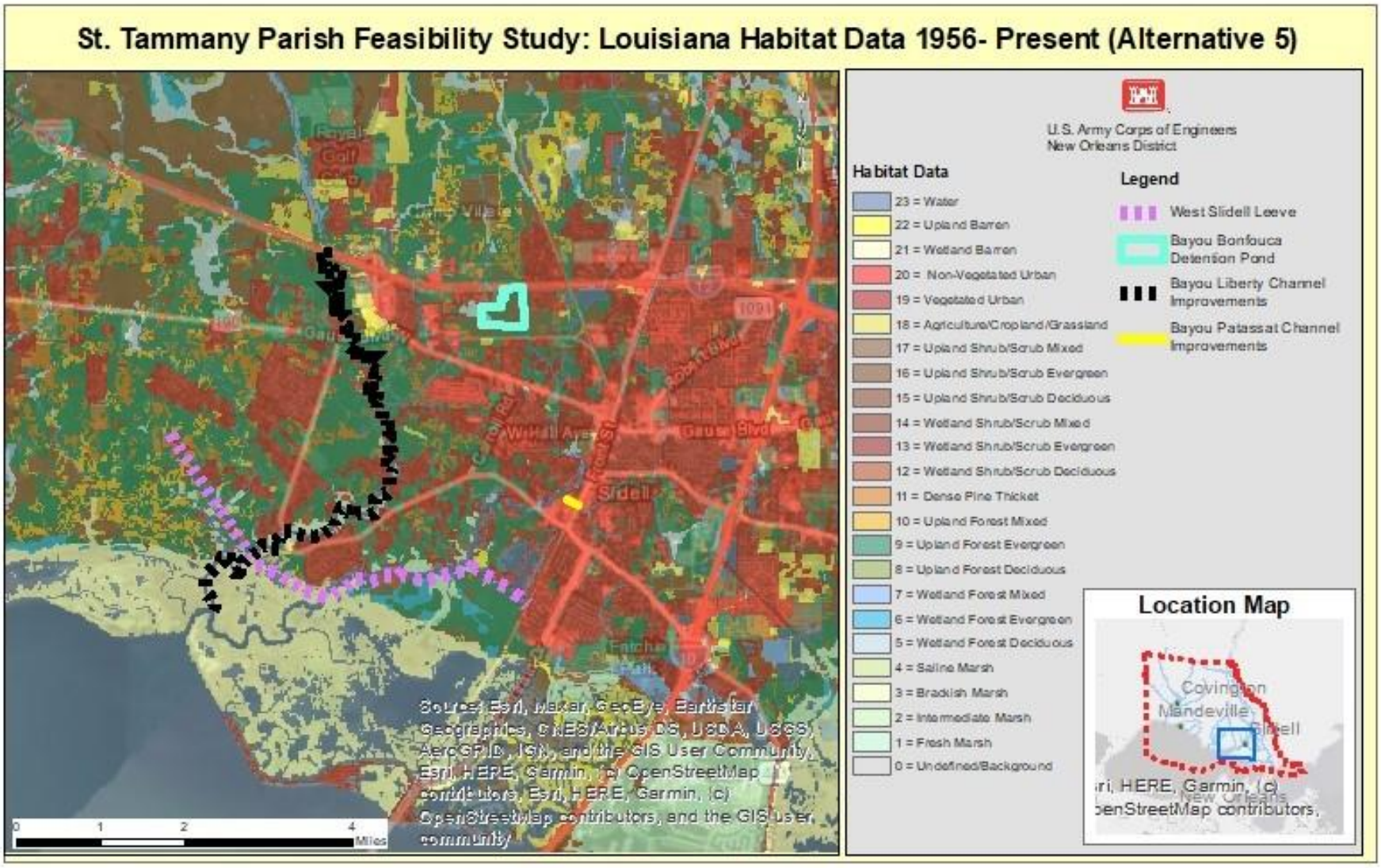

Figure 5-2: Louisiana Habitat Data 1956 – Present (Alternative 5)

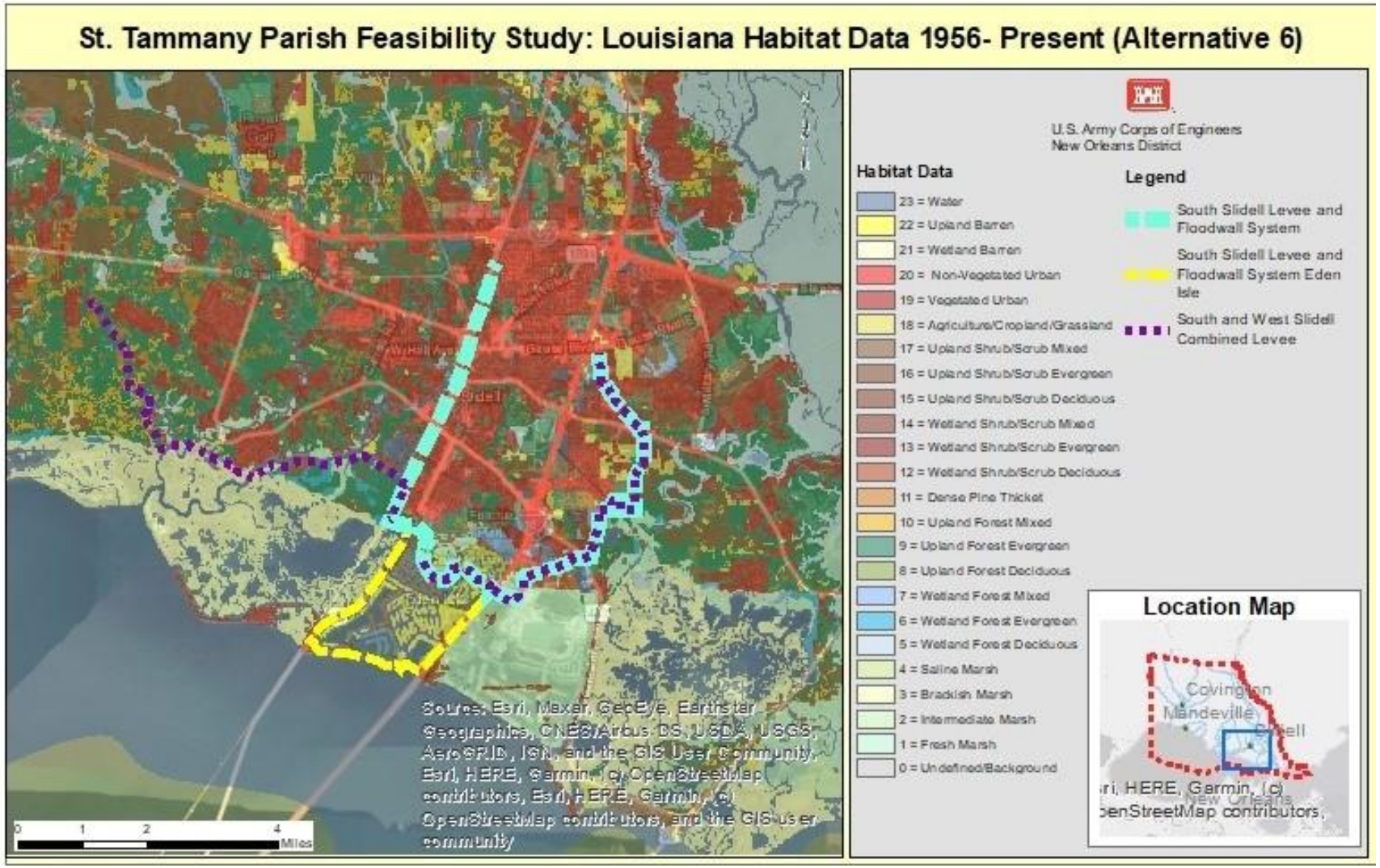

Figure 5-3: Louisiana Habitat Data 1956 – Present (Alternative 6)

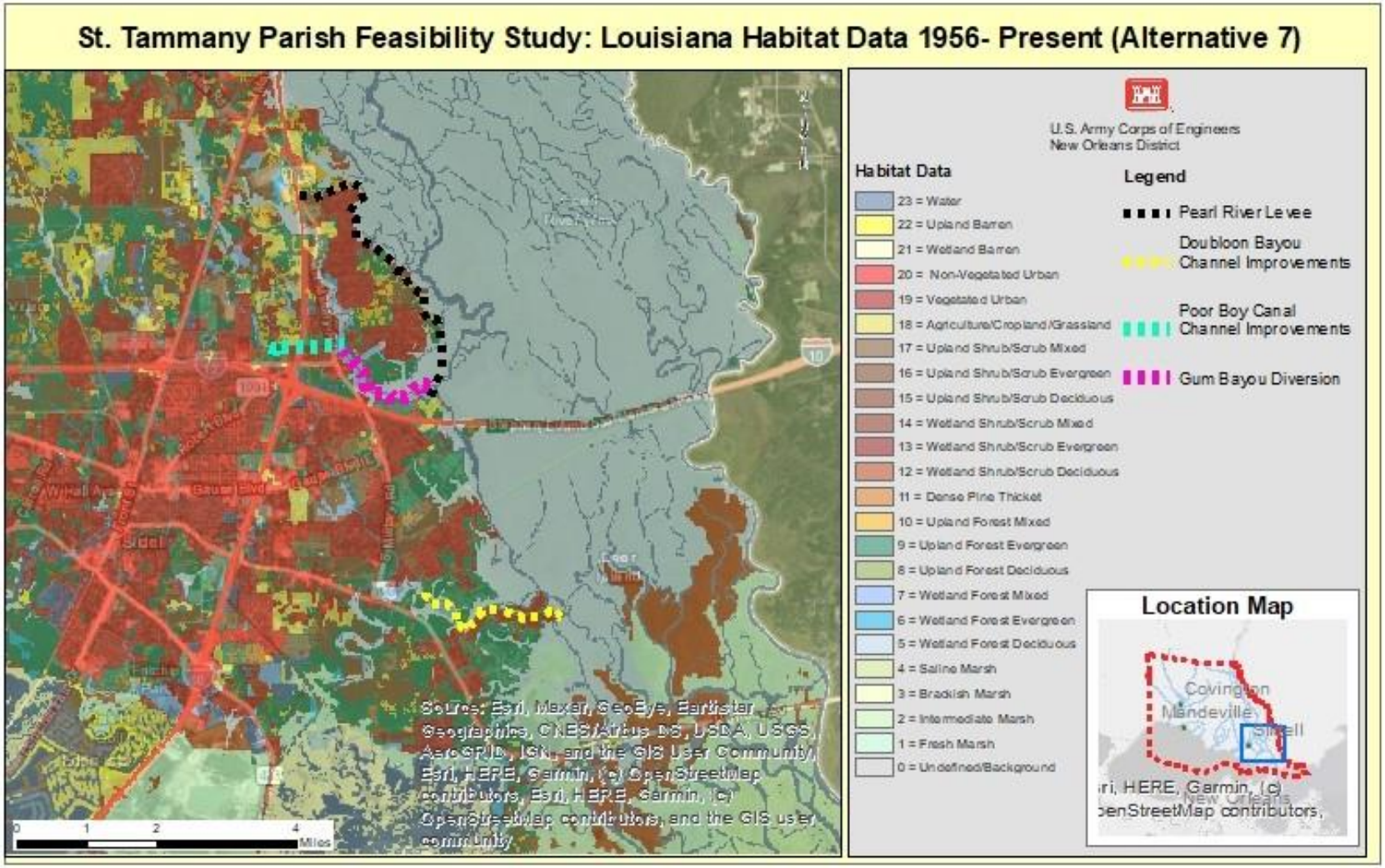

Figure 5-4: Louisiana Habitat Data 1956 – Present (Alternative 7)

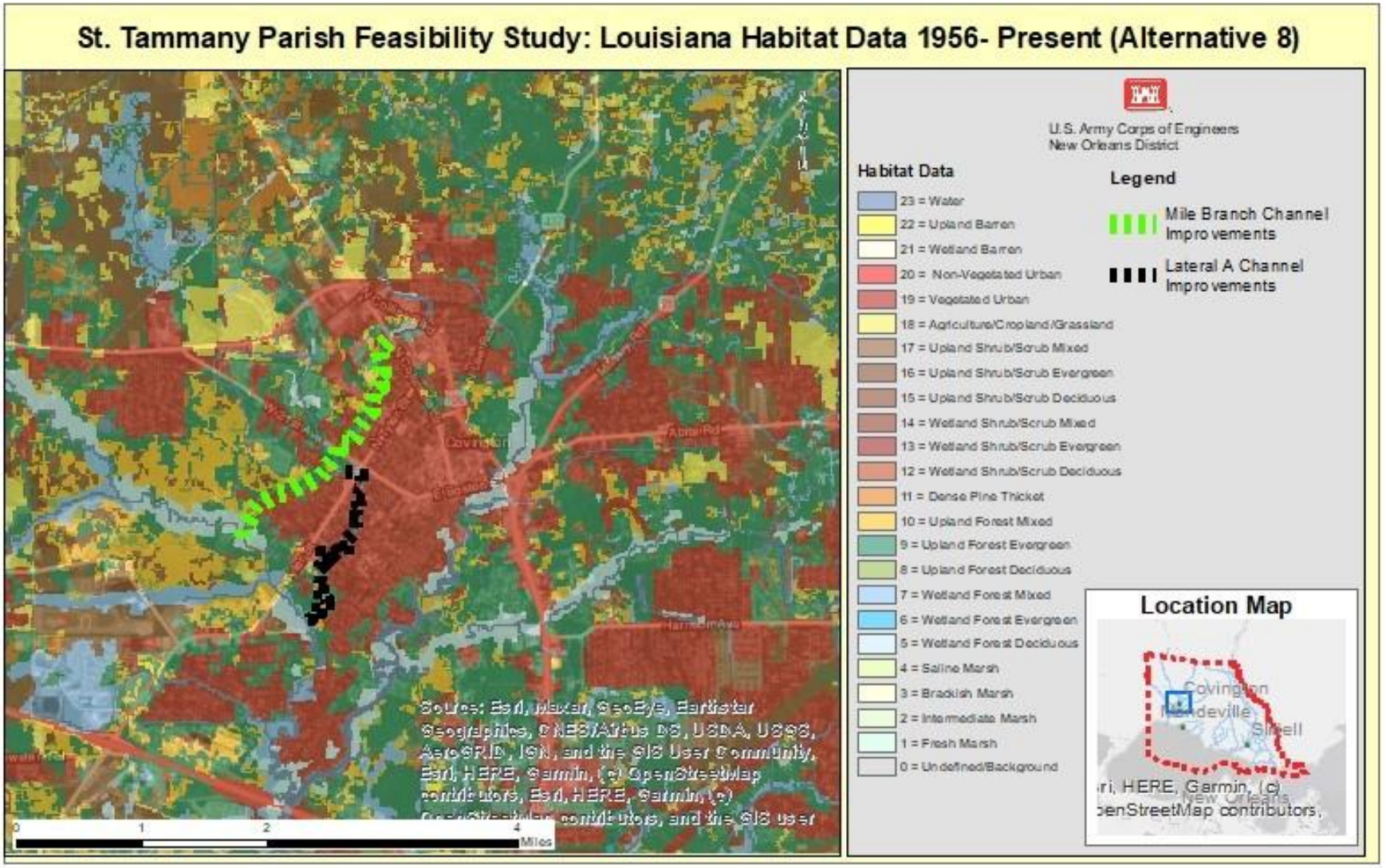

Figure 5-5: Louisiana Habitat Data 1956 – Present (Alternative 8)

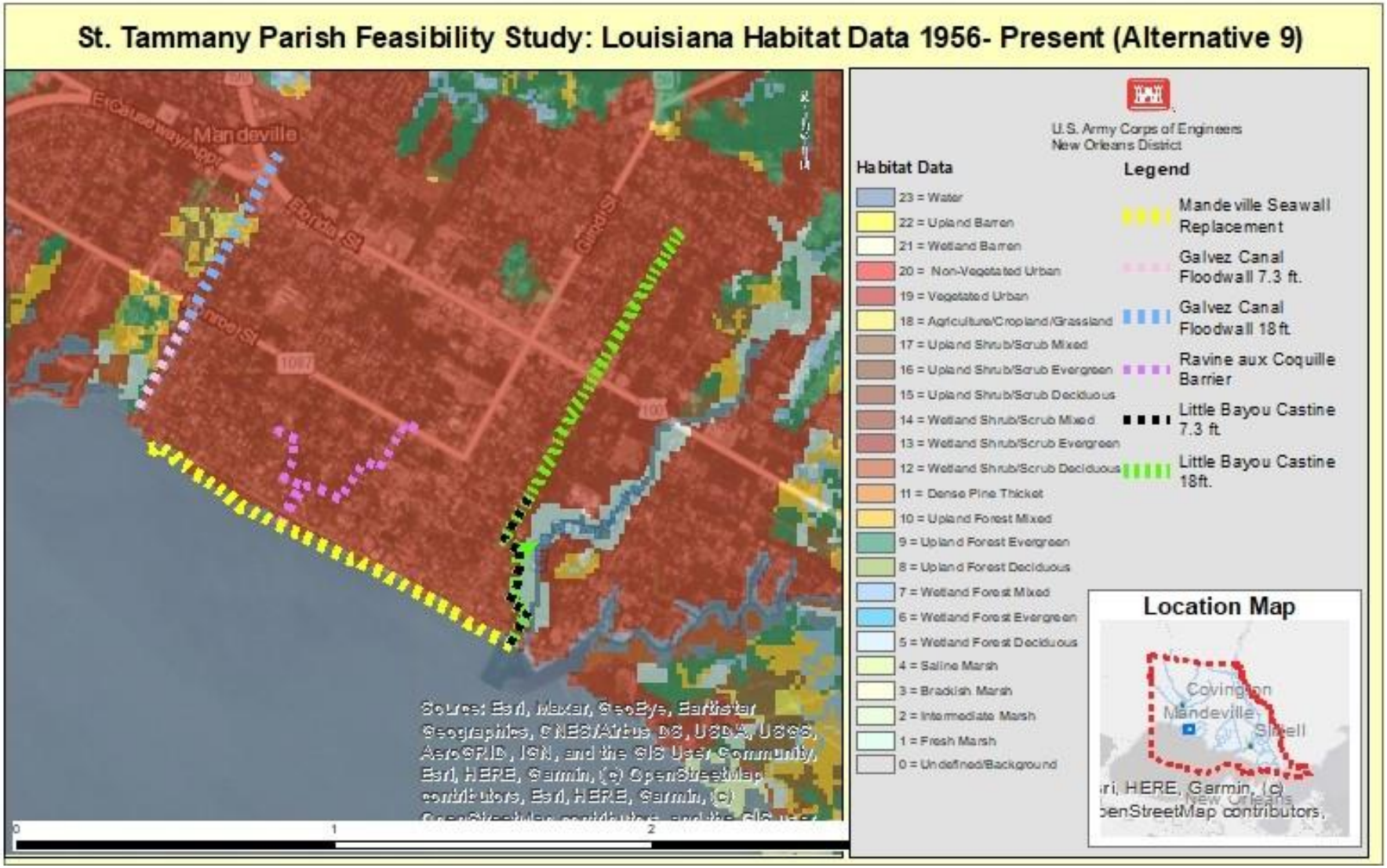

Figure 5-6: Louisiana Habitat Data 1956 – Present (Alternative 9)

5.3.1 Relevant Resources Affected

This section describes the direct, indirect, and cumulative effects of the No Action Alternative and the Final Array of Alternatives on relevant resources in the study area. Measures within alternatives were analyzed together where possible due to similar impacts for each resource. Impact acres represent current estimates and could be revised based on additional evaluation and coordination with USFWS and other resource agencies.

5.3.1.1 Wetlands Resources

A preliminary site assessment of existing vegetation was completed remotely using GIS surveys on the entire Final Array of alternatives using the National Wetland Inventory and USGS data for Hydrologic Unit Codes (HUC) 08090201and 0318004. Upland resources , specifically pine hardwoods and pine savannah are anticipated to be affected due to their proximity to coastal wetlands. A final wetland value assessment (WVA) will be included in the final report and completed prior to signing of the ROD. See Appendix C for a data map generated from USFWS National Wetland Inventory.

Alternative 1: No Action

Direct, indirect, and cumulative impacts

Without implementation of the proposed action, vegetative resources would not be impacted from construction. Forested wetlands and uplands would continue to be directly impacted specifically related to ongoing residential and commercial development, and indirectly impacted by the present conditions found throughout the parish. Communities would continue to experience riverine flooding from precipitation and storm surge, including cumulative impacts to those located in and around wetland and upland resources.

Alternative 2: Nonstructural

Direct, indirect, and cumulative impacts

Flood-proofing, structure raising, buyouts, and relocations are all options under this alternative. Flood-proofing and structure raising would have temporary negative impacts to vegetative communities, and residents would still be present. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. These impacts are temporary and based on construction activities, so they would not be expected to last. Buyouts and relocations would entail residents moving out of their existing homes and if the structures are razed and those actions result in the conversion of formerly residential areas to natural areas this could be considered a cumulative benefit to vegetative

communities and a reversion to historic norms for the area if current trends associated with increased real estate development in the parish change and the area revegetated naturally.

Alternative 4: Lacombe

Direct, indirect, and cumulative impacts

Alternative 4a consists of a 7.5 mile levee, floodwall, pump stations, and floodgates (S-028; See Table 4-3). Direct impacts would include removal of approximately 115 acres of BLH, swamp, and marsh habitats. It is anticipated that vegetative communities on both sides of the levee would shift to adjust to the changes in drainage. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. As sediment deposition is disrupted, the ability of wetlands to form in some areas is halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. The disruption to current wetland formation patterns is likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. As soil deposition shifts from one area to the next, this will change the size, shape, and location of marshes in the area. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. These adverse impacts would be offset, to an extent, with the operation of pump stations to help prevent stacking on the protected side of the levee. The removal of standing water will help to maintain current conditions and reduce adverse impacts associated with long periods of standing water.

Alternative 4a.1 consists of a 9 mile levee floodwall, pump stations, and floodgates (S-028; See Table 4-3) designed to protect the community of Lacombe. Direct impacts would include the removal of approximately 126 acres of BLH, swamp, and marsh habitats. The estimated acres of direct impact would be refined in coordination with resource agencies, if this alternative is selected, when the WVA is conducted during the next phase of the study. Indirect impacts to approximately 837 acres of BLH, swamp, and marsh habitats would be significant where drainage that empties into the Big Branch National Wildlife Refuge would be obstructed by the proposed levee before entering Lake Pontchartrain. It is anticipated that vegetative communities on both sides (protected side and floodside) of the levee would shift to adjust to the changes in drainage, as changes in hydrology results in changes in vegetative communities. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. As sediment deposition is disrupted, the ability of wetlands to form in some areas is halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. The disruption to current wetland formation patterns is likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. As soil deposition shifts from one area to

the next, this will change the size, shape, and location of marshes in the area. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. These adverse impacts would be offset, to an extent, with the operation of pump stations to help prevent stacking on the protected side of the levee. The removal of standing water will help to maintain current conditions and reduce adverse impacts associated with long periods of standing water. Approximately 595,000 cubic yards of borrow material would be needed for the construction of this levee.

Alternative 4b consists of the Combined Lacombe to West Slidell Levee that includes but is not limited to, a 13.7 mile levee that combines the Lacombe Levee with the West Slidell Levee from Alternative 5 together with a floodwall, pump stations and floodgates. (S-120, See Table 4-3) Direct impacts would include removal of approximately 2,133 acres of BLH, swamp, and marsh habitats. Indirect impacts would be significant where drainage is obstructed by the levee, particularly any drainage that currently empties into the Big Branch National Wildlife Refuge. It is anticipated that vegetative communities on both sides of the levee would shift to adjust to the changes in drainage. These are likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. Many of these changes would be due to the operations and maintenance of gates and pump stations which would pump surface flow from the inside of the levee system to the outside of that system. As sediment deposition is disrupted, the ability of wetlands to form in some areas is halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. The disruption to current wetland formation patterns is likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. As soil deposition shifts from one area to the next, this will change the size, shape, and location of marshes in the area. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. These adverse impacts would be offset, to an extent, with the operation of pump stations to help prevent stacking on the protected side of the levee. The removal of standing water will help to maintain current conditions and reduce adverse impacts associated with long periods of standing water.

The indirect impacts of the structural measures (Levees/control Structures/Pump Stations) could be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignments. Under day to day conditions the system would operate by gravity drainage, with pumps operating only during storm events that result in high exterior water levels. Hydrologic connectivity would generally be maintained between the wetlands within the levee-enclosed area, the surrounding wetlands and Lake Pontchartrain except during the closing of the system for storm events. Rainfall and high tides would still cause significant flooding of the wetlands within the levee-enclosed area. As stated above, the system would only prevent flooding of these areas under storm events. Hydrologic modeling will be conducted in the feasibility design phase to ensure that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above. Approximately 1,205,000 cubic yards of borrow material would be used for the construction of this levee. The proposed borrow sites include three sites in St. Tammany Parish and two sites in

Hancock County, Mississippi. More information regarding borrow locations can be found in Appendix B and quantities can be found in Engineering Appendix D.

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

Direct, indirect, and cumulative impacts

The Bayou Bonfouca Detention Pond is a detention pond measure designed to address riverine flooding. (S-004; See Table 4-3) Direct impacts would include removal of approximately 110 acres of BLH to be replaced by a pond. Indirect impacts to BLH would be expected to be minimal and temporary, potentially shifting vegetation as the result of changes in hydrology. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. As sediment deposition is disrupted due to sheet flow of landscape hydrology, the ability of wetlands to form in some areas could be halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. It is expected that the site would revegetate naturally upon completion of construction with native, and potentially invasive plant species as the result of disturbance. Cumulative impacts of this measure would be a loss of BLH habitat; this effect would contribute to fragmentation of existing habitat in an area surrounded by development; such development is expected to continue.

Bayou Liberty is a channel improvements measure (S-010; See Table 4-3) designed to clear the waterway over approximately 103 acres to improve flow and reduce the occurrence of stacking of water during high water events. Indirect impacts would be expected to be minimal and temporary, including the potential shifting of vegetative communities as the result of changes in hydrology. It is expected that the site would revegetate naturally upon completion of construction with native, and potentially invasive plant species as the result of disturbance. Cumulative impacts of this measure would be a temporary reduction in water quality and increased turbidity during construction as erosion increases due to a higher flow rate. Reduced water quality may create an opportunity for invasive plant species typically found in the area to thrive due to the disturbance of the soil and hydrology. It is expected that soils and sediment would stabilize upon completion of clearing and snagging construction activities in the waterway and overall water quality would be improved.

Bayou Patassat is a channel improvements measure (S-080; See Table 4-3) designed to clear the waterway of approximately 1 acre of marsh and swamp habitat to improve flow and reduce the occurrence of stacking of water during high water events. Indirect impacts would be expected to be minimal and temporary but include the potential shifting of vegetative communities from sediment erosion as the result of changing hydrology. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged

periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. It is expected that the site would revegetate naturally upon completion of construction. Cumulative impacts of this measure would be a temporary reduction in water quality and increased turbidity during construction as erosion increases due to a higher flow rate and may create an opportunity for invasive plant species to thrive due to the disturbance of the soil and hydrology. It is expected that soils and sediment would stabilize upon completion of the clearing and snagging construction activities in the waterway and overall water quality would be improved.

The West Slidell Levee measure is a 6.5 mile long levee with an additional 450 feet of floodwall, floodgates and pump stations (S-081; Table 4-3) designed to reduce the impact of storm surge events. Approximately 111 acres of marsh, swamp, and BLH habitat would be destroyed to create the levee right-of-way. Indirect impacts would be significant with the removal of approximately 1,254 acres of marsh, swamp, and BLH habitats.

As sediment deposition is disrupted, the ability of wetlands to form in some areas is halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. The disruption to current wetland formation patterns is likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. As soil deposition shifts from one area to the next, this will change the size, shape, and location of marshes in the area. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. These adverse impacts would be offset, to an extent, with the operation of pump stations to help prevent stacking on the protected side of the levee. The removal of standing water will help to maintain current conditions and reduce adverse impacts associated with long periods of standing water.

Anticipated erosion, particularly of marsh, would occur on the flood side of the levee because sediment inputs from runoff would be reduced and wave action against the levee would increase. The indirect impacts to the habitat would include the shifting of vegetative communities resulting from erosion and changing hydrology. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Cumulative effects would include these anticipated shifts in vegetation as drainage and flow across the area changes. Many of these changes would be reflective of the operations and maintenance of gates and pump stations. As sediment deposition is disrupted, the ability of wetlands to form in some areas is halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. The disruption to current wetland formation patterns is likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. As soil deposition shifts from one area to the next, this will change the size, shape, and location of marshes in the area. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. These adverse impacts would be offset, to an extent, with the

operation of pump stations to help prevent stacking on the protected side of the levee. The removal of standing water will help to maintain current conditions and reduce adverse impacts associated with long periods of standing water.

The indirect impacts of the structural measures (Levees/control Structures/Pump Stations) could be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignments. Under day to day conditions the system would operate by gravity drainage, with pumps operating only during storm events that result in high exterior water levels. Hydrologic connectivity would generally be maintained between the wetlands within the levee-enclosed area, the surrounding wetlands and Lake Pontchartrain except during the closing of the system for storm events. Rainfall and high tides would still cause significant flooding of the wetlands within the levee-enclosed area. As stated above, the system would only prevent flooding of these areas under storm events. Hydrologic modeling will be conducted in the feasibility design phase to ensure that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above. Approximately 611,000 cy of material would be used in this measure for the construction of the levee.

Alternative 6: South Slidell

Direct, indirect, and cumulative impacts

Alternative 6a consists of approximately 7.3 miles of levee with an additional 6 miles of floodwall, pump stations, and floodgates designed to reduce the impact of storm surge events. (S-074, S-075, S-76; Table 4-3) Direct impacts include the removal of approximately 46 acres, including 1 acre for staging, of marsh, swamp, and BLH habitat. Indirect impacts to approximately 453 acres of marsh and swamp habitats would result from the alteration of drainage and flow on the protected side of the levee, and anticipated erosion of marsh on the floodside of the levee. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes. As sediment deposition is disrupted, the ability of wetlands to form in some areas is halted while new wetlands may form where deposits are shifted as the result of construction and altered hydrology. The disruption to current wetland formation patterns is likely to have cumulative effects for the extensive marsh found along Lake Pontchartrain. As soil deposition shifts from one area to the next, this will change the size, shape, and location of marshes in the area. In some areas these long term effects would be considered positive where new wetlands form and negative in others where they are lost. These adverse impacts would be offset, to an extent, with the operation of pump stations to help prevent stacking on the protected side of the levee. The removal of standing water will help to maintain current conditions and reduce adverse impacts associated with long periods of standing water.

Many of these changes would be reflective of the operations and maintenance of gates and pump stations, and those plans will be developed if this measure is part of the TSP.

The indirect impacts of the structural measures (Levees/control Structures/Pump Stations) could be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignments. Under day to day conditions the system would operate by gravity drainage, with pumps operating only during storm events that result in high exterior water levels. Hydrologic connectivity would generally be maintained between the wetlands within the levee-enclosed area, the surrounding wetlands and Lake Pontchartrain except during the closing of the system for storm events. Rainfall and high tides would still cause significant flooding of the wetlands within the levee-enclosed area. As stated above, the system would only prevent flooding of these areas under storm events. Hydrologic modeling will be conducted in the feasibility design phase to ensure that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above. Approximately 851,000 cy of material would be used in this measure for the construction of the levee.

Alternative 6b adds an additional 6 miles of floodwall to the South Slidell levee (S-070, S-075, S-76; Table 4-3) together with pump stations, and floodgates designed to further reduce the impact of storm surge events in Eden Isle. There would be direct impact to approximately 134 acres, including 1 acre for staging, of marsh, swamp, and BLH habitats. There would be indirect impacts to approximately 2,332 acres of marsh and swamp habitat resulting from the alteration of drainage and flow on the protected side of the levee, and anticipated erosion of marsh and swamp habitat on the flood side of the levee. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes. Many of these changes would be reflective of the operations and maintenance of gates and pump stations, and those plans will be developed if this measure is part of the TSP.

The indirect impacts of the structural measures (Levees/control Structures/Pump Stations) could be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignments. Under day to day conditions the system would operate by gravity drainage, with pumps operating only during storm events that result in high exterior water levels. Hydrologic connectivity would generally be maintained between the wetlands within the levee-enclosed area, the surrounding wetlands and Lake Pontchartrain except during the closing of the system for storm events. Rainfall and high tides would still cause significant flooding of the wetlands within the levee-enclosed area. As stated above, the system would only prevent flooding of these areas under storm events. Hydrologic modeling will be conducted in the feasibility design phase to ensure that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above. Approximately 742,000 cy of material would be used in this measure for the construction of the levee.

Alternative 7: Eastern Slidell

Direct, indirect, and cumulative impacts

The Pearl River Levee measure contains approximately 5 miles of levee, and 0.5 mile of floodwall split into four different segments (S-060; Table 4-3). Direct impacts would include the removal of approximately 69 acres of marsh, swamp and BLH habitats, including 8 acres for staging and a pump station, There would be indirect impacts to approximately 511 acres of marsh and swamp habitats due to the alteration of drainage and flow on the protected side of the levee, and anticipated erosion of marsh and swamp on the floodside of the levee. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes, and potential stacking during high water events. Many of these changes would be reflective of the operations and maintenance of gates and pump stations, and those plans will be developed if this measure is part of the TSP.

The indirect impacts of the structural measures (Levees/control Structures/Pump Stations) could be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignments. Under day to day conditions the system would operate by gravity drainage, with pumps operating only during storm events that result in high exterior water levels. Hydrologic connectivity would generally be maintained between the wetlands within the levee-enclosed area, the surrounding wetlands and Lake Pontchartrain except during the closing of the system for storm events. Rainfall and high tides would still cause significant flooding of the wetlands within the levee-enclosed area. As stated above, the system would only prevent flooding of these areas under storm events. Hydrologic modeling will be conducted in the feasibility design phase to ensure that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above. Approximately 350,000 cy of material would be used for the construction of the levee.

The Gum Bayou Diversion channel improvements measure consists of a 1.8 mile long diversion designed to address flooding from high water events. (S-072; Table 4-3) Direct impacts include the removal of approximately 20 acres of marsh, swamp, and BLH habitats within the diversion footprint. There would be indirect impacts approximately 2 acres of marsh and swamp habitats due to the alteration of drainage and flow. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Cumulative effects are anticipated to be shifts in vegetation for marsh that are not significant. Many of these changes would be reflective of the operations

and maintenance of gates and pump stations, and those plans will be developed if this measure is part of the TSP.

The indirect impacts of the structural measures (Levees/control Structures/Pump Stations) could be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignments. Under day to day conditions the system would operate by gravity drainage, with pumps operating only during storm events that result in high exterior water levels. Hydrologic connectivity would generally be maintained between the wetlands within the levee-enclosed area, the surrounding wetlands and Lake Pontchartrain except during the closing of the system for storm events. Rainfall and high tides would still cause significant flooding of the wetlands within the levee-enclosed area. As stated above, the system would only prevent flooding of these areas under storm events. Hydrologic modeling will be conducted in the feasibility design phase to ensure that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above. Up to 100,000 cy of material would be excavated for construction of the diversion. The excavated material would be removed by truck or sidecast along the adjacent bank in the immediate proximity of construction. Sidecast material that falls back into the bayou would temporarily increase water turbidity and decrease water quality. Sediment deposits would form new bank along the bankline and would naturally revegetate or would move through the water channel to be deposited downstream.

The Poor Boy Canal channel improvements measure is designed to improve flow and drainage along the canal by clearing material over approximately 1 mile. (S-073; Table 4-3) The direct impact to approximately 4 acres, including marsh, swamp, and BLH would be refined in coordination with resource agencies if this measure is included in the TSP during the development of the WVA. Indirect impacts to approximately 1 acre of marsh and swamp habitat include potential shifting of vegetative communities as the result of changes in hydrology. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. It is expected that the site would revegetate naturally upon completion of construction with native, and potentially invasive plant species as the result of disturbance. Cumulative effects include shifts in marsh vegetation that would not be significant. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Up to 80,000 cy of material would be excavated requiring removal by truck or sidecast along the banks of the Poor Boy Canal. Sidecast material that falls back into the canal would temporarily increase water turbidity and decrease water quality. If the material forms a spoilbank, it would naturally revegetate. Some sediment would move through the water channel to be deposited downstream.

The Doubloon Bayou channel improvements measure is designed to improve flow and drainage along the canal by clearing material over approximately 3 miles. (S-069; See Table 4-3) Adverse direct impacts would be the removal of approximately 4 acres, including marsh, swamp, and BLH habitats. Adverse indirect impacts to approximately 35 acres of marsh and swamp habitat would be the potential shifting of vegetative communities as the result of changes in hydrology. It is expected that the site would revegetate naturally upon completion of construction. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance Cumulative effects are anticipated to be shifts in marsh habitat. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Up to 190,000 cy of excavated material would be removed by truck or sidecast along the Doubloon Bayou Channel banks. Sidecast material that falls back into the bayou would temporarily increase water turbidity and decrease water quality. Sidecast material that forms a spoilbank along the bayou would naturally revegetate. Some sediment would move through the water channel to be deposited downstream.

Alternative 8: Upper Tchefuncte/Covington

Direct, indirect, and cumulative impacts

The Mile Branch channel improvements measure is designed to improve flow and drainage along the canal by clearing material over approximately 2 miles. (S-057; See Table 4-3) The direct impact to approximately 5 acres, including swamp and BLH, will be refined in coordination with resource agencies when the WVA is conducted and included in the final report. Indirect impacts are estimated to be approximately 23 acres of BLH and swamp habitat, and include the potential shifting of vegetative communities as the result of changes in hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon construction completion. Cumulative effects are anticipated to be shifts in vegetation for swamp and BLH. Up to 130,000 cy of material would be removed by truck or sidecast along the bank. Sidecast material would temporarily increase water turbidity and decrease water quality, and naturally revegetate or move through the water channel to be deposited downstream. Information regarding the removal of material that is anticipated to be sidecast, or removed from the site and placed in an approved landfill can be found in Engineering Appendix D.

The Lateral A channel improvements measure is designed to improve flow and drainage along the canal by clearing material over approximately 1.73 miles. (S-121; See Table 4-3) The direct impact to approximately 7 acres, including swamp and BLH, would be refined in

coordination with resource agencies, if this alternative is selected, when the WVA is conducted. Indirect impacts are estimated to be to approximately 1 acre of BLH and swamp habitat, and include the potential shifting of vegetative communities as the result of changes in hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon completion of construction. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance. Cumulative effects are anticipated to be shifts in vegetation for swamp and BLH. Up to 104,000 cy of material would be removed and would require removal by truck or sidecast along the bank. Sidecast material would temporarily increase water turbidity and decrease water quality, and would naturally revegetate or move through the water channel to be deposited downstream. More information regarding the removal of material that is anticipated to be sidecast, or removed from the site and placed in an approved landfill can be found in Engineering Appendix D.

Alternative 9: Mandeville

Direct, indirect, and cumulative impacts

Alternative 9a consists of replacing the existing seawall with a new seawall with an 7.3 foot elevation NAVD 88 (2 feet higher than the existing seawall), and constructing floodwalls, 4 pump stations, floodgates, flood barriers, and passive drainage on Bayou Ravine Aux Coquilles and Little Castine Bayou to reduce the risk of flood damage from coastal storm surge. (S-118, S-046 S-047; See Table 4-3) The direct impact to approximately 14 acres, including marsh, swamp, and BLH, would be refined in coordination with resource agencies, if this alternative is selected, when the WVA is conducted. Indirect impacts are estimated to be approximately 1 acre of BLH and swamp habitat, and include the potential shifting of vegetative communities as the result of changes in hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon construction completion. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes, and potential stacking during high water events. Many of these changes would be reflective of the operations and maintenance of the four pump stations and those plans will be developed if this measure is part of the TSP. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance

Alternative 9b consists of replacing the existing seawall with a new seawall with an 7.3 foot elevation NAVD 88 (2 feet higher than the existing seawall), and constructing floodwalls, 2 pump stations, floodgates, and flood barriers to reduce the risk of flood damage from coastal storm surge. (S-118, S-046, S-048; See Table 4-3) The direct impact to approximately 14 acres, including marsh, swamp, and BLH, would be refined in coordination with resource

agencies, if this alternative is selected, when the WVA is conducted. Indirect impacts are estimated to be approximately 1 acre of BLH and swamp habitat, and include the potential shifting of vegetative communities as the result of changes in hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon construction completion. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes, and potential stacking during high water events. Many of these changes would be reflective of the operations and maintenance of the pump station, and those plans will be developed if this measure is part of the TSP. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance

Alternative 9c consists of replacing the existing seawall with a new seawall with an 18 foot elevation NAVD 88, and constructing floodwalls, 2 pump stations, floodgates, and flood barriers to reduce the risk of flood damage from coastal storm surge. (S-046, S-048, S-118, S-122; See Table 4-3) The direct impact to approximately 14 acres, including marsh, swamp, and BLH, would be refined in coordination with resource agencies if this alternative is selected when the WVA is conducted. Indirect impacts are estimated to be approximately 1 acre of BLH and swamp habitat, and include the potential shifting of vegetative communities as the result of changes in hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon construction completion. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes, and potential stacking during high water events. Many of these changes would be reflective of the operations and maintenance of the pump station, and those plans will be developed if this measure is part of the TSP. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance

TSP

South Slidell and West Slidell and Levee

The levee and floodwall alignment compromises 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 by constructing ramps 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, four gate complexes, and one channel floodgate. There would also be a total of three sluicegates, seven vehicular gates, one railroad gate along the Norfolk Southern Railroad, and seven ramps.

Direct impacts include the removal of approximately 157 acres, including 2 acre for staging, of marsh, swamp, and BLH habitat. Indirect impacts to approximately 1,707 acres of marsh, swamp, and BLH habitats would result from the alteration of drainage and flow on the protected side of the levee, and anticipated erosion of marsh on the floodside of the levee. Cumulative effects are anticipated to be shifts in vegetation as drainage and flow across the area changes. As the operations plans are developed and more modeling is conducted the plans will be developed to minimize impacts. Many of these changes would be reflective of the operations and maintenance of gates and pump stations, and those plans will be developed during optimization, and before the ROD is signed.

Bayou Patassat Channel Improvements

Bayou Patassat is a small tributary of Bayou Bonfouca also located in Slidell, Louisiana. The Bayou Patassat Channel Improvements would be performed between Bayou Vincent Pump Station and US Highway 11. The preliminary design of the channel improvements 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 work will be located between Bayou Vincent pump station and Highway 11. Approximately 0.17 miles (900 feet) of clearing and snagging will occur in Bayou Patassat.

The Bayou Patassat measure is designed to clear the waterway of approximately 1 acre of marsh and swamp to improve flow and reduce the occurrence of stacking of water during high water events. This direct impact acreage/assessment will be refined when the WVA is conducted. Indirect impacts would be expected to be minimal and temporary but include the potential shifting of vegetative communities from sediment erosion as the result of changing hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon completion of construction. Cumulative impacts of this measure would be a temporary reduction in water quality and increased turbidity during construction as erosion increases due to a higher flow rate and may create an opportunity for invasive plant species due to the disturbance of the soil and hydrology. It is expected that soils and sediment would stabilize upon completion of the clearing and snagging construction activities in the waterway and overall water quality would be improved.

As the operations plans are developed and more modeling is conducted the plans will be developed to minimize impacts.

Mile Branch Channel Improvements

The Mile Branch channel improvements start at the intersection of Mile Branch and Highway 190, crossing Highway 190 Business, and end at the intersection 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 will be lowered by 5 feet. Approximately 20 acres of channel will 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.

The direct impact to approximately 5 acres, including swamp and BLH, would be refined in coordination with resource agencies when the WVA is conducted. Indirect impacts are estimated to be approximately 23 acres of BLH and swamp habitat, and include the potential shifting of vegetative communities as the result of changes in hydrology, and this will be verified by hydraulic modeling during optimization. It is expected that the site will revegetate naturally upon construction completion. Cumulative effects are anticipated to be shifts in vegetation for swamp and BLH. Up to 130,000 cubic yards of material would be removed by truck or sidecast along the bank. Sidecast material would temporarily increase water turbidity and decrease water quality, and naturally revegetate or move through the water channel to be deposited downstream. More information regarding the removal of material that is anticipated to be sidecast, or removed from the site and placed in an approved landfill, can be found in Engineering Appendix D.

As the operations plans are developed and more modeling is conducted the plans will be developed to minimize impacts.

Nonstructural Elevations and Flood-Proofing

An estimated total of 8,498 structures could benefit from non-structural 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 50 year floodplain that are not included in the areas benefitted from the structural measures of the TSP. It is estimated that 6,643 homes will be raised and 1,855 structures floodproofed. These structures counts are preliminary and will continue to be evaluated and refined and are not absolute.

Floodproofing and structure raising would not have long-term, permanent, negative impacts to vegetative communities, and residents would still be present. Buyouts and relocations would entail residents moving out of their existing home and this could be considered a benefit to vegetative communities and a reversion to historic norms for the area if current trends associated with increased real estate development in the parish change and the area revegetated naturally.

5.3.1.2 Upland Resources

Alternative 1: No Action Alternative

Direct, Indirect, and Cumulative Impacts:

Without implementation of the proposed action, upland vegetative resources would not be impacted. Forested uplands in the project area would continue to be directly and indirectly impacted by the present natural and anthropogenic factors (e.g. development). Erosional forces from major flood events would continue to permanently adversely impact these communities.

Alternative 2: Nonstructural

Direct, Indirect, and Cumulative Impacts:

Elevating homes would not directly impact vegetation in any surrounding areas, although the shading 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.

Alternatives: 4, 5, 6, 7, 8, and 9

Direct, indirect, and cumulative impacts

Upland resources in each of the levee measures are limited due to the proximity to coastal wetlands and river systems. Impacts from the levee measures in each alternative would be limited to direct impacts within the footprint of the levee, and any staging areas used for construction activities. Channel clearing and seawall measure would cause no direct or indirect impacts to upland resources. Cumulative impacts to upland resources would be shifts in vegetation related to changes in landscape hydrology, or sheet flow. In areas where there is less water, plant communities will adjust, with those species adapted to less water becoming more prevalent. Conversely, in areas where there is more water for prolonged periods, plant communities that have adapted to higher standing amounts of water will be present. This presents an opportunity for invasive plant species to establish themselves as the result of disturbance.

TSP

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 any surrounding areas, although the shading 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.

5.3.1.2.1 Borrow Sources

The PDT initiated their investigations by identifying and ranking potential borrow sources in terms of the location, suitability and land use that best avoid and minimize adverse environmental impacts from the excavation, and haul distance. Throughout the process, the PDT coordinated with STPG, the NFS, stakeholders and other ongoing projects to identify potential borrow sources. In addition to identification of new borrow sites, the PDT investigated previous sites that were identified during the Hurricane Storm Damage Risk Reduction System (HSDRRS) borrow evaluation process https://www.mvn.usace.army.mil/Missions/Environmental/NEPA-Compliance-Documents/HSDRRS-Projects/) since some have readily available borrow materials and available site data. It was acknowledged that these sites may need additional investigations and their NEPA clearance updated prior to usage. Furthermore, the PDT used landowner parcel data, aerial maps, National Wetland Inventory datasets, United States Department of Agriculture (USDA) Soil Maps (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) existing geology and geotechnical information to identify sites within St. Tammany Parish and nearby Hancock County, Mississippi with potentially suitable soil characteristics and suitable land characteristics. The PDT identified potential borrow sites along with the previously investigated HSDRRS sites that were evaluated and screened based on the estimated amount of borrow available and environmental risks. Through the investigation, a total of 34 sites were identified. Table B4-1 in Appendix B contains further details on the screening and evaluation process and identifies the five sites the team moved forward.

Material obtained from borrow sources would be from five sites that would have no impact on wetlands or upland resources. All five borrow sources have been selected due to their having been previously cleared of all vegetation. Two sites in Mississippi (MS-1 and MS-2) are commercial sources that were previously 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. That evaluation is incorporated herein. The remaining three sites (STP-5, STP-6, and STP-9) are currently cleared of vegetation. See Table 5-1 and Figures 3-1, 5-7, 5-8, 5-9, 5-10, and 5-11 for more habitat data. More information regarding the selection of borrow sources can be found in Appendix B.

Table 5-1: Potential Borrow Site Identification for the St. Tammany Parish Feasibility Study.

Site #	Site Name	Location	Estimated Borrow Pit Acreage	Estimated Fill Volume (cubic yards)	Screening/Notes	Source	Haul Distance (Approximate distance in miles)
STP-5	**Cleared Site 5**	**Lacombe, LA**	**73**	**1,817,700**	**Carried Forward- barren, land with no vegetation, existing retention pond- potential to increasing the retention capacity at this site-beneficial location, falls within defined soil/environmental parameters, and already has a similar land use**	**PDT identified based on previously cleared lands and available soil data**	**2**
STP-6	**Cleared Site 6**	**Slidell, LA**	**10**	**249,000**	**Carried Forward, cleared barren land with no vegetation**	**PDT identified based on previously cleared lands and available soil data**	**3.5**
STP-9	**Cleared Site 9**	**Slidell, LA**	**17**	**423,300**	**Carried Forward, previously cleared land with no vegetation**	**PDT-cleared lands**	**3**
MS-1	**Pearlington**	**Hancock County, MS**	**326**	**8,000,000**	**Carried forward- 3 potential sites at location (2 approved). Potential commercial site. Remaining borrow available at each needs to be determined. Pearlington Phase 3 site has wetlands but wetland areas would be avoided**	**HSDRRS IER 19 and IER 23 (2008)**	**9.5**
MS-2	**Port Bienville**	**Hancock County, MS**	**677**	**16,857,300**	**Carried Forward- HSDDRS approved site- Potential commercial site previously planted in pine for commercial harvesting, mixture of overgrown pine habitat and cleared areas. Remaining borrow available needs to be determined, potential commercial site**	**HSDRRS IER 31 (2010)**	**11**

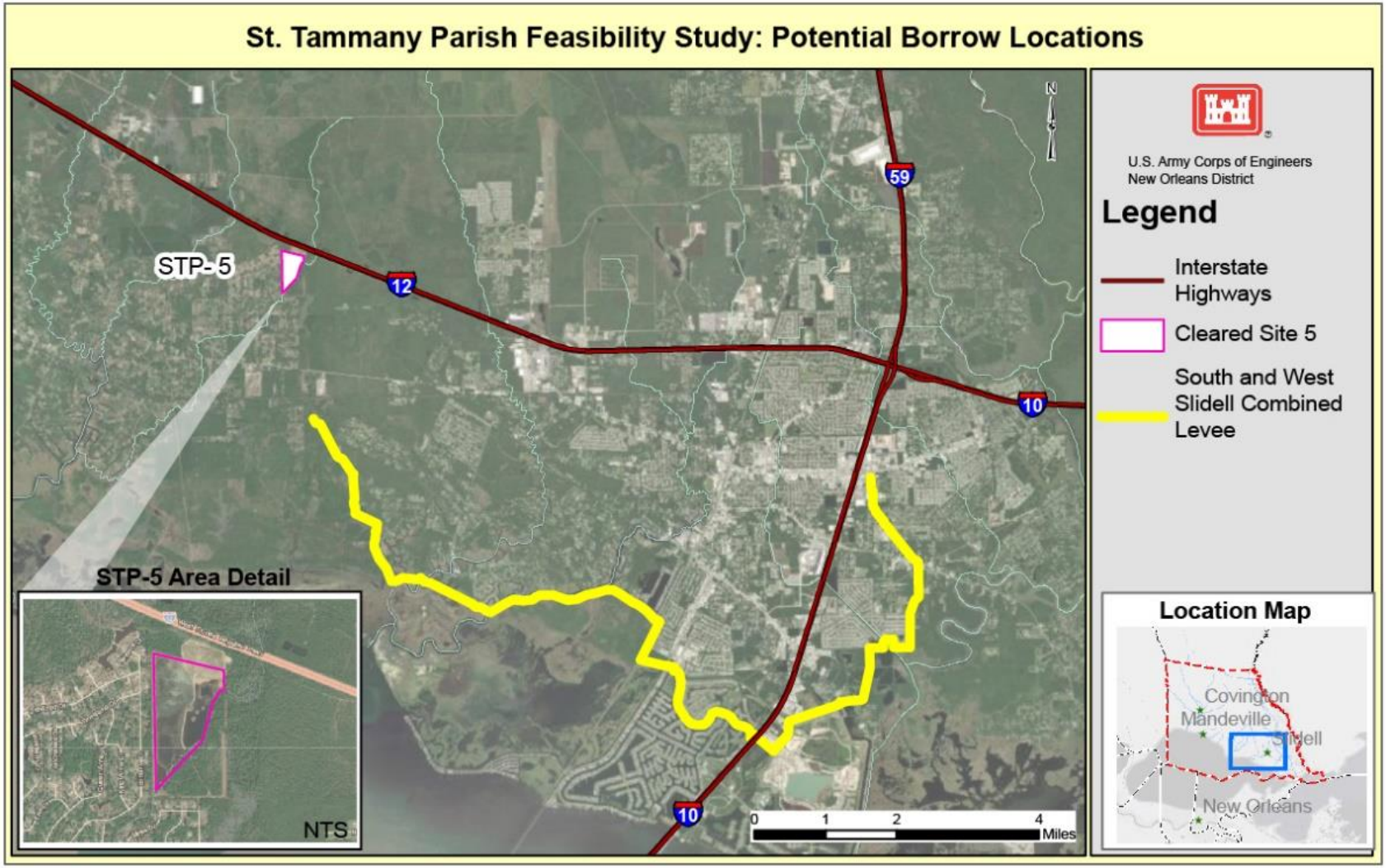

Figure 5-7: Borrow Site STP - 5

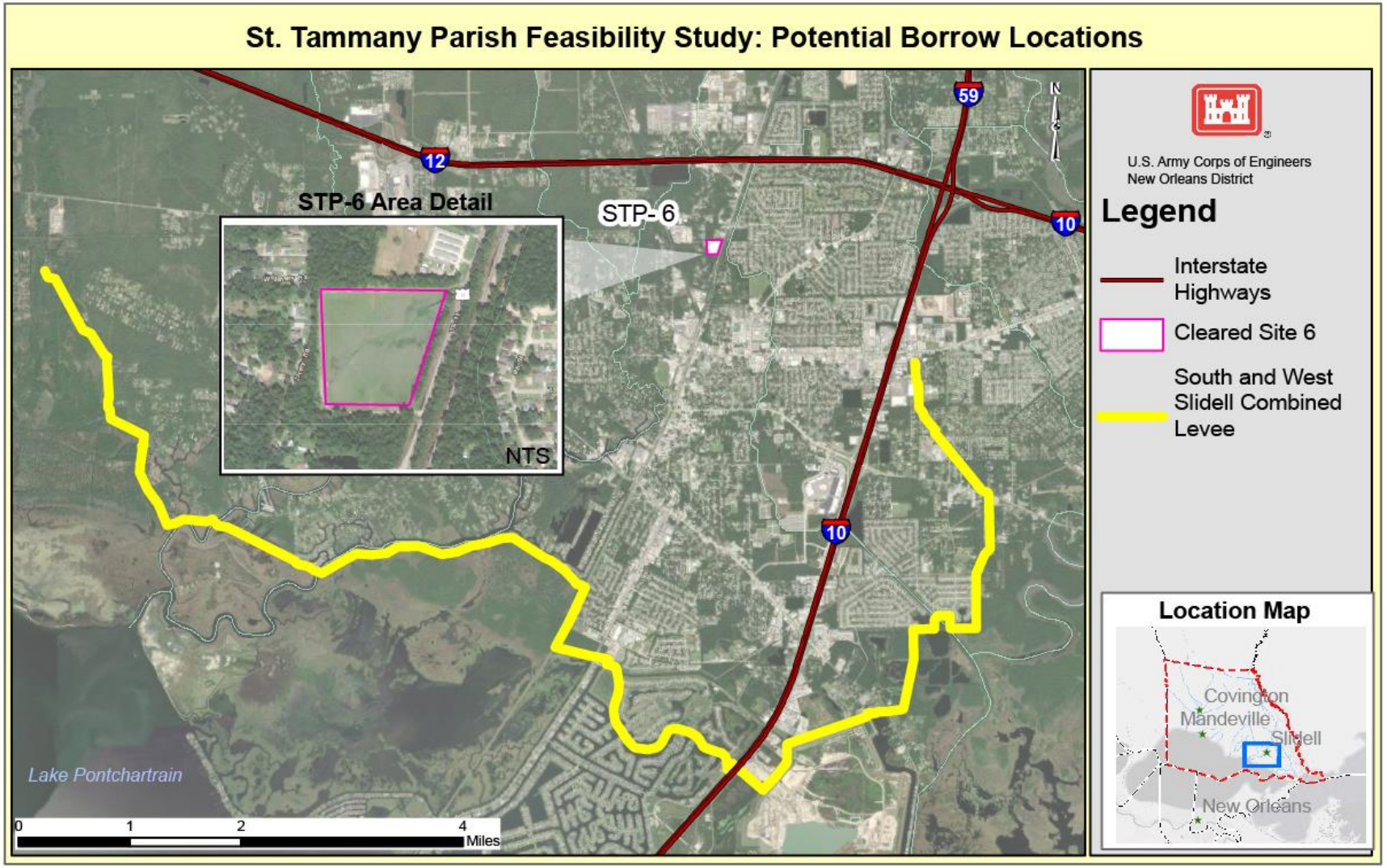

Figure 5-8: Borrow Site STP-6

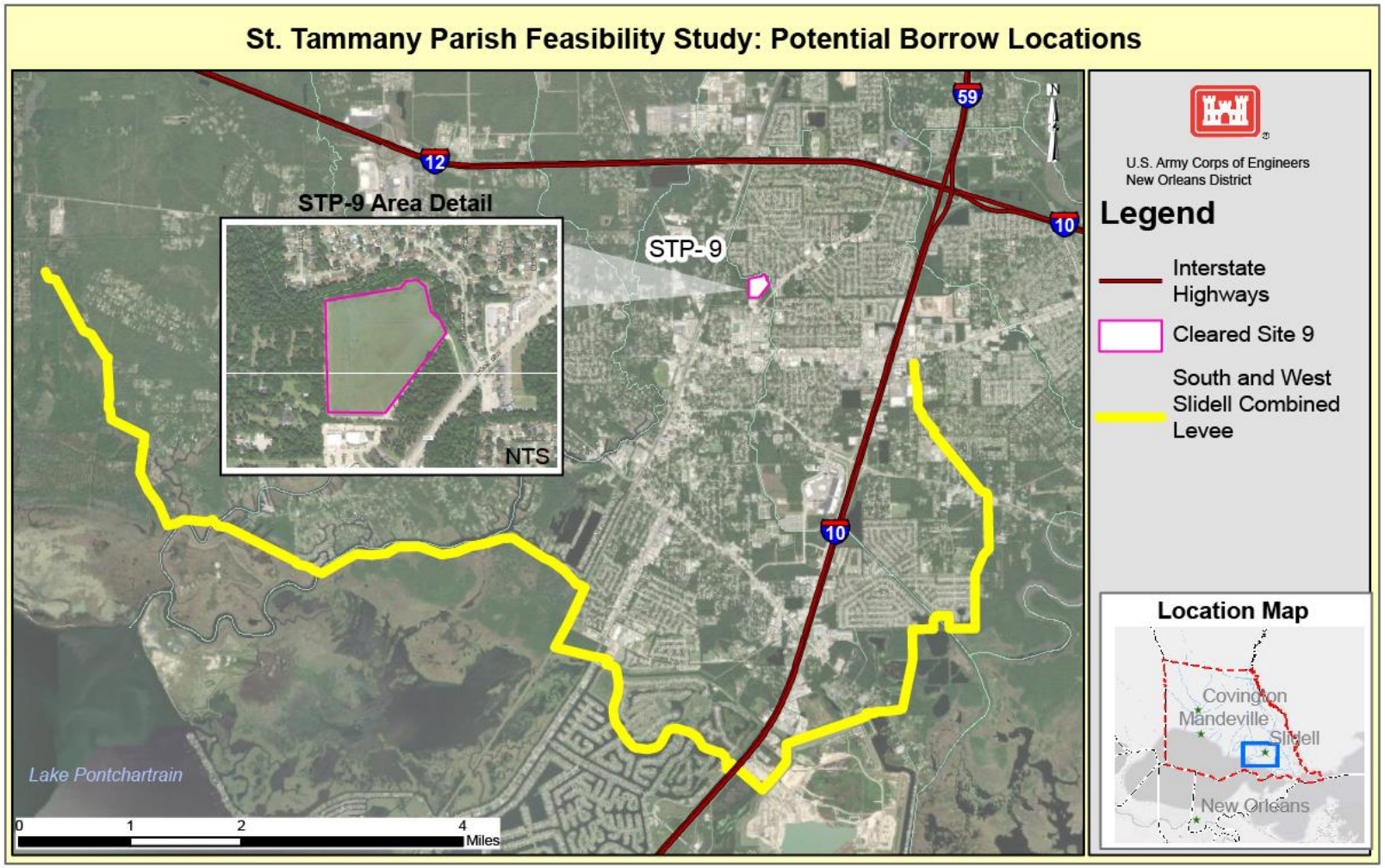

Figure 5-9: Borrow Site STP-9

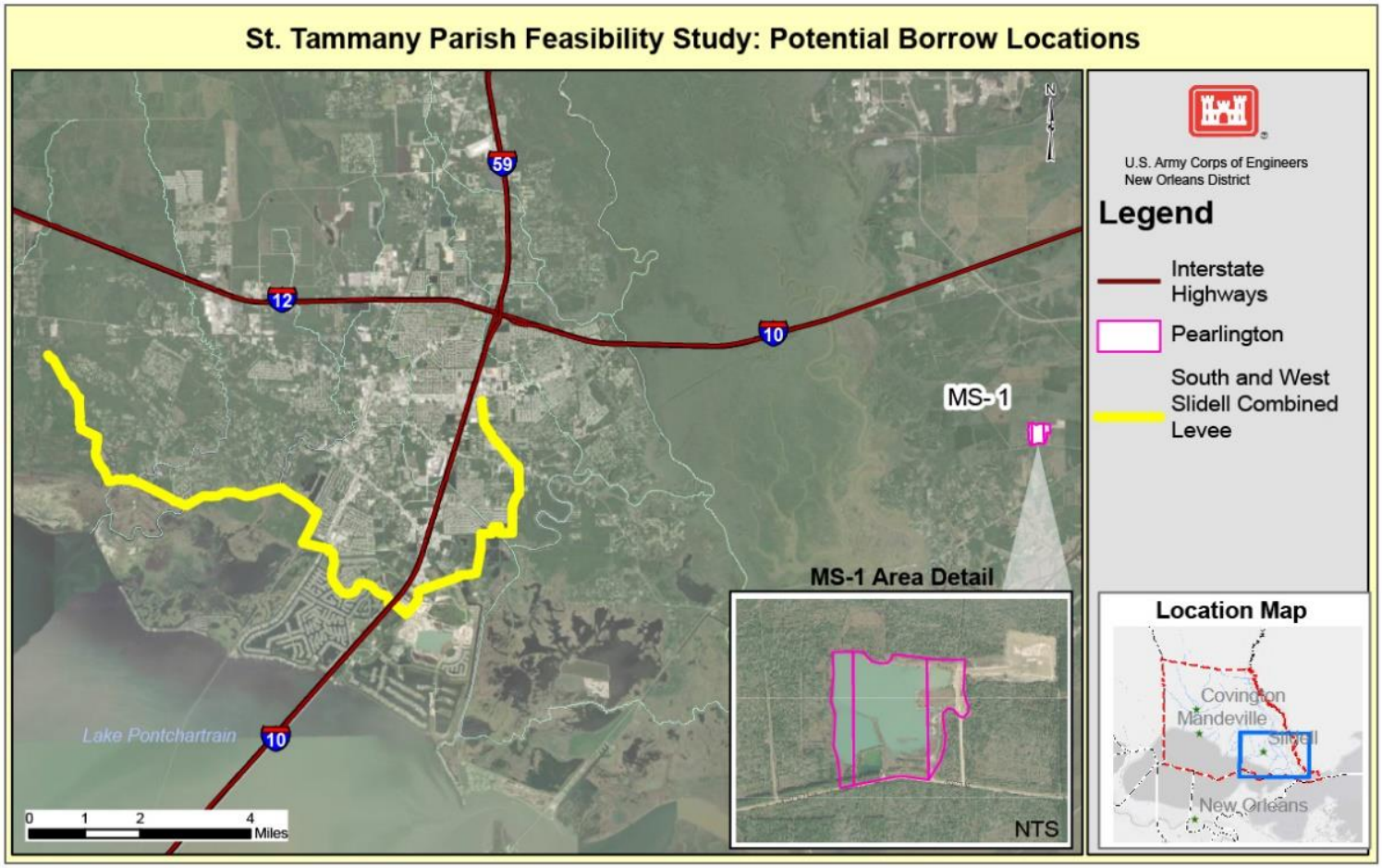

Figure 5-10: Borrow Site MS-1

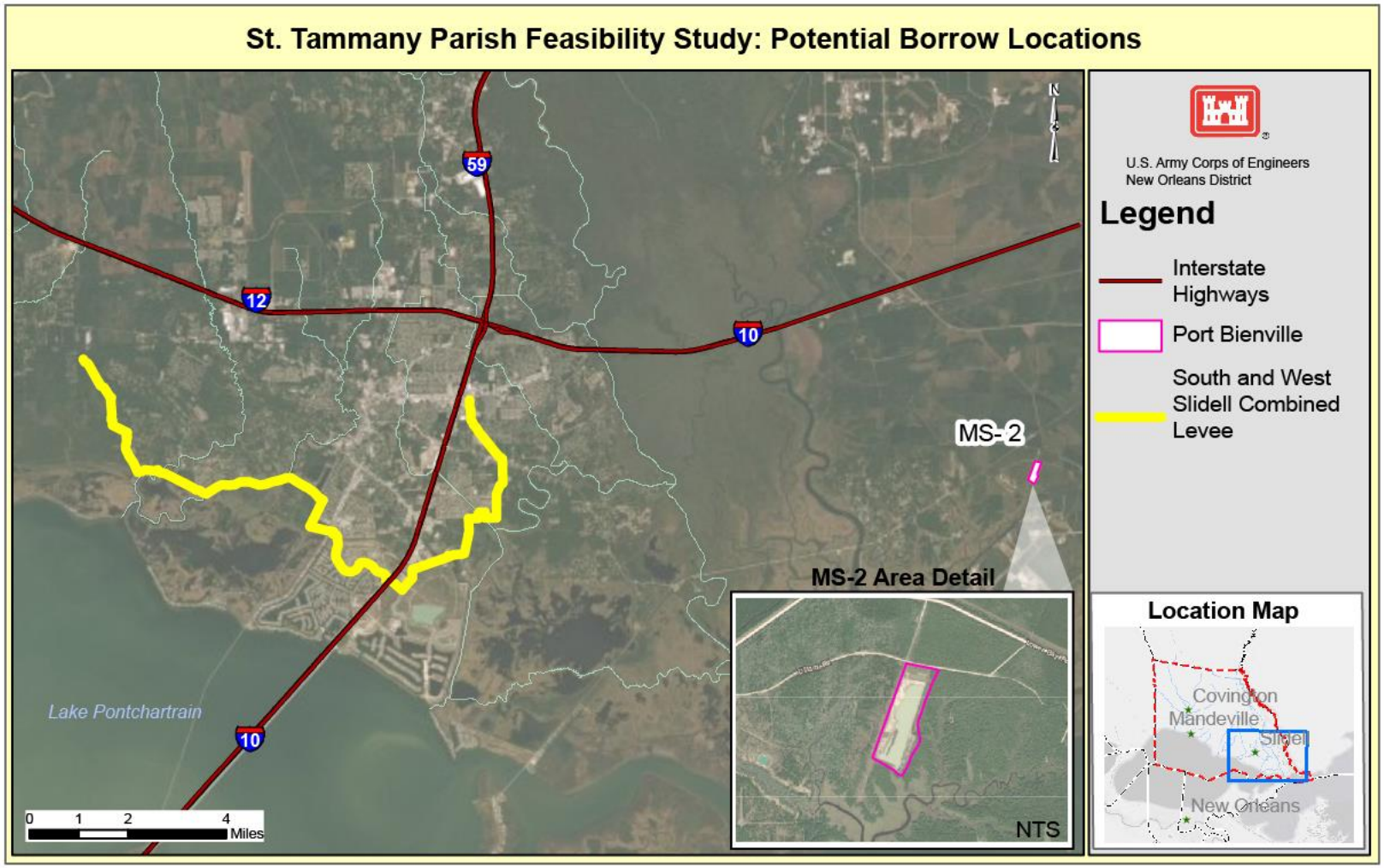

Figure 5-11: Borrow Site MS-2

5.3.1.3 Prime and Unique Farmlands

Alternative 1: No Action

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

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.

Alternatives 5, 8

These channel-clearing alternatives would not affect prime and unique farmlands. Soil and water bottoms would continue to experience both anthropogenic and natural impacts.

Alternative 4 (4a, 4a.1, and 4b)

The Alternative 4 levee measures would affect 1,334 acres of prime and unique farmlands. Farmland would be directly adversely impacted by these alternatives in areas within approximately 61% of the levee footprint and associated staging areas.

Alternative 5

The Alternative 5 levee measure would affect 865 acres of prime and unique farmlands. Farmland would be directly adversely impacted by these alternatives in areas within approximately 38% of the levee footprint and associated staging areas.

Alternative 6 (6a, 6b, and 6c)

The Alternative 6 levee measures would affect 143 acres of prime and unique farmlands. Farmland would be directly adversely impacted within approximately 13% of the levee footprint and associated staging areas.

Alternative 7

The Alternative 7 levee measures would affect 194 acres of prime and unique farmlands. Farmland would be directly adversely impacted within approximately 33% of the levee footprint and associated staging.

Alternative 9 (9a, b and c)

Direct, Indirect, and Cumulative Impacts: These seawall measures would not have an effect on prime and unique farmland. Soils would continue to experience both anthropogenic and natural impacts.

TSP

The TSP levee measures would affect 448 acres of prime and unique farmlands. Farmland would be directly adversely impacted within approximately 20% of the levee footprint and associated staging areas.

5.3.1.3.1 Borrow Sources

Borrow sites MS-01 and MS-02 in Mississippi are not currently listed as having prime and unique farmlands. Borrow site STP-5 would impact approximately 62 acres, STP-6 would impact less than one acre, and STP-9 would impact approximately five acres. Impacts to prime and unique farmlands will require coordination with the Natural Resources Conservation Service.

5.3.1.4 Aquatic and Fishery Resources

Alternative 1: No Action Alternative

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

Direct, indirect, and cumulative impacts

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

Alternative 4: Lacombe (4a, 4a.1, and 4b)

Direct, indirect, and cumulative impacts

Implementation of this alternative would have adverse direct impacts to migration and spawning aquatic species, and specifically to species that are reliant upon the National Wildlife Refuge. Any aquatic species on either side of the levee footprint variations would likely experience direct impacts from construction and alterations of drainage and flow into

Lake Pontchartrain. On the protected side of each of the levee footprints there would likely be stacking of water that shifts vegetative communities' aquatic resources and fisheries that rely upon them for habitat and foraging. On the flood side of each of the levee footprints there would likely be erosion related to shifts in vegetative communities. The operation and maintenance of gates and pump stations would significantly affect aquatic resources and fisheries issues by reducing stacking during high water events. Mitigation for impacts to aquatic and fisheries resources would need to be determined as the alternative is further refined. Indirect impacts would be shifts in vegetative communities related to changes in drainage and flow, with construction impacts being only temporary. Vegetative communities provide foraging and refugia for aquatic species that can be used for spawning and shelter. Cumulative impacts would entail a permanent shift in vegetation and impacts to spawning and migrating aquatic species that rely upon the waterways disrupted by these levee measures would be significant. 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 of any pump stations would contribute to noise and vibration during high water events. Further details regarding these operations can be found in Engineering Appendix D.

Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca

Direct, indirect, and cumulative impacts

Implementation of this alternative would have direct impacts to migration and spawning aquatic species. Any aquatic species on either side of the levee footprint variations would be likely to 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 drainage and flow, with construction impacts being only temporary. Vegetative communities provide foraging and refugia for aquatic species that can be used for spawning and shelter. Cumulative impacts would entail a permanent shift in vegetation, and impacts to spawning and migrating aquatic species that rely upon the waterways disrupted by these levee measures would be significant. 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.

Direct impacts from the channel clearing measures would be a temporary loss of water quality during construction, but lasting improvements to drainage and flow. Indirect impacts would be expected to be temporary and would likely improve the existing habitat to lasting benefits to aquatic resources and fisheries in the channels. Vegetative communities provide foraging and refugia for aquatic species that can be used for spawning and shelter. Cumulative impacts would entail a permanent shift in vegetation, and spawning and migrating aquatic species that rely upon the waterways would experience a loss in refugia that would be expected to be permanent. 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.

Alternative 6: South Slidell

Direct, indirect, and cumulative impacts

Implementation of Alternative 6 would have direct impacts to migration and spawning aquatic species. Any aquatic species on either side of the different levee footprint variations would be likely to 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. Cumulative impacts would entail a permanent shift in vegetation, and impacts to spawning and migrating aquatic species that rely upon the waterways disrupted by these levee measures would be significant. 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 Engineering Appendix D.

Alternative 7: Eastern Slidell

Direct, indirect, and cumulative impacts

Implementation of the levee measure in Alternative 7 would have direct impacts to migration and spawning aquatic species. Any aquatic species on either side of the levee footprint would be likely to experience direct impacts from construction and alterations of drainage and flow. Indirect impacts would be shifts in vegetative communities related to changes in drainage and flow, with construction impacts being only temporary. Vegetative communities provide foraging and refugia for aquatic species that can be used for spawning and shelter. The operation and maintenance of the pump station described would significantly affect aquatic resources and fisheries issues by reducing stacking during high water events, and plans developed if this measure becomes part of the TSP will be needed to address how to mitigate those impacts. Cumulative impacts would entail a permanent shift in vegetation, and impacts to spawning and migrating aquatic species that rely upon the waterways disrupted by this levee measure would be significant. 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 Engineering Appendix D.

Implementation of the diversion measure in Alternative 7 would have direct impacts to migration and spawning aquatic species due to construction activity and changes in flow altering vegetative communities. 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. Cumulative impacts would entail a permanent shift in vegetation, and impacts to aquatic species that rely upon the waterway would be significant. 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 Engineering Appendix D.

Implementation of the channel measures in Alternative 7 would have direct impacts to migration and spawning aquatic species due to construction activity and changes in flow altering vegetative communities. 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. Cumulative impacts would entail a permanent shift in vegetation, or its loss through erosion, and spawning and migrating aquatic species that rely upon the waterways would experience a loss in refugia that is expected to be permanent. 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.

Alternative 8: Upper Tchefuncte/Covington

Direct, indirect, and cumulative impacts

Implementation of the channel measures in Alternative 8 would have direct impacts to migration and spawning aquatic species due to construction activity and changes in flow altering vegetative communities. Indirect impacts would be shifts in vegetative communities related to changes in hydrology, with construction impacts being only temporary. Cumulative impacts would entail a permanent shift in vegetation, or its loss through erosion, and spawning and migrating aquatic species that rely upon the waterways would experience a loss in refugia that would be expected to be permanent. 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.

Alternative 9: Mandeville

Direct, indirect, and cumulative impacts

Implementation of the varying configuration of seawall and pump station measures in Alternative 9 would have direct impacts to migration and spawning aquatic species due to construction activity and changes in flow altering vegetative communities. Indirect impacts would be shifts in vegetative communities related to changes in hydrology, with construction impacts being only temporary. Cumulative impacts would a permanent shift in vegetation, or its loss through erosion, and spawning and migrating aquatic species that rely upon the waterways would experience a loss in refugia that would be expected to be permanent. 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.

TSP

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 different levee footprint would be likely to 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. Cumulative impacts would entail a permanent shift in vegetation, and impacts to spawning and migrating aquatic species that rely upon the waterways disrupted by these levee measures would be significant. 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 Engineering Appendix D.

Bayou Patassat Channel Improvements

Implementation of the channel clearing in Bayou Patassat would be a temporary loss of water quality during construction, but lasting improvements to drainage and flow. Indirect impacts would be expected to be temporary and would likely improve the existing habitat to lasting benefits to aquatic resources and fisheries in the channels. Vegetative communities provide foraging and refugia for aquatic species that can be used for spawning and shelter. Cumulative impacts would entail a permanent shift in vegetation, and spawning and migrating aquatic species that rely upon the waterways would experience a loss in refugia that would be expected to be permanent. 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.

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. Indirect impacts would be shifts in vegetative communities related to changes in hydrology, with construction impacts being only temporary. Cumulative impacts would entail a permanent shift in vegetation, or its loss through erosion, and spawning and migrating aquatic species that rely upon the waterways would experience a loss in refugia that would be expected to be permanent. 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.

Nonstructural Elevations and Flood-Proofing

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

5.3.1.5 Essential Fish Habitat (EFH)

Alternative 1: No Action and Alternative 2: Nonstructural:

No impact on EFH.

Alternative 4 Lacombe, Alternative 5 Bayou Liberty/Bayou Vincent/Bayou Bonfouca, Alternative 6: South Slidell, Alternative 7: Eastern Slidell, Alternative 8: Upper Tchefuncte/Covington, Alternative 9: Mandeville

Estuarine wetlands are the primary type of EFH that would be impacted with construction of each of the structural alternatives 4-9. Construction of the levee measures, channel clearing measures, and floodwalls or seawalls would directly impact estuarine emergent wetlands by changing hydrology in the study 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 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. Bull sharks use Lake Pontchartrain for spawning, and noise and activity or shifts in water quality as the result of construction activities would deter their utilization of the area. Cumulatively these impacts would be considered minimal due to the large size of the basin, and similar EFH located within the study area, specifically St. Tammany Parish. More information on EFH species and habitats can be found in Environmental Appendix C.

TSP

Estuarine wetlands are the primary type of EFH that would be impacted with construction of the TSP 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 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.

5.3.1.6 Wildlife

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

Alternative 1: No Action Alternative

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

Direct, indirect, and cumulative impacts

Flood-proofing, structure raising, buyouts, 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. Buyouts and 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.

Alternative 4: Lacombe

Direct, indirect, and cumulative impacts

Implementation of any of the levee measures in Alternative 4 would directly result in the loss of forested habitat for terrestrial wildlife species with the potential for species mortality and displacement for species present during construction. It is anticipated that displaced wildlife would return to similar habitat in the area once construction is complete. Traffic from proposed access roads would also directly impact wildlife species that are present during construction activities, resulting in further mortality and displacement. Indirect impacts associated with construction activities would potentially limit the range of mobile species to the adjacent wildlife refuges.

Cumulatively, these levee measures would be likely to contribute to the preservation of terrestrial habitat for wildlife in the area, particularly on the existing wildlife refuges. It is reasonably foreseeable that any of these levee measures would work to benefit future ecosystem restoration and mitigation projects in the area by reducing soil erosion and increasing stability.

Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca

Direct, indirect, and cumulative impacts

Direct, indirect, and cumulative impacts of the levee measures in Alternative 5 would be expected to be similar in nature to those described for Alternative 4: Lacombe previously.

Implementation of the channel improvement measure would directly result in the loss of a very small amount, under 1 acre, of forested habitat for terrestrial wildlife species due to construction activities. The area is in a highly developed residential area, and the species in the area are highly adaptive to the presence of anthropogenic activity. It is anticipated that any displaced wildlife would return to similar habitat once construction is complete.

Cumulatively, these measures would likely stabilize terrestrial habitat that is being lost to erosion.

Alternative 6: South Slidell

Direct, indirect, and cumulative impacts

Implementation of either of the levee measures in Alternative 6 would directly result in the loss of forested habitat for terrestrial wildlife species with the potential for species mortality and displacement for species present during construction. The area is in a highly developed residential area with limited terrestrial habitat. It is anticipated that any remaining displaced wildlife in this area would return to similar habitat once construction is complete. 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.

Cumulatively, these levee measures would be likely to contribute to the preservation of the last remaining terrestrial habitat for wildlife in the area, and in fact could help to stabilize terrestrial habitat that is being lost to erosion. It is reasonably foreseeable that either of these levee measures would work to benefit future ecosystem restoration or mitigation projects in the area by reducing soil erosion and increasing stability.

Alternative 7: Eastern Slidell

Direct, indirect, and cumulative impacts

Implementation of the levee measures in Alternative 7 would directly result in the loss of forested habitat for terrestrial wildlife species with the potential for species mortality and displacement for species present during construction. Due to its present condition, the area is in a highly developed residential area with limited terrestrial habitat. It is anticipated that any remaining displaced wildlife in the area would return to similar habitat once construction is complete. Indirect impacts would be on adjacent habitats that would experience a burden due to displacement. Where there is a permanent loss of habitat as the result of construction, then affected species would not return or utilize the affected habitat in the same manner.

Cumulatively, these measures would be likely to contribute to the preservation of the last remaining terrestrial habitat for wildlife in the area, and in fact could help to stabilize terrestrial habitat that is being lost to erosion. It is reasonably foreseeable that any of these measures would work to benefit future ecosystem restoration or mitigation projects in the area.

Alternative 8: Upper Tchefuncte/Covington

Direct, indirect, and cumulative impacts

Implementation of the channel improvement measures in Alternative 8 would directly result in the loss of a very small amount, under 1 acre, of forested habitat for terrestrial wildlife species due to construction activities. The area is in a highly developed residential area, and the species in the area are highly adaptive to the presence of anthropogenic activity. It is anticipated that any displaced wildlife would return to similar habitat once construction is complete. Cumulatively, these measures would likely stabilize terrestrial habitat that is being lost to erosion.

Alternative 9: Mandeville

Direct, indirect, and cumulative impacts

Implementation of the seawall measures in Alternative 9 would not directly result in the loss of the forested habitat for terrestrial wildlife species due to construction activities. The area is in a highly developed residential area directly on Lake Pontchartrain, and the remaining terrestrial species currently in the area are highly adaptive to the presence of anthropogenic activity. It is also adjacent to a state park, which mobile terrestrial wildlife would likely access. It is anticipated that any displaced wildlife would return to similar habitat once construction is complete. Cumulatively, these measures would likely to stabilize the remaining limited terrestrial habitat that is being lost to erosion.

TSP:

West Slidell and South Slidell Levees

Implementation of this levee measure would directly result in the loss of forested habitat for terrestrial wildlife species with the potential for species mortality and displacement for species present during construction. The area is in a highly developed residential area with limited terrestrial habitat. It is anticipated that any remaining displaced wildlife in the area would return to similar habitat once construction is complete. 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.

Cumulatively, these levee measures would be likely to contribute to the preservation of the last remaining terrestrial habitat for wildlife in the area, and in fact could help to stabilize terrestrial habitat that is being lost to erosion. It is reasonably foreseeable that either of these levee measures would work to benefit future ecosystem restoration or mitigation projects in the area by reducing soil erosion and increasing stability.

Bayou Patassat Channel Clearing

Implementation of the channel clearing would directly result in the loss of a very small amount, under 1 acre, of forested 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. It is anticipated that any displaced wildlife would return to similar habitat once construction is complete. Cumulatively, these measures would likely stabilize terrestrial habitat that is being lost to erosion.

Mile Branch Channel Clearing

Implementation of the channel clearing would directly result in the loss of a very small amount, under 1 acre, of forested 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. It is anticipated that any displaced wildlife would return to similar habitat once construction is complete. Cumulatively, these measures would likely stabilize terrestrial habitat that is being lost to erosion.

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. Buyouts and 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.

5.3.1.6.1 Borrow

Each of the five borrow sources currently consist 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. More information regarding the selection of borrow sources can be found in Appendix B.

5.3.1.7 Threatened, Endangered, and Protected Species

USACE has coordinated closely with the USFWS and the LDWF as cooperating agencies to identify protected species of concern throughout the study area. Listed species under the jurisdiction of USFWS include: 1) West Indian Manatee (T); 2) Red-cockaded Woodpecker (E); 3) Gopher Tortoise (T); 4) Ringed Map Turtle (T); and 5) Gulf Sturgeon (T). Additionally, the eastern portion of Lake Pontchartrain is designated as critical habitat for Gulf Sturgeon. Gulf sturgeon and its critical habitat also fall under NMFS jurisdiction. An exhaustive list of potentially present species was provided in the Planning Aid Letter from USFWS, but limited data suggests only a few known protected species occur within the TSP footprints. Surveys will be needed before construction for all structural alternatives, and consultation under the Endangered Species Act is required to address impacts, which is ongoing. 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 to aid 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. Please refer to Environmental Appendix C for more information.

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. Consultation on impacts to protected species will be needed to address these concerns if it is determined they are present.

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 excavation of material. More information regarding borrow including location sources can be found in Appendix B and quantities can be found in Engineering Appendix D.

The construction of levees and borrow canals 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 Alternative

Direct, indirect, and cumulative impacts

Under this alternative, 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. Please refer to Environmental Appendix C for more information.

Alternative 2: Nonstructural

Direct, indirect, and cumulative impacts

Flood-proofing, structure raising, buyouts, 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. Please refer to Environmental Appendix C for more information.

Alternative 4: Lacombe

Direct, indirect, and cumulative impacts

Protected species may occur within the area, and their presence within the area is likely due to the adjacent National Wildlife Refuges. The forested areas surrounding the area would allow wildlife to easily avoid the project activities. The proposed action would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS. Gulf sturgeon and West Indian manatee impacts identified during consultation will be addressed with USFWS and NMFS, and a Section 7 Endangered Species Act consultation is currently ongoing.

West Indian manatees and Gulf sturgeon are potentially present in the area and could be impacted by the construction activities associated with the levee measures. The NLAA determination for the West Indian manatee includes Standard Manatee Conditions for In-Water Activities to ensure there are no adverse effects potentially occurring in the area, construction guidelines can be found in Environmental Appendix C.

Bald eagles and Red cockaded woodpeckers could also potentially be impacted by loss of nesting habitat. During nesting season, construction must take place outside of USFWS/LDWF buffer zones. A USACE Biologist and USFWS Biologist would survey for nesting birds prior to the start of construction.

At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, freckleblly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll’s false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return to the area upon completion of construction activities. Please refer to Environmental Appendix C for more information.

Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca

Direct, indirect, and cumulative impacts

Direct, indirect, and cumulative impacts of the measures in Alternative 5 would be expected to be similar in nature to those described previously for Alternative 4: Lacombe. Bald eagles, red-cockaded woodpeckers, Gulf sturgeon, and the West Indian manatee could be potentially present within the area, and consultation with USFWS and NMFS would be required. The proposed action would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS. Impacts identified during consultation will be addressed with USFWS and NMFS if this measure or alternative is part of the selected plan. At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, frecklebly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll's false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return completion of construction activities. Please refer to Environmental Appendix C for more information.

Alternative 6: South Slidell

Direct, indirect, and cumulative impacts

Direct, indirect, and cumulative impacts of the measures in Alternative 6 would be expected to be similar in nature to those described previously for Alternative 4: Lacombe. Bald eagles, red-cockaded woodpeckers, Gulf sturgeon, and the West Indian manatee could potentially be present within the area, and consultation with USFWS and NMFS would be required. The proposed action would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS. Impacts identified during consultation will be addressed with USFWS and NMFS if this measure or alternative is part of the selected plan.

At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, frecklebly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll's false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return upon completion of construction activities. Please refer to Environmental Appendix C for more information.

Alternative 7: Eastern Slidell

Direct, indirect, and cumulative impacts

Direct, indirect, and cumulative impacts of the measures in Alternative 7 would be expected to be similar in nature to those described previously for Alternative 4: Lacombe. Bald eagles, red-cockaded woodpeckers, Gulf sturgeon, and the West Indian manatee could potentially be present within the area, and consultation with USFWS and NMFS would be required. The proposed action would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS. Impacts identified during consultation will be addressed with USFWS and NMFS if this measure or alternative is part of the selected plan.

At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, freckleblly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll's false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return upon completion of construction activities. Please refer to Environmental Appendix C for more information.

Alternative 8: Upper Tchefuncte/Covington

Direct, indirect, and cumulative impacts

Direct, indirect, and cumulative impacts of the measures in Alternative 8 would be expected to be similar in nature to those described previously for Alternative 4: Lacombe. Bald eagles, red-cockaded woodpeckers, Gulf sturgeon, and the West Indian manatee could be potentially present within the area, and consultation with USFWS and NMFS would be required. The proposed action would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS. Impacts identified during consultation will be addressed with USFWS and NMFS if this measure or alternative is part of the selected plan.

At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, freckleblly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll's false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return upon completion of construction activities. Please refer to Environmental Appendix C for more information.

Alternative 9: Mandeville Lakefront

Direct, indirect, and cumulative impacts

Direct, indirect, and cumulative impacts of the measures in Alternative 9 would be expected to be similar in nature to those described previously for Alternative 4: Lacombe. Bald eagles, red-cockaded woodpeckers, Gulf sturgeon, and the West Indian manatee could be potentially present within the area, and consultation with USFWS and NMFS would be required. The proposed action would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS. Impacts identified during consultation will be addressed with USFWS and NMFS if this measure or alternative is part of the selected plan.

At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, freckleblly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll's false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return upon completion of construction activities. Please refer to Environmental Appendix C for more information.

TSP

Protected species may occur within the area likely due to the adjacent National Wildlife Refuges. The forested areas surrounding the area would allow wildlife to easily avoid the project activities. The implementation of the TSP would be unlikely to cause adverse direct or indirect impacts to (i.e., may affect, not likely to adversely affect (NLAA)) federally-listed threatened or endangered species, or their critical habitat, under the jurisdiction of USFWS.

West Indian manatees and Gulf sturgeon are potentially present in the area and could be impacted by the construction activities associated with the levee measures. The NLAA determination for the West Indian manatee includes Standard Manatee Conditions for In-Water Activities to ensure there are no adverse effects potentially occurring in the area, construction guidelines can be found in Environmental Appendix C. Gulf sturgeon and West Indian manatee impacts identified during consultation will be addressed with USFWS and NMFS, and a Section 7 Endangered Species Act consultation is currently ongoing.

Bald eagles and Red cockaded woodpeckers could also potentially be impacted by loss of nesting habitat. During nesting season, construction must take place outside of USFWS/LDWF buffer zones. A USACE Biologist and USFWS Biologist would survey for

nesting birds prior to the start of construction. Impacts identified during consultation will be addressed with USFWS if this measure or alternative is part of the selected plan.

In addition to the direct loss of grassland and forested habitat, the implementation of some of the features of the TSP may indirectly impact migratory birds of conservation concern because construction of large-scale projects within forested habitats typically results in habitat fragmentation. Forest fragmentation may contribute to population declines in some avian species because fragmentation reduces avian reproductive success (Robinson et al. 1995). Fragmentation can alter the species composition in a given community because biophysical conditions near the forest edge can significantly differ from those found in the center or core of the forest. As a result, edge species could recruit to the fragmented area and species that occupy interior habitats could be displaced. The fragmentation of intact forests could have long-term adverse impacts on some forest interior bird species.

At-risk species of concern for USFWS that may be impacted by this alternative include: Golden-winged warbler, freckleblly madtom, saltmarsh topminnow, monarch butterfly, southern snaketail dragonfly, eastern grass beard skipper, tricolored bat, Alabama hickorynut, Correll's false dragon head, alligator snapping turtle, eastern diamondback rattlesnake, and Pearl River map turtle. Insufficient data is available to definitively determine presence of any of these species, but all may be present. Noise and vibration from construction activities would displace each of these species and change utilization of the site. Each species has a wide range, and each would likely return upon completion of construction activities. Please refer to Environmental Appendix C for more information.

5.3.1.8 Water Quality

Alternative 1: No Action Alternative

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 area continues to erode as a result of flood events and human development in the Area of Potential Effect (APE).

Alternative 2: Nonstructural

Direct, indirect, and cumulative impacts

This alternative would be similar in impacts to Alternative 1, but influence a smaller extent of the APE.

Alternatives: 4, 5, 6, 7, 8, and 9

Direct, indirect, and cumulative impacts

USACE is applying for a Water Quality Certification (WQC) from LDEQ to determine whether the construction of these proposed features would impact established site-specific water

quality standards, and will be included in the final report before a Record of Decision is signed. The construction contractor would be required to comply with any applicable conditions and requirements included as part of the issued WQC. USACE has filed for a Coastal Zone Consistency Determination with Louisiana Department of Natural Resources. This determination evaluates the TSP's consistency with enforceable policies of the state's coastal management program. The construction contractor would be required to comply with any special conditions pertaining to protection of water quality contained in LDNR's final determination for the TSP. Additionally, to help avoid and minimize the proposed action's impacts to water quality, the construction contractor would be required to prepare a Stormwater Pollution Prevention Plan (SWPPP) for review and approval by the USACE. The construction contractor would then be required to apply for and obtain a Stormwater General Permit (i.e., Louisiana Pollutant Discharge Elimination System General Permit) from the LDEQ. The construction contractor would further be required to comply with all applicable conditions and requirements set forth in the issued permit. The required permits and actions above are designed to lessen construction impacts on receiving waterbodies.

Activities for these alternatives 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 for these alternatives 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.

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.

5.3.1.9 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 5-1.

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)) would not apply.

Table 5-2: 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

With implementation of this alternative, no direct or indirect impacts to air quality would occur.

Alternatives 2, 4, 5, 6, 7, 8, and 9

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.

5.3.1.10 Hazardous, Toxic, and Radioactive Waste

The purpose of a Phase I ESA is to identify, to the extent feasible in the absence of sampling and analysis, the range of contaminants (i.e., *Recognized Environmental Conditions* [RECs]) within the scope of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and petroleum products. The 2002 Brownfields Amendments to the CERCLA require EPA to promulgate regulations establishing standards and practices for conducting “all appropriate inquiries”. “All appropriate inquiries” is a process of evaluating a property’s environmental conditions and assessing potential liability for any contamination. “All appropriate inquiries” must be conducted to obtain certain protections from liability under the federal Superfund Law (i.e., CERCLA). As directed by the EPA, the results of an “all appropriate inquiries” investigation must be documented in a report. The EPA requires no specific format, length, or structure of the written report. However, the EPA recommends utilizing the American Society for Testing and Materials (ASTM) E 1527-13 standard as it is consistent with the requirements and provisions in the “all appropriate inquiries” rule.

A preliminary Phase I ESA (preliminary ESA) was conducted to assess the potential for HTRW materials within the footprints for each of the measures in the Final Array of Alternatives and the results of each are presented. See Appendix C. This 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 RECs, and 2) site reconnaissance to accessible regions of the subject areas to determine if RECs are within the work item ROW. The site reconnaissance was conducted via public access roads and public parks due to no active right of entry (ROE) for this feasibility study.

Eight alternatives were investigated: Alternative 1. No Action, Alternative 2. Nonstructural, Alternative 4. Lacombe, Alternative 5. Bayou Liberty/ Bayou Vincent/Bayou Bonfouca, Alternative 6. South Slidell, Alternative 7. Eastern Slidell, Alternative 8. Upper Tchefuncte/Covington, Alternative 9. Mandeville Lakefront.

Task 1 Results:

A review of online databases of each alternative in the Final Array and the TSP was performed by CEMVN and the results are set forth below. Detailed maps are contained in Appendix C :

Alternatives 4: No RECs were found within a 1-mile radius of the study area.

Alternative 5: No RECs were found within a 1-mile radius of the study area.

Alternatives 6: One Superfund (National Priorities List) site, one Toxic Substances Control Act site, two Brownfields sites, and six TRI sites were found within a 1-mile radius of the study area.

Alternative 7: No RECs were found within a 1-mile radius of the study area.

Alternative 8: One Brownfields site was found within a 1-mile radius of the study area.

Alternatives 9: No RECs were found within a 1-mile radius of the study area.

Task 2 Results:

CEMVN made site visits to the alternative areas on 21 October 2020 and 22 October 2020. 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. Aforementioned indicators were found during the site visits.

Within Alternative 8, two waste tires were found on the northeast side of the bridge within the channel of Mile Branch. A rusted 50-gallon drum was found on the southwest side within channel of Mile Branch. Please see Environmental Appendix C for more information.

Based on the results of Task 1 and Task 2 described previously, the probability of encountering HTRW during the construction would be low. Though HTRW indicators were found within the channels, these items indicate de minimis risk of encountering HTRW, but should be addressed prior to any construction. When the final report is completed, ROD is signed, and funding allocated, then a final full Phase I ESA will be executed on the project features prior to construction. Additionally, new Phase I ESAs would be required within a 6 month period prior to the start of construction to ensure that no additional RECs are present.

5.3.1.10.1 Borrow

Some of the sites in the Slidell area were looked at for the W-14 Canal project back in 2011. The others would need to be surveyed for HTRW, however, all possible borrow areas do not have any apparent RECs or HTRW issues with the exception of the potential borrow site near the intersection of Hwy 59 and I-12.

5.3.1.11 Cultural, Historic, and Tribal Trust Resources

The USACE would fulfill its Section 106 procedures, described in Section 8.8 (Environmental Laws and Regulations: NHPA of 1966), if the TSP is carried forward by 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, that outlines the steps needed to identify and evaluate cultural resources and make determinations of effects (see Appendix C). This PA would be executed and in force prior to the USACE signing the Record of Decision. 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 will be documented at that time.

Alternative 1: No Action

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.

Alternative 2: Nonstructural

Direct, indirect, and cumulative impacts

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 above-ground historic properties 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.

Alternative 4: Lacombe

4a: Lacombe Levee

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, construction of structural features (levee, pump station, gate complex, road ramps), 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. No known archaeological sites are within the location of this alternative. No previously recorded historic built resources are located within the location of this alternative.

This measure includes the introduction of new visual elements (levee, pump station, gate complex, road ramps) 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.

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).

4a.1: Lacombe Levee Short

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for this alternative would be similar to *4a: Bayou Lacombe Levee* described previously.

4b: Lacombe Levee combined with West Slidell Levee

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for the considered action would be similar to *Measure 4a.1: Lacombe Levee Short* described previously and *Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca* described below. Additionally, Site 16ST40, Site 16ST42, and Site 16ST138 are located within the levee footprint and would require further investigation as to whether they may be adversely affected by construction of Alternative 4b. Previously recorded historic built resources are located within and adjacent to the alternative and would require further investigation.

Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca

Bayou Bonfouca Detention Pond

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, clearing and grubbing, excavation, and borrow fill. 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. No known archaeological sites are within the alternative. No previously recorded historic built resources are located within the alternative.

This measure includes the introduction of new visual elements 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.

The cumulative impacts to cultural resources for the considered action would be similar to *Measure 4a: Lacombe Levee* described previously.

Bayou Patassat Channel Improvements

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, clearing and snagging, 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. No known archaeological sites are within the location of this alternative. No previously recorded historic built resources are within the location of this alternative.

The indirect impacts to cultural resources for this alternative would be similar to *Measure: Bayou Bonfouca Detention Pond* described above.

The cumulative impacts to cultural resources for this alternative would be similar to *Measure: 4a –Lacombe Levee* described previously.

Bayou Liberty Channel Improvements

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for this alternative would be similar to *Measure: Bayou Patassat Channel Improvements* described previously. Additionally, Site 16ST143 is located within the channel footprint and would require further investigation as to whether it may be adversely affected by the channel improvements.

Alternative 6: South Slidell

6a: Slidell Levee

Direct, indirect, and cumulative impacts

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 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. 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 also includes components within the local Slidell Olde Town Preservation District.

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 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.

The cumulative impacts to cultural resources for this alternative would be similar to *Measure 4a: Lacombe Levee* described previously.

6b: Slidell Levee with Eden Isle

The direct, indirect, and cumulative impacts to cultural resources for the considered action would be similar to *Measure 6a: Slidell Levee* described previously. There are no known archaeological sites within the location of this alternative. Previously recorded historic built resources are located within and adjacent to the footprints of this alternative.

Alternative 7: Eastern Slidell

Gum Bayou Diversion

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for the considered measure would be similar to *Measure: Bayou Bonfouca Detention Pond* described previously. No known archaeological sites are within the proposed alternative. No previously recorded historic built resources are located within the footprint of this alternative.

Poor Boy Canal Channel Improvements

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, clearing and grubbing, mechanical dredging, 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. There are no known archaeological sites within the location of this alternative. No previously recorded historic built resources are located within the footprints of this alternative.

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 for this alternative would be similar to *Measure 4a: Bayou Lacombe Levee* described previously.

Doubloon Bayou Channel Improvements

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for the considered measure would be similar to *Measure: Poor Boy Canal Channel Improvements* described above. Site 16ST114 is located within the footprint; however, the turpentine cup scatter site was recommended not eligible due to lack of research potential. No previously recorded historic built resources are located within the footprints of this alternative.

Pearl River Levee

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, construction of structural features (levee, access gate, floodgate, pump station, gate complex), 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. Additionally, Site 16ST56/80 and Site 16ST151 are located within the footprint; however, the prehistoric sites were recommended not eligible due to disturbance and lack of research potential.

This measure includes the introduction of new visual elements (levee, access gate, floodgate, pump station, gate complex 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.

The cumulative impacts to cultural resources for the considered action would be similar to *Measure 4a: Bayou Lacombe Levee* described previously.

Alternative 8: Upper Tchefuncte/Covington

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 nomination to 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

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 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. One archaeological site, Wilson Cemetery (16ST273), is adjacent to the alternative at the northern end. 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.

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 for this alternative would be similar to *Measure 4a: Bayou Lacombe Levee* described previously.

Mile Branch Lateral A Channel Improvements

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for the considered measure would be similar to *Measure: Mile Branch Channel Improvements* described previously. No known archaeological sites are within the footprint of this alternative. There are previously recorded historic built resources adjacent to the footprint of this alternative; however, there are no previously recorded historic built resources within the location of this alternative.

Alternative 9: Mandeville Lakefront

Background: In 1994, Earth Search, Inc. conducted reconnaissance cultural resources investigations of the Mandeville seawall replacement on behalf of CEMVN (22-1744). The Study Area was bordered to the north by Lakeshore Drive, to the south by the present-day seawall, and extended from the westernmost end of Lakeshore Drive (one block west of West Beach Parkway) to 160 feet east of Little Bayou Castine, Seven backhoe trenches were excavated with two of the trenches placed at the suspected locations of portions of the original 1895 wooden seawall. Very few artifacts were recovered during the investigation. As a result, the reconnaissance survey indicated that replacement of the Mandeville seawall would not significantly impact archaeological resources.

In 1996, R. Christopher Goodwin & Associates, Inc. completed a Phase I cultural resources survey and inventory of the planned Mandeville Hurricane Protection Project Item on behalf of CEMVN (22-1967). The 200 m (656 ft) wide corridor consisted of approximately 311 ac (125.9 ha) and included Highway 190 to the north, Little Bayou Castine to the east, Causeway Boulevard to the west, and Lake Pontchartrain to the south. Approximately 44.7 ac (18.1 ha) was considered to be high probability areas for containing either prehistoric or historic cultural resources; the remaining 266.3 ac (1 07.8) were classified as low probability areas. Pedestrian survey and subsurface testing were completed on approximately 42.4 ac (17.2 ha) of the 44.7 ac (18.1 ha) of high probability areas. Despite the excavation of 92 shovel tests, no cultural resources loci or evidence of intact cultural deposits were identified. None of the surveyed areas are recommended for additional testing. However, Phase I cultural resource survey was recommended for the 2.3 ac (0.9 ha) where right-of-entry was denied. The architectural survey included a reconnaissance level examination and a preliminary visual assessment of each historic standing structure found within or immediately adjacent to the location of this alternative. The architectural investigations identified 47 built resources, including three that are currently listed in the NRHP, and the Old Mandeville Cemetery. The investigations also concluded that indirect (visual) impacts to historic buildings located along Lakeshore Drive and Little Bayou Castine would be adverse.

9a: Mandeville Seawall (7.3 ft) with Passive Drainage System

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, construction of structural features (seawall, floodwalls, pump stations, vehicular gates, pedestrian gates), 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. There are no known archaeological sites within the location of this alternative. Previously recorded historic built resources and one

individually NRHP listed building, the Dew Drop Social and Benevolent Hall, are located within the vicinity of one measure of this alternative.

This alternative includes a measure that would be located within the local Mandeville Historic Preservation District. This measure includes the introduction of new visual elements (seawall, floodwalls, pump stations, vehicular gates, pedestrian gates) 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.

The cumulative impacts to cultural resources for this alternative would be similar to *Measure 4a: Bayou Lacombe Levee* described previously.

9b: Mandeville Seawall (7.3 ft) with Pump Station on Bayou Ravine aux Coquilles

Direct, indirect, and cumulative impacts

This measure includes ground disturbing activities involving access, staging, construction of structural features (seawall, floodwalls, pump stations, gate complex, vehicular and pedestrian roller gates), 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. There are no known archaeological sites within the location of this alternative. Previously recorded historic built resources are located within and adjacent to the footprints of this alternative.

This alternative includes the introduction of new visual elements (seawall, floodwalls, pump stations, gate complex, vehicular and pedestrian roller gates) 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.

The cumulative impacts to cultural resources for the considered action would be similar to *Measure 4a: Bayou Lacombe Levee* described previously.

9c: Mandeville Seawall (18 ft) with Pump Station on Bayou Ravine aux Coquilles

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for the considered action would be similar to *Measure 9b: Mandeville Seawall (7.3 feet) with Pump Station on Bayou Ravine au Coquilles* described previously. There are no known archaeological sites within the location of this alternative. Previously recorded historic built resources are located within and adjacent to the location of this alternative.

TSP

Direct, indirect, and cumulative impacts

The direct, indirect, and cumulative impacts to cultural resources for the TSP would be the same as Alternative 2: Nonstructural, Combined *Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca* and *Measure 6a: Slidell Levee, Measure 5: Bayou Patassat Channel Improvements,* and *Measure 8: Mile Branch Channel Improvements* described above.

5.3.1.11.1 Borrow

STP-5	Cleared Site 5	Lacombe, LA	73	1,817,700	Carried Forward- existing retention pond- potential to increasing the retention capacity at this site-beneficial location, falls within defined soil/environmental parameters, and already has a similar land use	PDT-cleared lands, available soil data
STP-6	Cleared Site 6	Slidell, LA	10	249,000	Carried Forward	PDT-cleared lands, available soil data
STP-9	Cleared Site 9	Slidell, LA	17	423,300	Carried Forward	PDT-cleared lands, NRCS soil layer
MS-1	Pearlington	Hancock County, MS	326	8,000,000	Carried forward- 3 potential sites at location (2 approved). potential commercial site. Remaining borrow available at each needs to be determined. Pearlington Phase 3 site has wetlands and if determined to be needed to meet fill requirements the site would need mitigation	HSDRRS IER 19 and IER 23
MS-2	Port Bienville	Hancock County, MS	677	16,857,300	Carried Forward- HSDDRS approved site- potential commercial site previously planted in pine for commercial harvesting, mixture of overgrown pine habitat and cleared areas. Remaining borrow available needs to be determined, potential commercial site	HSDRRS IER 31

STP-5

In January 2011, SURA, Inc. conducted a 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 (Kuttruff et al. 2011). No cultural resources were identified within the St-5 borrow site.

STP-6

The St-6 borrow site 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 borrow area.

STP-9

In 2008, R. Christopher Goodwin & Associates, Inc. conducted a 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 (Moreno et al. 2012). One of the five areas surveyed included the proposed Robert Road Northern Detention Pond which encompasses the footprint of the currently proposed St-9 borrow area. The parcel surveyed included 30.28 acres (12.25 ha). No cultural material or evidence of intact cultural deposits was identified as a result of this investigation. A determination of No Historic Properties Affected was submitted to the LA SHPO on 9 September 2008 and 22 September 2011. SHPO concurred with his determination on 7 October 2008 and 16 November 2011.

MS-1

MS-1 was investigated for cultural resources for IER #19 and #23. During that time, the Mississippi Division of Archives and History (MDAH) had no record of historic or prehistoric archaeological sites eligible for listing or listed in the NRHP within MS-1. A Phase I survey of the proposed borrow area did not identify any cultural resources within the Pearlington area of potential effect (APE) (Pumphrey 2007). The MS SHPO concurred with CEMVN's determination on the proposed borrow area on 22 November 2006.

MS-2

MS-2 was investigated for cultural resources for IER #31. A Phase I cultural resources assessment was performed of the Port Bienville contractor-furnished borrow area and no National Register eligible cultural resources were identified. Concerns were raised by the Jena Band of Choctaws and the Mississippi Band of Choctaws, about the possibility of unrecorded burials within the proposed borrow area. At that time, a Memorandum of Agreement (MOA) was signed between the Jena Band and the Mississippi Band of the Choctaw Indians 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 agreement to resolve the adverse effects from the proposed undertaking. The new agreement may acknowledge, incorporate, or continue already agreed upon measures.

Kuttruff, L. Carl, Lea Taylor Gabour, Malcoln K. Shuman, and Phillip K. Taylor

2011 *Phase I Cultural Resources Survey of 156.41 Acres (63.30 Hectares) on Cypress Bayou, St. Tammany Parish, Louisiana*. Prepared for Department of Engineering, St.

Tammany Parish. On file at the Louisiana Department of Culture, Recreation, and Tourism, Baton Rouge, Louisiana. Report No. 22-3725. Moreno, Meredith, Emily Crowe, Nathanael Heller, and William P. Athens

2012 *Phase I Cultural Resources Survey and Archeological Inventory of the Proposed W-14 Drainage Canal Detention Ponds, St. Tammany Parish, Louisiana*. Prepared for USACE. On file at the Louisiana Department of Culture, Recreation, and Tourism, Baton Rouge, Louisiana. Report No. 22-3151. Pumphrey, E. and H. L. Richardson Seacat

2007. *A Phase I Cultural Resource Assessment of 424 Acres near Pearlington, Hancock County, Mississippi*. Report prepared for R. Scott Higginbotham, Soil Tech Consultants, Inc., Ridgeland, MS by Center for Archaeological Studies, University of South Alabama, Mobile, AL. USACE

2012 *Supplemental Environmental Assessment Southeast Louisiana (SELA) Urban Flood Control Project W-14 Drainage Canal, Slidell Area, St. Tammany Parish, Louisiana. SEA# 409A.*

5.3.1.12 Noise and Vibration

Alternatives 1 and 2

Direct, indirect and cumulative impacts: These alternatives would not have an impact on noise and vibration.

Alternatives 4, 5, 6, 7, 8, 9

Construction activities in each of the measures would consist of heavy equipment associated during levee construction, diversion construction, and channel clearing. Overall 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 Engineering Appendix D.

It is expected that the excavation of borrow material would contribute to noise and vibration in the general vicinity. More information regarding borrow including location sources can be found in Appendix B and quantities can be found in Engineering Appendix D.

5.3.1.13 Aesthetics

Alternative 1: No Action

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 2: Nonstructural

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 or demolishing historic structures.

Alternative 4: Lacombe

4a: Lacombe Levee

The direct, indirect, and cumulative impacts to visual resources caused by this measure 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 alterations to the Louisiana Natural and Scenic Rivers System's Bayou Lacombe.

4a.1: Lacombe Levee Short

The direct, indirect, and cumulative impacts to visual resources caused by this alternative would be similar to Alternative 4a.

4b: Lacombe Levee Combined with West Slidell Levee

The direct, indirect, and cumulative impacts to visual resources caused by this measure would be similar to measure 4a described previously.

Alternative 5: Bayou Liberty/Bayou Vincent/Bayou Bonfouca

The direct, indirect, and cumulative impacts to visual resources caused by this alternative are detailed in the cultural resources' section; these impact the area's viewshed and alterations to the Louisiana Natural and Scenic Rivers System's Bayou Liberty.

Alternative 6: South Slidell

6a: Slidell Levee

The direct, indirect, and cumulative impacts to visual resources caused by this measure are detailed in the cultural resources' section; these impacts would include the introduction of potentially visually distressful elements into the area's viewshed.

6b: South Slidell Leveee with Eden Isle

The direct, indirect, and cumulative impacts to visual resources for the considered measure would be similar to measure 6a described previously.

Alternative 7: Eastern Slidell

The direct, indirect, and cumulative impacts to visual resources caused by this 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 alterations to the Louisiana Natural and Scenic Rivers System.

Alternative 8: Upper Tchefuncte/Covington

The direct, indirect, and cumulative impacts to visual resources caused by this alternative are detailed in the cultural and recreational resources' sections; these impacts include the introduction of potentially visually distressful elements into the area's viewshed and alterations to the Louisiana Natural and Scenic Rivers System's Tchefuncte River.

Alternative 9: Mandeville Lakefront

The direct, indirect, and cumulative impacts to visual resources caused by this alternative are detailed in the cultural and recreational resources' sections; these impacts include the introduction of potentially visually distressful elements into the area's viewshed and/or modifications to the built-environment that includes alterations or demolition of historic structures. Additionally, there is the potential for significant viewsheds to be blocked due to proposed seawall heights or locations.

TSP

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 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 or demolishing historic structures.

Borrow

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.

5.3.1.14 Recreation

Alternative 1: No Action

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 recreation 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

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. An indirect impact of elevating structures on building costs of future recreational camps could result in fewer camps being constructed.

Alternative 4: Lacombe

With the proposed 9 mile-long Lacombe Levee measure (4a), recreational resources tied directly to Big Branch Marsh National Wildlife Refuge and along Lacombe Bayou could see significant direct and indirect impacts. Recreational resources would closely correspond to the environmental effects of hydrology alterations in the refuge.

Additionally, the eastern end of the proposed Lacombe Levee measure would terminate near Tammany Trace. Tammany Trace could see temporary, indirect impacts during construction. Coordination with the NFS and local stakeholders would be implemented to minimize potential recreational impacts.

The proposed pump station and 300 feet-gate complex on Bayou Lacombe would directly impact the flow of Bayou Lacombe, which is part of the Louisiana Natural and Scenic Rivers System. When the proposed features are in operation, Bayou Lacombe would no longer be free-flowing. Recreational boats would not be able to traverse the Bayou at this location during operation. (Appendix C Table C:3-3)

With the proposed 7.5 mile-long Lacombe Levee Short measure (4a.1), impacts to recreational resources would be similar to the 9 mile-long Lacombe Levee measure.

With the 13.7 mile-long Lacombe Levee Combined with West Slidell Levee measure (4b), anticipated impacts to recreational resources would be similar to those for the 9 mile-long Lacombe Levee measure, but to a greater extent. Recreational boats would not be able to traverse the 400 foot-wide Bayou Paquet gate Complex, the 400 foot-wide Bayou Liberty gate complex, or the 300 foot-wide Bayou Bonfouca gate complex during operation. (Appendix C Table C:3-4)

Alternative 5: Bayou Liberty/ Bayou Vincent/Bayou Bonfouca

With the proposed Bayou Bonfouca Detention Pond measure, there would be no direct impacts to existing recreation resources in the area. The detention area could provide future recreational components during design.

With the proposed clearing and snagging in 0.17 miles of Bayou Patassat measure and 8 miles of Bayou Liberty measure, there would be no direct impacts to existing recreation resources in the area. These proposed channel improvements measures could have temporary, indirect impacts to recreational fishing and boating associated with construction. The Bayou Liberty channel improvements measure proposes the clearing of a 25 feet-wide corridor (0.2 AC) for access and staging from the Tammany Trace Trailhead off Highway 190. Access and staging within this corridor would be coordinated with the NFS and local stakeholders to minimize recreational impacts associated with construction activity.

With the proposed West Slidell Levee measure, recreation resources tied directly to Big Branch Marsh National Wildlife Refuge would closely correspond to the environmental effects of hydrology alterations in the refuge. The proposed 100 feet-wide gate complex on Bayou Paquet, 400 feet-wide gate complex on Bayou Liberty, and 300 feet-wide gate complex on Bayou Bonfouca would directly 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. (Appendix C Table C3:1-5)

Alternative 6: South Slidell

With the proposed 13 mile-long Slidell Levee measure, there would be no direct impacts to existing recreation resources in the area. Heritage Park is in proximity to the western side of the system and could see temporary, indirect impacts such as interrupted access related to construction. Coordination with the NFS and local stakeholders would be implemented to minimize potential recreational impacts at Heritage Park. (Appendix C Table C:3-6)

With the proposed Eden Isle Levee measure, recreation resources tied directly to Big Branch Marsh National Wildlife Refuge could see significant impacts, which correspond to the environmental effects of hydrology alterations in the refuge and operation of closure features. Recreational boats would not be able to traverse the proposed 100 foot-wide Oak Harbor Marina marine gate for Eden Isle at Grand Lagoon during operation. (Appendix C Table C:3-7)

Alternative 7: Eastern Slidell

With the proposed 4.8 mile-long Pearl River Levee measure, recreation resources tied directly to Pearl River Wildlife Management Area and at intersecting waterways could see significant impacts. The Morgan River, a tributary of Pearl River and part of the Louisiana Natural and Scenic River System, is located east of the proposed levee. Recreational resources would closely correspond to the environmental effects of hydrology alterations in the WMA and operation of closure features, including the proposed Gum Bayou Diversion gate complex. The 12.2 acre staging and construction area for the Pearl River Pump Station Complex is in proximity to the Crawford Landing boat launch along West Pearl River and could see temporary, indirect impacts related to construction. The Davis Landing floodgate is in proximity to the Davis Landing boat launch along West Pearl River and could see temporary, indirect impacts related to construction. (Appendix C Table C:3-8)

For the proposed Pearl River Levee measure, borrow areas would be identified and designed. Incorporating environmental design features in newly constructed borrow areas can greatly enhance the diversity of fish and other wildlife that inhabit them while providing future recreational opportunities. (Part V of Environmental Design Considerations for Main Stem Levee Borrow Areas Along the Lower Mississippi River, Lower Mississippi River Environmental Program, Report 4, April 1986.)

With the proposed 1.8 mile-long Gum Bayou Diversion measure, there could be direct impacts to existing recreation resources in the area, mainly pertaining to the West Pearl River and its designation as part of the Louisiana Natural and Scenic River System. Temporary and indirect impacts to fishing and boating in West Pearl River would be associated with construction activity as the Gum Bayou Diversion intersects with West Pearl River. (Appendix C Table C:3-9)

With the proposed 1 mile-long of clearing, snagging, and mechanical dredging in Poor Boy Canal measure, there would be no direct impacts to existing recreation resources in the area.

With the proposed 3 mile-long of clearing, snagging, and mechanical dredging in Doubloon Bayou measure, impacts to recreation resources would be similar to those listed for the Gum Bayou Diversion measure. (Appendix C Table C:3-10)

Alternative 8: Upper Tchefuncte/Covington

The proposed 2.15 mile-long Mile Branch and 1.73 mile-long Mile Branch Lateral A channel improvements measures would directly impact the free-flow of these 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.) (Appendix C Table C:3-11)

Alternative 9: Mandeville Lakefront

With the proposed Mandeville Lakefront-Seawall Passive Drainage measure, recreation resources tied directly to the Lakefront at the seawall could see significant impacts. There is currently a high level of recreational activity along the Lakefront and existing seawall which includes frequent walking, jogging, biking, picnicking, and fishing. Impacts to the Mandeville Lakefront Park and East Lakefront Children's Park would closely correspond to the construction and operation of 4 pumping stations, 0.009 acres each in size, proposed at West Beach Parkway, Lafayette Street, Coffee Street, and Girod Street as they tie-in to the seawall. The proposed floodwalls at Ravine aux Coquilles East and West as well as the proposed floodwall at Little Bayou Castine have pedestrian gates along Lakeshore Drive. These would only be closed during operation and maintenance and interrupt recreational activities like walking, jogging, and biking, which utilize the length of the Lakefront. Most impacts would be temporary and indirect as they relate to construction activities and operation during storm events. (Appendix C Table C:3-12)

With the proposed Mandeville Lakefront-Seawall Pump Stations measure, impacts to recreation resources would be similar to those listed for the Mandeville Lakefront-Seawall Passive Drainage measure. Impacts to the Mandeville Lakefront Park and East Lakefront Children's Park would closely correspond to the 2 pump locations and operations proposed at Girod Street (100'x50') and Ravine aux Coquilles (2 acres) as they tie-in to the seawall. The floodwall at Little Bayou Castine is proposed to have 2 pedestrian gates along Lakeshore Drive. (Appendix C Table C:3-13)

With the proposed Mandeville Lakefront-18 ft Seawall measure, impacts to recreation resources would be similar to those listed for the Mandeville Lakefront-Seawall Pump Stations measure. Shoreline fishing would no longer be possible due to the height of the proposed seawall. The floodwall at Little Bayou Castine would intersect the Tammany Trace where a 30 foot-wide pedestrian gate is proposed. Access and staging would be coordinated with the non-federal sponsor and local stakeholders to minimize recreational impacts associated with construction activity. Impacts to recreational use of Tammany Trace would be temporary and indirect as they relate to construction activities and operation during storm events.

TSP

The direct, indirect, and cumulative impacts to recreational resources for the TSP would be the same as the South Slidell Storm Surge with West Slidell measure from Alternative 6, the Bayou Patassat Channel Improvements measure from Alternative 5, the Mile Branch Channel Improvements measure from Alternative 8, and the Nonstructural Alternative 2 as described above. (Appendix C Table C:3-14)

Borrow

For the five borrow sources identified, the proposed measures will 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."

5.3.1.15 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 Alternative:

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:

Raising 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, raising, and floodproofing were determined as being more cost effective than other nonstructural measures, such as buyouts or relocations. Further assessments will be performed on the nonstructural component once additional ADCIRC and HEC-RAS have been completed, which will include further assessment of acquisitions and relocations measures and other targeted evaluations. For the analysis, residential structures were to be raised 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.

Direct Impacts – Raising and floodproofing structures would result in direct impacts to population and housing (number of households) while structures are under construction. There would also be temporary direct impacts to overall employment, business, and industrial activity associated with the floodproofing of commercial structures if businesses need to temporarily close during construction. Direct impacts would also include a temporary monetary stimulus to the region due to spending associated with the construction activities in the area, an increase in Parish sales tax revenue during the implementation of nonstructural measures, and property values trending upward based on the reduction of flood damage and less dependency on flood insurance. If buyouts or relocations were to occur as part of this alternative, there would be direct, permanent impacts to population and housing (number of households) within communities which may affect employment and business.

Indirect Impacts – Indirect impacts may include an increase in the need for temporary housing while homes are being elevated, an increase in employment needed to complete any construction, and reduced risk of hurricane storm surge-related damages for lower-lying structures within communities.

Cumulative Impacts – Positive cumulative impacts from the nonstructural alternative include reduced risk of hurricane storm surge-related damages to minority and/or low-income populations, increases in regional economic growth and property values, and additional job creation during construction. Overall, population and households across the United States and in Louisiana have been increasing. The nonstructural alternative would lower the risk of damage to residential and commercial structures within the study area.

Alternative 4 Lacombe, Alternative 5 Bayou Liberty/Bayou Vincent/Bayou Bonfouca, Alternative 6: South Slidell, Alternative 7: Eastern Slidell, Alternative 8: Upper Tchefuncte/Covington, Alternative 9: Mandeville, TSP Alternative

All structural Alternatives are expected to have similar impacts

Direct Effects: There would be no direct impacts to socioeconomic resources. No permanent adverse direct impacts on population, income, and employment would be expected to occur as a result of alternatives.

Indirect Effects: The socioeconomic indirect impacts from the alternatives would be primarily beneficial and include storm damage risk reduction. Indirect impacts would include temporary, minor inconveniences from construction activities to those living near the construction areas, such as increases in traffic and noise in the areas affected by construction.

In the short-term, construction activities related to proposed action directly provide jobs, benefit businesses through the purchases of materials and supplies, and provide sales tax revenue to local governments. In the long-term, providing a level of risk reduction to communities in area would improve the confidence of residents and business community, and generate further interest in redevelopment of storm-damaged areas.

Therefore, implementation of any of the alternatives would have less than significant impacts to socioeconomics as related to project implementation.

5.3.1.16 Navigation

Alternatives 1: No Action and Alternative 2: Nonstructural:

No impacts to Navigation

Alternatives 4 Lacombe, Alternative 5-9 Bayou Liberty/Bayou Vincent/Bayou Bonfouca, Alternative 6: South Slidell Storm Surge Risk Reduction, Alternative 7: Eastern Slidell, Alternative 8: Upper Tchefuncte/Covington, Alternative 9: Mandeville, TSP Alternative

Lake Pontchartrain and the tributaries that drain into it primarily serves recreation boating interests, and limited fishing in areas. 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.

5.3.1.17 Environmental Justice

Identification of EJ communities is based upon two thresholds recommended in the "Promising Practices for EJ" document prepared by the Federal Interagency Working Group on EJ. EPA's EJSCREEN desktop tool displays U.S. Census Bureau's Census Block Group (CBG) data, which is a geographic area comprised of smaller Census Blocks, and is the unit of analysis used to identify EJ communities. A CBG is considered an EJ community if it is comprised of 50 percent or more of residents identifying as a minority or if 20 percent or more of households live below poverty level.

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 Indicator are presented for St. Tammany Parish, LA in Table 2 of the Appendix C EJ section. 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 TSP or with any of the final array alternatives will not exacerbate environmental concerns as identified by EPA's EJSCREEN tool. Nonetheless, best management practices will be utilized to avoid, reduce, and contain temporary impacts to human health and safety.

Alternative 1-No Action Alternative

Under the No Action Alternative, flood risk reduction would not occur. 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 communities 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

The nonstructural (NS) plan may cause temporary impacts to housing, both within EJ and non EJ communities while eligible residential structures are being elevated. How the implementation of the NS plan might impact low-income and minority communities is not yet known at this point in the planning process. If voluntary buyouts and resulting relocations are determined to be necessary, further evaluation of the impact to Environmental Justice will be assessed at that time.

For the nonstructural alternative in the final array, all structures within the 100- and 50-year flood zones would be considered to be in economically justified reaches and 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 2075 (end of the period of analysis).

Only eligible residential structures could be elevated. An eligible structure is, among several criteria, one that is engineeringly 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. Those with 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 property owners would bear those costs.

The implementation plan for the NS 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 will be identified. If necessary, a mitigation plan to address high and adverse impacts would be developed through public outreach to EJ communities and public meetings.

Alternative 4: Lacombe

There is an EJ communities along the Alternative 4 alignment, just north of Pichon Drive and Highway 190 along the most western segment of the proposed levee. There are no other EJ communities along the remainder of the alignment. All CBGs along the remainder of the alignment are majority White and have less than 20 percent of the population living below poverty. Additionally, there are no direct impacts to EJ residents who live along the proposed alignments. Indirect impacts are related to construction activities and are discussed in detail in Appendix B, EJ section.

Alternative 5: Bayou Liberty/ Bayou Vincent/Bayou Bonfouca

The *West Slidell Levee* measure includes 6.5 miles of levee and floodwall alignment to reduce flooding. This alignment is a combination of approximately 6.5 miles (34,000 feet) of levees and 0.08 miles (450 feet) of floodwall. An EJ community is located in the CBG just north and across Bayou Bonfouca; these residents are inside the risk reduction system and would not be directly, adversely impacted by the construction. The remainder of the areas along the West Slidell Area alignment are not EJ communities.

The CBG located directly to the east of the proposed Bayou Bonfouca Detention Pond is considered an EJ community based upon both minority and low-income thresholds. The area directly to the west of the site is also a low-income community but is majority white.

With the proposed Bayou Bonfouca Detention Pond measure, there would be no direct impacts to residents in the area. Indirect impacts from construction of the pond are expected to be temporary and related to noise and traffic delays. There are no long-term adverse impacts expected to the areas around the pond. The detention area could provide future flood risk reduction benefits to residents who are near the pond.

EJ communities are located around the proposed clearing and snagging in 0.17 miles of Bayou Patassat measure and 8 miles of Bayou Liberty measure. There would be no direct impacts to residents around the project sites. These proposed channel improvements measures could have temporary, indirect impacts to residents associated with construction. The Bayou Liberty channel improvements measure proposes the clearing of a 25 feet-wide corridor (0.2 AC) for access and staging from the Tammany Trace Trailhead off Highway 190. Access and staging within this corridor would be coordinated with the NFS and local stakeholders to minimize human impacts associated with construction activity.

Alternative 6: South Slidell

There are EJ communities spread throughout the entire 13-mile-long proposed Slidell Levee and floodwall measure (Alternative 6a); however, there would be no direct impacts to residents in the area. Indirect impacts could occur and include those related to construction activities including noise and traffic re-routing or delays. Coordination with the NFS and local stakeholders would be implemented to minimize potential impacts to residents in the vicinity of the project sites. Additionally, best management practices will be utilized, as described in the Appendix B EJ section.

Alternative 6b includes the Slidell levee and flood wall measure (alternative 6a) and adds in the Eden Isle floodwall. There are no EJ communities within or around the Eden Isle floodwall measure.

Alternative 6c includes the West Slidell Levee Alignment (alternative 5) and the South Slidell Levee and floodwall system (alternative 6a).

Alternative 7: Eastern Slidell

There are no EJ communities identified in the CBGs around the proposed 4.8-mile-long Pearl River Levee measure and the proposed 1.8-mile-long Gum Bayou Diversion measure. Residents are predominately white and not low-income.

There are no EJ communities around the proposed 1 mile-long of clearing, snagging, and mechanical dredging in Poor Boy Canal measure. There would be no direct impacts to residents in the area.

There are no EJ communities identified in the CBGs around the proposed 3 mile-long of clearing, snagging, and mechanical dredging in Doubloon Bayou measure, impacts to residents would be like those listed for the Gum Bayou Diversion measure.

Alternative 8: Upper Tchefuncte/Covington

There are EJ communities as identified in the CBGs around the proposed 2.15 mile-long Mile Branch Channel Improvement. The communities along the Mile Branch Channel Improvement may experience indirect impacts associated with channel improvement; these impacts will be temporary and minor. Positive flood risk reduction benefits are expected from these improvements to the channel. There is not an EJ community around the 1.73 mile-long Mile Branch Lateral A channel improvements measure.

Alternative 9: Mandeville Lakefront

There are no EJ communities as identified in the CBGs around the proposed Mandeville Lakefront-Seawall Passive Drainage measure, the proposed floodwalls at Ravine aux Coquilles East and West as well as around the proposed floodwall at Little Bayou Castine, and the proposed Mandeville Lakefront-Seawall Pump Stations measure.

TSP:

The TSP includes the slightly modified South and West Slidell combined levee (Alternative 6c), the Bayou Patassat Channel Improvements measure from Alternative 5, the Mile Branch Channel Improvements measure from Alternative 8, and part of the Nonstructural Alternative 2 plan as described above. The NS alternative for the TSP includes only those structures in the 50-year floodplain, as opposed to Alternative 2 which also includes structures from the 100-year floodplain. However, the impacts associated with the TSP NS plan 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 impact on EJ communities will be completed during PED, when structurally sound houses are identified.

Positive impacts to EJ communities identified in the EJ alternatives analysis above, include a decrease in flood risk to minority or low-income populations in the study area. 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. Structural alternatives, including levee alignments, floodwall construction and other structural measures, will not directly and adversely impact housing in the study area; therefore, there will be no direct impacts to EJ resources from the TSP or any of the Final Array measures. There are no permanent adverse impacts to EJ communities from the construction of the Flood Risk Management and Coastal Storm Risk Management measures. Housing will not be directly affected; that is, housing will not be acquired and removed to construct the structural alternatives.

Low-income and minority communities, as detailed in the alternatives analysis for the TSP measures, are located near the TSP measures and adverse indirect impacts are expected to occur. These indirect impacts are not expected to be high adverse impacts, will be temporary and related to construction activities. Adverse, indirect impacts of construction may include the following: transportation and traffic delays, noise, and dust and air quality impacts. These indirect impacts and their mitigation are discussed in Appendix C.

Impacts from the federal action, the construction of flood risk and coastal storm risk reduction measures, may cause adverse, indirect impacts to EJ resources and the human environment. However, these indirect impacts would not be considered high, adverse, or disproportionate, are temporary in nature and would likely be felt by those in EJ and non-EJ communities. Benefits from these systems would positively impact EJ communities spread throughout the study area and identified for specific alternatives. For a discussion of the other Final Array measures' impact to EJ resources, see Appendix C.

5.3.1.17.1 Borrow Sites: Potential Impacts to Environmental Justice

Material obtained from borrow sources would be from five sites that would have no direct impact on EJ communities. 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.

Borrow site STP-6 is in the Slidell area and is adjacent to a minority and low-income community, as identified using CBG data. Potential impacts to these communities include an increase in truck traffic accessing and leaving the borrow sites, noise and dust. During PED, the particulars of these impacts will 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 will be either nonexistent or very minimal. Additionally, the areas around the borrow sites are vastly white and not low-income.

Population groups residing near the borrow sites may experience minor, temporary, adverse indirect impacts due to added traffic congestion and construction 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 will be utilized to avoid, reduce, and contain temporary impacts to human health and safety.

Locations STP-1 and STP-6 borrow sites, both in the Slidell area, are in minority and low-income communities. Potential impacts to these communities include an increase in truck traffic accessing and leaving the borrow sites, noise and dust. During PED, the particulars of these impacts will 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-3, STP-5 and STP- 9 are located near communities that are predominately white and not low-income.

The two borrow sites in Mississippi, Pearlington and Port Bienville, are located on lands surrounded by undeveloped parcels and therefore impacts to minority and low-income residents will be either nonexistent or very minimal. Additionally, the areas around the borrow sites are vastly white and not low-income.

Population groups residing near the borrow sites may experience minor, temporary, adverse indirect impacts due to added traffic congestion and construction 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 will be utilized to avoid, reduce, and contain temporary impacts to human health and safety.

Section 6
Tentatively Selected Plan

The plan formulation process for this study identified potential solutions to rainfall, riverine and coastal storm related flooding across St. Tammany Parish. The study area had 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. Measures and alternatives from one geographic area were not compared to measures or alternatives from other areas of the parish that address a different flooding source. The measures that were determined to be incrementally justified from the Final Array of Alternatives were combined to form the TSP. The TSP is a comprehensive plan to address flooding parish-wide, which includes CSRM, FRM, and nonstructural measures (Figure 6-1). For additional details on the TSP measures, please see Appendix D. The TSP includes:

- Nonstructural Elevations and Flood Proofing (Alternative 2)

  Approximately 6,643 eligible residential structures would be elevated to the future 100-year flood stage up to 13 feet, and 1,855 eligible nonresidential structures in the 50 year floodplain would be floodproofed up to 3 feet. The floodproofing of eligible nonresidential structures will protect structures that are not included in the areas benefitted from the structural measures of the TSP. These structure counts are preliminary and will continue to be evaluated and refined and are not absolute at this time. To be considered preliminarily eligible for participation, a structure must meet the following criteria:

  1. Have a first-floor elevation (FFE) at or below the 0-50-year storm surge floodplain, based on hydrologic conditions predicted to occur in 2032 (the beginning of the 50-year period of analysis)
  2. Structure must be outside of the area of influence of the structural features recommended in the Tentatively Selected Plan (TSP) and not receiving flood risk reduction benefits from the structural features (i.e. outside of the area of influence of the West Slidell, South Slidell Levees, Bayou Patassat clearing and snagging and Mile Branch Channel Improvements).
  3. Must be economically justified meaning that the cost of the flood-proofing measure for the structure must not cost more than the total monetary value of the flood damages anticipated to be avoided over the 50-year period of analysis.

  The nonstructural elevations and floodproofing are voluntary, property owners who have preliminarily eligible structures that wish to participate in the flood proofing measures will 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.

- Bayou Patassat Channel Improvements-Clearing and Snagging (Alternative 5)

  Bayou Patassat is a small tributary of Bayou Bonfouca in Slidell. The work will be located between Bayou Vincent pump station and Highway 11. Approximately 0.17 miles (900 feet) will be cleared and snagged, which includes the removal trees, vegetation, debris, trash, or other obstructions within the channel. See Figure 6-1.

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

  The levee floodwall system is 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 by constructing ramps to the preliminary design elevation of 15 feet. The levee alignment would impact approximately 162 acres of construction area. The levee alignment would require approximately 1,602,000 cubic yards of fill. There would be five pump stations, four gate complexes, and one channel floodgate. There would also be a total of three sluicegates, seven vehicular gates, one railroad gate along the Norfolk Southern Railroad, and seven ramps. See Figure 6-2.

  Note: This alignment includes 49,100 feet of south Slidell segment and 36,800 feet of west Slidell segment of the Alternatives of the Final Array.

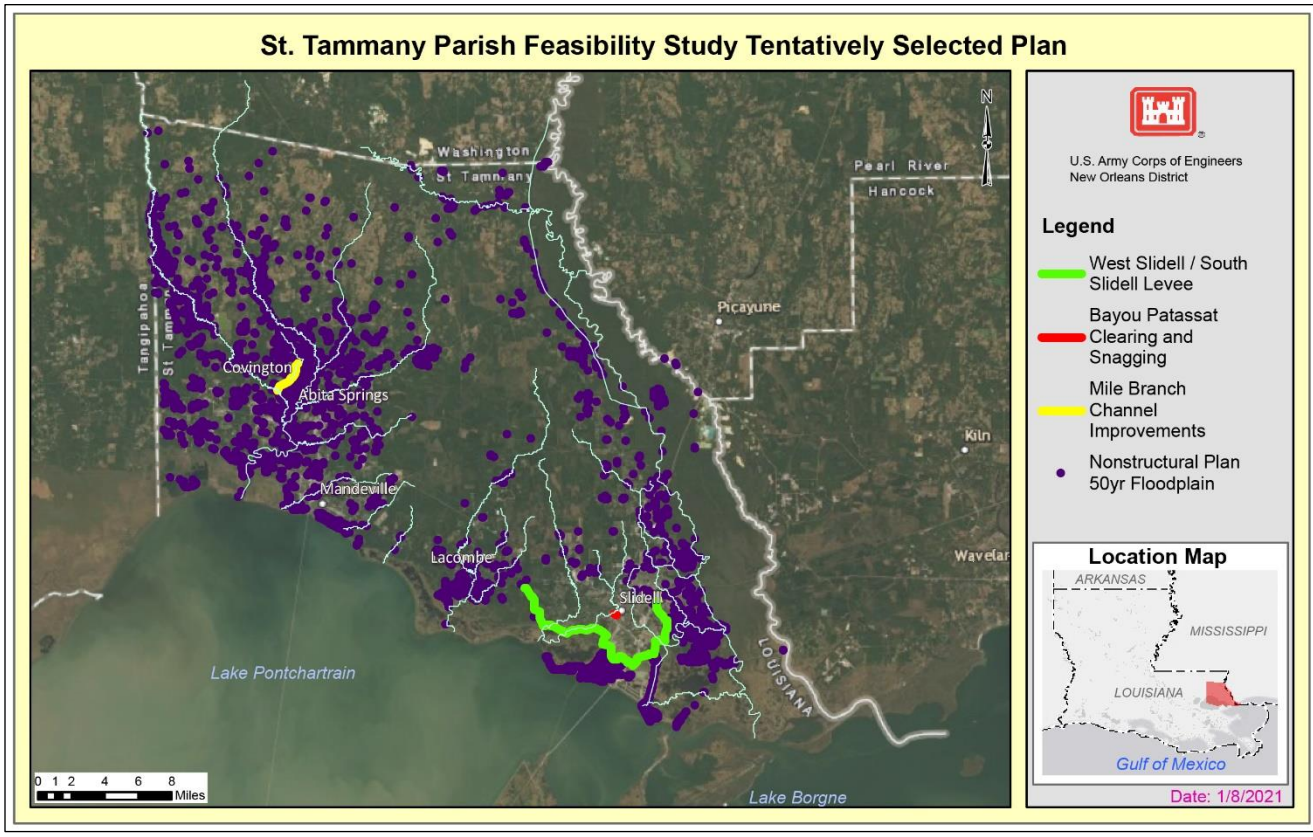

Figure 6-1. TSP/NED Plan

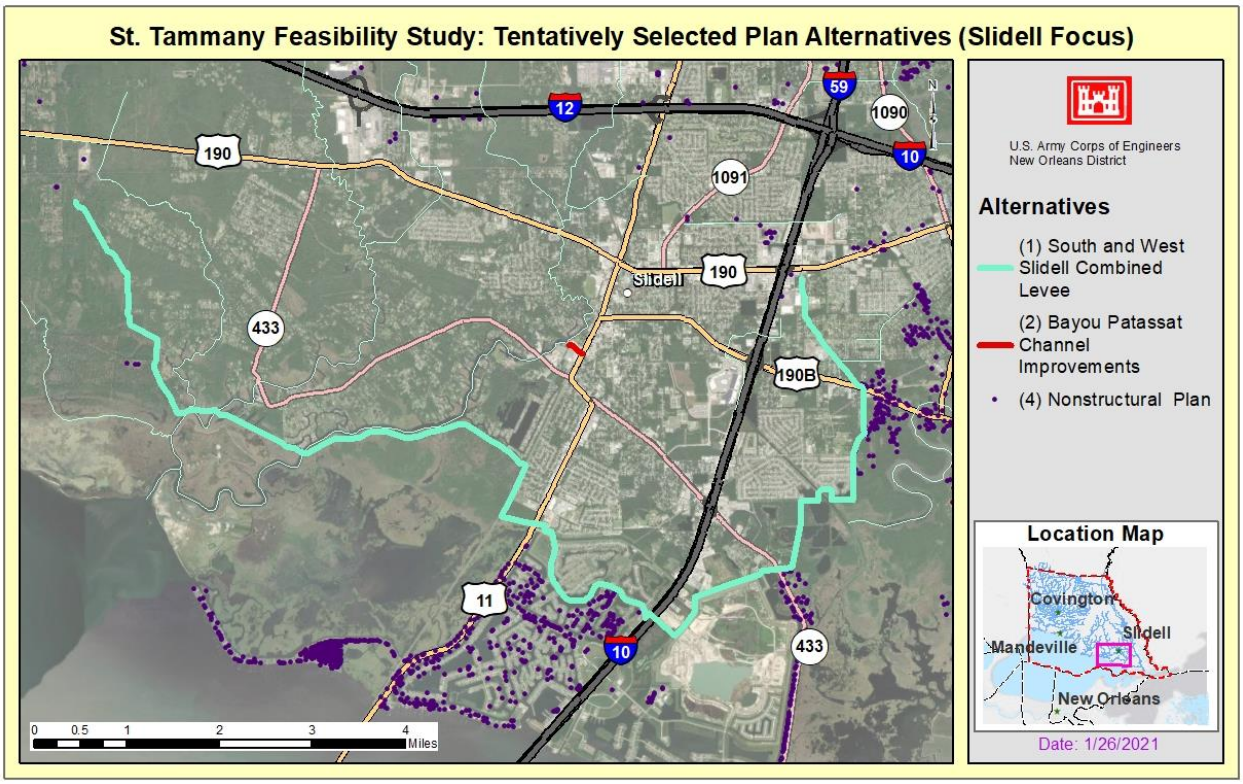

Figure 6-2. Slidell Region of the Tentatively Selected Plan (South Slidell and West Slidell Levees and Bayou Patassat)

- Mile Branch Channel Improvements (Alternative 8)

  The Mile Branch channel improvements start at the intersection of Mile Branch and Highway 190, crossing Highway 190 Business, and end at the intersection of Mile Branch and the Tchefuncte River. The channel improvements would be 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 the channel. The channel bottom will be lowered by 5 feet. Approximately 20 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.

  See Figure 6-3.

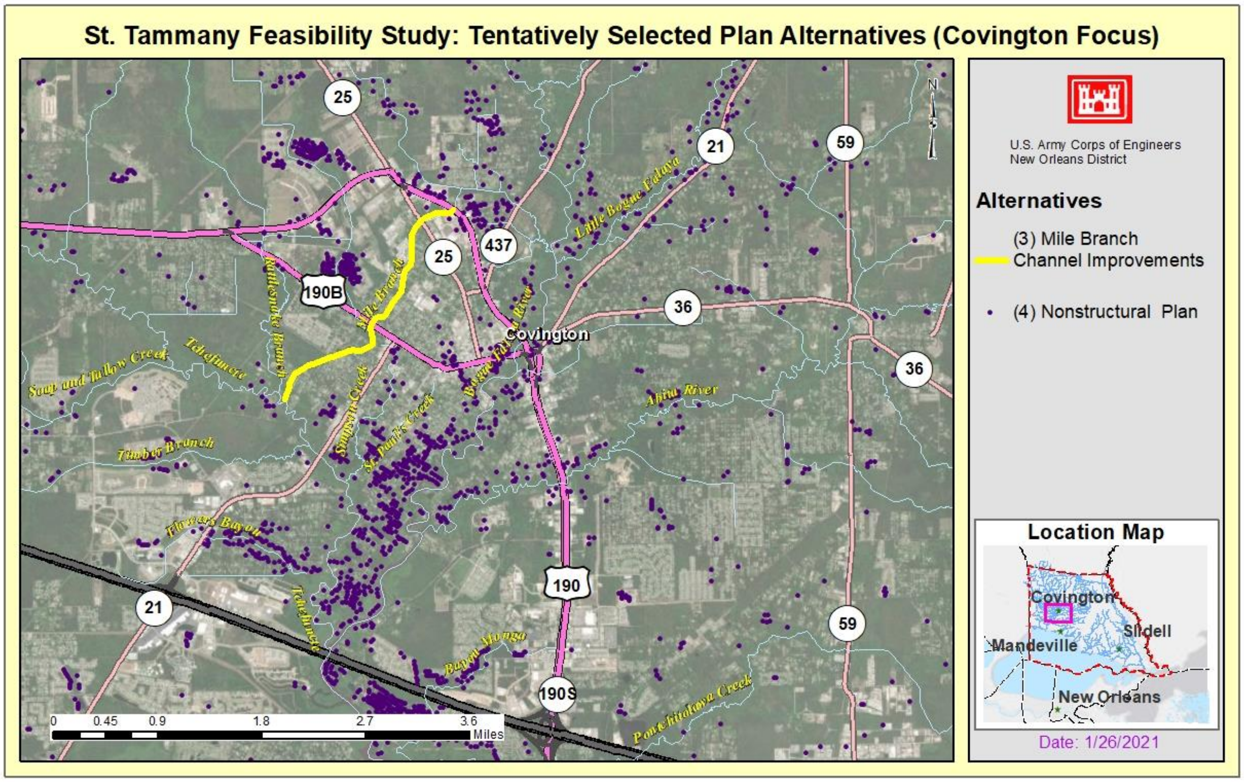

Figure 6-3. Mile Branch Region of the Tentatively Selected Plan (Mile Branch Channel Improvements)

The TSP is also the NED Plan and reasonably maximizes the RED, EQ and OSE benefit categories evaluated. This combined plan has the greatest economic net benefit and is consistent with protecting the environment while providing RED and OSE benefits. Table 6-1 provides the cost benefits, and the approximate numbers of structures with flood risk reduction for each measure in the TSP.

Table 6-1. Cost and Benefits Breakdown for each of the TSP/NED Plan Measures

	Combined South Slidell/ West Slidell Levee (S-074, S-075, S-076, S-077, S-081)	**Bayou Patassat Clearing Snagging (S-080)**	**Mile Branch Channel Improvements (S-057)**	**Rest of Parish Nonstructural (NS-09 & NS-11) 50 year**	**Combined Plan-Structural & NS 2%AEP for rest of the parish outside of structural influence**
First Cost	1,732,901,000	957,000	26,337,000	2,241,108,000	4,001,303,000
Benefits	118,160,000	133,000	2,221,000	157,421,000	277,935,000
AA Cost	70,985,000	46,000	1,115,000	79,263,000	151,409,000
Net Benefits	47,175,000	87,000	1,106,000	78,158,000	126,526,000
B/C Ratio	1.7	2.9	2.0	2.0	1.8
Approx. # structures with flood risk reduction	7,000	30	250	8,500	15,800

6.1 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 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 TSP is also the NED plan. The intent of comparing alternative plans in terms of the NED Plan is to identify the beneficial and adverse effects that the flood risk reduction alternative 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' national economic benefits, and the adverse NED effects were the national investment opportunities lost by committing funds to the implementation of a plan.

6.2 IMPLEMENTING THE TSP

Subject to project authorization and funding, and full environmental compliance, the construction of the structural features of the TSP is scheduled to begin in 2027. 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 will enter into a PPA. After the signing of a PPA, the NFS will 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.

This schedule assumes that the construction of the TSP will be completed by year 2032. Additional levee lifts will occur three times post initial construction at 5-7 years, 15-20 years, and 30 years. Please see Appendix H for additional information regarding implementation of the nonstructural component of the TSP. At the completion of construction of the project, or functional portions thereof, the NFS would be fully responsible for OMRR&R.

6.2.1 Real Estate required for construction of the structural measures of the TSP

A real estate plan (REP) was prepared to conform with the requirements of ER 405-1-12. The REP describing the real estate requirements and costs for the TSP is contained in Appendix G. The REP was prepared with estimated ROW requirements based on available information. The structural measures will impact a total of 108 private landowners. The nonstructural measures will include 6,643 residential elevations and 1,855 nonresidential commercial floodproofing measures. A description of the estates required for implementation is included in Appendix G. The total estimated real estate cost for structural features is $15,968,660. The total estimated real estate cost for nonstructural measures is $175,332,040. The REP and real estate cost estimates will be revised during the feasibility-level design and analysis and included in the final report.

6.2.2 Borrow required for construction of the structural components of the TSP

The intent of this initial investigation was to provide a level of detail sufficient to support the TSP decision, demonstrate that there are sufficient available options for borrow for the TSP, and provide NEPA evaluation for the five potential borrow sites, STP-5, STP-6, STP-9, MS-1, and MS-2.

The construction of the TSP is estimated to require approximately1.5 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. 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 in the vicinity of the TSP and evaluated and narrowed down to three potential borrow sites within St. Tammany Parish (STP-5, STP-6, STP-9) and two additional sites in Mississippi (MS-1, and MS-2). Final selection will be

conducted prior to acquisition of the site by the NFS. See Appendix B for additional information regarding the borrow site investigation and Section 5 for environmental resource analysis for the five borrow sites.

6.2.3 Relocations

In the event of a facility including utility, pipeline, cemetery, or town would affect the construction, operation, maintenance, repair, replacement, or rehabilitation of a USACE project or study, then the appropriate disposition of the impacted facility must be determined. Some facilities may require either a permanent or temporary physical adjustment or displacement to support project activities, engineering requirements, and operation and maintenance needs. A preliminary investigations, identifying, and verifying public facilities and utilities was performed for the TSP. The database research included the National Pipeline Database, State Online Natural Resources Information System =, LADNR, HIS, Inc. dataset, Penwell and the National Pipeline Mapping System data. Based on the findings of the preliminary relocations investigation, it was determined that an existing pipeline (ExxonMobil), a CLECO transmissions line, and the Norfolk Southern railroad would potentially be impacted, either requiring relocation of the facilities affected or requiring protection during construction. In such situations, USACE would incorporate the relocations process toward compensability and coordinate with facility owners throughout the design and development of the plans and specifications during PED. There are several requirements from CLECO Corporate Holdings, LLC that would have to be met to provide clearance between the construction activities associated with pile driving and the existing utility line on the northeast corner of the new alignment. See Appendix D for additional information regarding relocations.

6.2.4 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. OMRR&R for the measures of the TSP is under development. Preliminary OMRR&R costs were estimated for each structural measure by using costs based off previous studies and projects. 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 will be developed during feasibility level of design and PED.

6.2.5 Cost Sharing Requirements under the PPA

The State of Louisiana, acting through the CPRAB, will be the NFS for design, construction, operation, maintenance, repair, rehabilitation and replacement. It is anticipated the cost share for the design and construction of the project will 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 CPRAB 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 $4,001,303,000 at a FY 21 price level.

6.2.5 Federal Responsibilities under the PPA

The Federal government will 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.

6.2.6 Non-Federal Responsibilities under the PPA

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 will 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 will 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.

6.3 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. Risk and uncertainties will be further considered during the feasibility level design and analysis.

See Section 4 for information regarding how the PDT incorporated risk-informed decision making into the planning process.

6.3.1.1 Environmental Factors

Sea Level Change: Global, or eustatic, sea level rise and regional subsidence have affected and are projected to continue affecting the study area. Sea level rise and subsidence are referred to as relative sea level change (RSLC) in ER 1100-2-8162. ER 1100-2-8162 contains requirements for incorporating direct and indirect physical effects of projected future RSLC across the period of analysis for the project in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. Potential RSLC must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence.

Research by climate science experts predict continued or accelerated climate change for the 21st century and possibly beyond, which would cause a continued or accelerated rise in global mean sea level. Detailed analysis of climate vulnerability for this region may be reviewed in the “Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Lower Mississippi River Region 08” (USACE, 2015) report. The resulting local RSLC will likely impact USACE coastal project and system performance. As a result, managing, planning, engineering, designing, operating, and maintaining for RSLC must consider how sensitive and adaptable natural and managed ecosystems and human and engineered systems are to climate change.

See Appendix E contains detailed assumptions and analysis taken into account for RSLC factors in this study. Specific sections in Appendix E to refer to for further information regarding climate change and RSLC include sections 3.4, 4.4.2.2, 4.4.2.3, and 4.5.

For planning purposes, this study assumed a project completion year (base year) of 2032. The end of the 50-year period of analysis would be 2082. Utilizing the USACE SLC Calculator as directed by ER 1100-2-8162, the low, intermediate, and high rates were calculated. The intermediate rate was selected for use in the alternative and TSP evaluation phases in this report. In compliance with USACE policy (ER 1100-2-8162), the performance of the TSP under all three SLR scenarios of “low,” “medium,” and “high” will be analyzed for the final report DIFR and EIS. Figure 6-3 displays the USACE SLC calculator results.

USACE Curves computed using criteria in USACE EC 1165-2-212

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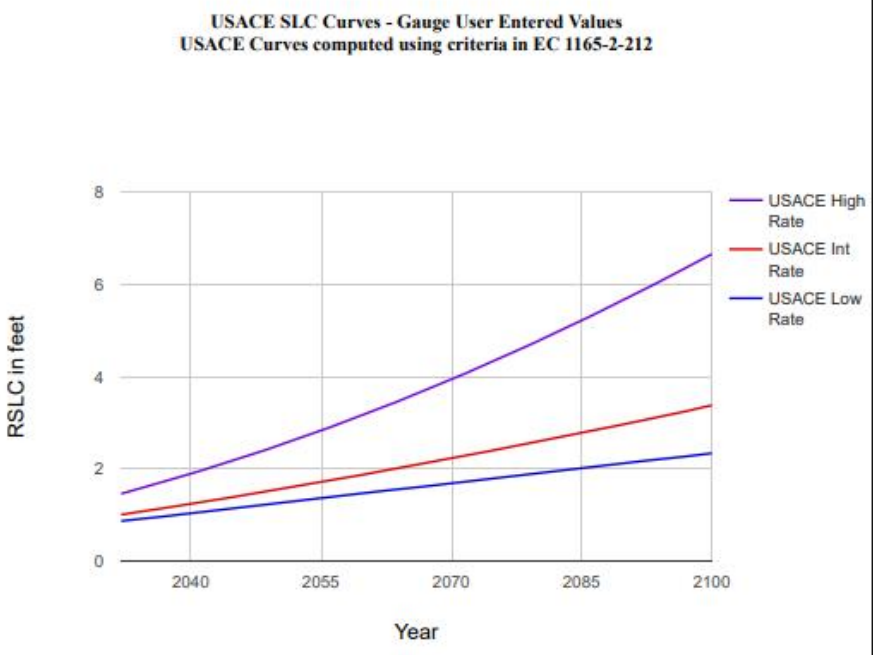
Gauge User Entered Values All values are in feet			
Year	USACE Low	USACE Int	USACE High
2032	0.87	1.01	1.46
2037	0.97	1.15	1.73
2042	1.08	1.30	2.01
2047	1.19	1.46	2.31
2052	1.30	1.62	2.63
2057	1.41	1.78	2.97
2062	1.52	1.95	3.33
2067	1.62	2.12	3.71
2072	1.73	2.30	4.10
2077	1.84	2.48	4.52
2082	1.95	2.67	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



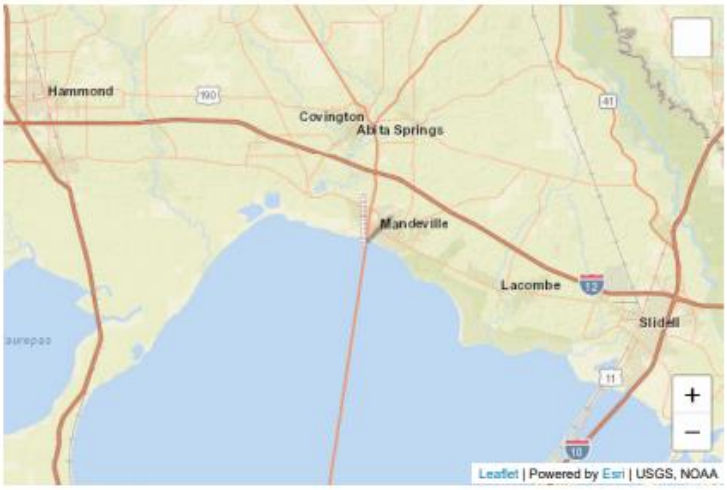


Figure 6-3. USACE Relative Sea Level Change Results for St. Tammany Parish Feasibility Study

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.

6.3.1.2 Engineering Factors

Levee/Structure Failure: The risk associated with the levee/structure system is its stability. Analysis of the earthen levee and associated T-walls and gates will be evaluated during feasibility-level design and analysis, and included in the final report and Appendix D: Engineering. The levee and other TSP features will be constructed to USACE standards.

Modeling Factors: Detailed information regarding model analysis, assumptions, and factors may be reviewed in Appendix E. 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. 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.

6.3.1.3 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.

6.3.1.4 Residual Damages and Residual Risks

Of the $488 million in the without project estimated annual damages (EAD) in the study area, about $280 million in estimated annual damages is due to coastal flooding and $208 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 70 percent and reduce the EAD caused by rainfall and riverine flooding by about 40 percent. However, the 40 percent reduction of rainfall and riverine damages is underestimated. Many of the structures that would be elevated or floodproofed to address coastal flooding would also address flooding from rainfall and riverine sources as well. To avoid double counting, these structures were not elevated or floodproofed in the rainfall/riverine model. As a result, the residual damages for rainfall and riverine sources are exaggerated.

6.3.1.5 Potential Induced Flooding

The flood risk that remains in the floodplain after the TSP is implemented is known as the residual flood risk. The measures in the Alternatives in the Final Array, including the TSP, were not directly modeled in ADCIRC. Determining storm surge response for the measures, and for a wide range of storms, requires numerous simulations of storms with different characteristics. Modeling of the TSP is required to show detailed responses. Prior coastal modeling for the 2009 LACPR study, the USACE Morganza to the Gulf project, and the ongoing USACE West Shore Lake Pontchartrain project were used by the PDT to provide some context for the estimates for this early stage of the study. Modeling on the TSP will be performed prior to the final report to better define the areas of potential induced flooding areas.

Based on the ADCIRC modeling of other systems, the PDT found that it may be possible to see increases of 1-3 feet in the 1 percent AEP water level on the floodside of the structural measures in the TSP. The structural measures of the TSP are not expected to cause significant changes to storm surge levels for the USACE Lake Pontchartrain and Vicinity system under HSDRRS or the USACE West Shore Lake Pontchartrain system. The potential for induced flooding will be further investigated during feasibility-level design and prior to the release of the final report. If any induced flooding is confirmed, the TSP would be refined to appropriately address the issue, which could include things such as additional nonstructural actions or refinement of TSP measures.

Section 7
Mitigation Assessment

7.1 HABITAT MITIGATION

Laws, regulations, and USACE policy requires the use of reasonable efforts to ensure that adverse impacts to significant resources have been avoided and minimized to the extent practicable and that remaining, unavoidable impacts have been compensated to the extent incrementally justified.

The Council on Environmental Quality's regulations (40 CFR 1508.20) implementing the procedural provisions of NEPA of 1969, as amended (42 U.S.C. 4321 et seq.) define "mitigation" as including:

a) avoiding the impact altogether by not taking a certain action or parts of an action;
b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and,
e) compensating for the impact by replacing or providing substitute resources or environments.

Pursuant to applicable laws and USACE policy, mitigation plans will comply with the mitigation standards and policies established pursuant to the Corps regulatory program (Section 906(d), WRDA 1986, as amended by Section 2036, WRDA 2007; Section 1040, WRRDA 2014; and Section 1162, WRDA 2016) (33 U.S.C. 2283(d)).

The Corps regulatory mitigation regulations, 33 CFR Part 332, require that a mitigation plan address the following 12 items: 1) objectives; 2) site selection; 3) site protection instrument; 4) baseline information; 5) determination of credits; 6) mitigation work plan; 7) maintenance plan; 8) performance standards; 9) monitoring requirements; 10) long-term management plan; 11) adaptive management plan; 12) financial assurances; and other information.

A general mitigation plan has been developed by CEMVN based on a preliminary desktop survey habitat analysis conducted in 2021and habitat analysis. During the 2021 desktop survey, CEMVN identified approximately 229 AAHUs of BLH, swamp and marsh within the TSP footprint that would be destroyed by construction of the TSP features. During a preliminary investigation of the proposed St Tammany Parish Feasibility Study project area, CEMVN tentatively determined approximately 251 acres of direct impacts to BLH, swamp and marsh from the TSP consisting of approximately 24 acres of Bottomland Hardwood (BLH) and Swamp and 227 acres of Marsh. The number of AAHU's will be further refined in the final WVA to develop exact mitigation acreages as construction footprints are optimized. In addition, there will likely be impacts within the staging area(s) and borrow excavation

sites; those impacts will also be addressed in the mitigation plan. A detailed mitigation plan will be developed by CEMVN and will be included in the final report.

The following are the mitigation alternatives for the TSP:

1. Purchasing BLH and marsh mitigation bank credits. At the time of screening, there were mitigation banks in the Lake Pontchartrain Basin that had BLH credits available for purchase. Many of these banks also have potential credits that could be released in the future. It is not known which banks would have credits available when the decision whether to purchase bank credits is made: some banks may not have enough credits remaining, some may be closed, and additional mitigation banks may be approved. As such, a generic mitigation bank for BLH and a generic bank for marsh, including in and out of coastal zone options, are used for the next step of the mitigation plan analysis using information obtained from existing banks in the basin; no specific banks is identified. The Regulatory In lieu fee and Bank Information Tracking System (RIBITS) (https://ribits.usace.army.mil/) has information on all currently approved banks in the basin including their credit availability.

2. Potential BLH and marsh USACE-constructed mitigation sites: Mitigation for the TSP impacts could include creation and/or restoration and/or enhancement of bottomland hardwood, swamp and marsh habitats as compensatory mitigation. The BLH restoration and enhancement areas (mitigation areas) would be sited in abandoned agriculture, scrub/shrub, pasture, and other non-forested areas of lower habitat value. Similarly, marsh mitigation areas would be sited in open water areas where the planted vegetation has the greatest likelihood of success. Both BLH and marsh mitigation sites would be coordinated with USFWS, NMFS, and Refuge staff as needed. Required earthwork for each mitigation site would primarily consist of removal of remnant spoil material (sand, sediments, gravel) in various portions of each of the mitigation sites in an effort to establish an appropriate hydroperiod for BLH and marsh plant species. Grading and gapping to ensure appropriate elevation and drainage, establishing access roads, and tillage would also be required in preparing the mitigation site. Following initial earthwork, plants typical of BLH and marsh habitats would be installed in the mitigation sites.

3. Coordination with USFWS is ongoing to define and assess impacts to pine hardwoods and pine savannah not covered under the WVA modeling. The final report will include a mitigation plan for these habitats.

I. Objectives

The objective of the proposed mitigation is to compensate for habitat losses, as measured by AAHUs, that are expected to occur during the construction of the proposed actions. The goal is to mitigate for impacts to approximately 229 AAHUs of marsh, swamp and bottomland hardwood forest wetlands (BLH-Wet). The required mitigation would offset the unavoidable losses of these habitat types. The proposed compensatory mitigation would replace the lost functions and services of the impacted habitat either through restoration or enhancement activities designed to create/increase/improve habitat functions and services at specific mitigation sites or through the purchase of mitigation bank credits or a combination of both a Corps-constructed project and the purchase of credits.

II. Site Selection, AAHUs and Baseline Information

In accordance with the USACE policy and guidance, compensatory mitigation is formulated to occur within the same watershed or hydrologic basin as the impacts and to replace the functions and services of each impacted habitat type with functions and services of the same habitat type.

Mitigation for fresh marsh, BLH and swamp impacts associated with the TSP could be achieved by creating the applicable habitat near the project site (as proposed by USFWS in their draft CAR) or in state water bottoms within the basin. Mitigation for BLH and/or Swamp impacts could be achieved by BLH and/or swamp restoration and/or enhancement in agriculture, scrub/shrub, pasture, and other non-forested areas of lower habitat value. Baseline information measuring the habitat quality and existing conditions at each mitigation site would be determined once specific sites are identified. Similarly, the benefits expected to be gained at each site, as measured in AAHUs would be determined after site identification. Mitigation AAHUs sufficient to fully offset impacted habitats would be achieved.

If mitigation credits were purchased, in-kind credits would be purchased from one or more banks in the Lake Pontchartrain basin in sufficient quantity to compensate for the lost AAHUs of the respective impacted habitats.

III. Site Protection, Financial Assurances and Long-term Management

If mitigation credits were purchased, the bank from which purchased would be required to protect and manage the habitat represented by those credits for the long-term in accordance with its Mitigation Bank Instrument, conservation servitude and financial assurances. If a Corps-constructed option is selected, the NFS would obtain any lands required for the Corps-constructed alternative. The NFS would be responsible to protect and maintain the project lands in accordance with the Project Partnership Agreement.

IV. Mitigation Work Plan

For marsh creation in open water areas, any submerged aquatic vegetation that is impacted at the potential mitigation sites would be offset by an increase in the size of the proposed marsh mitigation sites or the purchase of marsh mitigation credits from available mitigation banks. Fill (borrow material) needed to attain the desired final target grade elevation for mitigation features created in open water, could be obtained from the dredging of the sites of the water control structures. In addition, the borrow could be dredged or trucked from location(s) to be determined at a later date. Containment dikes may be needed during the construction of these mitigation features. If containment dikes are constructed, they would be gapped or degraded once the area has reached target elevation. Transportation and method of placement of the borrow material would be dependent upon the location of the mitigation site.

Earthwork that may be associated with the BLH and/or swamp mitigation sites could also include grading to ensure appropriate drainage, establishment of dirt access roads around the perimeter of the mitigation areas, establishment of dirt access roads within some of the mitigation areas, and tillage of soil in the mitigation areas. Any existing drainage features (drainage ditches, etc.) within or adjacent to the mitigation areas and within the property boundary would likely be removed to help ensure appropriate site hydrology, unless doing so would adversely affect drainage on off-site lands. It is assumed that the marsh mitigation areas would naturally vegetate. If the areas do not show potential for natural vegetative recruitment, then they would be planted with native fresh marsh species. Native canopy and midstory plants typical of BLH and swamp habitats would be installed in the BLH and swamp mitigation areas following completion of the initial earthwork.

V. Mitigation Performance Standards:

Below are general guidelines for mitigation projects. The general guidelines for swamp habitat are currently being revised by the Interagency Environmental Team (IET) and will be included in the final mitigation plan. Site specific success criteria and monitoring plans will be developed after project specific mitigation sites are identified and the associated mitigation plans developed.

1) BLH

A. Initial Success Criteria (at end of first growing season following the year planting meets construction requirements) –

1. Achieve a minimum average survival of 50% of planted canopy species (i.e. achieve a minimum average canopy species density of 269 seedlings/ac.).
2. The surviving plants must approximate the species composition and percentages specified in the initial plantings component of the final planting plan2 found in the project plans and specifications.

3. These criteria will apply to the initial plantings, as well as any subsequent replantings necessary to achieve this initial success requirement.

B. Intermediate Success Criteria (3 growing seasons following attainment of Native Vegetation A.) –

1. Achieve a minimum average density of 269 living native canopy species per acre (planted trees and/or naturally recruited native canopy species).
2. Achieve a minimum average density of 135 (50% of 269) living hard-mast producing species in the canopy stratum (planted trees and/or naturally recruited native canopy species). The remaining trees in the canopy stratum must be comprised of soft-mast producing native species.
3. This hard mast criteria will thereafter remain in effect for the duration of the overall monitoring period. Modifications to these criteria could be necessary for reasons such as avoidance of tree thinning if thinning is not warranted and the long-term effects of sea level rise on tree survival. Proposed modifications must first be approved by the USACE in coordination with the IET.

For BLH-Wet habitats only - Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. Plant community must exhibit characteristics and diversity indicative of a viable native forested wetland community, i.e. vegetation community where more than 50% of all dominant species are facultative (FAC) or wetter.

C. Long-Term Success Criteria (Within 6 growing seasons following attainment of B. and maintained for the duration of the remaining 50-year monitoring period)3 –

1. Attain a minimum average canopy cover of 80% by planted and/or naturally recruited native canopy species.

2. Achieve a minimum average density of 135 (50% of 269) living hard-mast producing species in the canopy stratum (planted trees and/or naturally recruited native canopy species). The remaining trees in the canopy stratum must be comprised of soft-mast producing native species.

Notes:

- There are no success criteria for midstory or understory species; however, data will be collected concurrently with scheduled monitoring throughout the 50-year project life.

- Greater flexibility for species composition may be allotted after multiple years of not meeting initial success criteria.

- The requirement that the above criteria remain in effect for the duration of the overall monitoring period may need to be modified later due to factors such as the effect of sea level rise on vegetative cover. Proposed modifications must first be approved by the USACE in coordination with the IET. If doesn’t meet 80% 6 Years Following Completion of 2.C, the IET would meet and discuss path forward. Greater flexibility

for species composition may be allotted after multiple years of not meeting initial success criteria.

2) Swamp

A. Initial Success Criteria (at end of first growing season following the year planting meets construction requirements)

1. Achieve a minimum average survival of 50% of planted canopy species excluding recruited seedlings (i.e. achieve a minimum average canopy species density of 269 seedlings/ac .).
2. The surviving plants must approximate the species composition and the species percentages specified in the initial plantings component of the Mitigation Work Plan.
3. These criteria will apply to the initial plantings as well as any subsequent replantings necessary to achieve this initial success requirement.

B. Intermediate Success Criteria

1. (3 growing seasons Following Completion of A)

a) Achieve a minimum average density of 250 living native canopy species per acre (planted trees and/or naturally recruited native canopy species).
b) Achieve a minimum average density of 125 living bald cypress trees (planted trees and/or naturally recruited native canopy species). The species composition of the additional native canopy species present must be generally consistent with the planted ratios for such species.
c) Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. This criterion will thereafter remain in effect for the duration of the remaining 50-year monitoring period.

2. (Within 12 Years Following Completion of A) Achieve one of the two following vegetative cover requirements:

a. The average percent cover by native species in the canopy stratum is at least 75%.
OR b. The average percent cover by native species in the canopy stratum is at least 50%, and; the average percent cover by native species in the midstory stratum exceeds 33%, or; the average percent cover by native species in the ground cover stratum (herbaceous cover) exceeds 33%.

C. Long-Term Success Criteria (Within 30 Years Following Completion of B.2)

1. Demonstrate that the average percent cover by native species in the canopy stratum is at least 80%.
2. Demonstrate that the average diameter at breast height (DBH) of living bald cypress trees exceeds 10 inches. This criterion will thereafter remain in effect for the duration of the overall monitoring period.

3. Demonstrate that the average DBH of the other living native trees in the canopy stratum (trees other than bald cypress) exceeds 12 inches. This criterion will thereafter remain in effect for the duration of the overall monitoring period.

4. Demonstrate that the average total basal area accounted for by all living native trees in the canopy stratum combined exceeds approximately 161 square feet per acre. This criterion will thereafter remain in effect for the duration of the overall monitoring period. Note: There are no success criteria for understory species, but data will be collected every monitoring event.

3) Marsh

A. Fresh marsh:

1. Initial Success Criteria (2 growing seasons following completion of initial construction activities in General Construction A.):

- Achieve a minimum average of 50% comprised of native herbaceous species.
- Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. (USACE 2010)

2. Intermediate Criteria (2 years following attainment of Native Vegetation Criteria A.1.):

- Achieve a minimum average of 60% comprised of native herbaceous species.
- Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria. (USACE 2010)

3. Long-Term Success Criteria (Every monitoring event after attainment of Native Vegetation Criteria A.2.):

- Achieve a minimum average cover of 60% comprised of native herbaceous species.
- Demonstrate that vegetation satisifies USACE hydrophytic vegetation criteria. (USACE 2010)

VI. MONITORING

Monitoring the constructed mitigation sites is required to ensure that the habitats meet established success criteria. The monitoring requirements for the TSP (mitigation) covers habitat restoration and enhancement success criteria over the 50-year period of analysis. ER 1105-2-100, Appendix C, Environmental Compliance (Revised 2019) sets forth the requirements for monitoring. See also WRDA 2007 Section 2036(a). The monitoring requirements for the TSP are briefly summarized in this section.

1) BLH and Swamp

Baseline Monitoring Report (First Monitoring Report) BLH and Swamp Within 90 days of completion of all final construction activities (e.g. eradication of invasive and nuisance plants, planting of native species, completion of earthwork, grading, surface water management system alterations/construction, etc.) associated with General Construction A. or B., a “baseline” monitoring report will be prepared. Information provided will typically include the following items:

- A detailed discussion of all mitigation activities completed.

- A description of the various features and habitats within the mitigation site. Various qualitative observations will be made to document existing conditions and will include, but not be limited to, potential problem zones, general condition of native vegetation, and wildlife utilization as observed during monitoring.

- A plan view drawing and shapefiles of the mitigation site showing the approximate boundaries of different mitigation features including planted areas, planted rows, areas involving eradication of invasive and nuisance plant species, surface water management features, access rows, proposed monitoring transects locations, sampling plot locations, photo station locations, and if applicable, piezometer and staff gage locations. • Initial and final construction surveys for areas having had topographic alterations, including elevations of all constructed surface water drainage features, drainage culverts, and/or water control structures. The initial and final construction surveys should also include cross-sectional surveys of topographic alterations involving the removal of existing linear features such as berms/spoil banks, or the filling of existing linear ditches or canals. The number of cross-sections must be sufficient to represent elevations of these features. The initial and final construction surveys must include areas where existing berms, spoil banks, or dikes have been breached.

- A detailed inventory of all canopy and midstory species planted, including the number of each species planted and the stock size planted. In addition, provide an itemization of the number of each species planted and correlate this itemization to the various areas depicted on the plan view drawing of the mitigation site.

- Photographs documenting conditions in the project area will be taken at the time of monitoring and at permanent photo stations within the mitigation site. At least two photos will be taken at each station with the view of each photo always oriented in the same general direction from one monitoring event to the next. The number of photo stations required and the locations of these stations will vary depending on the mitigation site. The USACE will make this determination in coordination with the IET and will specify the requirements in the project-specific Mitigation Monitoring Plan. At a minimum, there will be 4 photo stations established. For mitigation sites involving habitat enhancement/earthwork only, permanent photo stations will primarily be established in areas slated for planting of canopy and mid-story species, but some may also be located in areas where plantings are not needed.

- Multiple baseline reports may need to be submitted if additional plantings are required by the contractor to meet planting survival acceptance criteria. Each revision will be updated to incorporate information regarding the re-planting.

2) Marsh

A “baseline” monitoring report will be prepared upon completion of Final Construction Requirements B. and upon any re-plantings associated with construction. Information provided will typically include the following:

- A detailed discussion of all mitigation activities completed.

- A plan view drawing of the mitigation site showing the approximate boundaries of the restored marsh, significant interspersion features established within the marsh features (as applicable), proposed monitoring transect locations, proposed sampling plot locations, photo station locations and water level survey locations.

- Initial and final construction surveys of all project features (including but not limited to the fill area, fish dips, weirs, culverts, etc.) and an analysis of the survey data will be provided addressing attainment of topographic success criteria. If a project is immediately adjacent to existing marsh habitat, the topographic survey will include spot elevations collected within the existing marsh habitat near the restored marsh.

- Photographs documenting conditions in the project area will be taken at the time of monitoring. Photos will be taken at permanent photo stations within the restored marsh. At least two photos will be taken at each station with the view of each photo always oriented in the same general direction from one monitoring event to the next. The number of photo stations required and the locations of these stations will vary depending on the mitigation site. The USACE will make this determination in coordination with the Interagency Team and will specify the requirements in the Mitigation Monitoring Plan. At a minimum, 4 photo stations will be established within each marsh cell.

- For planted marsh only -- A detailed inventory of all species planted, including the number of each species planted, the stock size planted, and where the species were planted will be documented. For mitigation sites that include more than one planted marsh cell/feature, provide a breakdown itemization indicating the number of each species planted in each feature and correlate this itemization to the marsh features depicted on the plan view drawing of the mitigation site.

- As part of the as-built/final construction survey, water level surveys will be taken inside and outside the marsh creation site at predetermined locations identified in coordination with the IET and NFS. Each interior water level elevation should have a corresponding exterior water level elevation taken consecutively and within close proximity. If there appears to be disparity in water levels within the marsh creation site, additional shots may be required. The baseline monitoring report will provide the surveyed water level data and will compare it to

mean high and mean low water elevation data collected from a tidal elevation recording station in the general vicinity of the mitigation site. The report will further address estimated mean high and mean low water elevations at the mitigation site based on field indicators.

- Various qualitative observations will be made in the mitigation site to help assess the status and success of mitigation and maintenance activities. These observations will include: general estimate of the average percent cover by native plant species; general estimates of the average percent cover by invasive and nuisance plant species; general observations concerning colonization of the mitigation site by volunteer native plant species; general condition of native vegetation; trends in the composition of the plant community; wildlife utilization as observed during monitoring (including fish species and other aquatic organisms); the condition of interspersion features (tidal channels, trenasses, depressions, etc.) constructed within the marsh features, noting any excessive scouring and/or siltation occurring within such features; the natural formation of interspersion features within restored marshes; observations regarding general surface water flow characteristics within marsh interspersion features; the general condition of “gaps”, “fish dips”, or similar features constructed in permanent dikes; if present, the general condition of any armoring installed on permanent dikes. General observations made during the course of monitoring will also address potential problem zones and other factors deemed pertinent to the success of the mitigation project.

- A summary assessment of all data and observations along with recommendations as to actions necessary to help meet mitigation and management/maintenance goals and mitigation success criteria.

A more detailed description of the monitoring requirements is included in Appendix C.

VII. ADAPTIVE MANAGEMENT

This Adaptive Management (AM) Plan is for the St. Tammany Parish Louisiana Feasibility Study included in the draft IFR and EIS and is designed to mitigate for bottomland hardwood, swamp and fresh marsh impacts from the tentatively selected plan. The Water Resources Development Act (WRDA) of 2007, Section 2036(a) and USACE policy requires adaptive management to be included in all mitigation plans for fish and wildlife habitat and wetland losses. The adaptive management requirements for the TSP are briefly summarized in this section.

It should be noted that even though the proposed mitigation actions under the draft IFR and EIS include the potential purchase of credits from a mitigation bank, this section only details the Adaptive Management planning for constructible mitigation features for the feasibility study. In the event that mitigation bank credits are purchased the mitigation management and maintenance activities for the mitigation bank credits will be set forth in the Mitigation Banking Instrument (MBI) for each particular bank. The bank sponsor (bank permittee) will be responsible for these activities rather than the USACE and/or the local sponsor. USACE Regulatory staff reviews mitigation bank monitoring reports and conducts periodic

inspections of mitigation banks to ensure compliance with mitigation success criteria stated in the MBI. Adaptive management planning would be conducted and the planning elements would include: 1) development of a Conceptual Ecological Model (CEM), 2) identification of key project uncertainties and associated risks, 3) evaluation of the mitigation projects as a candidate for adaptive management and 4) the identification of potential adaptive management actions (contingency plan) to better ensure the mitigation project meets identified success criteria. The adaptive management plan is a living document and will be refined as necessary as new mitigation project information becomes available.

Section 8
Environmental Laws and Regulations

8.1 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 floodplain; however, the TSP would not promote future development within the floodplain that otherwise would not occur. The project is compliant with the order.

8.2 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 for as described in Chapter 7.

8.3 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 prepared a Consistency Determination for the study which is currently under review by the LADNR. LADNR's concurrence with the Coastal Zone Consistency Determination will be obtained by CEMVN before a ROD is signed.

8.4 FARMLAND PROTECTION POLICY ACT

The Farmland Protection Policy Act of 1981 was enacted to minimize the extent that Federal programs contribute to the unnecessary and irreversible conversion of prime or unique farmland to non-agricultural uses. The USDA-NRCS is responsible for designating prime or unique farmland protected by the act. Prime farmland, as defined by the act, 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 defined by the act as 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 survey report of the selected plan footprint are prime and unique farmlands. Construction of the TSP features, the associated borrow areas and the compensatory mitigation measures could potentially reduce the acreage of prime farmland. However, the flood management benefits provided to remaining farmland outweigh the impacts. Therefore, the overall impact to prime and unique farmland is not considered significant. Mitigation is not proposed for impacts to prime and unique farmland. Potential impacts to prime and unique farmland as a result of any project feature, including compensatory mitigation activities would be coordinated with NRCS.

8.5 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The Magnuson-Stevens Fishery Conservation and Management Act, as amended, Public Law 104-208, 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. The draft was provided to the NMFS for review and comment on *3 March 2021*. Any EFH conservation recommendations received from the NMFS will be incorporated into the final report. Consultation with NMFS will be completed prior to the signing of a ROD.

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 has been applied for and will be included in the final report. A Section 401 Water Quality Certification email was sent 9 May 2021 and a follow up email was sent 4 June 2021 to support our application. Water Quality Certification will be obtained before a ROD is signed.

As required by Section 404(b)(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 the TSP is currently ongoing. The Section 404(b)(1) public notice will be mailed later for concurrent public and agency review with the final report.

8.8 ENDANGERED SPECIES ACT OF 1973

The ESA helps to protect and recover T&E species of fish, wildlife, and plants. A biological assessment is currently being prepared by CEMVN in coordination with USFWS and NMFS for listed T&E species, including Atlantic sturgeon, West Indian manatee, Gopher tortoise, Ringed map turtle, Red-cockaded woodpecker, Louisiana quillwort, migratory shorebirds, and species of management concern (i.e. rare and very rare species) that are known to occur or believed to occur within the area. The final biological assessment will be included in the final report.

The implementation of the TSP would include Standard Manatee Conditions for In-Water Activities with the contractor instructing all personnel regarding the potential presence of manatees in the area, and the need to avoid collisions with these animals. If a manatee(s) is sighted within 100 yards of the area, moving equipment must be kept at least 50 feet away from the manatee or shut down. There would be restrictions on vessel operation and restrictions on the use of siltation barriers.

8.9 FISH AND WILDLIFE COORDINATION ACT OF 1943

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 were received via email28 April 2021, and it is included in Appendix C with USACE responses. A draft CAR is in process, and the final CAR will be included in the final report.

8.10 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. After an initial HTRW assessment, in the absence of a known HTRW concern, the proposed site would not require an HTRW investigation.

Engineer Regulation (ER) 1165-2-132 provides that in the Planning, Engineering and Design (PED) Phase that, for proposed project in which the potential for HTRW problems has not been considered, an HTRW initial assessment, as appropriate for a reconnaissance study, should be conducted as a first priority. If the initial assessment indicates the potential for HTRW, then testing, as warranted, and analysis similar to a feasibility study should be conducted prior to proceeding with the project design. An abridged HTRW Phase 1 ESA, dated October 26, 2020, was conducted for the study to facilitate early identification and consideration of HTRW issues by surveying the study area via aerial photography, conducting environmental database searches, and conducting site visits of the proposed project area. See Appendix C.

The abridged ESA identified the presence of several active, inactive, and plugged and abandoned oil/gas wells, several injection wells, and several oil and gas pipelines within the study area. Several industrial facilities such as chemical plants and refineries were also noted in the study area. There is a low probability of encountering HTRW from the wells, pipelines, and industrial facilities during construction of the project. If a recognized environmental condition is identified in relation to the project area, CEMVN would take the necessary measures to avoid the recognized environmental condition so that the probability of encountering or disturbing HTRW would continue to be low.

8.11 MIGRATORY BIRD TREATY ACT AMENDED

The MBTA (16 U.S.C. 703, et seq.) 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 FWS.

The bald eagle was removed from the list of T&E Species in August 2007, but continues to be protected under the Bald and Golden Eagle Protection Act (BGEPA) and the MBTA. . 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 and as part of the habitat assessment for the FEIS.

8.12 EXECUTIVE ORDER 12898: ENVIRONMENTAL JUSTICE

E.O. 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995 direct federal agencies to identify and address any disproportionately high and adverse human health or environmental effects of federal actions to minority and/or low-income populations.

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 below the Census Bureau's statistical poverty threshold for a family of four. The Census Bureau defines a "poverty area" as a census tract or block numbering area with 20 percent or more of its residents below the poverty threshold level and an "extreme poverty area" as one with 40 percent or more below the poverty threshold level.

Direct impacts to EJ communities from construction of the TSP are expected to be minimal. Overall, there are no disproportionately high and adverse human health or environmental effects from the proposed activities.

8.13 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 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 will establish procedures to satisfy the CEMVN's Section 106 responsibilities pursuant to 36 CFR Part 800.14(b). The final PA will be contained in the final report 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 will 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 will 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).

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).

Section 9
Public Scoping 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 study 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 shared with CEMVN to assess what work had previously been studied and what could be used by CEMVN in the study. Information exchange between CEMVN, the State, and local partners is ongoing and will continue throughout the study.

CEMVN held two public information meetings within 90 days after the commencement of the study: (1) 11 February 2020, at the Mandeville Community Center, and (2) 12 February 2020, in the Slidell Civic Auditorium. As part of the early coordination, general scoping at these public information meetings was conducted prior to the publication of a Notice of Intent. Presentations were provided to the public about the study, and PDT members were available to discuss alternative development and issues of local concern that would factor into the USACE planning process and analysis. Both public information 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 plan formulation process. Contact information was distributed to all attendees on how to submit comments for the study via letter, email, and telephone.

A public website page with the study information and multiple methods to provide feedback was created by CEMVN in June 2020. https://www.mvn.usace.army.mil/About/Projects/BBA-2018/studies/St-Tammany/

Due to the coronavirus, virtual public scoping meetings were held on 14 – 15 July 2020. The virtual meetings were broadcast from the CEMVN office and the public was notified about the meetings through the NOI published 19 June 2020, as well as through multiple social media channels and the 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 members during both meetings.

The meeting videos remain available on the CEMVN YouTube Channel, Facebook, & study website for public viewing. The official comment period ended on 3 August 2020.

The period for public comments to inform the scoping period ended on 3 August 2020. Input received from public meetings assisted the PDT in refining study problems and

opportunities, goals, objectives, potential measures, and alternative plans. See Appendix C for the Scoping Report, NOI, NOA, and other documentation regarding public scoping, participation, and coordination.

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. The USFWS, NMFS, LDWF, LA SHPO, the City of Slidell, the City of Mandeville, and the CNO have accepted the invitation to be cooperating agencies. They have all been included in the study planning and invited to participate in the PDT meetings. Due to the alignment of Alternatives 4, 5 and 6c near the HQ of the Southeastern Louisiana National Wildlife Refuge Complex in Lacombe, coordination with their office is ongoing to address their concerns regarding the levee alignments along Refuge property.

Subjects of common concern identified through public and stakeholder comments include, but are not limited to, the following:

1. Local drainage issues throughout the Parish;
2. Requests to explain adverse impacts/induced flooding from the West Shore Lake Pontchartrain Study to Eden Isle
3. Impacts to Gulf sturgeon, red cockaded woodpecker, and gopher tortoise habitats from the any proposed construction by the natural resource agencies.

See Appendix C for the public notices, coordination letters, Scoping Report, and public comments received to date.

In partial fulfillment of USACE's responsibilities under EO 13175, the following federally recognized tribes that have historic interest in Louisiana and the study area were invited to participate in the planning process as cooperating agencies: 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).

A public notice will be published in the Baton Rouge and New Orleans Advocate for the 45-day comment period starting with the public release of the draft report on 11 June 2021. A NOA will also be published in the Federal Register. Preparation of this report has been coordinated with appropriate Congressional, federal, tribal, state, and local interests, as well as environmental groups and other interested parties.

This DIFR and DEIS is available for public review beginning June 11, 2021. The official closing date is 45 days from the date on which the notice of availability of this DIFR and DEIS appears in the Federal Register during this review period. Comments may be mailed or emailed to:

U.S. Army Corps of Engineers
Attention: Project Management
CEMVN–PMR, Room 331,

7400 Leake Avenue New Orleans, LA 70118
Email: sttammanyfs@usace.army.mil

Section 10
Conclusion

10.1 RECOMMENDATION

At this phase of the study, prior to concurrent review of the draft report, CEMVN identified the TSP 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 TSP but support is also subject to concurrent review of the draft report. CEMVN will continue to coordinate with the NFS to complete feasibility level of design on the TSP.

An implementation plan for the nonstructural features of the TSP will be further developed and documented in the revised final decision document. Concurrent review of this draft report includes public, technical, legal, and policy reviews, as well as a Type I IEPR. The PDT, the CEMVN management, and USACE vertical team representatives throughout the agency will consider comments provided during the review period prior to providing feedback to prior to providing feedback to a USACE Headquarters Senior Leaders Panel. This panel will consider the evaluation of the significant public, technical, legal, policy and IEPR comments on the TSP and other alternatives to determine the endorsement of a recommended plan and proposed way forward to complete feasibility-level design and the final report.

The final report is anticipated to be submitted in 2023 to USACE headquarters. After the final feasibility report is submitted to headquarters, a Chief's Report will be developed. On the Chief of Engineers signs the report, the Chief of Staff signs 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 is also supplied to the Office of the Assistant Secretary of the Army for Civil Works for review by the Administration.

While the TSP recommended herein, provides a significant suite of measures to reduce FRM and CSRM flood risk in St. Tammany Parish, Louisiana, the TSP will not solve all flooding within this Parish. A residual flood risk may remain after the implementation of the TSP. In addition, locations outside of the areas benefitted by the TSP are likely to continue to experience impacts from flooding. USACE recommends that further actions by the NFS and other local governmental entities be explored to further reduce and mitigate flood damages and increase overall resiliency in the study area.

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 CPRA, identified the West Slidell Levee, South Slidell Levee as structural alternatives and nonstructural risk reduction as alternatives warranting further investigation.

List of Preparers

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Distribution of the DIFR and DEIS

Electronic copies of the Notice of Availability of the report 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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St. Tammany Parish Coastal Protection Gap Analysis Report. 2020. Prepared by Neel Shaffer for CPRA, St. Tammany Parish and the St. Tammany Levee, Drainage and Conservation District (STLDCD)

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
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