WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
FINAL INTEGRATED FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

VALUE ENGINEERING

APPENDIX G

U.S. ARMY CORPS OF ENGINEERS

NEW ORLEANS DISTRICT

VALUE ENGINEERING REPORT:

West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction

Feasibility Phase

(Update Supplement to VE Study CEMVN-00-10)

February 2014

CEMVN-VE-14-02

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INTRODUCTION

This report documents Feasibility Phase Value Engineering (VE) application to this project. It serves as an update supplemental to a previous VE study (CEMVN-VE-00-10) that was performed in 2000, early in the planning phase. That study has exceeded its allowable 6-year viability per ER 11-1-321 and must be updated per this document.

In conducting this update, project functions, current issues as well as pertinent recommendations from the previous VE workshop were considered and documented below.

As a result of this review several original and new VE recommendations are presented as **Appendix A,** and should be further considered in further project development.

PROJECT DESCRIPTION

The proposed project provides flood risk reduction for a portion of the southwest Lake Pontchartrain Basin (see below project location map).

The Tentatively Selected Plan (TSP) levee and flood wall alignment starts form the east at the West Guide levee of the Bonnet Carré Spillway to the US-51 interchange, where it then tracks north across US-51 and along a pipeline transmission corridor. The approximately 18.27-mile alignment crosses I-10 and follows the pipeline corridor through wetlands near the Belle Terre exit until it reaches Hope Canal. The alignment then turns south and extends to the MRL (see below plan map). Elevation and/or acquisition of structures outside the alignment would reduce risk of storm surge-related damage to structures in areas west of the Hope Canal.

Construction of this plan will require 3,365,000 cubic yards of geotextile fabric; nearly 26,000 cubic yards aggregate limestone road; 5,300 linear feet of T-walls; 300 linear feet of flood gates; 200 linear feet of drainage gates; 4 pump stations; and 2 railroad gates. Environmental structures (sluice gates) will be built at existing bayous/canals that intersect the proposed flood protection barrier.

Although mitigation planning was integrated into the overall plan formulation process, implementation of the TSP requires compensatory mitigation for unavoidable project-induced impacts that will require replacing or providing substitute resources. A mitigation plan for the TSP will be completed following the feasibility level design and analysis and will be included in the final feasibility report.

The current TSP cost estimate is as follows:

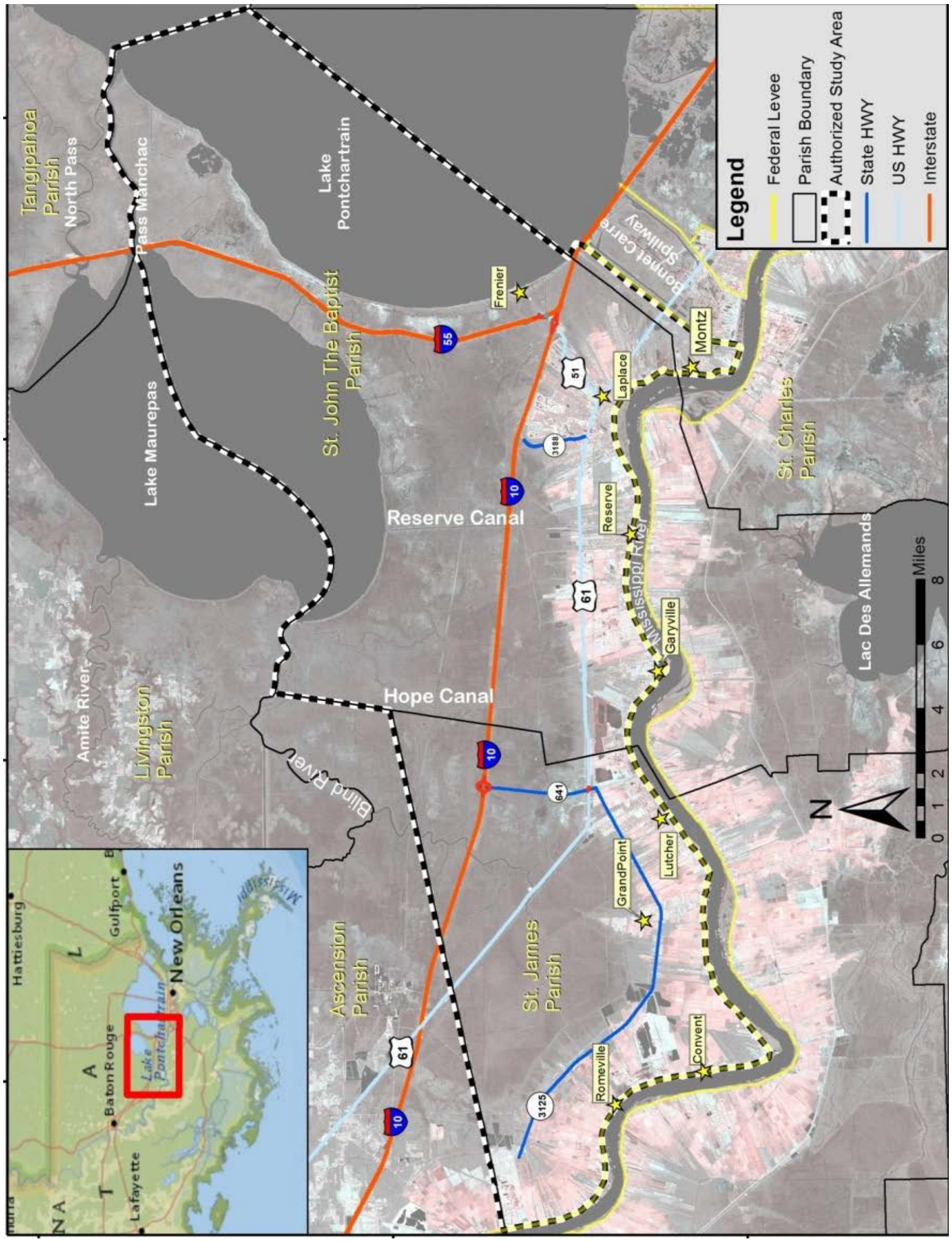
	Total	Federal	Non-Federal
PED	$7,500,000	$4,875,000	$2,625,000
Construction	$761,051,070	$557,500,446	$203,550,625
Pipeline Relocations	$35,100,000	-	$35,100,000
Lands, Easements, & ROW*	$84,700,000	$15,052,750	$69,647,250
Total First Costs**	**$888,351,070**	**$577,428,196**	**$310,922,875**

*** Federal costs are Administrative Cost of Non-Federal Sponsor Oversight**
**** Monitoring and Adaptive Management costs not included.**

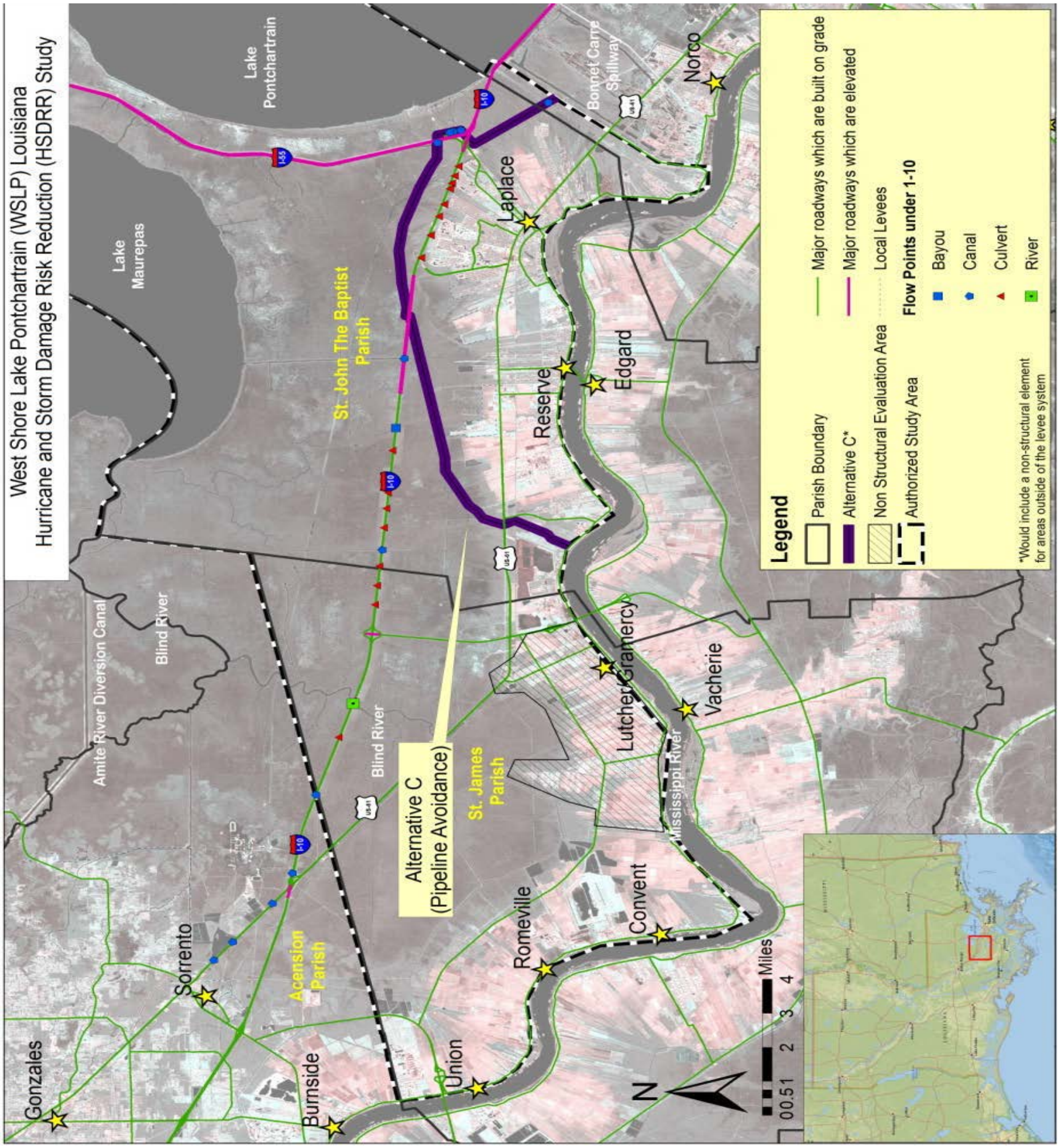
Future estimated annual operation, maintenance, rehabilitation and replacement costs for this plan are $520,000 for levee grass cutting and periodic repairs, plus $3,607,000 for pump stations and gate structures. Additional annual costs for environmental mitigation is also required and not included in the above.

Baseline information foe this VE update was obtained from the document, ***"West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study, Integrated Draft Feasibility Report and Environmental Impact Statement, August, 2013".*** Further information extracted from this document regarding the TSP and other project alternatives (A&D) can be respectively found in **Appendices B and C.**

(Project Location Map)



(Plan Map of TSP)



RE-PROPOSED AND NEW VE SUGGESTIONS

The list below contains suggestions carried forward from the previous VE study (see next section) or newly identified items addressing project functions and/or current issues (Ref. **Appendix D**. The following are presented/discussed in **Appendix A:**

Item 1 – *Consider non-implemented features of the Amite River Diversion Canal Modification Project for mitigation*

Item 2 – *Designate permanent conservation areas inside proposed levee alignment*

Item 3 – *Consider internal water flow in mitigation feature design*

Item 4 – *Re-consider alignment to incorporate additional NER benefits*

Item 5 – *Address options for I-55 crossing*

Item 6 – *Evaluate pump station capacity requirements; address consistency with other CoE projects*

Item 7 – *Consider optimized pump station design*

CONSIDERATION OF VE PROPOSALS FROM PREVIOUS WORKSHOP

The 'parent' VE study document for this update supplemental is ***"West Shore Lake Pontchartrain, Louisiana Hurricane Protection Project, Value Engineering Study, September 2000, CEMVN-00-10".*** The following is a list of recommendations and design comments contained in that report with current disposition as applied to the current plan. As noted, items were integrated into the current design, eliminated for reasons noted or remain viable and are 're-proposed' for further consideration:

Recommendation 3,4,16,17- ***Use a pumped drainage system.*** Eliminated due to environmental need to have inflow/outflow on a constant basis for the proposed gated waterways

Recommendation 18,43 - ***Consolidate drainage structures***. Integrated in current design.

Recommendation 11 - ***Use geotubes.*** Eliminated; geotube levee core determined not to be viable

Recommendation 29 – ***Incorporate reserve relief canal diversion guide levee.*** Eliminated; new expanded alignment selected.

Recommendation 12 – ***Compromise between Plans 1 & 3.*** Eliminated; new expanded alignment selected.

Recommendation 2- ***Eliminate Hwy. 51 protection.*** Eliminated; Hwy 51 and I-55 access determined to be a critical items.

Recommendation 6 – ***Construct north-south levee.*** Eliminated; open levee alignment would not be effective in long duration tidal event.

Recommendation 39 - ***Consider composite plan.*** Eliminated; new expanded alignment selected.

Design Comment (DC)-44 – ***Add interceptor canal.*** Integrated in current design.

DC-14 - ***Purchase environmental easements.*** Not defined in current plan; suggestion remains viable is carried forward. ***See Appendix A, Items 2 and 4.***

DC-21- ***Use "potato ridges" for wetland maintenance.*** Not defined in current plan; concept remains viable for consideration in potential mitigation feature design. Re-defined as, "Consider internal water flow in mitigation feature design". ***See Appendix A, Item 3***.

DC-26 - Use natural gas to fuel pump stations. Eliminated; natural gas supply interrupted in are during Hurricane Katrina and is now not considered a reliable fuel source.

DC-I 0 – Consider future development for pump station design capacities. There may be some issues with pump station capacity requirements; topic is carried forward. ***See Appendix A, Item 6.***

DC-15 - Incorporate a floodplain management plan. The PDT will address EO-11-988 "use of Floodplain" guidance.

DC-7 -Reconcile FEMA and corps flood data. New H&H modeling has been performed and calibrated with recent major storm event data (Hurricane Isaac).

DC-9 –Design for hurricane protection only. Eliminated; new expanded alignment determined to be cost-effective versus alignment bordering development (Alt. A).

DC-5 -Reduce levee heights (westward). **Implemented; (see ED Appendix; cost avoidance savings to be determined)**

DC-24-Design for larger hurricane event. Preliminary design is based on 0.01 probability event level of protection. This is in accordance with current regional design protection and appears to be slightly higher than the previous Cat. 3 model hurricane event. Future optimization may also be performed (recommendation partially implemented).

DC-30-Increase levee crown width to 10 feet. Implemented.

DC-8 - Revisit Airline Highway tie-in. Eliminated; new expanded alignment selected.

DC-41,42-Check I-55 crossing. Initial system elevation (2020) will not impact I-55 bridge; future 2070 will and there is no current design plan. Recommendation is carried forward. ***See Appendix A, Item 5.***

DC-22 – Revisit borrow material availability. New alignment assumes available/suitable borrow along protected reach of levee.

DC-45 - Revisit O&M requirements and costs. Implemented.

DC –6–Consider effects of Illinois Central Gulf Railroad (IGC). Model has incorporated this feature; railroad ballast embankment not suitable as a levee structure.

DC-1 - Consider levee location south of I-10 along Belle Terre reach. Eliminated; new expanded alignment selected.

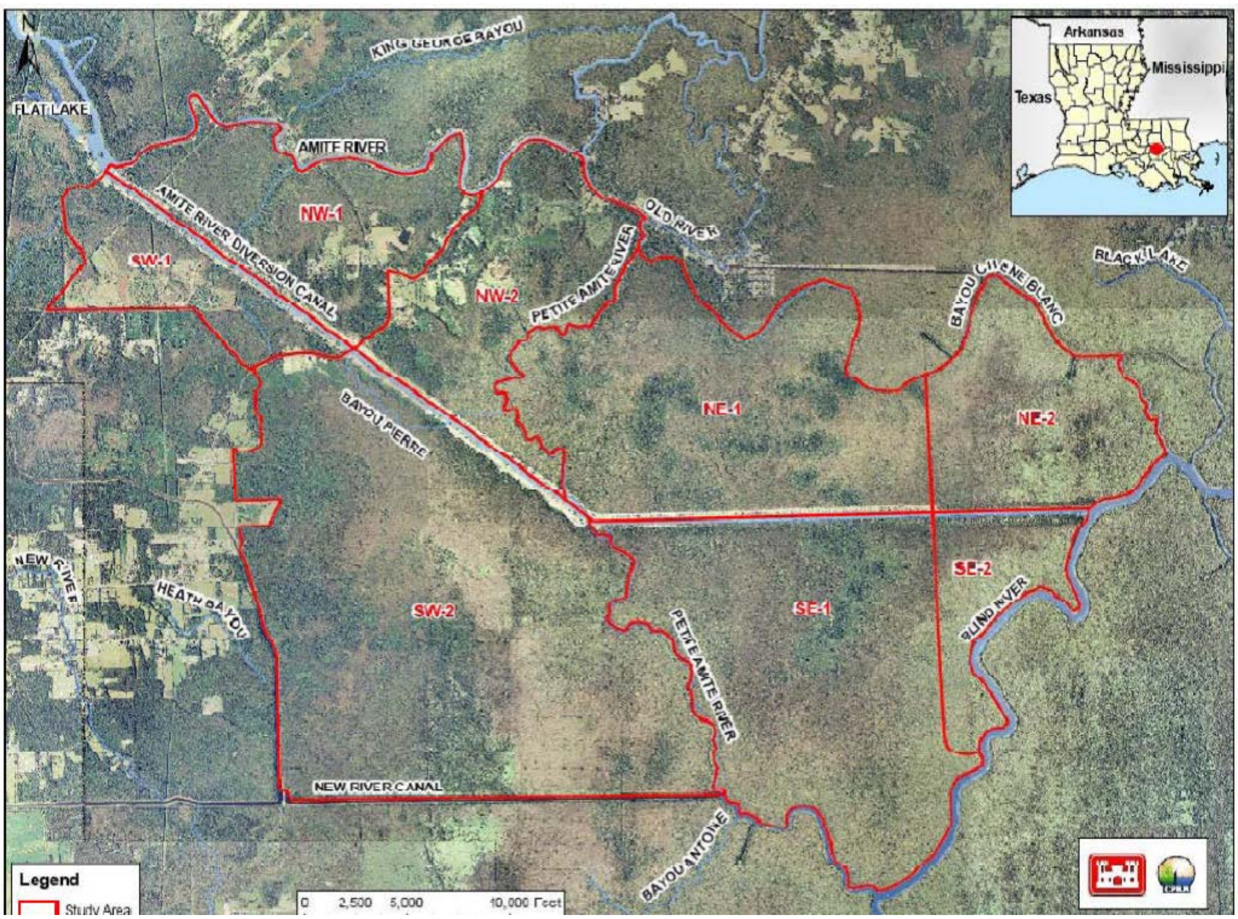
DC-35-Consider I-wall along 1-10 (Belle Terre reach). New alignment has ample right-of-way for less expensive earthen levee.

DC-38 - Consider floodgate on MRGO near Paris Road. Implemented for other HSDRRS project.

APPENDIX A

Re-Proposed and New Value Engineering Recommendations

<u>Item 1 – Consider non-implemented features of the Amite River Diversion Canal Modification Project for mitigation -</u> A recent change in the LCA program indicates that the State no longer supports the lower basin project features of the item subject project (see below map). The potential benefit areas of these features are in close proximity to Westshore and could potentially be targeted as mitigation for the project and likely be far less costly than other measures. Amite River Diversion Canal Modification project features are described below.



AMITE RIVER DIVERSION CANAL MODIFICATION PROJECT AREA MAP

Alternative Measures In Subunit NE-2

The measures currently being considered for Subunit NE-2 include the following:

Bank opening, north bank of Blind River, Location 1 (proposed by site reconnaissance team)

Channel dredging, pull boat trace, Location 2 (proposed by site reconnaissance team)

Bank opening, north bank of Amite River Diversion Canal, Location 3 (proposed as component of Measure BO14)

Bank opening, north bank of Amite River Diversion Canal, Location 5 (proposed by site reconnaissance team)

Bank opening, north bank of Amite River Diversion Canal, Location 6 (proposed as component of Measure BO14)

Two openings in railroad grade north of Amite River Diversion Canal, strategically located (proposed as component of Measure BO23)

Vegetative planting in degraded areas

Alternative Measures In Subunit SE-2

The measures currently being considered for Subunit NE-2 include the following:

Bank opening, south bank of Amite River Diversion Canal, Location 4 (proposed as component of Measure BO15)

Channel dredging and/or clearing and snagging of Blind River tributaries, north bank of Blind River (proposed by site reconnaissance team)

Two openings in railroad grade south of Amite River Diversion Canal, strategically located (proposed as component of Measure BO24)

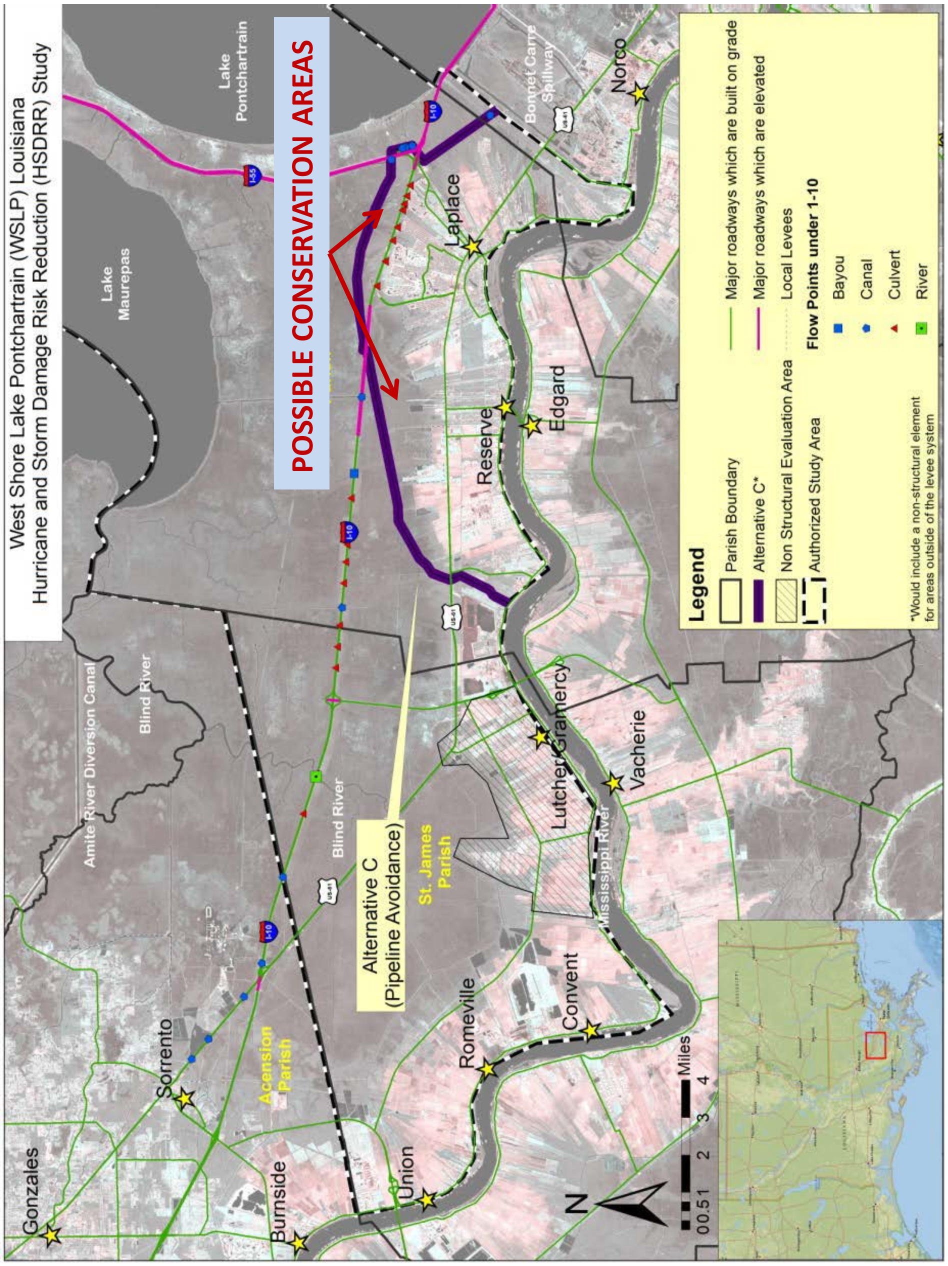
Vegetative planting in degraded areas.

Openings in Railroad Grade, Strategically Located (Subunits NE-1/NE-2 and SE-1/SE-2)

In addition, locations for openings in the relic railroad grade north and south of the Amite River Diversion Canal were determined through LiDAR analysis. Two locations were determined to exhibit characteristics that would constitute ideal locations for establishing hydrologic connectivity between Subunits NE-1 and NE-2. These locations were selected because they occupy topographic low points between vegetated hummocks and/or channel banks.

Item 2 – Designate permanent conservation areas inside proposed levee alignment -

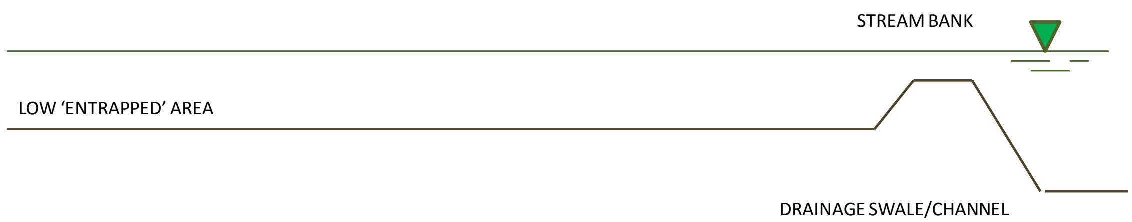
There appears to be the potential to reserve some of the areas that will be enclosed by the project. While the purchase of environmental easements may, or may not, necessary, assuming future development of all enclosed and mitigating for same does not appear prudent since wetland development permits would not be granted. Two such possible areas are suggested and shown on the map below (additional areas should also be investigated). Water flow through drainage gates should be adequate to maintain hydrologic conditions. Also, there is the potential for future trails and other appropriate interaction features. Designating these reserve areas reduces indirect mitigation cost.


West Shore Lake Pontchartrain (WSLP) Louisiana
Hurricane and Storm Damage Risk Reduction (HSDRR) Study
POSSIBLE CONSERVATION AREAS
Lake Maurepas
Lake Pontchartrain
Amite River Diversion Canal
Blind River
Bonnet Carre Spillway
Gonzales
Sorrento
Burnside
Union
Romeville
Convent
Lutcher
Gramercy
Vacherie
Reserve
Edgard
Laplace
Norco
Mississippi River
Acension Parish
St. James Parish
Alternative C
(Pipeline Avoidance)
Miles
0 0.5 1 2 3 4
N
Legend
Parish Boundary
Alternative C*
Non Structural Evaluation Area
Authorized Study Area
Major roadways which are built on grade
Major roadways which are elevated
Local Levees
Flow Points under 1-10
Bayou
Canal
Culvert
River
*Would include a non-structural element for areas outside of the levee system

Item 3 – Consider internal water flow in mitigation feature design – Project mitigation areas will likely be located in area with hydrologic inflow and outflow. Investigation of existing local cypress swamps indicates the possibility of degradation due to flow entrapment. This is particularly evident in areas subject to tropical storm tidal flow events. It is therefore recommended that internal water flow modifications be considered for proposed mitigation areas. Such features mostly consist of berm excavation to connect apparent entrapment areas to drainage outlets as further described and depicted in schematics below.

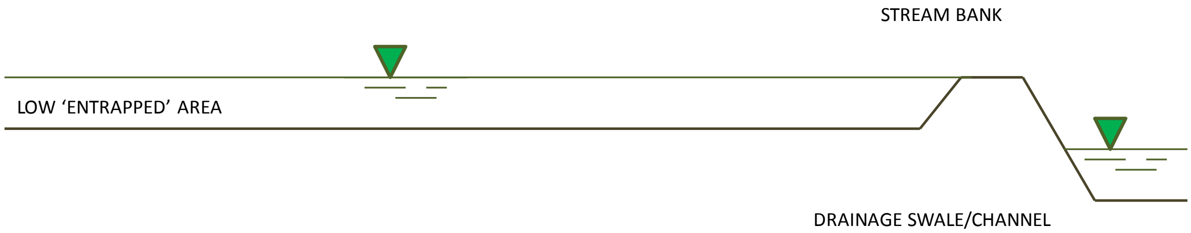
(Description of Alternative Concept) Obtain further refined LiDAR and other data to identify 'trapped' low areas and/or possible unwanted collection points of freshwater diversion flow. Connect low areas to natural drainage outlets via strategically placed cuts in natural or man-made berms (such as canal spoil banks

INITIAL NORMAL FLOW CONDITION

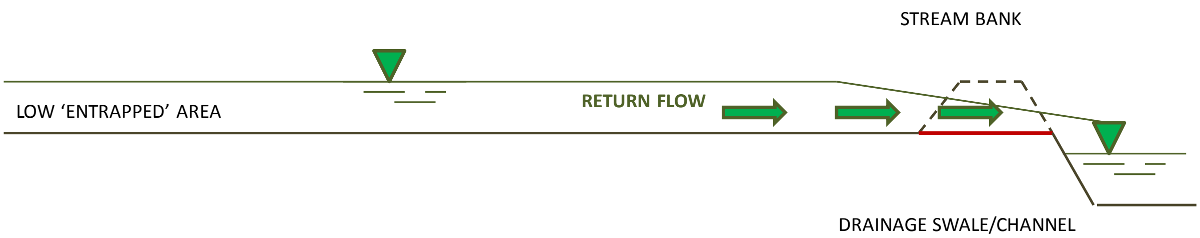


TIDAL SURGE FLOOD CONDITION

EXISTING CONDITIONS – POSSIBLE WATER ENTRAPMENT
(SCHEMATIC SECTION – NO SCALE)



POST TIDAL SURGE FLOOD CONDITION



POST TIDAL SURGE FLOOD CONDITION – **WITH PROPOSED BANK CUT**

PROPOSED BANK CUT

(SCHEMATIC SECTION – NO SCALE)

Item 4 – Re-consider alignment to incorporate additional NER benefits - The current philosophy and assumptions regarding levee placement and environmental impacts of this project appear to be as follows:

- Restricting open tidal flow, particularly sheet-flow, has negative impacts.
- It is assumed that all areas inside the levee system will be developed and eliminate habitat (indirect environmental impact).
- A key early assumption was that an adjacent proposed project – *'Convent/Blind River Diversion'* would have positive effects on major cypress swamps from the Mississippi River northward beyond US Highway 61 (US61). See below map.

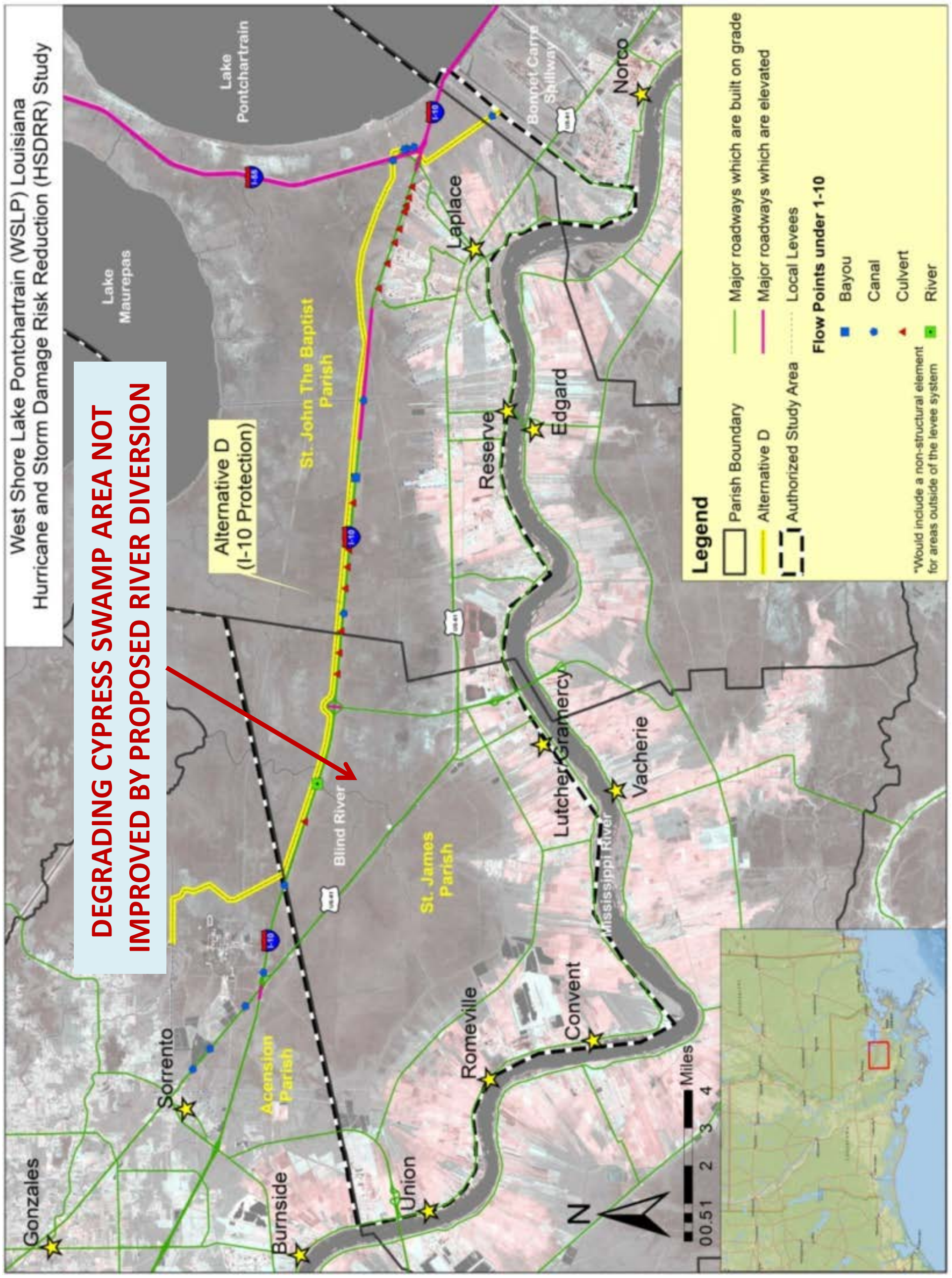
It is suggested that these above presumptions be re-visited with the following considerations:

- The current project design calls for gated drainage structures that will allow control of inflow and outflow to the interior; this 'leaky levee' concept is being embraced for the Morganza to the Gulf and other projects as environmentally sound. The control of saltwater intrusion, particularly when sea level rise is considered, may be a critical ***positive*** factor in maintaining area cypress swamps.

- It is possible to restrict development inside the levee system either by designating select areas as environmental reserves. This can be accomplished via purchase of an environmental easement (as required by CoE policy), by local ordinance or by simple designation since it appears very remote that a federal permit would ever be granted to develop these areas. While outright easement purchase may ***(or may not)*** be more expensive than mitigation, a waiver of CoE policy could be considered.

- Recent hydraulic analysis indicated the proposed Convent/Blind River Diversion Project will not have benefit to the part of the target area – that north of US61. As such, there is currently no proposed plan for protection of this significant cypress swamp area. Its primary degradation, apparently due in large part to saltwater intrusion and entrapment could be retarded with flow control such as a gated levee system could offer.

Given these reconsiderations, it may be determined that a westward extension of the proposed levee (similar to previous Alternative D) may actually produce net environmental benefits (NER) or at least not have nearly the negative impacts (and associated mitigation cost) as previously estimated. Without such an extension, continued loss of a vast area of significant cypress swamp will continue to degrade at its current rate of loss.


West Shore Lake Pontchartrain (WSLP) Louisiana
Hurricane and Storm Damage Risk Reduction (HSDRR) Study
DEGRADING CYPRESS SWAMP AREA NOT
IMPROVED BY PROPOSED RIVER DIVERSION
Alternative D
(I-10 Protection)
Lake Maurepas
Lake Pontchartrain
St. John The Baptist Parish
St. James Parish
Acension Parish
Bonnet Carre Spillway
Blind River
Mississippi River
Gonzales
Sorrento
Burnside
Union
Romeville
Convent
Lutcher
Gramercy
Vacherie
Reserve
Edgard
Laplace
Norco
N
0 0.5 1 2 3 4 Miles
Legend
Parish Boundary
Alternative D
Authorized Study Area
Major roadways which are built on grade
Major roadways which are elevated
Local Levees
Flow Points under 1-10
Bayou
Canal
Culvert
River
*Would include a non-structural element for areas outside of the levee system

<u>Item 5 – Address options for I-55 crossing –</u> Current levee/floodwall design indicates that elevated I-55 is higher than the required 2020 flood height but not the 2070. In lieu if raising the bridge a wave-break structure could be placed just northwest and northeast of the bridge/levee intersection. This would reduce wave run-up and may allow levee/floodwall height reduction such that it passes under the bridge structure. Another option that can be implemented either independently of supplemental to a wave-break structure would be to design the low section of levee/floodwall as an actual weir. Conveyance to an acceptable drainage point cold be improved via concrete paved swales or small canals such that short period overtopping flow can be safely handled.

<u>Item 6 – Evaluate pump station capacity requirements; address consistency with other CoE projects –</u> Further design of proposed pump stations should carefully consider proper conveyance capacity and unit redundancy. Recent hurricane risk reduction projects have been constructed in areas already under pumped stormwater systems; replacement or maintenance of pump stations adhered to existing drainage capacity and system requirements. This project is different in that proposed pumps will replace an existing gravity system and should convey flow greater than or equal to current *<u>under all conditions</u>*.

MVN projects where conversion to pumped drainage has been implemented usually select an apparent 'reasonable' design flow event, such as a 0.04 annual probability. This practice is not uniformly used in other districts as Jacksonville (SAJ) uses 0.01 or greater for conversion systems in their Everglades Restoration Projects. Regardless of the above, an assessment of existing gravity drainage conveyance should be performed and matched or exceeded.

Conveyance design should be adequate under all conditions; existing gravity design should be calculated under low tide conditions (yields current maximum drainage capacity that should be maintained or exceeded). Also, proposed pumping plants should convey this flowrate under maximum design tidal conditions. In short, a design rainfall can be expected in conjunction with a major tropical storm (note that they are NOT statistically independent events).

Proper unit redundancy should also be considered. Local practice does not require an additional pump unit to meet maximum design capacity with one (largest) unit (including ancillary items such as screens, etc.) out of operation. This is not the case for SAJ/South Florida Water Management District where unit redundancy is included in their design. Consideration to unit redundancy should be applied to pump station design in this project.

It may be possible to combine unit redundancy with adjacent pump stations given that most (all) will be hydraulically connected via a manifold canal (borrow pit canal). As such, a single additional unit may be adequate at the middle pump station plus maybe one or two other stations.

<u>Item 7 – Consider optimized pump station design -</u> A number of new pump stations are proposed for this project. Preliminary design indicates 'traditional 'type facilities for this range of station capacity (see below preliminary design sketch). Major features include, but are not limited to the following:

- vertical pumps with direct diesel drive
- siphonic discharge
- climber intake screen cleaning mechanism
- closed interior station with a operator 'safehouse' contained in the station building
- internal permanent lifting crane

In addition to considerations of proper station capacity and unit redundancy discussed in the above recommendation, 'lessons learned' from recent District, other Corps and local projects offer a number of possible options that could significantly improve design cost-effectiveness. Items that should be fully evaluated are:

(Pump type)

Vertical pumps are generally cost-effective in most drainage applications. However, for stations in the capacity ranges designated in this project, other options are possible and may indirectly allow changes in total station configuration that could save significant cost. One option is electric submersible units powered by separate generators. Use of this type of pump offers much flexibility in the overall station structural design and can easily be automated (see comments below). This type of station has been recently constructed at Oakdale (see below photo) and is under consideration for permanent pumps at the Harvey Canal Sector Gates – 770 CFS (see design sketches below).

(Discharge configuration)

Given that these stations will not operate many hours power supply and energy savings afforded by lower operating head achieved via siphonic discharge do not warrant the cost of the discharge tubes. **<u>It is important to note that these pumps must perform under near zero head conditions (gates closed tidal surge not yet arrived) as well as full flood elevation water levels.</u>** As such, this would likely result in the need for induced head under normal tide levels via a 'saxophone' type (end turned upwards) discharge tube. This further increases the cost of the discharge tubes as well as reduces some of the desired power/energy recovery. Over top of wall open discharge requires a slight increase in driver power and very small added energy use but greatly simplifies the pumping system and first cost. This design concept has been successfully used for the East Ascension, Oakville and West Closure Complex pump stations.

(Screen cleaning mechanism)

Current local standards call for intake screen cleaning units to be fully operable under hurricane (wind conditions >120 mph) conditions. There appears to be very limited available units that can meet this requirement and is almost a sole-source condition. Units are very expensive relative to those that cannot achieve this criterion. Others in hurricane areas do not adhere to this standard and offer that it may not be practical or safe given that screen cleaning operation in very high wind conditions would either result in debris blowing right back into the intake or launched into the station structure. To address possible screen clogging during hurricane events, separated screen bridges are designed slightly wider. The possibility of Individual pump screens clogging is addressed in overall unit redundancy per discussed above. Cleaning mechanisms should, however, be designed to release debris away from the screen such that front-loader removal is not necessary to after the storm event.

(Equipment and operator housing structure)

Current local preference is to completely house all equipment and operation control in one large building. Post Katrina criteria also require an operator 'safehouse' capable of withstanding extreme hurricane conditions. Regardless of station size such a large containment structure is not necessary. Pump drivers and ancillary equipment can be protected via 'shell' covers with an independent qualified safehouse control room. Lifting crane(s) can either be brought in as needed or by external on an open frame or gantry track (see item below). A good example of such station configuration is the East Ascension Parish Pump Station. While the control room was not built to safehouse standards, the rest of the station utilizes such a shell cover concept (see below photo). *Also note that his station includes gravity gates integrated in the pump station structure (between each pump).*

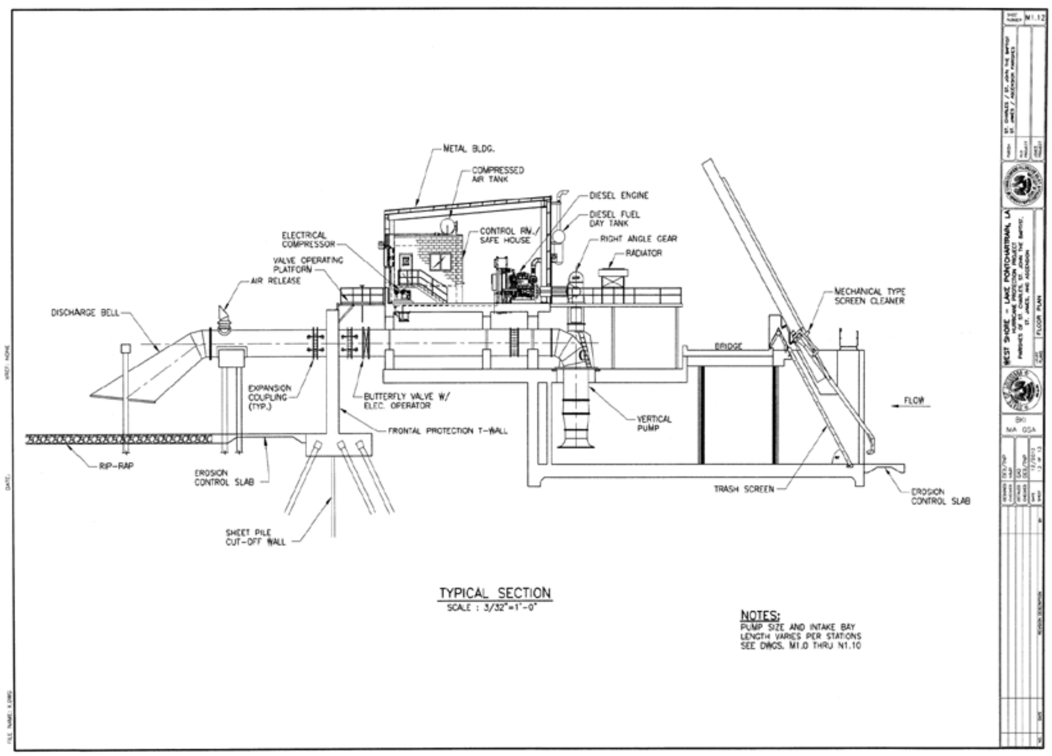
(Lifting crane)

Current local preference is to have a crane, capable of lifting the largest piece of equipment, permanently installed inside the single station building. This requires that the building have excessive height (and cost) to both house and support the crane. Since lifting a pump must be a planned event, it is possible to bring in a locally owned or rented crane for each event. A more favorable option is to have an external crane on a frame and/or gantry track in conjunction with a removable cover shell or low-rise building (roof panel).

(Auto-operation of some stations)

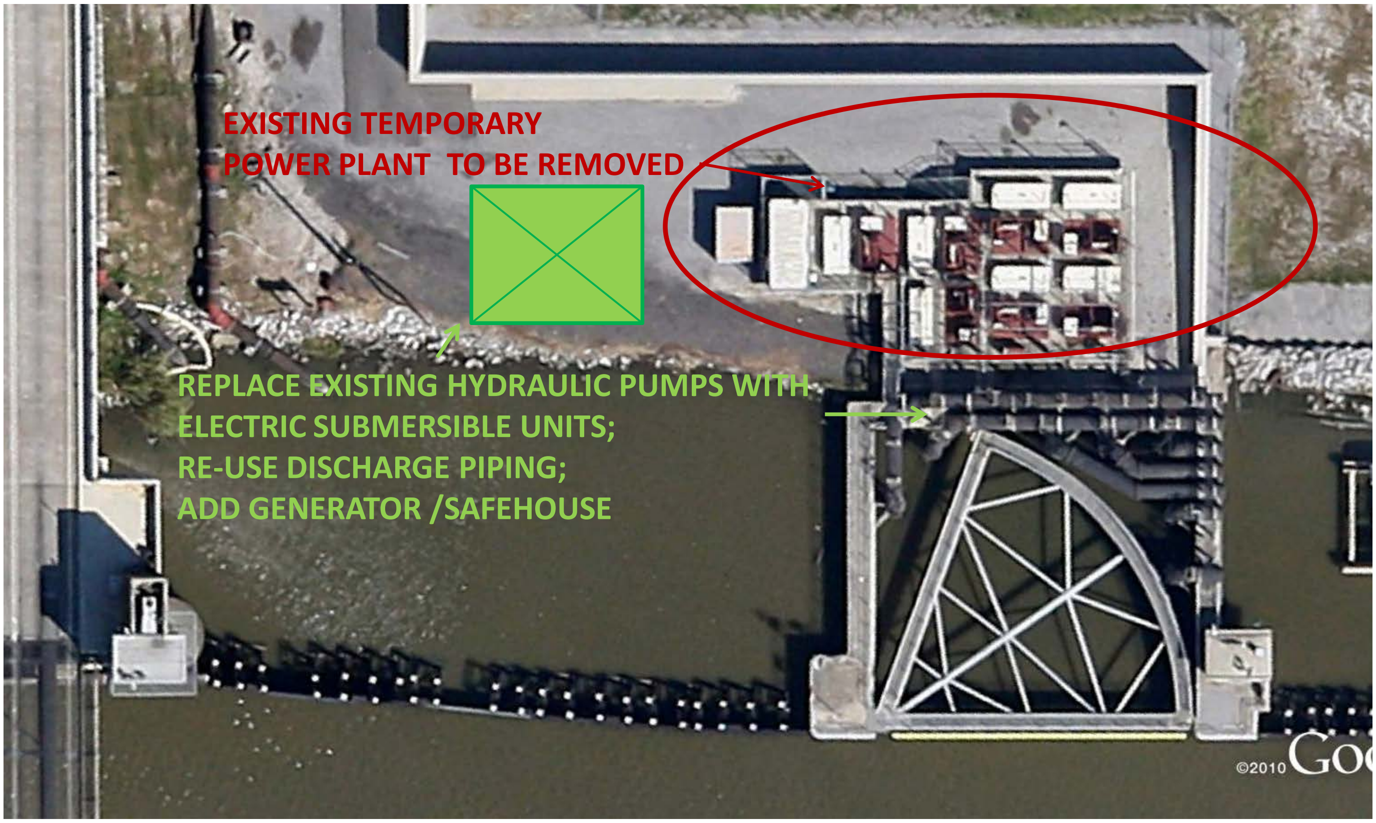
Safehouses may be expensive, particularly if elevated above levee breach event water level. Also, manning each pump station in an event is not desired if a reliable alternative exists. It is proposed that perhaps only one or two stations be manned and have SCADA monitoring of the other facilities. The un-manned stations could be auto-control by a fairly simple and reliable float switch system. This becomes a more viable option in conjunction with alternative pump type and discharge options discussed above.

All of the above considerations may be integrated into a comprehensive cost-effective design. It is recommended that the above mentioned local pump stations utilizing these alternative concepts as well as other stations with similar function such as Jacksonville District / South Florida Water Management District.

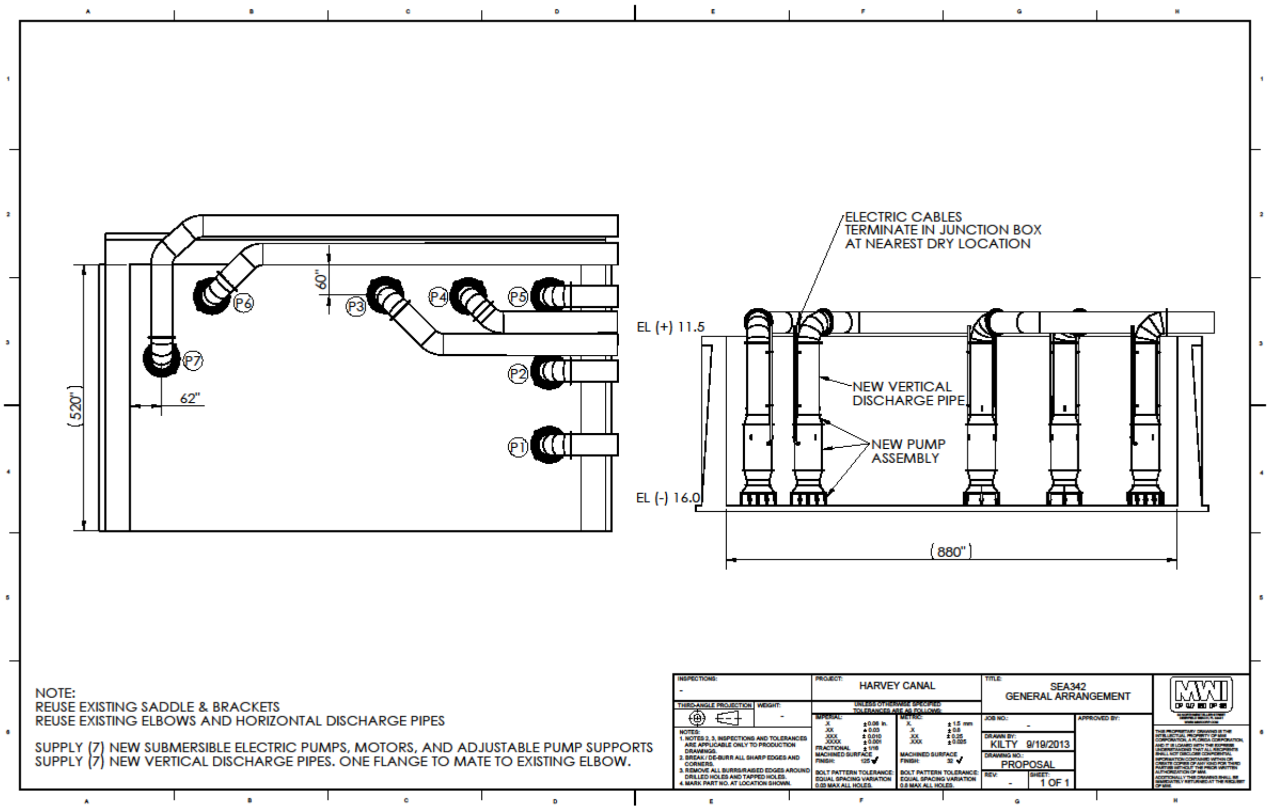


TRADITIONAL PUMP STATION

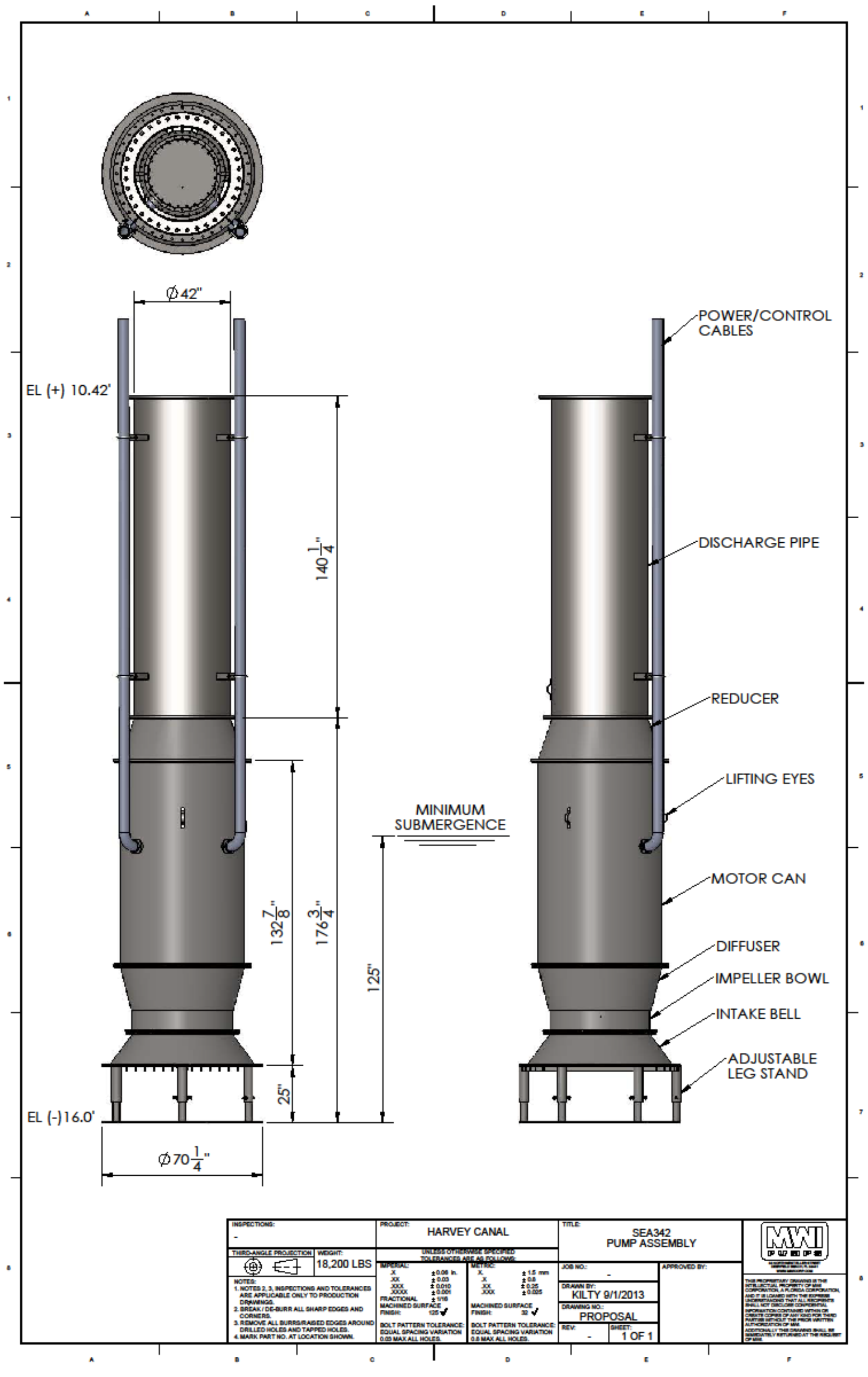
OAKVILLE PUMP STATION - ELECTRIC SUBMERSIBLE PUMPS WITH GENERATOR BUILDING



HARVEY CANAL SECTOR GATE - PROPOSED PUMP REPLACEMENT PLAN (ELECTRIC SUBMERSIBLES WITH GENERATOR BUILDING)



HARVEY CANAL SECTOR GATE - PROPOSED PUMP REPLACEMENT PLAN (ELECTRIC SUBMERSIBLES WITH GENERATOR BUILDING)



ELECTRIC SUBMERSIBLE PUMP

EAST ASCENSION PARISH PUMP STATION – 1,000 CFS PUMP UNITS

WITH DRAINAGE GATES BETWEEN PUMP UNITS

APPENDIX B

Description of the Tentatively Selected Plan from *"West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study, Integrated Draft Feasibility Report and Environmental Impact Statement, August, 2013"*

5.0 TENTATIVELY SELECTED PLAN (*NEPA Required)

Alternative C is the Tentatively Selected Plan (TSP). Feasibility-level design will commence after the SMART Planning Agency Decision Milestone and will finish before a Final Report.

5.1 Description of the Tentatively Plan

The TSP is an 18.27-mile risk reduction system around the communities of Montz, Laplace, Reserve and Garyville with non-structural components in St. James Parish. The alignment of the TSP is shown in Figure 3-4. The risk of storm surge damage would be reduced for over 7,000 structures and four miles of I-10 located in the system. Inclusion of this segment of I-10 would help maintain a major emergency evacuation and re-entry route for residents of southeast Louisiana, including residents in the New Orleans metropolitan area. The TSP also includes non-structural measures for 1,571 structures in the communities of Gramercy, Lutcher and Grand Point that are located outside of the proposed levee system. It is estimated that these non-structural measures would include elevation of 1,481 structures and acquisition of 90 structures. Implementation of non-structural features will be developed in more detail during feasibility level of design and analysis during which time an economic analysis will be conducted based on economic reaches. In developing the plan, consideration with be given to community cohesion and the requirements of EO 12898.

The structural component of the system would consist of earthen levees, floodwalls (T-walls), floodgates, drainage structures and pump stations located along the alignment. The preliminary level of design, based on modeling for a 1 percent AEP storm event includes levee elevations that would range from +13.5 NAVD88 on the eastern reaches near the Bonnet Carré Spillway to +7.0 NAVD88 in the western portion of the project area. They would be constructed with 3:1 side slopes with a 10-foot crown width. Construction of levees would involve the placement of 3,100,000 cubic yards of compacted and uncompacted clay (borrow) material on top of 3,400,000 square yards of geotextile fabric. Approximately 26,124 cubic yards of aggregate limestone would be used to build a road on the levee crown. A conveyance canal at a depth of -10 ft. NAVD88 would be situated along the levee. Floodwalls would be located under the I-10/I-55 interchange and other areas where space is limited. Nine floodwall sections would span 5,304 linear feet over the length of the system. The system would include 2,080 feet of drainage gates, 288 feet of roadway gates, two railway gates, and thirty-six pipeline crossings. Four pump stations would be located along the alignment to ensure the project does not adversely impact local drainage. Design parameters will be further refined during feasibility level design and analysis which may result in changes to the design parameters; however the TSP is anticipated to reduce risk for at minimum a 1 percent AEP storm event but not exceed a 0.5 percent AEP storm event.

The TSP would maintain hydrologic connectivity to the extent practicable through the use of water control structures except during closure for hurricane and tropical storm surge events. When the system is closed, pumps would operate on average for 1.7 storm events per year, which equates to closure of structures on average 8.5 days per year.

The structural alignment would directly convert approximately 856 acres to uplands including approximately 775 acres of hydric soils, 14.8 acres of water bottoms and 55.4 acres of prime farmlands. Approximately 8,424 acres of wetlands could be indirectly impacted due to enclosing the project area within the levee system. Further investigation is required to determine if cultural resources are located within any part of the footprint. Additional environmental investigations will be performed during feasibility-level design and analysis.

The estimated cost of the TSP is $880,851,070. The BCR for the TSP is equal to 1.63 to 1 with annualized net benefits equal to approximately $23,000,000.

5.1.1 Real Estate Requirements

A Real Estate Plan (REP) describing the real estate requirements and costs for the project can be found in Appendix C. The REP was prepared with estimated right-of-way (ROW) requirements based on available information. The REP and real estate cost estimates will be revised during feasibility-level design and analysis.

The estimated cost of real estate acquisition for structural features is $3,283,000. The alignment follows State-owned land and the property of approximately 120 owners. A standard perpetual levee easement for approximately 856 acres will be acquired for the construction of levees and floodwalls. A non-standard perpetual underground piling easement will also be acquired for all floodwalls. A standard Drainage Ditch Easement would be acquired for the areas needed for the conveyance canal. Borrow material for this project would come from the Bonnet Carré Spillway which is owned in fee by the Federal Government or from alternative sources not yet identified. A standard temporary work area easement will be acquired for staging areas. Mitigation land will be acquired in fee, excluding rights to minerals (with restrictions on use of surface). A non-material deviation will be made to the standard road easement to revise the rights necessary for a temporary non-exclusive road access (Appendix C).

The estimated cost of real estate acquisition for the non-structural feature is $81,417,000. Approximately 1,571 landowners may be impacted by this feature. The feature entails property acquisitions and structure raisings. At this time there has not been sufficient evaluation to determine particular structures to be included in the feature. A detailed evaluation of the work entailed in structure raising will be accomplished during the feasibility level design and analysis. At that time, the appropriate real estate interests to be acquired for non-structural measures will be determined, and the real estate costs will be refined. Displaced persons and businesses may be entitled to Public Law 91-646, Title II Relocations Assistance.

The total estimated cost of real estate for the project is $84,700,000. The CPRAB will have the responsibility of acquiring all necessary real estate interests for the project.

5.1.2 Relocation Assistance

Levee construction may cause relocations and/or temporary interruptions to pipelines. The existing carrier line would remain in operation while a bypass line would be constructed through a sleeve in the T-wall cutoff piles. When a bypass is complete and in place, the tie-in with the existing line would follow. Potential cost of this work is presented in Table 5-1. Detailed information will be developed during feasibility-level design and analysis.

Table 5-1: Unit cost of pipeline relocations.

Description	Estimated Quantity	Cost
≤6" Diameter	14	$515,000 each
>6" to ≤12" Diameter	16	$700,000 each
>18" to ≤24" Diameter	5	$1,550,000 each
> 24" Diameter	1	$1,920,000 each

5.1.3 Operation and Maintenance, Repair, Rehabilitation and Replacement

The purpose of operation and maintenance, repair, rehabilitation and replacement (OMRR&R) is to sustain the constructed project. The estimated annual OMRR&R cost is $4,128,075 (Table 3-4). This estimate will be further refined during feasibility-level design and analysis. After the

District Engineer provides notice of construction completion for the project, or functional portion of the project, the CPRAB will commence OMRR&R responsibilities associated with the project.

5.1.4 Benefit Analysis

Project Benefits

Models were run to determine the effects of storms on area resources. Hydrologic modeling results were developed to help establish the existing and future conditions and determine potential measures needed to address surge and storm-related damages. A database of values, types, and first floor elevations was developed for all structures in the area. This information was compared to the surge modeling to determine storm damages. Maps showing inundation of structures that could be damaged under FWP conditions will be developed.

Mitigation Plan Benefits

Habitat value analysis will be completed during feasibility-level design and analysis. Ecological model results will be combined with cost data to develop mitigation plans.

5.1.5 Risk & Uncertainty Analysis

Risk and uncertainty are intrinsic in water resources planning and design. This section describes various categories of risk and uncertainty pertinent to the study. Risk and uncertainty will be further considered during feasibility-level design and analysis.

5.1.5.1 Environmental Factors

Relative Sea Level Rise*:* There is uncertainty about how much sea level change (SLC) would occur in the region. Higher than estimated RSLR could cause salt water intrusion into the freshwater swamp causing significant changes to this habitat.

An assessment of RSLR was included in plan formulation and alternatives analysis. The evaluation of RSLR is documented in Appendix B and will be refined during feasibility level design and analysis. Calculations based on EC 1165-2-212 determined that the low, intermediate and high rates of RSLR at 2070 are 1.81 feet per year, 2.32 feet per year, and 3.95 feet per year, respectively (Table 2-2). The intermediate RSLR rate was applied.

RSLR could impact the benefits achieved by the TSP. Because the project was developed using the intermediate RSLR rate, the TSP would provide more benefits than anticipated should the low RSLR rate result and less benefits with the high RSLR rate. The non-structural component would be less effective because structures would have to be raised to a height that would increase their risk from wind damage during a storm.

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 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 Isaac can alter the expected return period for other storms. To reduce the uncertainties of storm events, storms with varying degrees of size, intensity, and path are included in the modeling. By using a long-term record of different storm scenarios, the effects of such storms are incorporated into the modeling. The team is then able to reduce the uncertainty in the determination of project benefits (Appendix B).

5.1.5.2 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 Appendix B. The levee and other features will be constructed to meet USACE standards.

Hydrologic Flows: There is uncertainty as to whether the levee system would potentially induce flooding internally and externally to the levee alignment. Modeling results will be analyzed during feasibility level design and included in the final report. Hydrologic modeling (ADCIRC and STWAVE) will show if the TSP could potentially induce flooding in these area and allow for more accurate engineering and design of the levee system. The project will incorporate features to mitigate for any potential induced flooding.

The risk of running the ADCIRC and STWAVE models is the assumption that the models appear to provide a specific response on the TSP in any given scenario; however it is only a representative point of reference in a complex system. While the analysis is enhanced by the models, application of the models can introduce error and uncertainty. Calibration and verification efforts are employed so that the models more closely replicate observed changes or at least provide insight into the limitations of the model.

Models are limited by basic, underlying assumptions and uncertainties. Some of the simplifying assumptions include the model parameters. A sensitivity discussion will be completed during feasibility-level design and analysis and included in Appendix B of the final report. Another uncertainty is that a limited number of storm scenarios are modeled. It is assumed that various storm scenarios over a number of years will represent a much higher indicator of the levees ability to withstand major storm events.

The models also use available historic data to extrapolate future storm conditions and frequency. The size and frequency of storms included in the model are based on statistical analysis but do not account for meteorological changes, such El Nino and La Nina effects, that can increase or decrease storms over a period of several years. Neither do the models account for the potential of increased storms due to climate change.

5.1.5.3 Economic Factors

The risk for economics is in under or overestimating the future benefits associated with the project alternatives. The with-project damages and overall benefits associated with the alternatives were estimated based on the existing and future without-project damages. This could potentially result in the TSP not being economically justified or preliminary estimates of the benefit cost ratios being overstated. A full economic analysis will be conducted during feasibly level design and documented in the final report. Additional uncertainty surrounding variables such as population growth, first floor elevations, structure value, depth damage relationships and additional inputs are consistent with typically accepted project uncertainty.

The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5a certified model was used to calculate the damages for the without project existing and future conditions. Economic and engineering inputs were necessary for the model to calculate damages for existing conditions (2012), the project base year (2020) and the final year in the period of analysis (2070). The inputs included structure inventory, future development, 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 entered into the model. 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.

5.1.5.4 Implementation Factors

Non-structural costs were based on a 100% structural survey of area improvements. Structures located in the 2020 and 2070 100-year floodplains were evaluated by comparing the cost of elevating the structure to the cost of acquiring the structure. The greater cost was used to determine an estimate of the cost of the non-structural feature. Relative sea level rise greatly impacts the number of structures to be raised, resulting in uncertainty as to how many structures would have to be raised. A minimum cost of the non-structural feature of $53,143,789 was developed based on the cost of reducing risk to structures in the 2020 100-year floodplain. A maximum cost of $305,256,794 was developed based on the cost of reducing risk to structures in the 2070 100-year floodplain. During feasibility level of design, the non-structural feature will be further evaluated by economic reach. The resulting evaluation may reduce the number of structures that would be included in the non-structural feature.

5.2 Implementation Requirements

5.2.1 Preconstruction Engineering and Design

Detailed design of the WSLP Project will be shared between CPRAB and the USACE. All detailed design will be in accordance with USACE's regulations and standards.

5.2.2 Construction and LERRD

Construction would be in accordance with the USACE's regulations and standards. Lands, easements, right-of-ways, relocations and disposal areas (LERRD) would be the responsibility of the CPRAB (Appendix C).

5.2.3 Cost Sharing

The State of Louisiana, acting through the PLD, is the non-Federal sponsor for the feasibility study. The cost-share during the feasibility phase is 50% Federal and 50% non-Federal. Following the feasibility phase, the CPRAB will be the non-Federal Sponsor for the planning, design, construction, operation, maintenance, repair, replacement and rehabilitation of the project. The cost share for the planning, design and construction of the project will be 65% Federal and 35% non-Federal. The CPRAB must provide all project LERRD required for the project. OMRR&R of the project would be a 100% CPRAB responsibility. A full description of the non-Federal and Federal responsibilities after the feasibility phase of the project is contained in Section 8.2 of this report. The OMRR&R costs are estimated to have a present value of $4,128,075 at 2012 price levels and include a 25% contingency. AM&M costs are not included in the estimate at this time; those costs will be included in the final report. Table 5-2 presents the cost apportionment.

Table 5-2: Cost apportionment of the TSP.

	Total	Federal	Non-Federal
PED	$7,500,000	$4,875,000	$2,625,000
Construction	$761,051,070	$557,500,446	$203,550,625
Pipeline Relocations	$35,100,000	-	$35,100,000
Lands, Easements, & ROW*	$84,700,000	$15,052,750	$69,647,250
Total First Costs**	**$888,351,070**	**$577,428,196**	**$310,922,875**

*** Federal costs are Administrative Cost of Non-Federal Sponsor Oversight**
**** Monitoring and Adaptive Management costs not included.**

5.3 Mitigation Plan

Although mitigation planning was integrated into the overall plan formulation process, implementation of the TSP requires compensatory mitigation for unavoidable project-induced impacts that will require replacing or providing substitute resources. A mitigation plan for the TSP will be completed following the feasibility level design and analysis and will be included in the final report. Additional information is located in Appendix A.

5.4 Adaptive Management & Monitoring

Incorporation of AM&M activities into the mitigation plan will address ecological and other uncertainties that could prevent successful implementation of mitigation project measures. The AM&M Plan will establish a framework for decision-making that utilizes monitoring results and other information, as it becomes available, to update project knowledge and adjust mitigation management actions through adaptive management. Integration of AM&M into the mitigation project will ensure success under a wide range of conditions and enable implementing corrective actions in cases where monitoring demonstrates that the mitigation project or measures are not achieving ecological success. An AM&M plan will be developed and included as part of the mitigation plan in the final report. Additional information is located in Appendix A.

5.5 Views of the Non-Federal Sponsor

The PLD and the CPRAB support and recognize the importance of hurricane risk reduction in St. Charles, St. John the Baptist and St. James Parishes. This study is included in the 2012 Louisiana Comprehensive Master Plan for a Sustainable Coast and is supported by the Louisiana Congressional delegation. The USACE has worked as a team along with an interagency team and local stakeholders to develop a feasible comprehensive plan that would provide hurricane storm surge risk reduction to the citizens in the area. Construction of the proposed system would immediately allow for improved storm surge risk reduction in the three-parish area, which could potentially reduce life, health and safety risk to residents and interruptions to vital hurricane evacuation routes.

Figure 5-1: St. James Parish flooding after Hurricane Isaac.

APPENDIX C

Description of Project Alternatives A,C and D from *"West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study, Integrated Draft Feasibility Report and Environmental Impact Statement, August, 2013"*

Four plans with non-structural measures were carried forward and identified as follows:

Plan 9 + non-structural → **Alternative A**
Plan 10 + non-structural → **Alternative B**
Plan 11+ non-structural → **Alternative C**
Plan 12 → **Alternative D**

These alternatives were further evaluated considering alignments with respect to the I-10 corridor. Alternative B would not provide greater risk reduction for the evacuation routes than any of the other plans. Alternative B would reduce risk to the same number of structures as Alternative C but would enclose approximately 4,000 more acres of wetlands. Based on this, Alternative B was eliminated.

3.5 Final Array of Alternatives (*NEPA required)

The final array of alternatives carried forward for consideration included **the No Action Alternative**, **Alternative A**, **Alternative C**, and **Alternative D** (Figure 3-4). Engineering details on each can be found in Appendix B. Comparative details are shown in Table 3-2. The team assumed that Alternatives A, C, and D would provide equal levels of risk reduction. The least costly plan would have the highest net benefits. Analysis is based on a 1% AEP storm event.

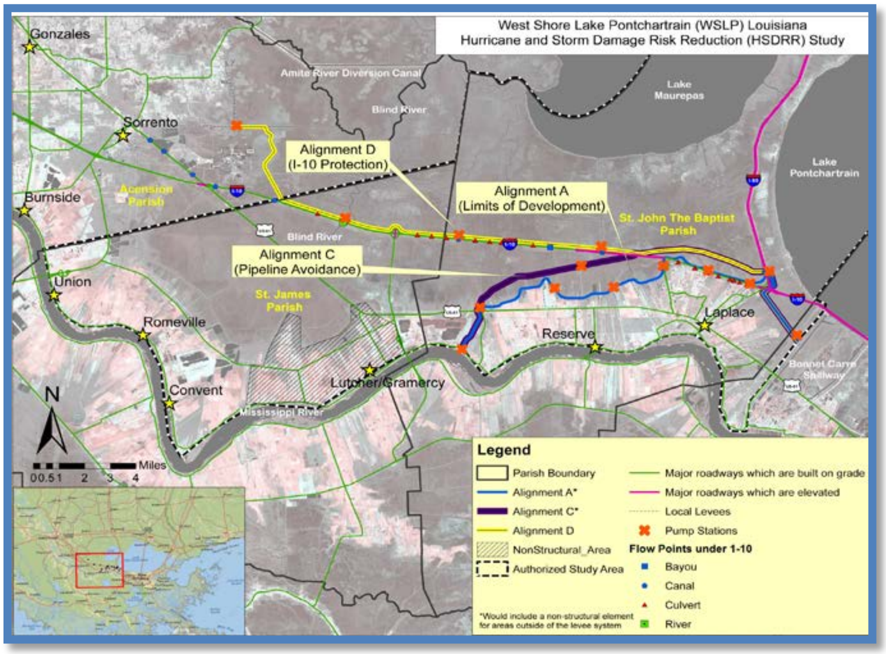


Figure 3-4: Final array of alternative plans.

No Action Alternative (Future without-project condition)

Under the No Action Alternative no risk reduction would occur. The area would continue to experience storm surge damage. This would be exacerbated by RSLR and increased impacts to wetlands due to salinity. As wetlands erode and subside, they would provide less risk reduction.

Table 3-2: Comparative details for final array of alternative plans.

Alternative	Length of Alternative	Size of Study Area Behind Alternative	Number of Structures Behind Alternative	Communities Behind Alternative	Miles of I-10 Behind Alternative	Wetlands Behind Alternative	Number of Pipeline Crossings
A	20 miles	38 sq miles	16,919	Montz, Laplace, Reserve, Garyville	4 miles	~5 sq miles	70
C	18 miles	47 sq miles	16,919	Montz, Laplace, Reserve, Garyville	4 miles	~16 sq miles	36
D	28 miles	160 sq miles	21,840	Montz, Laplace, Reserve, Garyville, Lutcher, Gramercy, Grandpoint	15 miles	~79 sq miles	14

Alternative A: Bonnet Carré Spillway to the Hope Canal to Mississippi River

Alternative A (Figure 3-5) would provide risk reduction to St. Charles, St. John the Baptist and St. James Parishes. The approximately 20.41-mile levee and floodwall alignment begins at the West Guide levee of the Bonnet Carré Spillway, north of transmission line and pipeline corridors and extends west around the interstate interchange and along the wetland/non-wetland interface. The alignment turns south near Hope Canal, until it reaches the Mississippi River Levee (MRL). Elevation and/or acquisition of structures outside of the alignment would reduce risk of storm surge-related damage in areas west of the Hope Canal.

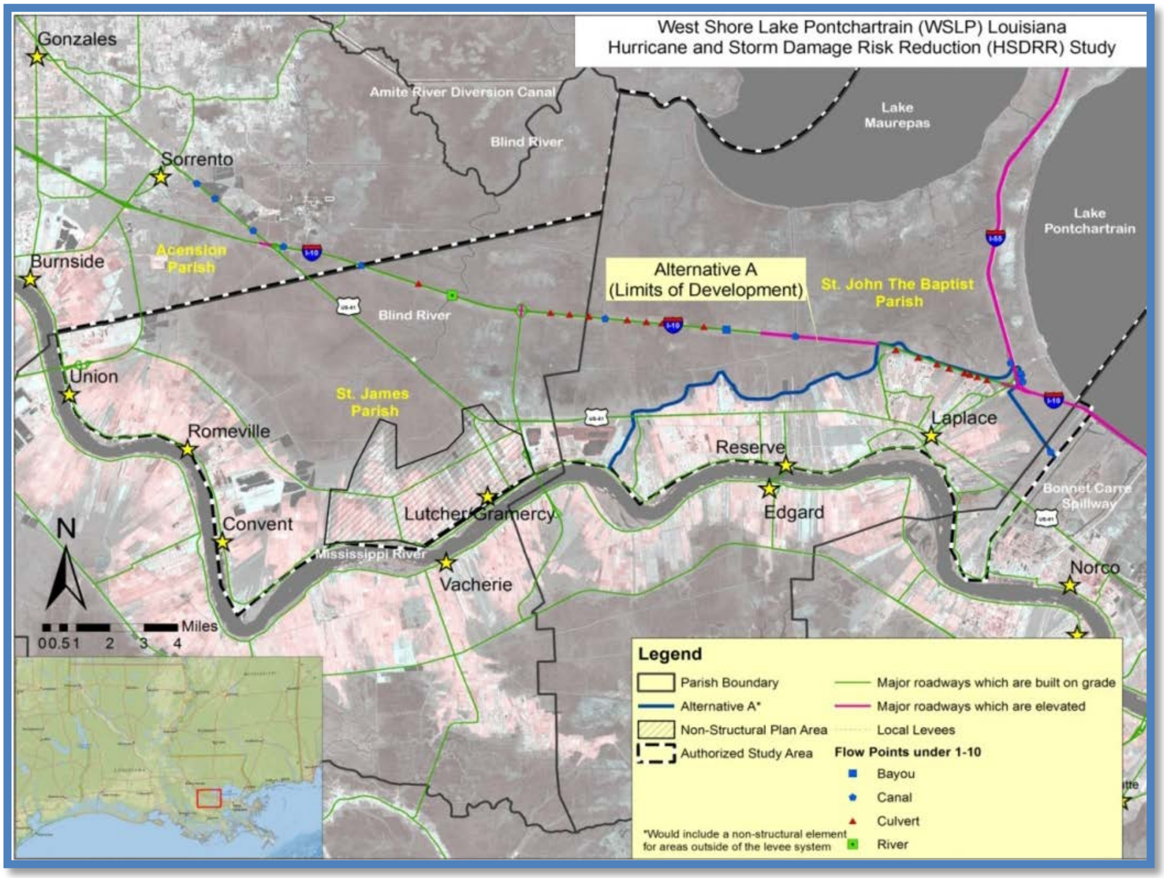


Figure 3-5: Alignment and features of Alternative A.

Construction would require roughly 3,100,000 cubic yards of earthen borrow material; 3,700,000 yards of geotextile fabric; 30,000 cubic yards of aggregate limestone road; nearly 5,000 linear feet of T-walls to cross under the interstate, or as frontal risk reduction for pump stations; 1,200 linear feet of flood gates; 240 linear feet of drainage gates; and 2 railroad gates. Eight pump stations on the alignment would require 25,000 cubic yards of concrete, 230,000 square feet of sheet pile, nearly 7,000 tons of riprap, and 151,000 linear feet of concrete piles. Multiple culverts with flap gates would be constructed. Because the alternative hugs the wetland/non-wetland interface, Alternative A has the least adverse wetland impacts. However, the plan has the greatest residual risk (the risks left after all construction and safety measures have been assessed) because overtopping of the levee by surge would cause immediate inundation of populated areas. It also has the most pump stations which results in more maintenance and greater risk of system failure. It is the least adaptable because expansion of the levee would require the purchase and/or relocation of existing structures. The plan does not reduce risk to infrastructure in St. James Parish.

Alternative C: Bonnet Carré Spillway to the Hope Canal to Mississippi River

Alternative C (Figure 3-6) evaluates the feasibility of avoiding multiple pipeline and utility crossings. It follows the Alternative A alignment between the West Guide levee of the Bonnet Carré Spillway to the US-51 interchange, where it then tracks north across US-51 and along a pipeline transmission corridor. The approximately 18.27-mile alignment crosses I-10 and follows the pipeline corridor through wetlands near the Belle Terre exit until it reaches Hope Canal. The alignment then turns south and extends to the MRL. Elevation and/or acquisition of structures outside the alignment would reduce risk of storm surge-related damage to structures in areas west of the Hope Canal.

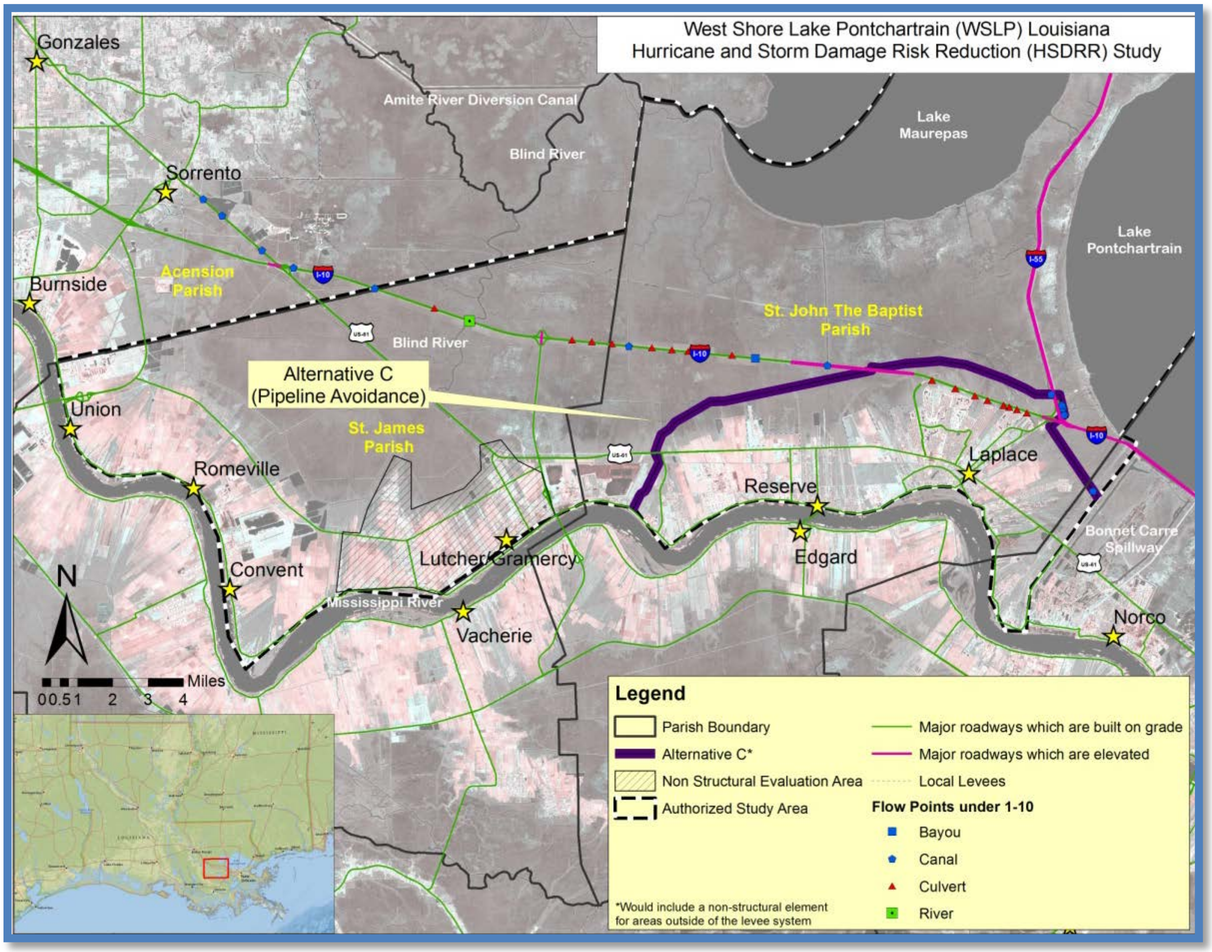


Figure 3-6: Alignment and features of Alternative C.

Construction of the alternative would require roughly the same amount of borrow material as Alternative A. It would require 3,365,000 cubic yards of geotextile fabric; nearly 26,000 cubic yards aggregate limestone road; 5,300 linear feet of T-walls; 300 linear feet of flood gates; 200 linear feet of drainage gates; 4 pump stations; and 2 railroad gates. Environmental structures similar to those identified for Alternative A would be built. This alternative encloses more wetlands than Alternative A, and would require more environmental structures, but has less residual risk because levee overtopping would not immediately inundate populated areas. It is more adaptable should changing conditions require modifications to the structures because the alignment does not abut existing structures. However, the plan does not reduce risk to infrastructure in St. James Parish.

Alternative D: Bonnet Carré Spillway to Ascension Parish

Alternative D (Figure 3-7) is a westward extension of the Alternative C alignment along the I-10 corridor into Ascension Parish. It continues west at the St. James Parish line slightly north of I-10 until it reaches the Old New River, where it proceeds north to the non-Federal Laurel Ridge levee in Ascension Parish. Measures to maintain water flow and to reduce impacts to enclosed wetlands would be built. Alternative D reduces risk to communities in St. Charles, St. John and St. James Parishes and provides a level of risk reduction to a segment of the I-10 hurricane evacuation route.

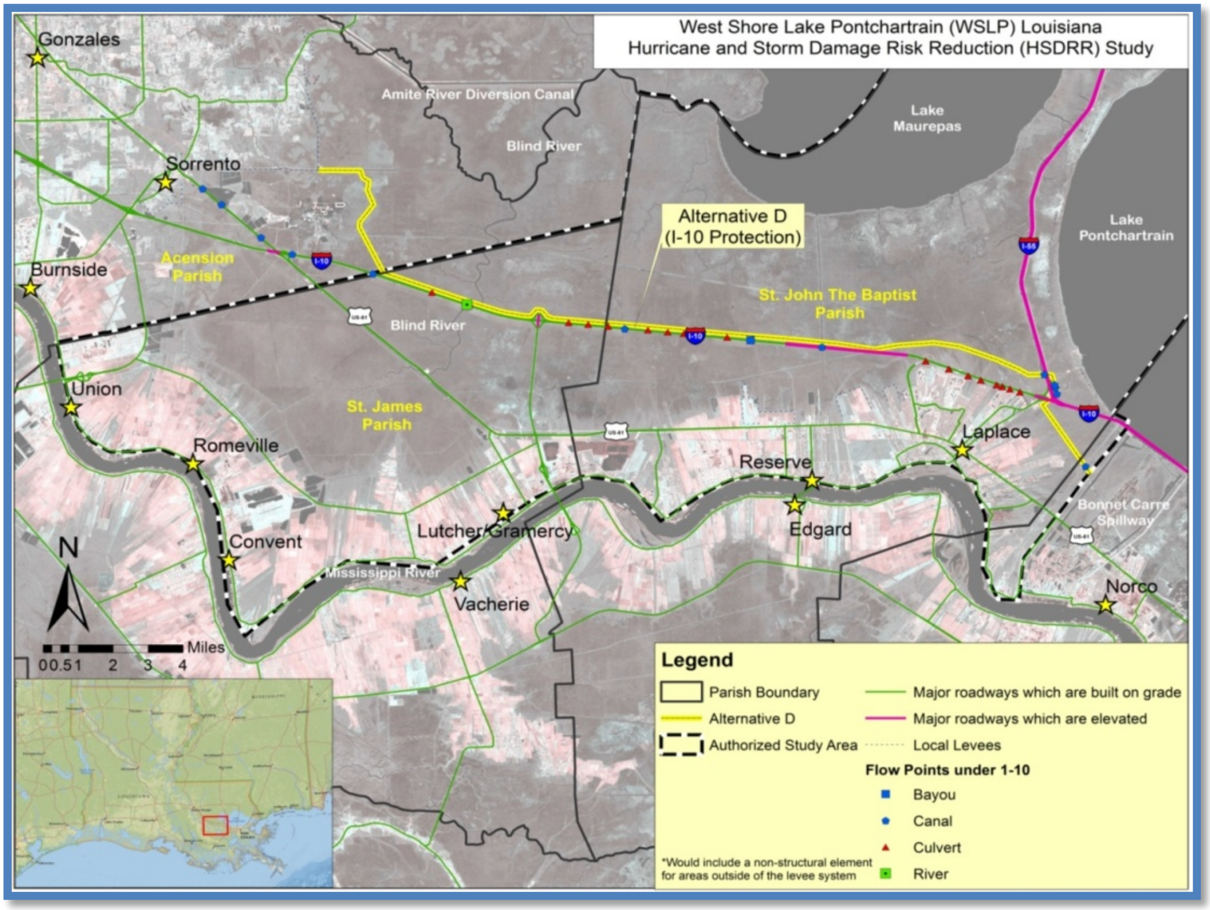


Figure 3-7: Alignment and features of Alternative D.

Construction of the approximately 28-mile alternative would require 3,700,000 cubic yards of borrow material, 3,037,000 square yards of geotextile fabric; approximately 37,000 cubic yards of aggregate limestone road; just over 4,000 linear feet of T-walls; 300 feet of flood gates; 400 feet of drainage gates; approximately 6 pump stations; nearly 24,000 cubic yards of concrete; almost 200,000 square feet of sheet pile; approximately 5,900 tons of rip rap; 154,000 linear feet of concrete piles; and environmental structures, most notably at Blind River, a Louisiana Scenic River. It encloses the most acres of wetlands requiring more environmental structures than any of the other alternatives. Each of these structures would require maintenance because failure of the environmental structures could increase adverse environmental impacts. The greater number of structures results in more maintenance and a greater risk of failure. There is concern about potential impounding of large areas of wetlands under this alternative, especially if the river diversion projects are constructed. Alternative D provides the greatest structural risk reduction and would reduce risks to roads and other infrastructure in St. James Parish.

3.6 Cost Estimates

Estimated costs for levees, floodwalls, and pump stations; real estate costs; operation and maintenance, repair, rehabilitation and replacement (OMRR&R); environmental mitigation; and non-structural features were totaled for each alternative and compared to each other to help identify a TSP. Costs for the non-structural features of Alternative A and Alternative C, and costs associated with mitigation for indirect impacts are uncertain. For this reason, a range of costs was developed for each feature.

Non-structural Cost: Non-structural costs were based on a 100% structure survey of area improvements. The cost of raising and/or acquiring structures located in the 2020 and 2070 100-year floodplains was evaluated by comparing the cost of elevating the structure to the cost of acquiring the structure. The lesser cost was used to determine the cost of the non-structural feature. RSLR greatly impacts the number of structures to be raised, resulting in uncertainty as to how many structures would have to be raised by any given date. A minimum cost of the non-structural feature of $53,143,789 was developed based on the cost of reducing risk to structures in the 2020 100-year floodplain. A maximum cost of $305,256,794 was developed based on the cost of reducing risk to structures in the 2070 100-year floodplain. The maximum cost was used for comparison.

Indirect Impact Cost: At this stage, mitigation costs for indirect impacts remain uncertain due to limited hydrologic information and lack of a full wetland value assessment (WVA). To reduce the uncertainty of costs associated with mitigating for indirect impacts, a maximum cost based on Morganza to the Gulf and Lake Pontchartrain and Vicinity project estimates, and a minimum cost based on local mitigation bank costs were developed. These costs were averaged. In place of WVA analysis, habitat reduction values from 5 - 75 percent were calculated. Using these values, the average estimated mitigation cost associated with indirect impacts ranged from $871,000,000 to $980,000,000 for Alternative A, $844,000,000 to $1,000,000,000 for Alternative C, and $672,000,000 to $2,200,000,000 for Alternative D.

Based on available information, the habitat reduction value impacts are estimated to be approximately 15 percent of the total enclosed wetlands, as shown in Table 3-3. The risk reduction features will be designed to maintain existing hydrologic flows to the extent practicable. If this can be achieved, indirect impacts would be limited to those that occur during closure of structures for storm surge events – an estimated 8.5 days per year. A WVA analysis based on hydrologic modeling will be conducted on the TSP during feasibility design.

Table 3-3: Estimated first costs for final array of alternative plans.

	Alternative A	Alternative C	Alternative D
Levees & Floodwalls	$335,898,670	$334,156,997	$339,508,346
Pump Stations	$132,162,500	$112,687,500	$166,437,500
Pipeline Relocations	$70,300,000	$35,100,000	$11,693,750
Real Estate	$3,849,000	$3,283,000	$2,434,000
Direct Habitat Impacts	$17,000,791	$35,710,811	$43,323,364
Indirect Mitigation Cost (15%)	$23,123,679	$54,655,968	$327,687,626
Non-Structural 2070*	$305,256,794	$305,256,794	$0
Total Cost	**$887,591,434**	**$880,851,070**	**$891,084,586**

***Some non-structural costs will be LERRD costs that are the responsibility of the NFS. The non-structural costs will be spread over the entire period of analysis and will be heavily discounted and result in less than 17% of the total average annual costs.**

OMRR&R Cost: Table 3-4 provides preliminary OMRR&R cost estimates for each alternative. Annual costs will be refined during feasibility level design and analysis. Upon notice of completion of construction of the project, or a functional portion of the project, the CPRAB shall commence OMRR&R responsibilities for the project (Chapter 8).

Table 3-4: Comparison of annual OMRR&R cost for final array of alternative plans.

Alternative	Levee Grass Cutting		Structure OMRR&R ($)	Total OMRR&R ($)
	(acres)	($)		
Alternative A	390	$234,000	$7,277,050	$7,511,050
Alternative C	868	$520,800	$3,607,275	$4,128,075
Alternative D	1269	$761,400	$5,421,538	$6,182,938

NOTE: Based on levee right-of-way acreage, 2012 dollars, and includes a 25% contingency. OMRR&R costs for mitigation are not included. Cost include grass cutting; pump station and flood gate replacement; and other planned OMRR&R activities.

3.7 Summary of Accounts and Comparison of Alternatives

Plans in the final array are assumed to provide equal levels of risk reduction. To facilitate evaluation and comparison of the alternatives, four Federal Accounts were used to assess the effects of alternatives. The accounts are National Economic Development (NED), Environmental Quality (EQ), Other Social Effects (OSE), and Regional Economic Development (RED).

No Action Alternative: No NED benefits would be associated with the No Action Alternative. There would continue to be adverse impacts to the EQ as salinity levels increase in the area, affecting wetlands and eventually causing impacts to residents (OSE) in the immediate vicinity of the study by reducing the natural swamp buffer. Reducing the natural buffer could also cause uncertainty to RED by impacting major oil refineries in the region and the overall economy.

Alternative A: Alternative A provides NED benefits, but provides less net benefits than Alternative C. It encloses the fewest acres of wetlands, resulting in the least adverse impacts to EQ. However, it risks immediate inundation of developed areas in an overtopping event; thus reducing safety to residents (OSE) in the area. It limits future modification or reinforcement of the system due to its proximity to existing structures. It would also risk disruptions to the local drainage patterns northward if design parameters are exceeded. (Figure 3-8). While Alternatives C and D would disrupt existing drainage if design parameters are exceeded, the damage resulting would be greatest for Alternative A due to

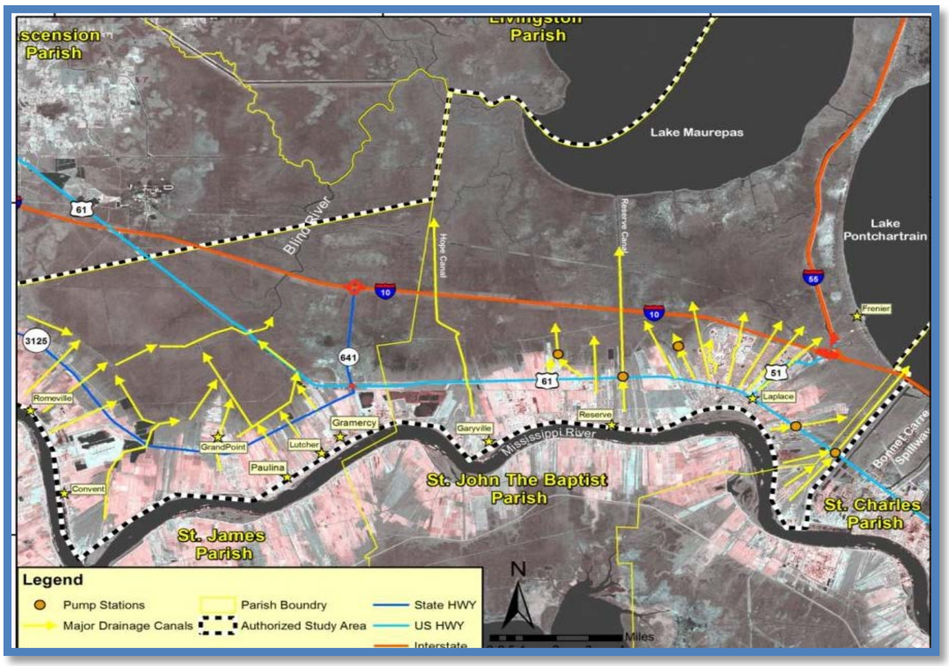


Figure 3-8: Study area drainage patterns.

the close proximity of the levee to existing structures. There is no risk reduction to roads in St. James Parish which could flood, preventing employees from accessing vital industries.

Alternative C: Alternative C maximizes benefits. It has more adverse impacts on EQ than Alternative A but reduces impacts to wetlands compared to Alternative D. In case of a major storm surge event that exceeds the federally authorized project design, Alternative C could reduce the risk to OSE because storm surge would, over time, first fill in the wetlands before potentially inundating developed areas. Because this alternative addresses an uncertain yet reasonably foreseeable need to modify the system, it could provide stability to RED in developed areas. The alignment can be enlarged should RSLR be greater than anticipated without displacing area residents. There is no risk reduction to roads in St. James Parish.

Alternative D: Alternative D provides NED benefits, but does not maximize those benefits. It provides risk reduction to a larger area thus reducing risk to more area residents. Structural risk reduction is provided to roads in St. James Parish, reducing the risk that employees would be unable to access critical infrastructure and places of employment. Additionally, because the levee is not located in close proximity to existing structures, the threat of flooding due to exceedence of design parameters is lessened. Alternative D poses potential uncertainties concerning the impoundment of large areas of wetlands, especially if the river diversion projects are constructed. While it would prevent saltwater intrusion, it would risk impacting hydrology by enclosing approximately 54,800 acres of swamp and would impact the EQ of the Maurepas WMA as well as Blind River, a Louisiana Scenic River. Per the Wild and Scenic River Act, construction within 100 feet of a scenic stream requires a permit.

Economic Costs Comparison: The parametric implementation costs were annualized using the current interest rate (3.75%) and a 50 year period of analysis (2020-2070) as shown in Table 3-5. In 2020, only 5% of the benefits are derived from St. James Parish and only 219 structures are located within the 100-year floodplain. The cost of the non-structural feature for Alternatives A and C increases from approximately $53,000,000 (in year 1) to over $305,000,000 (in year 50) due to RSLR. Most of the structures would not reside in the 100-year floodplain until the later years of the period of analysis. Because of this, the non-structural costs were spread evenly over a 53-year period beginning in 2017 and ending in 2069; and then compounded or discounted to the 2020 base year. The annual benefits were compared to the cost assuming a 100-year level of risk reduction. The total annual benefits were then compared to the total annual costs.

Table 3-5: Economic comparison of final array of alternative plans.

Alternative	Implementation Costs ($ millions)	Annual OMRR&R ($ millions)	Equivalent Annual Benefits ($ millions)	Annual Costs ($ millions)	Benefit-to-Cost Ratio	Annualized Net Benefits ($ millions)
A	887.6	7.5	59.9	40.5	1.48	19.4
C	881.0	4.1	59.9	36.8	1.63	23.0
D	891.1	6.2	59.9	46.7	1.28	13.2

Alternative C has the lowest cost and the highest net benefits followed by Alternative A and Alternative D. The preliminary benefit to cost ratio (BCR) for Alternative C is equal to 1.63 to 1 with annualized net benefits of approximately $23,000,000. For Alternative A the BCR is 1.48 and for Alternative D it is 1.28 with net benefits of $19,400,000 and $13,200,000, respectively.

Hydrologic information is limited, so estimates were not developed to evaluate the number of environmental structures that would be required for the alternatives. The inclusion of environmental structures could greatly increase the cost of Alternative D, which encloses 79 square miles of wetlands, in comparison to Alternative A (5 square miles) and Alternative C (15 square miles). Benefits such as reductions in emergency costs and damage to roadways have not been calculated and would expect to be greatest for Alternative D and the least for Alternative A. These benefits are usually minimal and would not impact the selection of the TSP.

Alternative A tracks the wetland-non-wetland interface in Laplace to its termination at the Hope Canal in western St. John the Baptist Parish. It requires the largest number of pump stations (8 pump stations) compared to Alternative C (4 pump stations) and would require approximately $7,500,000 in OMRR&R cost to maintain the fully constructed alternative compared to $4,100,000 in OMRR&R for Alternative C. If overtopped, Alternative A would allow immediate inundation at developed areas and I-10, resulting in the greatest residual risk.

3.8 Identifying the Tentatively Selected Plan

Alternative C is the tentatively selected plan (TSP) and the NED plan as determined by the evaluation criteria. It fulfills the planning objectives stated in Section 1.5. It reasonably maximizes net benefits, consistent with protecting the Nation's environment in accordance with national environmental statutes, applicable Executive Orders, and other Federal planning requirements.

APPENDIX D

Project Functions and Current Issues

The following list of ***project functions*** were identified and considered as a basis for possible improvement to the current project plan:

Protect Life/Property	Sustain Commerce
Block Surge	Remove Water
Drain Rainfall	Maintain Drainage
Convey Flow	Place Barrier
Lift Water	Prevent Backflow
Reduce Overtopping	Prevent Breaching
Dissipate Energy	Prevent Erosion
Maintain Pipeline Commerce	Elevate Structure
Protect Structures	Relocate Structures

Current project issues as reported by the project managers are:

- Design and decision data is limited by new Smart Planning guidance
- Non-structural measures difficult to quantify and incrementally justify
- Project is politically sensitive; public perception and desire for maximum structural alternative
- Controversy with determination of environmental impacts versus potential benefits when addressing wetlands and swamp that would be on the protected side of the levee.