Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix F – Economics

February 2024

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Introduction

UPDATES

The measures that comprised the Draft TSP identified in the Draft Integrated Feasibility Report and Environmental Impact Statement (DIFR-EIS) are displayed in table F:0-1. Subsequent to the release of the Draft Tentatively Selected Plan (TSP) described in the DIFR-EIS, it was discovered that the clearing and snagging of Bayou Patassat would not be as effective as the Hydraulic and Hydrologic (H&H) modeling originally estimated. An updated analysis of this measure yielded a benefit/cost (b/c) ratio of 0.5. As a result, the measure was not carried forward as part of the Optimized TSP.

Table F:0-1 Draft TSP in DIFR-EIS, FY21 Price Level and Discount Rate

Alternative	South Slidell with West Slidell Levee	Mile Branch Channel Improvements	Bayou Patassat Channel Improvements	2% AEP Non structural	TSP
Project First Cost	$1,732,901	$26,337	$957	$2,241,108	$4,001,303
Interest During Construction	$111,470	$1,694	$62	$6,928	$120,154
Total Investment Cost	$1,844,371	$28,032	$1,018	$2,248,034	$4,121,455
AA Investment Costs	$65,029	$988	$36	$79,263	$145,316
AA O&M Costs	$5,956	$127	$10	$0	$6,093
Total AA Costs	$70,985	$1,115	$46	$79,263	$151,409
Without Project EAD	488,462	488,462	488,462	488,462	488,462
EAD Reduced Benefits	118,160	2,221	133	157,421	277,935
Net Benefits	47,175	1,106	87	78,158	126,526
B/C Ratio	1.7	2.0	2.9	2.0	1.8

Prior to finalizing the Optimized TSP, various levee and floodwall alignments were investigated and analyzed. This comparison is displayed in Table F:0-2. The West and South Slidell with West Slidell Levee and Floodwall System was the alignment selected based on having the highest net benefits.

Table F:0-2 Levee Alignment Comparison, FY21 Price Level and Discount Rate

Alternative	South Slidell Levee	South Slidell Levee with Eden Isle	West Slidell Levee	South Slidell with West Slidell Levee	Lacombe Levee	West Slidell Levee with Lacombe Levee
Project First Cost	$1,042,158	$1,682,008	$888,576	$1,732,901	$461,934	$1,347,853
Interest During Construction	$67,037	$108,196	$57,158	$111,470	$29,714	$86,701
Total Investment Cost	$1,109,195	$1,790,204	$945,734	$1,844,371	$491,648	$1,434,554
AA Investment Costs	$39,108	$63,119	$33,345	$65,029	$17,335	$50,580
AA O&M Costs	$3,264	$3,313	$2,692	$5,956	$1,361	$4,150
Total AA Costs	$42,372	$66,432	$36,036	$70,985	$18,696	$54,730
Without Project EAD	$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
Net Benefits	$33,334	$26,682	$6,419	$47,175	($10,158)	($3,557)
B/C Ratio	1.8	1.4	1.2	1.7	0.5	0.9

Furthermore, an analysis was conducted to determine the levee elevations that would maximize the net benefits of the West and South Slidell Levee and Floodwall System. The results of the optimization effort are displayed in table F:0-3. The levee elevations corresponding to the 1% AEP were found to provide the optimal level of risk reduction. Also, a new aggregation method was developed for the nonstructural analysis

Table F:0-3 Levee Optimization

St. Tammany Levee Optimization FY21 Price Level and Discount Rate				
AEP	**EAD Reduced**	**AA Cost**	**Net Benefits**	**BCR**
0.5%	128,110.40	81,822.80	46,287.60	1.57
1%	118,160.90	70,984.60	47,176.30	1.66
2%	87,024.30	60,146.50	26,877.80	1.45

Finally, the certified cost of the measures comprising the Recommended Plan were finalized and released. A certified cost addendum was added to Section 12 displaying an updated summary of results for the Recommended Plan.

1.1 METHODOLOGY OVERVIEW

This appendix contains the economic evaluation of the Optimized TSP and Recommended Plan for the St. Tammany Parish, Louisiana Feasibility Study (study). This appendix was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies, ER 1110-2-1302 "Civil Works Cost Engineering" and the Coastal Storm Risk Management (CSRM) National Economic Development (NED) Manual. The NED Procedures Manual for Flood Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the User's Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC-FDA).

This appendix consists of a description of the methodology used to determine NED damages, benefits, and projects costs. The sources of damages for this analysis are structures, contents, and vehicles. The project benefits are accrued due to reducing damages to structures through the lowering of stages caused by coastal flooding and rainfall and riverine flooding. The coastal flooding was modeled separately from the rainfall and riverine modeling. The HEC-FDA model was used to calculate these project benefits. The model is described in Section 3. The damages and costs for the Optimized TSP were calculated using FY 2023 price levels. The FY 2023 Federal discount rate of 2.5 percent was used to calculate interest during construction on the Optimized TSP from the beginning of construction up to 2032 which is the base year of the study. This discount rate was also used to discount the future operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs for the Optimized TSP occurring throughout the 50-year period of analysis back to the 2032 (project base year). The annualized costs and interest during construction (IDC) values are shown in Section 4.

The study area is divided up into the sub-basins shown in Figure F:1-1. For modeling purposes, some of the sub-basins shown were subdivided into smaller reaches based on H&H behavior and the study locations. These smaller reaches are shown in Figure F:3-1 and Figure F:3-2. Intermediate sea-level rise was used in this analysis for the computation of damages and benefits. Hydrologic conditions are expected to change in the future due to sea-level rise and subsidence. As a result, the discount rate is also used to calculate the equivalent annual damages and benefits between the future condition of 2082 and the base year of 2032. No future development was included in the analysis. In accordance with ER 1105-2-101, uncertainty parameters were estimated for all major variables used in the analysis, such as structure value, first floor elevation, content-to-structure value ratios, and depth-damage functions. The development of these uncertainty parameters is described in Section 2.

The evaluation of structural measures is included in Section 5. The evaluation of nonstructural measures is included in Section 6. Section 7 includes the identification of the measures that comprise the Optimized TSP.

1.2 STUDY AREA

The study area encompasses all of St. Tammany Parish, which is approximately 1,124 square miles and located in southeastern Louisiana (Figure F:1-1). St. Tammany Parish is located on the northeast shore of Lake Pontchartrain and is home to over 258,111 residents. 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.

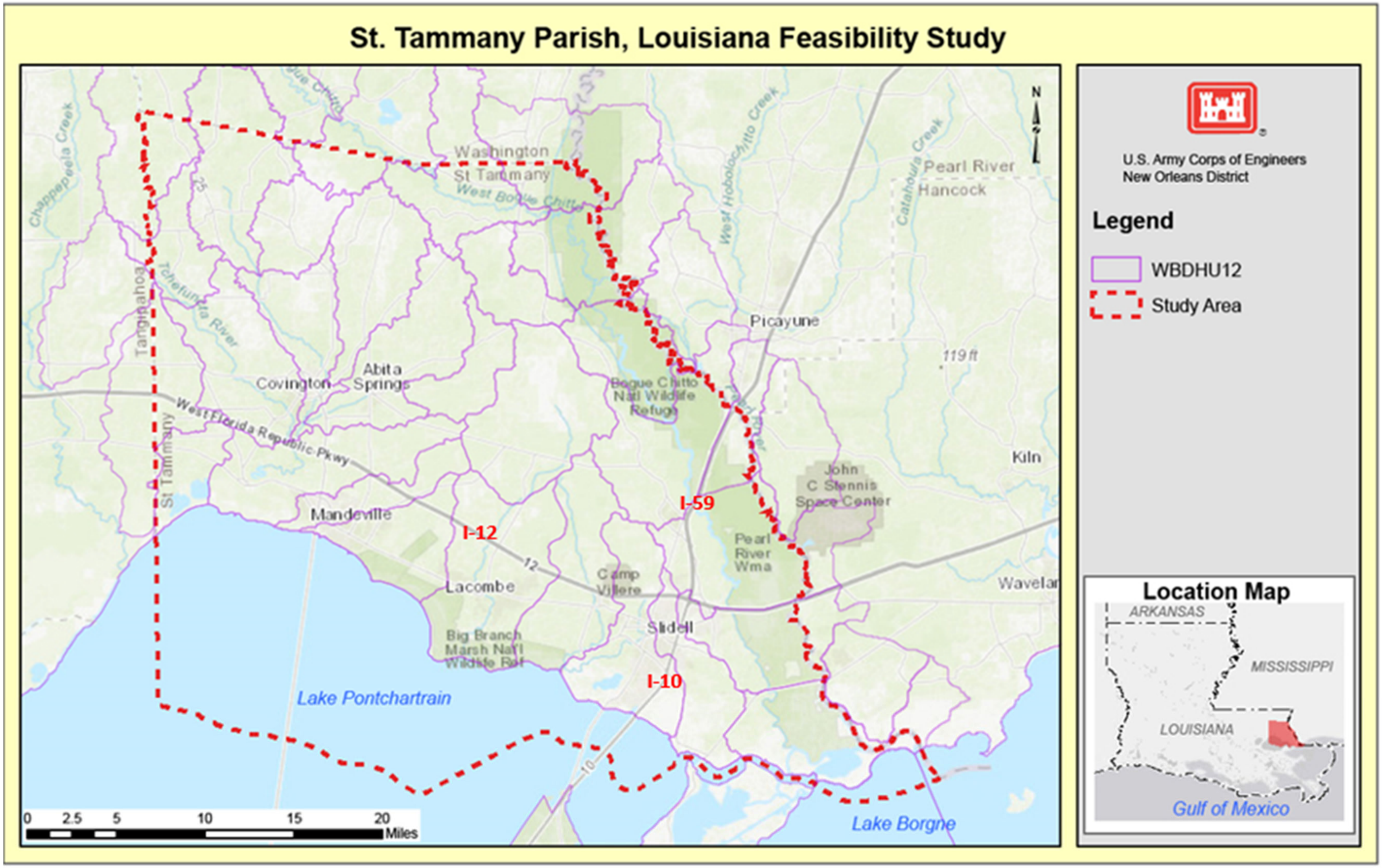


Figure F:1-1. St. Tammany Parish Study Area Boundary

The Pearl River runs along the Mississippi-Louisiana state line and is the eastern boundary of the study area. Lake Pontchartrain, one of the largest estuaries in the United States, serves as the southern border. Tangipahoa Parish is located along the western boundary, and Washington Parish is located along the northern boundary. There are 36 hydrologic sub-basins, as defined by the United States Geological Survey (USGS) 12- digit hydrologic unit delineations (WBDHUC12) within the study area. The majority of St. Tammany Parish's population resides along the edge of Lake Pontchartrain, and many commute into New Orleans. Major communities in the study area include Slidell, Mandeville, Covington, Abita Springs, Pearl River, and Madisonville. St. Tammany Parish is the fastest-growing parish in Louisiana and one of the fastest-growing communities in the nation. Major industries in the study area are health care and social assistance, retail trade, professional, scientific, and technical services, construction, finance, and insurance. The total number of acres by land use of developed agricultural, and undeveloped land in the study area is shown in Table F:1-1.

Table F:1-1. Land Use

Land Class Name	Acres	Percentage of Total
Developed Land	80,190	15%
Agricultural Land	316	0%
Undeveloped Land	455,312	85%
Total	535,817	100%

National Agriculture Statistics Service (NASS), National Cropland Data Layer (CDL), 2020

The significant flood events in the study area are shown in Table F:1-2.

Table F:1-2. St. Tammany Parish Flood Events

Date	Event	Date	Event
Aug-69	Hurricane Camille	Aug-02	Tropical Storm Bertha
Apr-79	Heavy Rainfall	Sep-02	Tropical Storm Isidore
Apr-80	Heavy Rainfall	Oct-02	Hurricane Lili
Dec-82	Heavy Rainfall	Sep-04	Hurricane Ivan
Jan-83	Heavy Rainfall	Aug-05	Hurricane Katrina
Mar-83	Heavy Rainfall	Jan-06	Heavy Rainfall
Apr-83	Heavy Rainfall	Oct-07	Heavy Rainfall

Aug-85	Hurricane Danny	May-08	Heavy Rainfall
Nov-85	Hurricane Juan	Aug-08	Tropical Storm Fay
Feb-88	Heavy Rainfall	Sep-08	Hurricane Ike
Apr-88	Heavy Rainfall	Sep-08	Hurricane Gustav
Jun-89	Heavy Rainfall	Apr-09	Heavy Rainfall
May-91	Heavy Rainfall	Oct-09	Heavy Rainfall
Aug-92	Hurricane Andrew	Nov-09	Heavy Rainfall
Apr-95	Heavy Rainfall	Nov-09	Tropical Storm Ida
May-95	Heavy Rainfall	Dec-09	Heavy Rainfall
Oct-95	Hurricane Opal	Sept-11	Tropical Storm Lee
Aug-96	Heavy Rainfall	Aug-12	Hurricane Isaac
Oct-96	Coastal Flooding	Mar-16	Heavy Rainfall
Jan-98	Heavy Rainfall	Aug-16	Heavy Rainfall
Mar-98	Heavy Rainfall	Dec-18	Heavy Rainfall
Sep-98	Tropical Storm Frances	Feb-20	Pearl River Flooding
Sep-98	Hurricane Georges	Jun-20	Tropical Storm Cristobal
Jun-01	Heavy Rainfall	May -20	Heavy Rainfall
Jun-01	Tropical Storm Allison	Oct-20	Hurricane Zeta

GEC 2012 and Neel Shaffer

1.3 POPULATION, NUMBER OF HOUSEHOLDS, AND EMPLOYMENT

Tables F:1-3, F:1-4, and F:1-5 display the population, number of households, and the employment (number of jobs) for St. Tammany Parish for the years 2000, 2010, 2020, and projections for 2025 and 2045. The population has increased 35% since the year 2000 compared to an 18% increase for the country as a whole.

Table F:1-3. Historical and Projected Population by Parish

Parish	2000	2010	2020	2025	2045
St. Tammany	192,131	234,567	258,447	262,054	275,133

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

Table F:1-4. Historical and Projected Households by Parish

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

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

Table F:1-5. Historical and Projected Employment by Parish

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

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

1.4 INCOME

Table F:1-6 shows the actual and projected per capita personal income levels for St. Tammany Parish from 2000 to 2025.

Table F:1-6. Per Capita Income ($) by Parish

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

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

1.5 RACIAL AND ETHNIC COMPOSITION

Table F:1-7 displays the racial and ethnic composition of the population.

Table F:1-7. Racial and Ethnic Composition

White	75.50%
African American	14.60%
Hispanic or Latino	6.40%
Asian	1.60%
American Indian	0.60%
Other	1.30%

Source: U.S. Census Bureau

1.6 UNEMPLOYMENT

Table F:1-8 displays the unemployment rate for St. Tammany Parish for selected years. The rate has been declining since 2020 and has been less than the national average since 2020.

Table F:1-8. Unemployment Rate

2000	2010	2020	2022
4.2	5.5	4.8	2.7

Source: U.S. Bureau of Labor Statistics

1.5 COMPLIANCE WITH POLICY GUIDANCE LETTER 25 AND ER 1165-2-26

Given continued growth in population in the study area, it is expected that development will continue to occur with or without the implementation of the Optimized TSP. The implementation of the Optimized TSP will not conflict with USACE Planning Guidance Letter 25 “Federal Participation in Land Development at Structural Flood Damage Reduction Projects”, ER 1165-2-26, “Implementation of Executive Order (EO) 11988 on Floodplain Management”, and EO 11988, generally state that the primary objective of a flood risk reduction project is to protect existing development, rather than to make undeveloped land available for more valuable uses. However, the overall growth rate is anticipated to be the same with or without the project in place. Thus, the Optimized TSP would not induce development, but would rather reduce the risk of the population being displaced after a major flood event.

SECTION 2

Asset Inventory in Study Area

2.1 STRUCTURE INVENTORY

There are 100,252 residential structures and 11,440 non-residential structures in the total structure inventory. The source of the inventory is the National Structure Inventory (NSI) version 2. This updated version of the inventory uses Zillow data, Environmental Systems Research Institute (ESRI) map layer data, and CoreLogic data to improve structure placement and the square footage of structures over the previous version of the NSI. RS Means data was used to calculate the depreciated replacement value of structures. The RS Means construction cost index was used to update the depreciated replacement value from FY 2018 to FY 2023. The RS Means Construction Cost Index is a database of current construction cost estimates that includes location factors and a catalogue of historical cost estimates so that costs can be compared over time and escalated when needed. The NSI2 inventory was joined with parcel data to improve structure placement. Table F:2-1 displays the structure counts by occupancy type. Table F:2-2 displays the inventory values.

Table F:2-1. Structure Counts by Occupancy Type

Structure Category	
Residential	**Number**
Single Family 1-Story Slab	20,389
Single Family 1-Story Pier	40,374
Single Family 2-Story Slab	28,105
Single Family 2-Story Pier	778
Manufactured, modular and mobile homes	10,606
Total	100,252
Non-Residential	**Number**
Multi-Family	2,181
Professional	2,409
Public	973
Repair	921
Restaurants	726
Retail	1,883
Warehouse	2,347
Total	11,440

Table F:2-2

Structure, Content, and Vehicle Values FY23 Prices $1,000						
Residential		Commercial		Public		Vehicles
Structure	Contents	Structure	Contents	Structure	Contents	
$11,161,346	$7,714,321	$2,313,870	$2,287,928	$900,797	$506,022	$741,604

The foundation heights of the structures were updated through stratified sampling by study area sub-basin. The strata identified were based on the sub-basin boundaries located within the study area. In cases where sub-basins contained few structures, they were consolidated into a stratum with a neighboring sub-basin. A total of 21 strata were identified. The following formula was used to determine sample size based on foundation height at the 95 percent level of confidence n = ((Z*S)/E)^2.

n = sample size for a Stratum

Z = 1.96 (95 percent level of confidence)

S = (max height - min height)/6

E = allowable error (precision); 0.3 feet is the allowable error for foundations

The calculation is shown below.

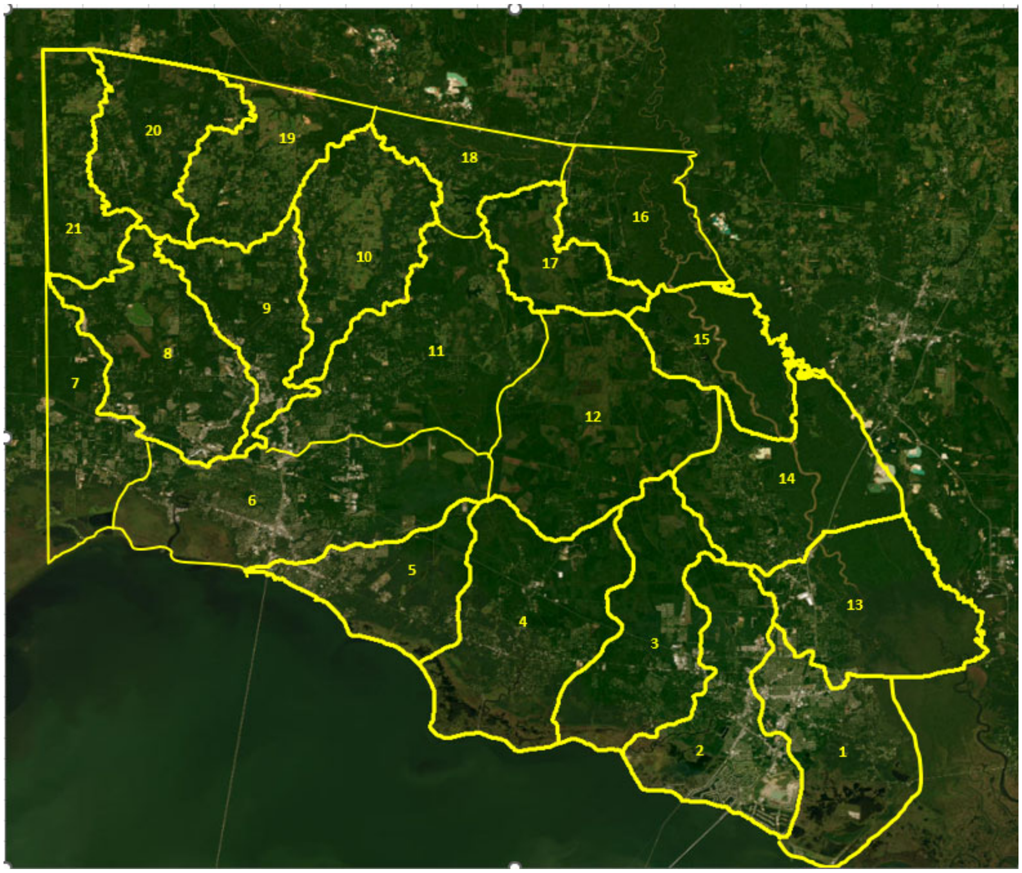
S=(5-0)/6	n=((1.96*0.83333)/0.3)^2
S=5/6	n=((1.633327)/0.3)^2
S=0.83333	n=(5.444423)^2
	n=30

A total of 30 structures were sampled in each stratum. The selected structures were then located on Google Earth to determine their foundation heights. Table F:2-3 displays the foundation heights by damage category for each sub-basin in the study area.

Table 2:2-3. Foundation Heights by Damage Category and Sub-basin

	Residential		Mobile	Non
Stratum	**Slab**	**Pier**	**Modular**	**Residential**
1	0.66	2.75	2.02	1
2	1.05	2.75	2	1.38
3	0.75	2.6	2	1.03
4	0.78	5	2	1
5	0.67	3.8	2	1
6	0.74	3	2.02	1
7	0.58	2.25	2	1.03
8	0.52	1.83	2	1
9	0.53	2.22	2	1
10	0.5	1.4	2.02	1
11	0.81	2.14	2.02	1.5
12	0.6	1.2	2.17	1.03
13	0.6	1.2	2.17	1.03
14	0.92	2.5	2.13	0.5
15	0.53	1.33	2	1
16	0.75	2.6	2	1.03
17	0.53	1.33	2	1
18	0.5	1	2	1
19	0.52	1	2	1
20	0.5	1	2	1
21	0.52	1	2	1

Figure 2:1 Study Area Sub-Basins



2.2 STRUCTURE VALUE UNCERTAINTY

The uncertainty surrounding the residential structure values was based on the depreciation percentage applied to the average replacement cost per square foot calculated from the four exterior wall types. A triangular probability distribution was used to represent the uncertainty surrounding the residential structure values in each occupancy category. The most-likely depreciated value was based on the average construction class and a 20 percent depreciation rate (consistent with an observed age of a 20-year old structure in average condition), the minimum value was based on the economy construction class and a 45 percent depreciation rate (consistent with an observed age of a 30-year old structure in poor condition), and the maximum value was based on the luxury construction class and a 7 percent depreciation rate (consistent with an observed age of a 10-year old structure in good condition). These values were then converted to a percentage of the most-likely value with the most-likely value equal to 100 percent of the average value for each occupancy category and the economy and luxury class values equal to a percentage of these values. The triangular probability distributions were entered into the HEC-FDA model to represent the uncertainty surrounding the structure values in each residential occupancy category.

The uncertainty surrounding the non-residential structure values was based on the depreciation percentage applied to the average replacement cost per square foot calculated from the six exterior wall types. A triangular probability distribution based on the depreciation percentage associated with an observed age (determined using the professional judgment of personnel familiar with the study area) and the type of frame structure was used to represent the uncertainty surrounding the non-residential structure values in each occupancy category. The most-likely depreciated value was based on the depreciation percentage (25 percent) assigned to structures with an observed age of 20 years for masonry and wood construction, the minimum depreciated value was based on the depreciation percentage (40 percent) assigned to structures with an observed age of 30 years for framed construction, and the maximum depreciated value was based on the on the depreciation percentage (8 percent) assigned to structures with an observed age of 10 years for masonry on masonry or steel construction. These values were then converted to a percentage of the most-likely value with the most-likely value being equal to 100 percent and the minimum and maximum values equal to percentages of the most-likely value. The triangular probability distributions were entered into the HEC-FDA model to represent the uncertainty surrounding the structure values for each non-residential occupancy category. The structure value uncertainty values are displayed in Table F:2-4.

Table F:2-4. Structure Value Uncertainty

Maximum and Minimum Structure Value Uncertainty by Occupancy Type		
	Minimum	**Maximum**
1 story Residential	69%	116%
2 story Residential	69%	116%
Manufactured, modular and mobile homes	48%	147%
Multifamily	80%	123%
Public	80%	123%
Retail	80%	123%
Repair	80%	123%
Restaurant	80%	123%
Grocery	80%	123%
Professional	80%	123%
Warehouse	80%	123%

2.3 VEHICLE INVENTORY AND VALUES

Based on 2020 Census information for St. Tammany Parish, there are an average of approximately 2.0 vehicles associated with each household (owner occupied housing or rental unit). According to the Southeast Louisiana Evacuation Behavioral Report published in 2006 following Hurricanes Katrina and Rita, approximately 70 percent of privately owned vehicles are used for evacuation during storm events. The remaining 30 percent of the privately owned vehicles remain parked at the residences and are subject to flood damages. According to Kelly Blue Book, the average value of a used car was $27,564 as of October 2022. Since only those vehicles not used for evacuation can be included in the damage calculations, an adjusted average vehicle value of $8,269 ($27,564 x 0.30) was assigned to each individual residential automobile structure record in the HEC-FDA model. Two vehicles were assigned to each single-family residential structure. The number of vehicles assigned to multi-family structures were based on the number of units of each structure. Only vehicles associated with residential and multi-family structures were included in the analysis. Vehicles associated with non-residential properties were not included in the evaluation.

Vehicle Value Uncertainty

The uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function. The most likely value was $8,269, which is the average value of a used vehicle, $27,564, adjusted for the 70 percent evacuation rate. The maximum value used was $14,484, which is the average value of a new vehicle, $48,281, adjusted for the evacuation rate. The minimum value used was $1,448, which is the average 10-year depreciation value of a vehicle, $4,828, adjusted for the evacuation rate. The percentages were developed for the most-likely, minimum, and the maximum values with the most-likely equal to 100 percent, and the minimum and the maximum values as percentages of the most-likely value (minimum=17 percent, most-likely=100 percent, maximum=175 percent). These percentages were entered into the HEC-FDA model as a triangular probability distribution to represent the uncertainty surrounding the vehicle value for both residential and non-residential vehicles.

2.4 FIRST FLOOR ELEVATIONS

Topographical data based on North American Vertical Datum (NAVD 88) vertical datum was used to assign ground elevations to structures and vehicles in the study area. The assignment of ground elevations and the placement of structures were based on a digital elevation model with a 15-feet-by-15 feet grid resolution developed by the United States Geological Survey (USGS). The ground elevation was added to the height of the foundation of the structure above the ground to obtain the first-floor elevation of each structure in the study area. Vehicles were assigned to the ground elevation of the adjacent residential structures.

2.5 ELEVATION UNCERTAINTY

There are two sources of uncertainty surrounding the first-floor elevations: the use of the lidar data for the ground elevations and the methodology used to determine the structure foundation heights above ground elevation. The error surrounding the lidar data was determined to be plus or minus 0.5895 feet at the 95 percent level of confidence. This uncertainty was normally distributed with a mean of zero and a standard deviation of 0.3 feet.

The uncertainty surrounding the foundation heights for the residential structure categories and commercial structures was estimated by calculating the standard deviations surrounding the sampled mean values. An overall weighted average standard deviation for all of the sampled structures was computed for each residential and non-residential structure category and for all of the residential and non-residential structures, regardless of structure category. There is also potential uncertainty in the first-floor elevation of a structure that is located on a parcel with a significant slope. In such a case, the first-floor elevation of the structure could vary across its footprint. Such parcels are not common in the study area, so this source of uncertainty is not captured in this analysis.

Uncertainty can only be applied to structure occupancies in the HEC-FDA model. To develop a standard deviation for each structure occupancy, first, the structures in each residential category had to be grouped into the structure occupancies; second, a mean foundation height value was the structures within the structure occupancy; third, the standard deviation as a percentage of the mean foundation height value for all the sampled residential structures was calculated and that percentage was applied to the mean foundation value of the residential and non-residential occupancies; fourth, the calculated standard deviation for each structure occupancy was entered into the HEC-FDA model.

2.6 DEPTH-DAMAGE RELATIONSHIPS AND CONTENT-TO-STRUCTURE VALUE RATIO

Depth-damage relationships define the relationship between the depth of flooding and the percent of damage at varying depths that occurs to structures and contents. These mathematical functions are used to quantify the flood damages to a given structure. The content-to-structure value ratio (CSVR) is expressed as a ratio of two values: the depreciated replacement cost of contents and the depreciated replacement cost of the structure. One method to derive these relationships is the “Expert Opinion” method described in the “Handbook of Forecasting Techniques, IWR Contract Report 75-7, December 1975” and “Handbook of Forecasting Techniques, Part II, Description of 31 Techniques, Supplement to IWR Contract Report 75-7, August 1977.” A panel of experts was convened to develop site-specific depth-damage relationships and CSVRS for feasibility studies associated with Jefferson and Orleans Parishes. Professionals in the fields of residential and non-residential construction, general contractors, insurance claims adjusters with experience in flood damage, and a certified restoration expert were selected to sit on the panel. The panel was tasked with developing an array of residential and non-residential structure and content types. Residential structure types were divided into one-story on pier, one-story on slab, two-story on pier, two-story on slab, and manufactured, modular and mobile homes. Non-residential structure types were categorized as metal-frame walls, masonry bearing walls, and wood or steel frame walls. Residential contents were evaluated as one-story, two-story, or manufactured, modular, and mobile homes. Non-residential content categories included the following types: eating and recreation, groceries and gas stations, multi-family residences, repair and home use, retail and personal services, professional businesses, public and semi-public, and warehouse and contractor services. The results of this panel were published in the report "Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-To-Structure Value Ratios (CSVRS) In Support Of the Jefferson and Orleans Flood Control Feasibility Studies, June 1996 Final Report." The long duration, saltwater depth-damage functions were used to assess the damages from coastal flooding. The short-duration, freshwater depth-damage functions were used to assess the damages from rainfall and riverine flooding.

2.7 DEBRIS REMOVAL

Following Hurricanes Katrina and Rita, interviews were conducted with experts in the fields of debris collection, processing, and disposal to estimate the cost of debris removal following a storm event. Information obtained from these interviews was used to assign debris removal costs for each residential and non-residential structure in the structure inventory. The experts provided a minimum, most likely, and maximum estimate for the cleanup costs associated with the 2 feet, 5 feet, and 12 feet depths of flooding. A prototypical structure size in square feet was used for the residential occupancy categories and for the non-residential occupancy categories. The experts were asked to estimate the percentage of the total cleanup caused by floodwater and to exclude any cleanup that was required by high winds.

To account for the cost/damage surrounding debris cleanup, values for debris removal were incorporated into the structure inventory for each record, according to its occupancy type. These values were then assigned a corresponding depth-damage function with uncertainty in the HEC-FDA model. For all structure occupancy types, 100 percent damage was reached at 12 feet of flooding. All values and depth-damage functions were selected according to the long-duration flooding data specified in a report titled "Development of Depth-Emergency Cost and Infrastructure Damage Relationships for Selected South Louisiana Parishes." The debris clean-up values provided in the report were expressed in 2010 price levels for the New Orleans area. These values were converted to 2023 price levels using the indexes provided by Gordian's 2023 edition of "Square Foot Costs with RS Means Data." The debris removal costs were included as the "other" category on the HEC-FDA structure records for the individual residential and non-residential structures and used to calculate the expected annual without-project and with-project debris removal and cleanup costs. The debris removal cost is displayed by structure type for both saltwater and freshwater flooding in table F:2-5.

Table F:2-5

Debris Removal Cost by Occupancy Type FY23 Price Level		
Occupancy Type	**Saltwater**	**Freshwater**
Mobile Home	$9,457	$8,902
One-Story Pier Home	$9,406	$9,217
One-Story Slab Home	$9,170	$9,168
Two-Story Pier Home	$9,373	$9,217
Two-Story Slab Home	$12,281	$9,168
Multi-Family Residence	$16,586	$13,718
Eating or Recreation Facility	$55,599	$54,170
Professional Office	$57,522	$55,261
Public Facility	$57,522	$55,261
Retail Business	$57,177	$54,916
Repair Facility	$59,528	$54,035
Warehouse	$102,008	$67,636

2.8 DEBRIS REMOVAL COSTS UNCERTAINTY

The uncertainty surrounding debris percentage values at 2 feet, 5 feet, and 12 depths of flooding were based on range of values provided by the four experts in the fields of debris collection, processing, and disposal. The questionnaires used in the interview process were designed to elicit information from the experts regarding the cost of each stage of the debris cleanup process by structure occupancy type. The range of responses from the experts were used to calculate a mean value and standard deviation value for the cleanup costs percentages provided at 2 feet, 5 feet, and 12 feet depths of flooding. The mean values and the standard deviation values were entered into the HEC-FDA model as a normal probability distribution to represent the uncertainty surrounding the costs of debris removal for residential and non-residential structures. The depth-damage relationships containing the damage percentages at the various depths of flooding and the corresponding standard deviations representing the uncertainty are shown with in the depth–damage tables.

2.9 DAMAGES TO STREETS AND HIGHWAYS

The reduction of potential flood damages to streets and highways in an evaluation area can form a significant category of benefits attributable to a project alternative. Major and secondary highways are defined as roadways with four lanes with relatively higher volumes of traffic and access, while streets are defined as roadways with two lanes with relatively lower volumes of traffic and access. The NED costs associated with transportation infrastructure were estimated based on data obtained during interviews with professionals familiar with infrastructure inundation impacts. The information compiled as part of the interview process can be found in the report entitled, "Development of Depth-Emergency Costs and Infrastructure Damage Relationships for Selected South Louisiana Parishes," dated March 2012.

The professionals interviewed provided costs for three components of streets (street surface, street base, and street curb), three components of major and secondary highways (road surface, road base, and road shoulder, and three components of railroad tracks (electrical interlocking and grade crossings and non-electrical track structures). The experts also provided estimates of the depreciation of the roadways. The value of each mile of roadway and railway component was discounted by the estimated depreciation percentage. Finally, the experts estimated the percentage of the road components that would be damaged at the 2-feet, 5-feet, and 12-feet depths of flooding.

The damage to the highways, streets and railroad tracks per mile was calculated by multiplying the cost of the materials and labor to replace each infrastructural component by the inverse of the depreciation percentage by the percentage damage to each component. The minimum, most likely, and maximum damages for each roadway and railway component were used to develop a range of values for the total cost of the infrastructural damages per mile. Using a normal distribution, a mean value for the damages per mile and a standard deviation were calculated for each of the three depths of flooding. The mean value for the damages per mile in the report were updated from 2010 to 2023 values using the roads, railroads, and bridges index from the Civil Works Construction Cost Index System. An HEC-FDA structure record was created for each roadway or railroad segment within a station. The elevation and value per segment of roadway or railroad in each station were entered on the structure record for the HEC-FDA model. The value was based on the costs of replacing or repairing a roadway or railways segment on a per mile basis. The repair cost per mile was estimated to be approximately $4.6 million for highways, $840 thousand for streets, and $540 thousand for railroads.

The depth-damage relationships for major and secondary highways, streets and railroads were converted to percentages and entered into the HEC-FDA model, along with the major and secondary highways, streets, and railroad track structure records. The damage value for each mile of highways, streets, and railroads at 12 feet of flooding was used as the infrastructure value, and the stage-probability relationships for each station within the study area reaches was used to calculate the expected annual without-project and with-project damages to major and secondary highways, streets and railroad tracks.

2.10 DAMAGES TO STREETS AND HIGHWAYS UNCERTAINTY

The uncertainty surrounding the damage percentages for each mile of streets and highways at the three depths of flooding (2 feet, 5 feet, and 12 feet) was represented by a normal probability distribution with mean values and standard deviations. The depth-damage relationships containing the damage percentages at the various depths of flooding and the corresponding standard deviations representing the uncertainty are shown with in the tables for depth–damage relationships.

SECTION 3

Damages and Benefits Estimation

3.1 MODEL OVERVIEW

The HEC-FDA Version 1.4.3 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, 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.

3.2 HEC-FDA MODEL CALCULATIONS

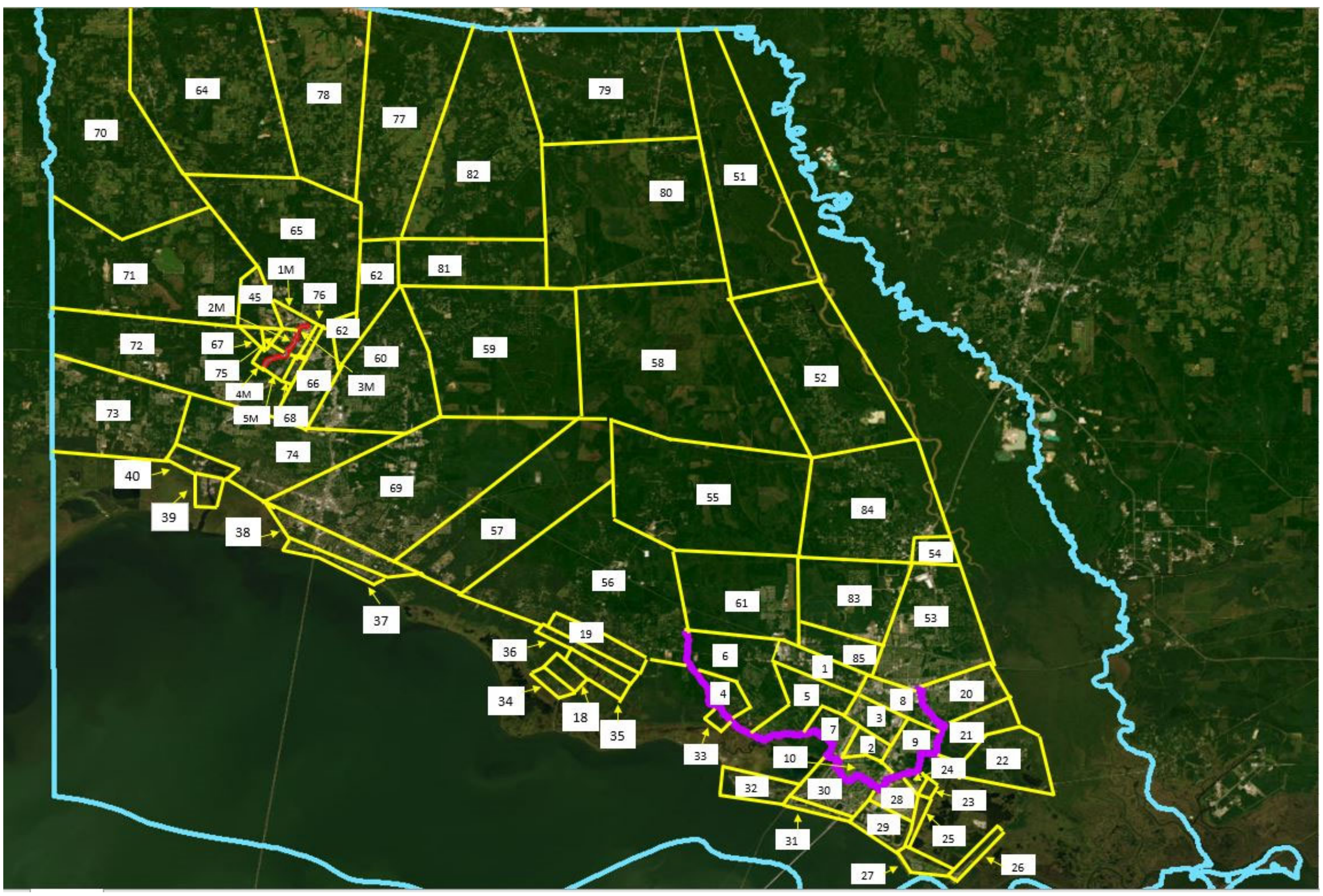
The HEC-FDA model was used to evaluate flood damages using risk-based analysis. Damages were reported at the index location for each of the study area reaches. A range of possible values, with a maximum and a minimum value for each economic variable (first floor elevation, structure and content values, and depth-damage relationships), was entered into the HEC-FDA model to calculate the uncertainty or error surrounding the elevation-damage, or stage-damage, relationships. The model also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-probability relationships. The possible occurrences of each variable were derived using Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, a sampling technique was used to select from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes.

The two general types of flooding originate from different sources and were modeled separately. The coastal flooding represents storm surge from the Gulf of Mexico exclusively and was modeled in ADCIRC. The inland flooding was modeled in HEC-River Analysis System (RAS) and represents the overflow from inland streams resulting from rainfall in addition to ponding from rainfall. Four separate HEC-FDA models were used in the analysis, one for the West and South Slidell Levee and Floodwall System, one for the nonstructural aggregates affected by coastal storm surge, one for the Channel Improvements at Mile Branch, and one for nonstructural aggregates affected by rainfall/riverine flooding.

3.3 STUDY AREA REACHES

The study area reaches are shown in figure F:3-1. The reaches were based on the hydrologic unit code 12 sub-basin boundaries. Additional reaches were parsed out of the sub-basin boundaries based on hydrologic behavior and the location and hydraulic influence of the structural measures, and the disadvantaged community delineations. The purple line represents the levee alignment. The red line represents the channel improvements at Mile Branch. Reaches 1M through 5M are the reaches that are located within the influence area of the Channel Improvements at Mile Branch. They are separate from reaches 1 through 5 located on the interior of the West and South Slidell levee and floodwall system.

Figure F:3-1 Study Area Reaches



3.4 HYDRAULIC AND HYDROLOGIC UNCERTAINTY PARAMETERS

HEC-FDA requires the input of the standard deviation of error associated with stages determined by the hydraulic modeling. Additionally, a period of record of historic gage data, must be input in order to calculate the distribution for the flow data determined in the hydrologic analysis.

3.5 STAGE-DAMAGE RELATIONSHIPS WITH UNCERTAINTY

The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study area reach under 2032 and 2081 conditions. The possible occurrences of each economic variable were derived using Monte Carlo simulation. A total of 1,000 iterations were executed by the model. The sum of all sampled values was divided by the number of samples to yield the expected value for a specific simulation. A mean and standard deviation was automatically calculated for the damages at each stage. See section 11 for stage-damage functions for population centers of interest.

3.6 STAGE-PROBABILITY RELATIONSHIPS WITH UNCERTAINTY

The HEC-FDA model used an equivalent record length of 50 years for each study area reach to generate a stage-probability relationship with uncertainty using graphical analysis. The model used eight stage-probability events together with the equivalent record length to define the full range of the stage-probability or stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided. For the coastal flooding, stages were provided for the 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, and 0.001 annual exceedance probability (AEP) events. Place holders were used for the 1.0 AEP event. For the rainfall and riverine flooding, stages were provided for the 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.005, and 0.002 AEP events. The counts of inundated structures by probability event are displayed by category and reach in tables F:3-1 through F: 3-12. The damages by probability event are displayed in tables F:3-13 and F:3-16.

Table F:3-1, Coastal Inundated Residential Structures by Reach and Probability Event, 2032

Reach	10%	5%	2%	1%	0.50%	0.20%	0.10%
1	3	9	42	64	115	149	179
2	6	72	311	559	875	1192	1298
3	30	121	255	358	447	510	535
4	4	10	33	54	74	97	105
5	59	136	430	587	728	887	1088
6	36	60	234	336	405	459	490

7	248	401	765	826	845	879	905
8	0	0	2	11	18	20	20
9	55	443	940	1237	1392	1453	1457
10	7	7	7	7	7	7	7
18	6	9	11	13	16	19	25
19	0	1	1	3	5	9	11
20	0	0	92	322	635	894	990
21	23	80	234	333	427	474	487
22	176	315	452	497	527	536	539
23	8	18	25	25	25	25	25
24	3	4	4	4	4	4	4
25	0	0	25	76	110	128	135
26	0	0	5	15	19	22	26
27	0	0	0	0	5	9	27
28	145	145	145	145	145	145	145
29	1	9	23	52	102	182	244
30	39	81	185	354	583	918	1347
31	0	0	2	4	7	9	10
32	0	0	0	0	0	4	8
33	0	5	9	11	11	11	11
34	0	0	0	0	0	8	38
35	0	0	3	10	18	54	129
36	18	47	65	79	90	106	124
37	0	0	1	1	4	33	83
38	17	66	149	255	407	639	865
39	0	0	0	0	5	28	45

40	80	130	178	201	227	262	288

Table F:3-2, Coastal Inundated Commercial Structures by Reach and Probability Event, 2032

Reach	10%	5%	2%	1%	0.50%	0.20%	0.10%
1	1	2	14	25	35	43	43
2	1	16	91	130	169	217	217
3	11	42	139	185	206	217	222
4	2	3	7	7	7	7	7
5	21	52	116	137	140	140	142
6	2	3	12	15	16	19	22
7	13	26	63	69	70	70	70
8	0	0	0	3	3	3	3
9	1	11	48	58	60	60	60
10	2	2	2	2	2	2	2
18	0	0	0	0	0	0	0
19	0	7	8	9	11	12	14
20	0	0	15	33	53	81	86
21	2	36	84	105	111	121	123
22	21	38	50	51	53	53	53
23	5	5	5	5	5	5	5
24	6	6	6	6	6	6	6
25	0	0	0	3	4	4	4
26	0	3	8	14	15	20	20
27	0	0	0	2	3	6	10
28	0	0	0	0	0	0	0
29	0	1	1	2	2	2	2
30	4	7	11	19	39	71	84
31	0	0	4	5	5	6	6
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	1	1	1	2	6
36	4	10	13	13	13	14	17
37	3	14	14	16	19	27	40
38	7	29	60	83	118	178	209
39	1	1	1	1	5	8	13
40	20	40	56	61	69	75	77

Table F:3-3, Coastal Inundated Public Structures by Reach and Probability Event, 2032

Reach	10%	5%	2%	1%	0.50%	0.20%	0.10%
1	0	0	0	0	0	1	1
2	0	1	6	12	18	20	20
3	1	3	16	26	28	29	29
4	0	0	0	0	0	0	0
5	0	0	1	1	1	2	2
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	1	1	1	1	1	1
10	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	1	1	2	4	4
21	0	0	4	5	7	8	8
22	0	4	5	5	5	5	5
23	0	0	0	0	0	0	0
24	1	1	1	1	1	1	1
25	0	0	4	7	8	8	8
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0
30	0	0	0	2	3	6	6

31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	1	1	1	1	1	2	3
38	0	3	8	17	22	26	30
39	0	0	0	0	0	0	1
40	2	5	6	7	7	7	8

Table F:3-4, Riverine Inundated Residential Structures by Reach and Probability Event, 2032

Reach	10%	5%	2%	1%	0.50%	0.20%
45	15	26	53	134	209	249
50	0	0	0	0	0	0
51	2	2	2	4	9	12
52	47	61	70	86	104	125
53	294	461	623	766	903	1,027
54	0	0	0	0	0	0
55	10	26	29	38	47	59
56	81	101	119	141	165	197
57	9	13	19	35	53	72
58	5	10	16	27	40	48
59	100	173	245	316	423	500
60	143	209	255	309	388	455
61	9	22	32	43	57	79
62	52	93	99	109	121	124
63	14	29	39	70	98	121
64	31	45	65	95	118	129
65	73	138	227	295	372	444
66	74	185	304	430	560	654
67	1	1	1	3	6	8
68	8	9	9	10	11	11

69	17	25	33	46	67	101
70	123	201	227	257	285	298
71	295	424	505	592	672	770
72	194	306	393	516	656	823
73	140	226	281	352	420	522
74	223	409	535	658	737	822
75	13	20	21	34	61	76
76	17	35	46	58	66	77
77	14	32	43	52	59	59
78	14	18	19	20	23	25
79	13	27	34	49	58	65
80	10	16	27	39	53	67
81	6	9	13	14	20	22
82	6	10	14	17	22	25
83	7	11	14	21	37	58
84	22	30	35	41	49	70
85	1	1	1	3	9	12
1M	2	5	21	108	196	288
2M	5	9	25	36	51	74
3M	9	19	79	113	155	185
4M	4	10	13	17	20	31
5M	6	12	27	42	99	173

Table F:3-5, Riverine Inundated Commercial Structures by Reach and Probability Event, 2032

Reach	**10%**	**5%**	**2%**	**1%**	**0.50%**	**0.20%**
45	2	3	4	5	9	9
50	0	0	0	0	0	0
51	1	3	3	4	5	5
52	4	6	7	8	9	13
53	19	29	44	57	67	79
54	0	0	0	1	1	1
55	1	3	5	6	7	10
56	5	8	10	12	17	25
57	3	5	5	6	6	6
58	0	1	5	5	7	8
59	4	8	13	18	20	26

60	16	29	35	50	67	85
61	6	13	18	23	29	34
62	4	14	15	15	15	16
63	1	2	2	2	2	5
64	0	0	0	0	1	1
65	11	29	46	57	63	71
66	9	24	45	69	87	93
67	2	4	4	5	5	5
68	0	0	0	0	0	0
69	3	4	4	7	10	15
70	11	14	15	15	17	19
71	13	21	27	32	33	38
72	14	26	40	49	60	71
73	10	15	19	22	26	33
74	25	45	65	78	95	102
75	1	1	1	2	13	68
76	12	13	14	22	27	32
77	0	0	1	1	2	3
78	0	0	0	0	0	0
79	1	2	3	4	6	6
80	1	1	1	1	1	2
81	0	0	0	0	0	0
82	1	1	3	3	3	3
83	0	2	2	2	3	5
84	2	2	4	6	6	6
85	0	0	0	0	1	4
1M	2	3	8	19	31	39
2M	6	7	7	9	11	17
3M	1	6	9	20	34	43
4M	0	0	0	0	0	0
5M	2	6	7	10	18	31

Table F:3-6, Riverine Inundated Public Structures by Reach and Probability Event, 2032

Reach	10%	5%	2%	1%	0.50%	0.20%
45	4	8	9	16	42	61
50	0	0	0	0	0	0

51	0	0	0	0	0	1
52	0	0	1	1	1	1
53	2	4	6	6	7	7
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	2	2
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	1
60	1	1	1	2	5	5
61	0	1	1	1	1	1
62	0	0	0	0	0	0
63	0	0	0	0	0	0
64	0	0	0	3	3	3
65	1	1	1	3	3	3
66	1	5	8	15	16	16
67	0	0	0	0	0	0
68	0	0	0	1	1	1
69	4	4	4	5	5	7
70	0	0	0	0	0	0
71	0	1	6	8	8	9
72	0	0	0	0	1	3
73	0	0	0	0	0	0
74	1	3	6	8	8	9
75	0	0	0	0	0	0
76	1	2	2	2	3	3
77	1	2	2	2	2	2
78	0	0	0	0	0	0
79	0	0	0	0	0	0
80	2	2	2	2	3	4
81	0	0	0	0	0	0
82	0	0	0	0	0	0
83	0	0	0	0	0	0
84	0	0	0	0	0	0
85	0	0	0	0	0	1
1M	0	0	0	0	3	5
2M	3	3	3	3	3	4
3M	0	0	0	0	0	1

4M	0	0	0	0	0	0
5M	0	0	1	1	2	4

Table F:3-7, Coastal Inundated Residential Structures by Reach and Probability Event, 2082

Reach	10%	5%	2%	1%	0.50%	0.20%	0.10%
1	7	10	130	156	187	194	194
2	87	325	732	1194	1284	1336	1338
3	321	478	483	504	527	537	541
4	4	26	79	99	106	116	116
5	167	215	762	964	1165	1344	1419
6	75	166	421	460	490	511	519
7	635	653	823	853	884	934	939
8	0	0	16	20	20	20	20
9	484	1147	1394	1427	1452	1457	1458
10	0	0	0	0	0	7	7
18	8	11	13	21	30	39	40
19	0	4	8	11	12	21	29
20	0	15	377	757	950	1052	1095
21	60	169	380	460	482	490	493
22	270	395	466	477	538	541	543
23	3	4	4	4	25	25	25
24	1	1	1	1	4	4	4
25	0	28	96	120	135	135	135
26	0	5	18	22	26	27	27
27	0	0	5	9	27	74	94
28	145	145	145	145	145	145	145
29	1	9	23	52	102	182	245

30	55	204	619	973	1447	1885	2001
31	0	4	8	9	11	12	14
32	0	0	1	7	18	47	98
33	4	11	11	11	12	12	12
34	0	0	2	26	54	75	86
35	3	11	30	100	185	290	341
36	15	57	92	109	128	154	159
37	1	1	18	60	137	221	282
38	77	267	532	748	998	1273	1417
39	0	0	19	38	63	97	103
40	148	185	229	253	272	302	313

Table F:3-8, Coastal Inundated Commercial Structures by Reach and Probability Event, 2082

Reach	10%	5%	2%	1%	0.50%	0.20%	0.10%
1	2	2	39	43	43	43	43
2	25	66	158	217	217	217	217
3	156	189	189	211	220	222	222
4	4	4	7	7	7	7	7
5	60	65	140	140	143	144	144
6	3	4	17	21	23	25	26
7	38	38	70	70	70	70	70
8	0	0	3	3	3	3	3
9	10	40	60	60	60	60	60
10	2	2	2	2	2	2	2
18	0	0	0	0	0	0	0

19	0	10	11	13	15	16	17
20	0	5	44	69	85	90	93
21	29	83	109	120	123	123	123
22	39	50	53	53	53	53	53
23	5	5	5	5	5	5	5
24	6	6	6	6	6	6	6
25	0	0	4	4	4	4	4
26	3	8	14	20	20	20	21
27	0	0	4	6	10	14	23
28	0	0	0	0	0	0	0
29	0	1	1	2	2	2	2
30	8	13	57	72	86	93	94
31	2	4	6	6	6	6	7
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	1
35	1	1	2	5	13	22	26
36	6	10	13	16	21	23	23
37	8	16	22	34	50	69	86
38	17	66	148	199	221	269	297
39	1	1	7	11	13	13	15
40	53	62	72	77	78	78	79

Table F:3-9, Coastal Inundated Public Structures by Reach and Probability Event, 2082

Reach	10%	5%	2%	1%	0.50%	0.20%	0.10%
1	0	0	0	1	1	1	1

2	5	15	17	20	20	20	20
3	25	26	26	28	29	29	29
4	0	0	0	0	0	0	0
5	0	0	1	2	2	2	2
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	1	1	1	1	1	1
10	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	1	3	4	4	4
21	0	4	6	8	8	8	8
22	4	5	5	5	5	5	5
23	0	0	0	0	0	0	0
24	1	1	1	1	1	1	1
25	0	5	8	8	8	8	8
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0
30	0	0	3	6	6	6	6
31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0

35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	1	1	1	3	3	3	4
38	1	17	23	26	37	48	49
39	0	0	0	0	2	6	6
40	5	7	7	8	8	8	9

Table F:3-10, Riverine Inundated Residential Structures by Reach and Probability Event, 2082

Reach	10%	5%	2%	1%	0.50%	0.20%
45	15	26	53	134	209	249
50	0	0	0	0	0	0
51	2	2	2	4	9	12
52	47	61	70	86	104	125
53	294	461	623	766	903	1,027
54	0	0	0	0	0	0
55	10	26	29	38	47	59
56	81	101	119	141	165	197
57	9	13	19	35	53	72
58	5	10	16	27	40	48
59	100	173	245	316	423	500
60	143	209	255	309	388	455
61	9	22	32	43	57	79
62	52	93	99	109	121	124
63	14	29	39	70	98	121
64	31	45	65	95	118	129
65	73	138	227	295	372	444
66	74	185	304	430	560	654
67	1	1	1	3	6	8
68	8	9	9	10	11	11
69	17	25	33	46	67	101
70	123	201	227	257	285	298
71	295	424	505	592	672	770
72	194	306	393	516	656	823

73	140	226	281	352	420	522
74	223	409	535	658	737	822
75	13	20	21	34	61	76
76	17	35	46	58	66	77
77	14	32	43	52	59	59
78	14	18	19	20	23	25
79	13	27	34	49	58	65
80	10	16	27	39	53	67
81	6	9	13	14	20	22
82	6	10	14	17	22	25
83	7	11	14	21	37	58
84	22	30	35	41	49	70
85	1	1	1	3	9	12
1M	2	5	21	108	196	288
2M	5	9	25	36	51	74
3M	9	19	79	113	155	185
4M	4	10	13	17	20	31
5M	6	12	27	42	99	173

Table F:3-11, Riverine Inundated Commercial Structures by Reach and Probability Event, 2082

Reach	10%	5%	2%	1%	0.50%	0.20%
45	2	3	4	5	9	9
50	0	0	0	0	0	0
51	1	3	3	4	5	5
52	4	6	7	8	9	13
53	19	29	44	57	67	79
54	0	0	0	1	1	1
55	1	3	5	6	7	10
56	5	8	10	12	17	25
57	3	5	5	6	6	6
58	0	1	5	5	7	8
59	4	8	13	18	20	26
60	16	29	35	50	67	85
61	6	13	18	23	29	34
62	4	14	15	15	15	16
63	1	2	2	2	2	5
64	0	0	0	0	1	1

65	11	29	46	57	63	71
66	9	24	45	69	87	93
67	2	4	4	5	5	5
68	0	0	0	0	0	0
69	3	4	4	7	10	15
70	11	14	15	15	17	19
71	13	21	27	32	33	38
72	14	26	40	49	60	71
73	10	15	19	22	26	33
74	25	45	65	78	95	102
75	1	1	1	2	13	68
76	12	13	14	22	27	32
77	0	0	1	1	2	3
78	0	0	0	0	0	0
79	1	2	3	4	6	6
80	1	1	1	1	1	2
81	0	0	0	0	0	0
82	1	1	3	3	3	3
83	0	2	2	2	3	5
84	2	2	4	6	6	6
85	0	0	0	0	1	4
1M	2	3	8	19	31	39
2M	6	7	7	9	11	17
3M	1	6	9	20	34	43
4M	0	0	0	0	0	0
5M	2	6	7	10	18	31

Table F:3-12, Riverine Inundated Public Structures by Reach and Probability Event, 2082

Reach	10%	5%	2%	1%	0.50%	0.20%
45	4	8	9	16	42	61
50	0	0	0	0	0	0
51	0	0	0	0	0	1
52	0	0	1	1	1	1
53	2	4	6	6	7	7
54	0	0	0	0	0	0
55	0	0	0	0	0	0

56	0	0	0	0	2	2
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	1
60	1	1	1	2	5	5
61	0	1	1	1	1	1
62	0	0	0	0	0	0
63	0	0	0	0	0	0
64	0	0	0	3	3	3
65	1	1	1	3	3	3
66	1	5	8	15	16	16
67	0	0	0	0	0	0
68	0	0	0	1	1	1
69	4	4	4	5	5	7
70	0	0	0	0	0	0
71	0	1	6	8	8	9
72	0	0	0	0	1	3
73	0	0	0	0	0	0
74	1	3	6	8	8	9
75	0	0	0	0	0	0
76	1	2	2	2	3	3
77	1	2	2	2	2	2
78	0	0	0	0	0	0
79	0	0	0	0	0	0
80	2	2	2	2	3	4
81	0	0	0	0	0	0
82	0	0	0	0	0	0
83	0	0	0	0	0	0
84	0	0	0	0	0	0
85	0	0	0	0	0	1
1M	0	0	0	0	3	5
2M	3	3	3	3	3	4
3M	0	0	0	0	0	1
4M	0	0	0	0	0	0
5M	0	0	1	1	2	4

Table F:3-13, Coastal Damages by Category, Without Project 2032, $1,000s

	10%	5%	2%	1%	0.50%	0.20%	0.10%
RES	327,624	747,950	1,625,619	2,316,377	3,103,500	3,961,852	4,597,942
COM	61,018	154,393	501,920	688,897	855,823	1,051,252	1,162,200
PUBL	2,454	14,971	68,834	142,490	230,299	267,831	284,516

Table F:3-14, Coastal Damages by Category, Without Project 2082, $1,000s

	10%	5%	2%	1%	0.50%	0.20%	0.10%
RES	910,593	1,642,994	2,987,579	3,862,053	4,624,643	5,436,424	5,838,280
COM	306,054	511,393	875,086	1,073,833	1,180,961	1,280,205	1,364,416
PUBL	48,377	184,372	230,392	257,377	305,876	367,297	377,392

Table F:3-15, Riverine Damages by Category, Without Project 2032/2082, $1,000s

	50%	10%	5%	2%	1%	0.50%	0.20%
RES	59,611	231,681	517,849	773,633	1,069,046	1,405,913	1,832,672
COM	2,985	20,375	64,370	108,725	162,628	220,524	306,143
PUBL	1,015	2,782	7,074	12,432	22,362	34,012	60,294

Table F:3-16, Coastal Damages by Category, With Project 2032, $1,000s

	10%	5%	2%	1%	0.50%	0.20%	0.10%
RES	72,104	73,920	83,160	257,899	580,933	2,919,449	3,835,807
COM	18,806	32,036	46,096	107,062	198,951	960,350	1,092,452
PUBL	12	283	1,165	37,896	118,814	238,872	274,641

TableF:3-17, Coastal Damages by Category, With Project 2082, $1,000s

	10%	5%	2%	1%	0.50%	0.20%	0.10%
RES	75,601	129,802	500,942	1,040,104	1,692,606	5,297,281	5,764,900
COM	31,901	69,475	217,769	355,617	462,628	1,229,680	1,341,942
PUBL	577	73,227	126,399	178,246	230,086	366,227	376,445

Table F:3-18, Riverine Damages by Category, With Project 2032/2082, $1,000s

	50%	10%	5%	2%	1%	0.50%	0.20%
RES	7,118	12,881	35,685	148,184	351,788	632,494	1,137,466
COM	299	654	3,672	28,122	72,262	142,304	240,562
PUBL	47	100	385	2,798	12,081	23,455	47,158

3.7 EXPECTED ANNUAL DAMAGES

The HEC-FDA model uses Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of exceedance (probability). From these weighted damages, the HEC-FDA model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without-project alternative, the EAD were totaled for each study area reach to obtain the total without-project EAD under 2032 and 2081 conditions. Tables F:3-3 and F:3-4 show the without-project damages by damage category for 2032 and 2081. Tables F:3-5 and F:3-6 show the without-project damages by reach for 2032 and 2081 respectively. The increase in damages from 2032 to 2082 are due to sea-level rise and subsidence. No future development was included in this analysis. In order to establish a life cycle approach for the coastal portions of the study area, the first-floor elevations of certain structures were adjusted to account for the most-likely future condition in which structures receiving greater than 50 percent damage by the 0.10 (10-year) AEP event in the without project condition in 2032 would self-mitigate, or elevate themselves apart from any action by the Federal Government, in the future. These adjustments were made to 83 structures on the interior of the West and South Slidell Levee and Floodwall System and 189 other structures located throughout the other coastal sections of the study area.

Table F:3-3. Expected Annual Damages by Year and Damage Category, Coastal, $1,000s

Year	Auto	Commercial	Highway	Manufactured, modular and mobile homes	Rail	Residential	Street	Total
2032	13,134	49,546	713	1,810	42	145,979	4,116	215,339
2082	40,178	173,211	1,824	4,013	130	361,659	8,992	590,007

Table F:3-4. Expected Annual Damages by Year and Damage Category, Rainfall/Riverine, $1,000s

Year	Auto	Commercial	Manufactured, modular and mobile homes	Residential	Total
2032	13,516	20,230	3,041	150,108	186,895
2082	13,930	20,837	3,058	155,744	193,569

Table F:3-5. Expected Annual Damages by Reach, Coastal, $1,000s

Reach	2032	2082
1	1,400	2,564
2	11,282	31,700
3	11,615	61,686
4	909	1,583
5	16,874	31,215
6	6,231	10,893
7	28,912	59,078
8	552	617
9	24,669	61,314
10	1,229	518
18	451	1,396
19	486	563
20	5,495	10,666
21	12,320	29,491
22	41,224	76,907
23	888	1,619
24	474	1,385
25	1,448	4,288
26	636	1,468
27	414	1,679
28	7,733	19,575
29	1,648	1,733
30	13,545	52,364
31	463	2,019
32	535	2,340
33	204	589
34	247	1,207
35	836	4,807
36	2,049	5,365
37	1,646	5,785
38	8,143	58,650
39	420	1,877

40	10,361	43,065

Table F:3-6. Expected Annual Damages by Reach, Rainfall/Riverine, $1,000s

Reach	2032	2082
45	2,476	2,485
50	0	0
51	461	461
52	2,589	2,595
53	21,307	21,420
54	52	52
55	1,131	1,147
56	3,924	3,951
57	930	931
58	552	553
59	7,814	7,814
60	14,555	14,655
61	1,043	1,043
62	3,625	3,625
63	1,604	1,604
64	2,203	2,203
65	8,104	8,104
66	14,176	14,989
67	316	316
68	378	381
69	2,965	3,036
70	8,907	8,907
71	17,147	17,147
72	18,667	19,232
73	15,159	15,985
74	19,104	23,223
75	1,044	1,044
76	1,601	1,604
77	1,186	1,186

Reach	2032	2082
78	452	452
79	1,143	1,143
80	957	957
81	670	670
82	557	557
83	1,255	1,255
84	2,112	2,112
85	123	125
1M	1,308	1,308
2M	1,009	1,009
3M	1,959	1,959
4M	489	489
5M	1,839	1,839

3.8 EQUIVALENT ANNUAL DAMAGES

The HEC-FDA model uses the discount rate to discount the future damages and benefits occurring in 2082 back to the base year of 2032. Table F:3-7 displays the levee elevations by reach for the West and South Slidell Levee and Floodwall System. Once the levee is overtopped, it is assumed that the interior stages will equal stages that are exterior to the levee. Tables F:3-8 and F:3-9 show the equivalent annual damages by reach for the without-project condition and the damages reduced for each structural measure.

Table F:3-7

Levee Elevations by Reach		
Reach	**2032**	**2082**
1	13.5	17.5
2	14	17.5
3	16	20
4	13.5	17.5
5	13.5	17.5
6	13.5	17.5
7	13.5	17.5
8	16	20
9	16	20
10	16	20

Table F:3-8. Equivalent Annual Damages by Reach and Measure, West and South Slidell Levee and Floodwall, FY 2023 Price Level, FY 2023 Discount Rate, $1,000s

Reach	Without Project Damages	With Project Damages	Damages Reduced
1	1,854	73	1,780
2	19,239	177	19,061
3	31,126	20	31,107
4	1,172	5	1,167
5	22,462	340	22,123
6	8,048	105	7,943
7	40,667	93	40,574
8	577	300	278
9	38,948	1,339	37,609
10	952	7	946
Total	165,045	2,458	162,588

Table F:3-9. Equivalent Annual Damages by Reach and Measure, Rainfall and Riverine, FY 2023 Price Level, FY 2023 Discount Rate, $1,000s

Reach	Without Project Damages	With Project Damages	Damages Reduced
1M	1,308	677	631
2M	1,009	268	741
3M	1,959	333	1,626
4M	489	447	42
5M	1,839	1,407	432
Total	6,605	3,133	3,472

SECTION 4
Project Costs

4.1 AVERAGE ANNUAL COSTS

Interest During Construction (IDC) as a requirement when calculating economic costs. Part of the consideration in calculating IDC is the duration of construction. The duration of construction is the length of time funds are committed to an individual structure. This concept is straight forward when looking at a levee, for example. The time from start (no levee) to finish (finished feature) is identified and IDC calculated accordingly. The timing for nonstructural project implementation is less defined. For example, 100 structures may be elevated over the course of a year, but the time to implement a nonstructural measure at a single structure is only 3 months. Thus, the IDC should only be calculated for 3 months. Therefore, when calculating IDC for nonstructural measures or plans, the length of time will be based on construction duration for a specific measure and/or structure, and not the overall duration of construction for the entire project. The initial construction cost, along with the schedule of expenditures, were used to determine the interest during construction and gross investment cost at the end of the installation period (2032). The FY 2023 Federal discount rate of 2.5 percent was used to discount the costs of the Optimized TSP to the base year and then amortize the costs over the 50-year period of analysis. The operations, maintenance, relocations, rehabilitation, and repair costs for each alternative was discounted to present value and annualized using the Federal discount rate of 2.5 percent for 50 years. Figure F:4-1 displays the Total Project Cost Sheet for the West and South Slidell Levee and Floodwall. Table F:4-1 displays the construction schedule for the West and South Slidell Levee and Floodwall. Table F:4-2 displays the OMRR&R schedule for the West and South Slidell Levee and Floodwall. Table F:4-3 displays the total project first costs, the average annual construction costs, the annual operation and maintenance costs, and the total average annual costs for the West and South Slidell Levee and Floodwall System. Figure F:4-2 displays the Total Project Cost Sheet for the Mile Branch Channel Improvements. Tables F:4-4 through F:4-6 display the corresponding cost schedules and summary data for the Channel Improvements at Mile Branch.

Figure F:4-1, Total Project Cost Breakdown-West and South Slidell Levee and Floodwall

Civil Works Work Breakdown Structure		ESTIMATED COST			
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F
02	RELOCATIONS	$17,352	$6,420	37.0%	$23,772
06	FISH & WILDLIFE FACILITIES	$45,108	$16,690	37.0%	$61,799
06	FISH & WILDLIFE FACILITIES	$13,555	$5,015	37.0%	$18,570
11	LEVEES & FLOODWALLS	$135,295	$50,059	37.0%	$185,354
11	LEVEES & FLOODWALLS	$47,011	$17,394	37.0%	$64,405
11	LEVEES & FLOODWALLS	$52,112	$19,281	37.0%	$71,394
11	LEVEES & FLOODWALLS	$44,690	$16,535	37.0%	$61,225
11	LEVEES & FLOODWALLS	$32,201	$11,915	37.0%	$44,116
11	LEVEES & FLOODWALLS	$260,812	$96,500	37.0%	$357,312
11	LEVEES & FLOODWALLS	$53,551	$19,814	37.0%	$73,365
13	PUMPING PLANT	$538,868	$199,381	37.0%	$738,250
15	FLOODWAY CONTROL & DIVERSION STRUCTURE	$84,605	$31,304	37.0%	$115,909
	CONSTRUCTION ESTIMATE TOTALS:	$1,325,161	$490,310		$1,815,471
01	LANDS AND DAMAGES	$42,903	$10,726	25.0%	$53,629
30	PLANNING, ENGINEERING & DESIGN	$271,658	$100,513	37.0%	$372,171
31	CONSTRUCTION MANAGEMENT	$145,768	$53,934	37.0%	$199,702
	PROJECT COST TOTALS:	$1,785,490	$655,483	36.7%	$2,440,973

Table F:4-1. West and South Slidell Levee and Floodwall Construction Cost Schedule, FY 2023 Price Level, FY 2023 Discount Rate of 2.5%

Discounting/ Compounding Year	Calendar Year	Yearly Cost	Compounded Value	Compound Factor
4.5	2027	43,051,907	48,111,599	1.1175
3.5	2028	428,659,649	467,354,182	1.0903
2.5	2029	515,936,706	548,789,875	1.0637
1.5	2030	590,145,912	612,414,128	1.0377
0.5	2031	523,396,663	529,898,734	1.0124
-0.5	2032	0	0	0.9877
-1.5	2033	31,673,284	30,521,600	0.9636
-2.5	2034	41,155,662	38,691,888	0.9401
-3.5	2035	21,097,215	19,350,474	0.9172
-4.5	2036	0	0	0.8948
-5.5	2037	21,541,162	18,805,629	0.8730
-6.5	2038	31,748,373	27,040,602	0.8517
-7.5	2039	8,706,758	7,234,816	0.8309
-8.5	2040	0	0	0.8107
-9.5	2041	9,946,501	7,866,718	0.7909
-10.5	2042	9,946,501	7,674,847	0.7716
-11.5	2043	9,946,501	7,487,656	0.7528
-12.5	2044	0	0	0.7344
-13.5	2045	0	0	0.7165
-14.5	2046	0	0	0.6990
-15.5	2047	26,254,318	17,905,268	0.6820
-16.5	2048	10,723,404	7,134,916	0.6654
-17.5	2049	8,298,541	5,386,840	0.6491
-18.5	2050	8,298,541	5,255,454	0.6333
-19.5	2051	36,822,928	22,751,128	0.6179
-20.5	2052	0	0	0.6028
-21.5	2053	0	0	0.5881
-22.5	2054	0	0	0.5737
-23.5	2055	0	0	0.5597
-24.5	2056	0	0	0.5461
-25.5	2057	0	0	0.5328
-26.5	2058	0	0	0.5198
-27.5	2059	0	0	0.5071
-28.5	2060	0	0	0.4947
-29.5	2061	0	0	0.4827
-30.5	2062	0	0	0.4709

-31.5	2063	0	0	0.4594
-32.5	2064	34,902,650	15,643,459	0.4482
-33.5	2065	0	0	0.4373
-34.5	2066	0	0	0.4266
-35.5	2067	0	0	0.4162
-36.5	2068	0	0	0.4060
-37.5	2069	0	0	0.3961
-38.5	2070	0	0	0.3865
-39.5	2071	0	0	0.3771
-40.5	2072	0	0	0.3679
-41.5	2073	0	0	0.3589
-42.5	2074	1,554,794	544,388	0.3501
-43.5	2075	27,165,028	9,279,445	0.3416
-44.5	2076	0	0	0.3333
-45.5	2077	0	0	0.3251
-46.5	2078	0	0	0.3172
-47.5	2079	0	0	0.3095
-48.5	2080	0	0	0.3019
-49.5	2081	0	0	0.2946

Table F:4-2. West and South *Slidell Levee and Floodwall OMRR&R Cost Schedule, FY23 Price Level, FY23 Discount Rate of 2.5%*

Discounting/ Compounding Year	Calendar Year	Yearly Cost	Compounded Value	Compound Factor
4.5	2027	0	0	1.1175
3.5	2028	0	0	1.0903
2.5	2029	0	0	1.0637
1.5	2030	0	0	1.0377
0.5	2031	0	0	1.0124
-0.5	2032	0	0	0.9877
-1.5	2033	2,899,351	2,793,927	0.9636
-2.5	2034	2,880,189	2,707,767	0.9401
-3.5	2035	5,302,995	4,863,934	0.9172
-4.5	2036	2,880,189	2,577,291	0.8948
-5.5	2037	7,427,630	6,484,388	0.8730
-6.5	2038	5,302,995	4,516,646	0.8517
-7.5	2039	2,880,189	2,393,271	0.8309
-8.5	2040	2,880,189	2,334,899	0.8107
-9.5	2041	5,302,995	4,194,155	0.7909

-10.5	2042	13,607,223	10,499,507	0.7716
-11.5	2043	2,880,189	2,168,186	0.7528
-12.5	2044	5,302,995	3,894,690	0.7344
-13.5	2045	2,880,189	2,063,710	0.7165
-14.5	2046	2,880,189	2,013,376	0.6990
-15.5	2047	9,907,924	6,757,138	0.6820
-16.5	2048	2,880,189	1,916,360	0.6654
-17.5	2049	2,880,189	1,869,620	0.6491
-18.5	2050	5,302,995	3,358,379	0.6333
-19.5	2051	2,880,189	1,779,531	0.6179
-20.5	2052	34,261,568	20,652,279	0.6028
-21.5	2053	5,302,995	3,118,589	0.5881
-22.5	2054	2,880,189	1,652,471	0.5737
-23.5	2055	2,880,189	1,612,167	0.5597
-24.5	2056	5,302,995	2,895,920	0.5461
-25.5	2057	67,635,359	36,034,229	0.5328
-26.5	2058	2,880,189	1,497,058	0.5198
-27.5	2059	5,302,995	2,689,149	0.5071
-28.5	2060	2,880,189	1,424,921	0.4947
-29.5	2061	2,880,189	1,390,167	0.4827
-30.5	2062	70,723,623	33,303,249	0.4709
-31.5	2063	2,880,189	1,323,181	0.4594
-32.5	2064	2,880,189	1,290,908	0.4482
-33.5	2065	5,302,995	2,318,845	0.4373
-34.5	2066	2,880,189	1,228,705	0.4266
-35.5	2067	7,485,118	3,115,311	0.4162
-36.5	2068	5,302,995	2,153,278	0.4060
-37.5	2069	2,880,189	1,140,975	0.3961
-38.5	2070	2,880,189	1,113,146	0.3865
-39.5	2071	5,302,995	1,999,533	0.3771
-40.5	2072	33,558,935	12,345,015	0.3679
-41.5	2073	2,880,189	1,033,667	0.3589
-42.5	2074	5,302,995	1,856,765	0.3501
-43.5	2075	2,880,189	983,859	0.3416
-44.5	2076	2,880,189	959,862	0.3333
-45.5	2077	9,907,924	3,221,416	0.3251
-46.5	2078	2,880,189	913,611	0.3172
-47.5	2079	2,880,189	891,328	0.3095
-48.5	2080	5,302,995	1,601,083	0.3019
-49.5	2081	2,880,189	848,378	0.2946

Table F:4-3. Average Annual Costs, West and South Slidell Levee and Floodwall, FY 2023 Price Level, FY 2023 Discount Rate of 2.5%

Measure	Slidell Levee and Floodwall
Project First Cost	$2,440,973
Interest During Construction	$105,378
Total Investment Cost	$2,546,351
AA Investment Costs	$86,564
AA O&M Costs	$7,609
Total AA Costs	$94,173
Construction Duration (Years)	5

Figure F:4-2, Total Project Cost Breakdown, Mile Branch

Civil Works Work Breakdown Structure		ESTIMATED COST			
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F
02	RELOCATIONS	$570	$251	44.0%	$822
06	FISH & WILDLIFE FACILITIES	$2,867	$1,262	44.0%	$4,129
08	ROADS, RAILROADS & BRIDGES	$13,764	$6,056	44.0%	$19,821
09	CHANNELS & CANALS	$8,756	$3,853	44.0%	$12,608
07	POWER PLANT	$0	$0 -		$0
08	ROADS, RAILROADS & BRIDGES	$0	$0 -		$0
09	CHANNELS & CANALS	$0	$0 -		$0
10	BREAKWATER & SEAWALLS	$0	$0 -		$0
	CONSTRUCTION ESTIMATE TOTALS:	$25,958	$11,422		$37,380
01	LANDS AND DAMAGES	$22,278	$5,569	25.0%	$27,847
30	PLANNING, ENGINEERING & DESIGN	$5,321	$2,341	44.0%	$7,663
31	CONSTRUCTION MANAGEMENT	$2,855	$1,256	44.0%	$4,112
	PROJECT COST TOTALS:	$56,413	$20,589	36.5%	$77,002

Table F:4-4. Mile Branch Channel Improvements Cost Schedule, FY 2023 Price Level, FY 2023 Discount Rate of 2.5%

Discounting/ Compounding Year	Calendar Year	Yearly Cost	Compounded Value	Compound Factor
4.5	2027	36,805,825	41,131,443	1.1175
3.5	2028	13,124,189	14,308,892	1.0903
2.5	2029	7,442,455	7,916,367	1.0637
1.5	2030	8,096,155	8,401,651	1.0377
0.5	2031	11,533,375	11,676,653	1.0124
-0.5	2032	0	0	0.9877
-1.5	2033	0	0	0.9636
-2.5	2034	0	0	0.9401
-3.5	2035	0	0	0.9172
-4.5	2036	0	0	0.8948
-5.5	2037	0	0	0.8730
-6.5	2038	0	0	0.8517
-7.5	2039	0	0	0.8309
-8.5	2040	0	0	0.8107
-9.5	2041	0	0	0.7909
-10.5	2042	0	0	0.7716
-11.5	2043	0	0	0.7528
-12.5	2044	0	0	0.7344
-13.5	2045	0	0	0.7165
-14.5	2046	0	0	0.6990
-15.5	2047	0	0	0.6820
-16.5	2048	0	0	0.6654
-17.5	2049	0	0	0.6491
-18.5	2050	0	0	0.6333
-19.5	2051	0	0	0.6179
-20.5	2052	0	0	0.6028
-21.5	2053	0	0	0.5881
-22.5	2054	0	0	0.5737
-23.5	2055	0	0	0.5597
-24.5	2056	0	0	0.5461
-25.5	2057	0	0	0.5328
-26.5	2058	0	0	0.5198
-27.5	2059	0	0	0.5071
-28.5	2060	0	0	0.4947
-29.5	2061	0	0	0.4827
-30.5	2062	0	0	0.4709

-31.5	2063	0	0	0.4594
-32.5	2064	0	0	0.4482
-33.5	2065	0	0	0.4373
-34.5	2066	0	0	0.4266
-35.5	2067	0	0	0.4162
-36.5	2068	0	0	0.4060
-37.5	2069	0	0	0.3961
-38.5	2070	0	0	0.3865
-39.5	2071	0	0	0.3771
-40.5	2072	0	0	0.3679
-41.5	2073	0	0	0.3589
-42.5	2074	0	0	0.3501
-43.5	2075	0	0	0.3416
-44.5	2076	0	0	0.3333
-45.5	2077	0	0	0.3251
-46.5	2078	0	0	0.3172
-47.5	2079	0	0	0.3095
-48.5	2080	0	0	0.3019
-49.5	2081	0	0	0.2946

Table F:4-5. Mile Branch Channel Improvements OMRR&R Cost Schedule, FY23 Price Level, FY23 Discount Rate of 2.5%

Discounting/ Compounding Year	Calendar Year	Yearly Cost	Compounded Value	Compound Factor
4.5	2027	0	0	1.1175
3.5	2028	0	0	1.0903
2.5	2029	0	0	1.0637
1.5	2030	0	0	1.0377
0.5	2031	0	0	1.0124
-0.5	2032	0	0	0.9877
-1.5	2033	165,732	159,706	0.9636
-2.5	2034	165,732	155,810	0.9401
-3.5	2035	165,732	152,010	0.9172
-4.5	2036	165,732	148,303	0.8948
-5.5	2037	165,732	144,686	0.8730
-6.5	2038	165,732	141,157	0.8517
-7.5	2039	165,732	137,714	0.8309
-8.5	2040	165,732	134,355	0.8107
-9.5	2041	165,732	131,078	0.7909

-10.5	2042	165,732	127,881	0.7716
-11.5	2043	165,732	124,762	0.7528
-12.5	2044	165,732	121,719	0.7344
-13.5	2045	165,732	118,750	0.7165
-14.5	2046	165,732	115,854	0.6990
-15.5	2047	165,732	113,028	0.6820
-16.5	2048	165,732	110,271	0.6654
-17.5	2049	165,732	107,582	0.6491
-18.5	2050	165,732	104,958	0.6333
-19.5	2051	165,732	102,398	0.6179
-20.5	2052	165,732	99,900	0.6028
-21.5	2053	165,732	97,464	0.5881
-22.5	2054	165,732	95,087	0.5737
-23.5	2055	165,732	92,767	0.5597
-24.5	2056	165,732	90,505	0.5461
-25.5	2057	165,732	88,297	0.5328
-26.5	2058	165,732	86,144	0.5198
-27.5	2059	165,732	84,043	0.5071
-28.5	2060	165,732	81,993	0.4947
-29.5	2061	165,732	79,993	0.4827
-30.5	2062	165,732	78,042	0.4709
-31.5	2063	165,732	76,139	0.4594
-32.5	2064	165,732	74,281	0.4482
-33.5	2065	165,732	72,470	0.4373
-34.5	2066	165,732	70,702	0.4266
-35.5	2067	165,732	68,978	0.4162
-36.5	2068	165,732	67,295	0.4060
-37.5	2069	165,732	65,654	0.3961
-38.5	2070	165,732	64,053	0.3865
-39.5	2071	165,732	62,490	0.3771
-40.5	2072	165,732	60,966	0.3679
-41.5	2073	165,732	59,479	0.3589
-42.5	2074	165,732	58,029	0.3501
-43.5	2075	165,732	56,613	0.3416
-44.5	2076	165,732	55,232	0.3333
-45.5	2077	165,732	53,885	0.3251
-46.5	2078	165,732	52,571	0.3172
-47.5	2079	165,732	51,289	0.3095
-48.5	2080	165,732	50,038	0.3019
-49.5	2081	165,732	48,817	0.2946

Table F:4-6. Average Annual Costs, Mile Branch, FY 2023 Price Level, FY 2023 Discount Rate of 2.5%

Measure	Mile Branch Channel Improvements
Project First Cost	$77,002
Interest During Construction	$6,433
Total Investment Cost	$83,435
AA Investment Costs	$2,942
AA O&M Costs	$162
Total AA Costs	$3,104
Construction Duration (Years)	5

SECTION 5

Economic Justification

5.1 NET BENEFITS

The net benefits of the structural measures were calculated by subtracting the average annual costs from the equivalent annual benefits. The net benefits were used to determine the economic justification of the project measures included in the Optimized TSP. Tables F:5-1 and F:5-2 summarize the equivalent annual damages and benefits, total first costs, average annual cost, b/c ratio, and equivalent annual net benefits for the West and South Slidell Levee and Floodwall System, and the Mile Branch channel features of the Optimized TSP.

Table F:5-1. Net Benefit Summary, Slidell Levee and Floodwall, FY 23 Price Level, FY 23 Discount Rate, $1,000s

Measure	Slidell Levee and Floodwall
Project First Cost	$2,440,973
Interest During Construction	$105,378
Total Investment Cost	$2,546,351
AA Investment Costs	$86,564
AA O&M Costs	$7,609
Total AA Costs	$94,173
Without Project EAD	$572,971
EAD Reduced Benefits	$162,588
Net Benefits	$68,415
B/C Ratio	1.7

Table F:5-2. Net Benefit Summary, Mile Branch Channel Improvements, FY 23 Price Level, FY 23 Discount Rate, $1,000s

Measure	Mile Branch Channel Improvements
Project First Cost	$77,002
Interest During Construction	$6,433
Total Investment Cost	$83,435
AA Investment Costs	$2,942
AA O&M Costs	$162
Total AA Costs	$3,104
Without Project EAD	$572,971
EAD Reduced Benefits	$3,472
Net Benefits	$368
B/C Ratio	1.1

SECTION 6
Nonstructural Analysis

6.1 NONSTRUCTURAL OVERVIEW

According to Planning Bulletin 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. Aggregates were arranged based on several factors. Since the study area is subject to flooding from a variety of rivers, lakes, and bayous, as well as coastal flooding, aggregates were primarily grouped according to source of flooding. Furthermore, the inland aggregates that were grouped by riverine flood sources were further divided based on whether structures were located either in a rural or urban area where applicable. The coastal aggregates were further subdivided based on geographic boundaries. Using this method, 20 aggregates were identified. The net benefits of each aggregate were based on incremental floodplain. The aggregates are displayed in Figure 6.1. For the nonstructural analysis, structure elevation for residential structures and dry floodproofing for nonresidential structures were the measures considered.

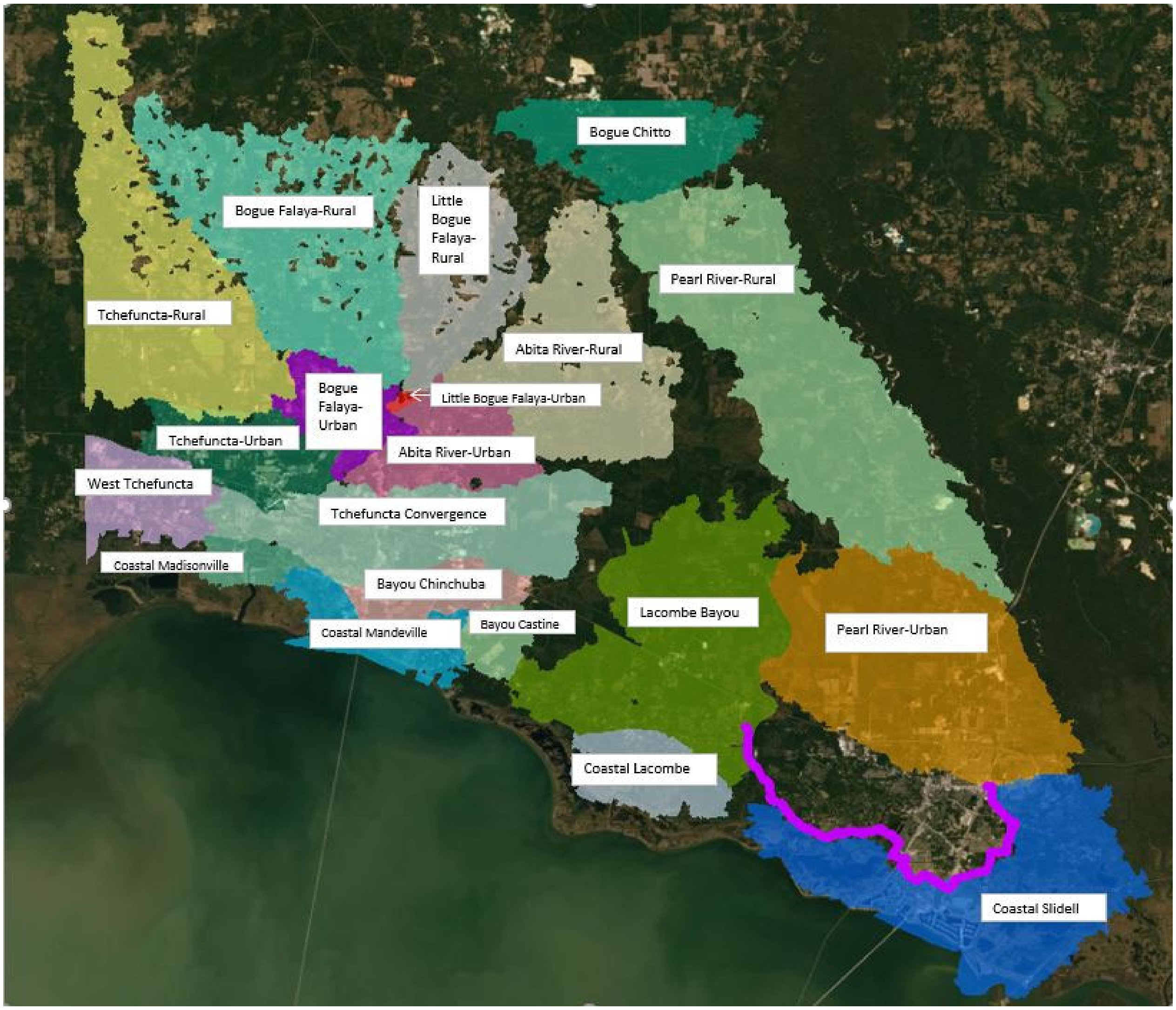


Figure F:6.1 Nonstructural Aggregates

The structure counts per aggregate and floodplain are displayed in Tables F:6-1 and F:6-2. The damages reduced by incremental floodplain for the coastal and riverine aggregates are displayed in Tables F:6-2 and F:6-3.

Table F:6:1

Structure Counts Nonstructural Coastal Aggregates				
Aggregate	**10% AEP**	**5% AEP**	**2% AEP**	**1% AEP**
Coastal Slidell	392	463	1,024	835
Coastal Lacombe	28	46	28	26
Coastal Mandeville	28	84	120	140
Coastal Madisonville	103	73	64	29

Table F:6.2

Structure Counts Nonstructural Riverine Aggregates				
Aggregate	**10% AEP**	**4% AEP**	**2% AEP**	**1% AEP**
Bogue Chitto	14	14	8	10
Rural Pearl River	67	24	22	10
Urban Pearl River	362	214	202	85
Bayou Lacombe	97	41	24	3
Bayou Castine	12	5	6	1
Abita River Rural	115	86	91	38
Abita River Urban	160	79	51	40
Little Bogue Falaya Rural	78	74	25	11
Little Bogue Falaya Urban	15	16	10	15
Bogue Falaya Rural	151	117	156	106
Bogue Falaya Urban	139	159	151	119
Bayou Chinchuba	24	8	8	0
Rural Tchefuncte	442	219	115	43
Urban Tchefuncte	208	124	98	57
West Tchefuncte	155	86	58	0
Tchefuncte Convergence	248	209	148	68

Table F:6-3. Damages Reduced by Incremental Floodplain, Coastal, $1,000's

Aggregate	Without Project Damages	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	133,437	38,397	22,290	18,252	5,859
Coastal Lacombe	7,681	1,662	985	324	302
Coastal Mandeville	31,083	1,711	3,693	4,790	5,601
Coastal Madisonville	24,093	8,973	5,451	3,335	641
Total	196,294	50,743	32,419	26,701	12,402

Table F:6-4. Damages Reduced by Incremental Floodplain, Rainfall and Riverine, $1,000's

Reach	Without Project Damages	10% AEP	4% AEP	2% AEP	1% AEP
Bogue Chitto	1,143	500	238	55	39
Rural Pearl River	4,010	1,930	313	191	34
Urban Pearl River	25,937	11,525	3,407	1,491	573
Bayou Lacombe	5,072	2,830	517	147	16
Bayou Castine	930	415	85	32	2
Abita River Rural	9,037	3,539	1,280	700	230
Abita River Urban	14,594	6,159	1,493	631	321
Little Bogue Falaya Rural	5,368	3,241	1,051	271	77
Little Bogue Falaya Urban	1,604	496	391	75	59
Bogue Falaya Rural	13,237	4,421	1,862	1,262	529
Bogue Falaya Urban	17,835	4,167	2,587	1,728	802
Bayou Chinchuba	2,992	1,668	106	63	0
Rural Tchefuncte	26,054	15,192	3,590	1,021	298
Urban Tchefuncte	18,887	6,863	2,392	1,043	317
West Tchefuncte	15,481	4,877	1,874	624	0
Tchefuncte Convergence	20,709	9,562	3,776	1,235	338
Total	182,890	77,385	24,962	10,567	3,635

6.2 NONSTRUCTURAL IMPLEMENTATION COSTS

6.2.1 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 plus one foot) for each structure. Elevation costs by structure were summed to yield an estimate of total structure elevation costs. For screening to the final number of structures included in the nonstructural plan, the cost per square foot 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. Composite costs were derived for residential structures by type: slab and pier foundation, one story and two-story configuration, and for manufactured, modular and mobile homes. These composite unit costs also vary by the number of feet that structures may be elevated. The cost per square foot to raise an individual structure to the target height was multiplied by the footprint square footage of each structure to compute the costs to elevate the structure. A labor estimate of $15,000 per structure to complete required administrative activities by the Non-Federal Sponsor in implementing this nonstructural measure was added to the cost of implementation. Additional miscellaneous cost of $15,000 per structure was added to the cost of implementation. Also, a contingency of 34.5 percent was added to the cost of implementation. Table F:6-5 shows the cost per square foot of structure raising by occupancy type and height raised.

Table F:6-5. Cost per Square Foot of Structure Raising by Occupancy Type and Number of Feet raised, FY 2023 Price Level

	1STY-SLAB			2STY-SLAB			1STY-PIER			2STY-PIER			MANUFACTURED, MODULAR & MOBILE HOMES		
Ft. Raised	**Min**	**Most Likely**	**Max**	**Min**	**Most Likely**	**Max**	**Min**	**Most Likely**	**Max**	**Min**	**Most Likely**	**Max**	**Min**	**Most Likely**	**Max**
1	$100	$112	$124	$112	$124	$137	$87	$100	$111	$97	$110	$121	$49	$55	$61
2	$100	$112	$124	$112	$124	$137	$87	$100	$111	$97	$110	$121	$49	$55	$61
3	$102	$115	$126	$115	$126	$139	$91	$103	$115	$101	$114	$126	$49	$55	$61
4	$106	$119	$130	$123	$135	$147	$91	$103	$115	$101	$114	$126	$49	$55	$61
5	$106	$119	$130	$123	$135	$147	$91	$103	$115	$101	$114	$126	$61	$68	$73
6	$109	$121	$133	$125	$137	$149	$93	$106	$118	$103	$116	$128	$61	$68	$73
7	$109	$121	$133	$125	$137	$149	$93	$106	$118	$103	$116	$128	$61	$68	$73
8	$112	$125	$137	$129	$142	$153	$96	$109	$120	$106	$119	$130	$61	$68	$73
9	$112	$125	$137	$129	$142	$153	$96	$109	$120	$106	$119	$130	$61	$68	$73
10	$112	$125	$137	$129	$142	$153	$96	$109	$120	$106	$119	$130	$61	$68	$73
11	$112	$125	$137	$129	$142	$153	$96	$109	$120	$106	$119	$130	$61	$68	$73
12	$112	$125	$137	$129	$142	$153	$96	$109	$120	$106	$119	$130	$61	$68	$73
13	$118	$129	$142	$137	$149	$162	$98	$110	$123	$109	$121	$133	$61	$68	$73

Non-Residential Structures.

The dry flood proofing measure was applied to all non-residential structures. Separate cost estimates were developed to flood proof these structures based on their relative square footage. If the square footage was between 0 and 20,000, then the total cost equaled $147,240; between 20,000 and 100,000 square feet equaled $456,137; and greater than 100,000 square feet equaled $1,149,313. These costs were developed by contacting local contractors and were escalated to FY 2023 prices. Also, a labor estimate of $15,000 per structure to complete required administrative activities by the Federal sponsor in accomplishing this nonstructural measure was added to the cost of implementation. Additional miscellaneous cost of $15,000 per structure was added to the cost of implementation. Also, a contingency of 34.5 percent was added to the cost of implementation.

Operations, Maintenance, Relocations, Rehabilitation, and Repair

For elevation measures, there are no further resources necessary to ensure that the engineered activity operates as intended. For flood proofing measures, periodic inspection of the work, which may be required, is expected to be insignificant (approximately $500 per structure over several years). Such inspection costs are an extremely small percentage of the overall cost of implementation and can be considered capitalized in the initial cost of implementation.

Average Annual Cost

The cost per structure of elevating and floodproofing is grouped together by aggregate and annualized over the 50-year period of construction at the current Federal Discount Rate. The average annual cost per aggregate is displayed in tables F:6-6 and F:6-7.

Table F:6-6. Average Annual Cost by Aggregate and Incremental Floodplain, Coastal, $1,000s

Aggregate	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	6,380	7,776	17,768	14,881
Coastal Lacombe	300	522	286	230
Coastal Mandeville	655	1,645	2,145	2,220
Coastal Madisonville	1,609	919	1,154	387
Total	8,944	10,862	21,353	17,718

Table F:6-7. Average Annual Cost by Aggregate and Incremental Floodplain, Riverine, $1,000s

Aggregate	10% AEP	4% AEP	2% AEP	1% AEP
Bogue Chitto	153	118	59	90
Rural Pearl River	658	252	247	190
Urban Pearl River	3,930	2,817	2,692	1,251
Bayou Lacombe	997	467	297	23
Bayou Castine	176	56	59	18
Abita River Rural	1,165	973	1,083	347
Abita River Urban	2,959	1,069	674	513
Little Bogue Falaya Rural	1,164	1,046	296	164
Little Bogue Falaya Urban	173	207	146	181
Bogue Falaya Rural	1,630	1,397	1,843	1,344
Bogue Falaya Urban	2,013	2,347	2,092	1,744
Bayou Chinchuba	321	100	172	0
Rural Tchefuncte	5,418	2,438	1,473	449
Urban Tchefuncte	3,302	1,974	1,403	895
West Tchefuncte	2,597	1,442	963	0
Tchefuncte Convergence	3,852	3,151	2,120	1,217
Total	30,505	19,853	15,619	8,425

6.3 NONSTRUCTURAL RESULTS

6.3.1 Net Benefits

The net benefits for each aggregate are displayed in Tables F:6-8 and F:6-9. For the coastal aggregates, coastal Slidell yields positive net benefits through the 2 percent AEP event. The other coastal aggregates yield positive net benefits through the 1 percent AEP event. For the riverine aggregates, all yield positive net benefits through the 4 percent AEP event.

Table F:6-8. Net Benefits by Aggregate and Incremental Floodplain, Coastal, $1,000s

Aggregate	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	32,017	14,514	484	-9,022
Coastal Lacombe	1,362	463	38	72
Coastal Mandeville	1,056	2,048	2,645	3,381
Coastal Madisonville	7,364	4,532	2,181	254

Table F:6-9. Net Benefits by Aggregate and Incremental Floodplain, Riverine, $1,000s

Aggregate	10% AEP	4% AEP	2% AEP	1% AEP
Bogue Chitto	347	121	-4	-52
Rural Pearl River	1,272	61	-56	-156
Urban Pearl River	7,595	590	-1,201	-678
Bayou Lacombe	1,833	50	-151	-6
Bayou Castine	240	29	-28	-16
Abita River Rural	2,374	307	-383	-117
Abita River Urban	3,200	424	-43	-192
Little Bogue Falaya Rural	2,077	5	-25	-86
Little Bogue Falaya Urban	323	184	-71	-122
Bogue Falaya Rural	2,792	465	-581	-815
Bogue Falaya Urban	2,154	239	-364	-941

Aggregate	10% AEP	4% AEP	2% AEP	1% AEP
Bayou Chinchuba	1,347	7	-109	0
Rural Tchefuncte	9,774	1,153	-452	-151
Urban Tchefuncte	3,562	419	-360	-578
West Tchefuncte	2,280	432	-339	0
Tchefuncte Convergence	5,711	625	-885	-879

6.3.2 Participation Rate Analysis

St. Tammany Parish officials estimate that participation in the nonstructural program would be high based on participation in local pilot programs offered in the parish. Results were also analyzed based on participation rates of 75% and 50%. The results are shown in tables F:6-10 through F:6-13. With a participation rate of 75%, the nonstructural plan would include 4,724 structures. With a participation rate of 50%, the nonstructural plan would include 3,074 structures.

Table F:6-10. Participation Rate of 75%, Net Benefits by Aggregate, Coastal, $1,000s

Aggregate	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	24,074	11,536	165	0
Coastal Lacombe	995	359	13	42
Coastal Mandeville	706	1,637	1,420	2,345
Coastal Madisonville	6,110	3,258	1,662	171

Table F:6-11. Participation Rate of 75%, Net Benefits by Aggregate, Riverine, $1,000s

Aggregate	10% AEP	4% AEP
Bogue Chitto	234	97
Rural Pearl River	1,117	69
Urban Pearl River	6,134	513
Bayou Lacombe	1,418	-11
Bayou Castine	216	30
Abita River Rural	1,914	173
Abita River Urban	2,562	405
Little Bogue Falaya Rural	1,472	-14
Little Bogue Falaya Urban	229	117
Bogue Falaya Rural	2,185	409
Bogue Falaya Urban	1,873	124
Bayou Chinchuba	404	-3
Rural Tchefuncte	7,282	812
Urban Tchefuncte	2,555	248
West Tchefuncte	1,554	342
Tchefuncte Convergence	3,330	64

Table F:6-12. Participation Rate of 50%, Net Benefits by Aggregate, Coastal, $1,000s

Aggregate	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	16,998	6,212	397	0
Coastal Lacombe	707	134	40	52
Coastal Mandeville	488	1,248	1,759	131
Coastal Madisonville	4,336	2,525	1,172	143

Table F:6-13. Participation Rate of 50%, Net Benefits by Aggregate, Riverine, $1,000s

Aggregate	10% AEP	4% AEP
Bogue Chitto	150	84
Rural Pearl River	635	4
Urban Pearl River	3,771	454
Bayou Lacombe	1,104	101
Bayou Castine	51	29
Abita River Rural	1,354	119
Abita River Urban	1,125	303
Little Bogue Falaya Rural	1,196	-80
Little Bogue Falaya Urban	158	59
Bogue Falaya Rural	1,431	146
Bogue Falaya Urban	1,620	-31
Bayou Chinchuba	356	20
Rural Tchefuncte	4,591	610
Urban Tchefuncte	1,675	106
West Tchefuncte	1,152	138
Tchefuncte Convergence	2,369	183

6.3.3 Final Nonstructural Results

The nonstructural screening and optimization process yielded a total of 5,583 residential structures and 827 nonresidential structures to be included in the nonstructural component of the Optimized TSP. After the number of structures were identified for inclusion, cost refinements were made, and an updated cost estimate was developed. Table F:6-14 displays the simplified three-month construction schedule for the nonstructural plan for the purpose of calculating interest during construction. Figure F:6-1 displays the Total Project

Cost Sheet for the Nonstructural Plan. Table F:6-15 displays the summary of results for the nonstructural plan.

Figure F:6-1, TPCS-Nonstructural Plan

Civil Works Work Breakdown Structure		ESTIMATED COST			
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*
19	BUILDINGS, GROUNDS & UTILITIES	$1,225,013	$404,254	33.0%	$1,629,268
18	CULTURAL RESOURCE PRESERVATION	$14,056	$4,639	33.0%	$18,695
05	LOCKS	$0	$0	-	$0
06	FISH & WILDLIFE FACILITIES	$0	$0	-	$0
07	POWER PLANT	$0	$0	-	$0
08	ROADS, RAILROADS & BRIDGES	$0	$0	-	$0
09	CHANNELS & CANALS	$0	$0	-	$0
10	BREAKWATER & SEAWALLS	$0	$0	-	$0
	CONSTRUCTION ESTIMATE TOTALS:	$1,239,070	$408,893		$1,647,963
01	LANDS AND DAMAGES	$136,611	$34,153	25.0%	$170,764
30	PLANNING, ENGINEERING & DESIGN	$61,953	$20,445	33.0%	$82,398
31	CONSTRUCTION MANAGEMENT	$24,781	$8,178	33.0%	$32,959
	PROJECT COST TOTALS:	$1,462,416	$471,668	32.3%	$1,934,084

Table F:6-14, Complete Nonstructural Plan Construction Schedule, FY23 Price Level, FY23 Discount Rate of 2.5%

Discounting/ Compounding Year	Calendar Year	Yearly Cost	Compounded Value	Compound Factor
0.125	2031	1,934,084,000	1,940,062,921	1.0031

Table F:6-15, Complete Nonstructural Plan, $1,000s

Project First Cost	$1,934,084
Interest During Construction	$5,979
Total Investment Cost	$1,940,063
AA Investment Costs	$68,403
EAD Reduced Benefits	$218,754
Net Benefits	$150,351
B/C Ratio	3.2

SECTION 7

RELATIVE SEA-LEVEL CHANGE

7.1 Overview

To address the uncertainty of relative sea-level change, project performance was assessed at the intermediate rate of sea level rise as it offered the best balance between equally likely scenarios (i.e., the historic rate of sea level rise continuing indefinitely and the high rate including accelerated rates of change caused by warming temperatures and accelerated ice melt). In recognition of the uncertainty presented by sea level rise, adaptation capacity has been incorporated into the final feasibility-level design to maximize the overall usefulness of the system over the life of the project by including redundancy and robustness in the design, so they are adaptable to future conditions including the high rate of sea-level change. CEMVN will continue to monitor local conditions and determine if the intermediate scenario of sea level change is reasonably representative of observed conditions. If observed conditions significantly exceeding the intermediate projection are identified during design or construction, reevaluation of the Optimized TSP will be required.

7.2 EFFECTS ON COASTAL MEASURES

In addition to intermediate sea-level change, the coastal Slidell Levee and the coastal nonstructural aggregates were also analyzed under alternate low and high sea-level change scenarios. The results of the effects of the alternative RSLR scenarios on the performance of the coastal levee are summarized in table F:7:1. The results for the coastal nonstructural aggregates are shown in tables F:7-2 and F:7-3. Under the low relative sea-level change scenario, there would be 1,024 fewer structures included in the nonstructural plan due to the Coastal Slidell aggregate not being economically justified at the 2% AEP event. Under the high relative sea-level change scenario, an additional 835 structures would be included in the nonstructural plan due to the Coastal Slidell aggregate being justified at the 1% AEP event.

Table F:7-1

Slidell Levee Relative Sea-Level Rise Scenarios FY23 Price Level and Discount Rate $1,000s		
	Low	**High**
Without Project Damages	115,850	203,190
Damages Reduced	113,459	199,350
Average Annual Cost	94,173	94,173
Net Benefits	19,286	105,177
B/C Ratio	1.2	2.1

Table F:7-2, Net Benefits, Low Relative Sea-Level Change

Aggregate	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	13,416	7,766	-1,298	-9,286
Coastal Lacombe	744	370	9	12
Coastal Mandeville	5,567	2,811	971	64
Coastal Madisonville	996	696	583	540

Table F:7-3, Net Benefits, High Relative Sea-Level Change

Aggregate	10% AEP	5% AEP	2% AEP	1% AEP
Coastal Slidell	41,212	33,746	31,932	1,139
Coastal Lacombe	1,650	1,528	648	741
Coastal Mandeville	1,366	7,721	19,773	33,490
Coastal Madisonville	9,517	7,028	6,252	1,475

The Optimized TSP

7.1 THE OPTIMIZED TSP COMPONENTS

The Optimized TSP is comprised of the West and South Slidell Levee and Floodwall System, the Mile Branch channel improvements, and the nonstructural plan. The nonstructural plan consists of elevating approximately 5,583 preliminarily eligible residential structures up to 13 feet from ground level and dry floodproofing 827 approximately preliminarily eligible non-residential structures up to 3 feet. Each measure is economically justified and contributes to the overall net benefits of the Optimized TSP, which has an overall b/c ratio of 2.3. Table F:7-1 displays the net benefit summary for Optimized TSP. Figure F:7-1 contains a map of the structural and nonstructural features included in the Recommended Plan. There was no double counting of benefits between the coastal and rainfall/riverine models. The structural components of the Optimized TSP which are the levee, floodwall, and channel improvements, address different sources of flooding, and are located in different parts of the study area. For the nonstructural measures, structures that are primarily affected by coastal flooding were modeled exclusively in the coastal model, and structures that were primarily affected by rainfall/riverine flooding were modeled exclusively in the rainfall/riverine model.

Table F:7-1. Net Benefit Summary of the Recommended Plan, FY23 Price Level, FY 23 Discount Rate, $1,000s

Measure	Slidell Levee and Floodwall	Mile Branch Channel Improvements	Nonstructural	Recommended Plan
Project First Cost	$2,440,973	$77,002	$1,934,084	$4,452,059
Interest During Construction	$105,378	$6,433	$5,979	$117,790
Total Investment Cost	$2,546,351	$83,435	$1,940,063	$4,569,849
AA Investment Costs	$86,564	$2,942	$68,403	$157,909
AA O&M Costs	$7,609	$162	$0	$7,771
Total AA Costs	$94,173	$3,104	$68,403	$165,680
Without Project EAD	$572,971	$572,971	$572,971	$572,971
EAD Reduced Benefits	$162,588	$3,472	$218,754	$384,814
Net Benefits	$68,415	$368	$150,351	$219,134
B/C Ratio	1.7	1.1	3.2	2.3

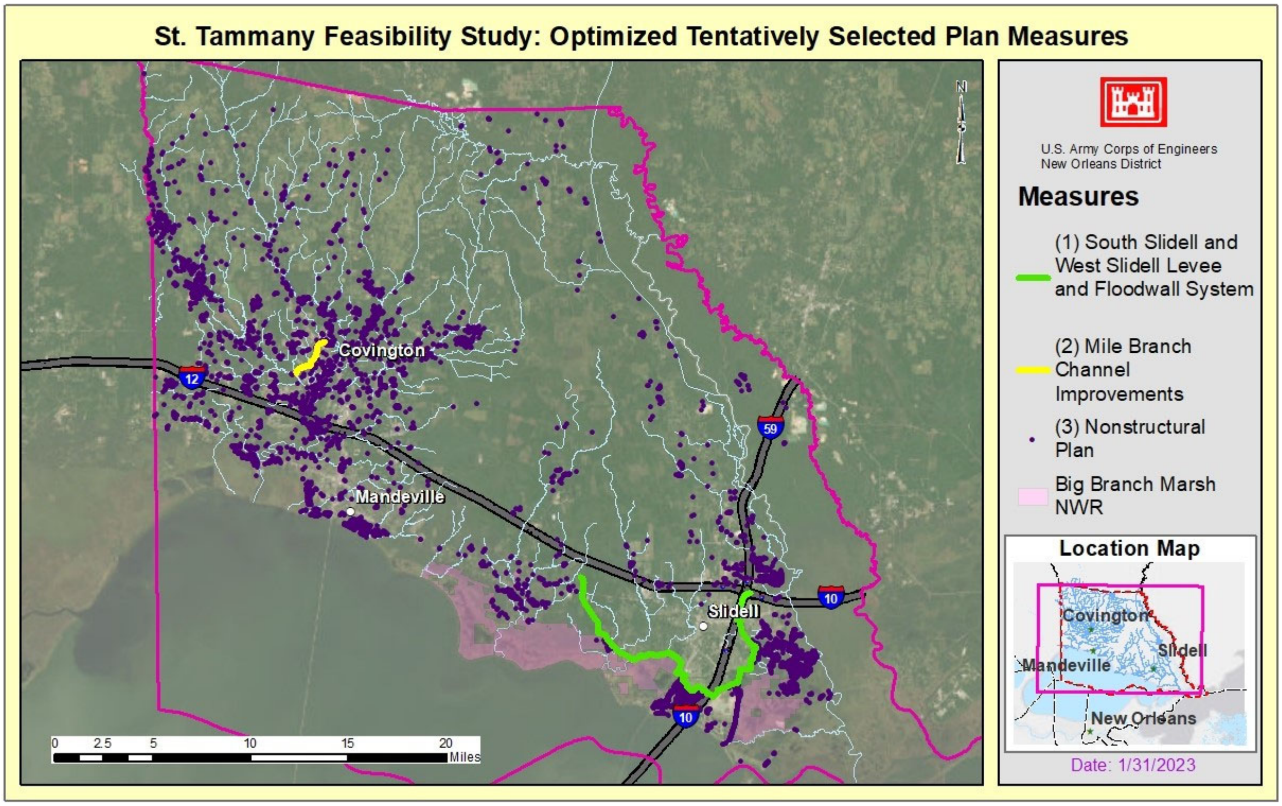


Figure F:7-1. Measures Comprising the Optimized TSP

7.2 RESIDUAL RISK

Of the $573 million in the without project EAD in the study area, about $383 million in estimated annual damages is due to coastal flooding and $190 million in EAD is due to rainfall and riverine flooding. The Optimized TSP is currently estimated to reduce the EAD caused by coastal flooding by about 80 percent and reduce the EAD caused by rainfall and riverine flooding by about 60 percent.

7.4 Risk Analysis Probability

The HEC-FDA model used the uncertainty surrounding the economic and engineering inputs to generate results that can be used to assess the performance of the Optimized TSP plan. Tables F:7-2 through F:7:4 show the expected annual benefits of the separable elements that comprise the Optimized TSP at the 75, 50, and 25 percentiles. These percentiles reflect the percentage chance that the benefits will be greater than or equal to the indicated values. The benefit exceedance probability relationship for the Optimized TSP can be compared to the point estimate of its average annual cost. The table indicates the percent chance that the expected annual benefits will exceed the expected annual costs therefore the benefit cost ratio is greater than one and the net benefits are positive. The net benefits and B/C ratios are also displayed at each of the percentiles.

Table 7-2. Risk Analysis Probability that Expected Annual Benefits Exceed Annual Costs, West and South Slidell Levee and Floodwall System (FY 2023 Price Level; FY 2023 Discount Rate; $1,000s)

		Probability that Damages Reduced exceed indicated values				
Measure	**Equivalent Annual Damages Reduced**	**0.75**	**0.5**	**0.25**	**Average Annual Costs**	**Probability Benefits Exceed Costs**
Slidell Levee and Floodwall	162,588	108,514	159,210	212,519	$94,173	Greater than 75%
Net Benefits		14,341	65,037	118,346		
B/C Ratio		1.2	1.7	2.3		

Table 7-3. Risk Analysis Probability that Expected Annual Benefits Exceed Annual Costs, Mile Branch Channel Improvements (FY 2023 Price Level; FY 2023 Discount Rate; $1,000s)

		Probability that Damages Reduced exceed indicated values				
Measure	**Equivalent Annual Damages Reduced**	**0.75**	**0.5**	**0.25**	**Average Annual Costs**	**Probability Benefits Exceed Costs**
Mile Branch Channel Improvements	3,472	2,524	3,395	4,273	$3,104	Greater than 50%
Net Benefits		-580	291	1,169		
B/C Ratio		0.8	1.1	3.7		

Table 7-3. Risk Analysis Probability that Expected Annual Benefits Exceed Annual Costs, Nonstructural Plan (FY 2023 Price Level; FY 2023 Discount Rate; $1,000s)

		Probability that Damages Reduced exceed indicated values				
Measure	**Equivalent Annual Damages Reduced**	**0.75**	**0.5**	**0.25**	**Average Annual Costs**	**Probability Benefits Exceed Costs**
Nonstructural	218,754	175,758	220,251	262,736	$68,403	Greater than 75%
Net Benefits		107,355	151,848	194,333		
B/C Ratio		2.6	3.2	3.8		

The results from the HEC-FDA model were also used to calculate the long-term annual exceedance probability (AEP) and the conditional non-exceedance probability, or assurance, for various probability storm events. The model provided a target stage to assess project performance for each study area reach for the base year, 2032, in the 50-year period of analysis under both without-project and with-project conditions. For study area reaches without proposed levees or berms, the target stage was set by default at the elevation where the model calculated five percent residual damages for the 1% AEP (100-year) event.

The HEC-FDA model calculated a target stage AEP with a median and expected value that reflected the likelihood that the target stages will be exceeded in a given year. The median value was calculated using point estimates, while the expected value was calculated using Monte Carlo simulation. The results also show the long-term risk or the probability of a target stage being exceeded over 10-year, 30-year, and 50-year periods. Finally, the model results show the conditional non-exceedance probability or the likelihood that a target stage will not be exceeded by the 10% AEP (10 year), the 4% AEP (25-year), the 2% AEP (50-year), the 1% AEP (100-year), the 0.4% AEP (250-year), and the 0.2% AEP (500-year). Tables 7-4 and 7-5 display the project performance results for each study area reach for the Recommended Plan under without-project and with-project conditions.

Table 7-4, Project Performance, Without Project Condition, 2032

				Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	Target Stage	Median	Expected	10	30	50	0.1	0.04	0.02	0.01	0.004	0.002
1	4.85	0.199	0.1987	0.8909	0.9987	1	0.0426	0.0195	0.0097	0.008	0.0019	0.0006
2	4.07	0.1	0.12	0.7215	0.9784	0.9983	0.1922	0.0117	0.0043	0.0027	0.0008	0.0002
3	3.98	0.1984	0.197	0.8886	0.9986	1	0.0459	0.0233	0.0138	0.0226	0.0081	0.0016
4	5.68	0.1978	0.1973	0.8889	0.9986	1	0.045	0.0277	0.0107	0.0128	0.0034	0.0011
5	4.87	0.2002	0.1993	0.8917	0.9987	1	0.0439	0.0211	0.0089	0.0069	0.0019	0.0004
6	5.48	0.1995	0.1984	0.8905	0.9987	1	0.0443	0.0254	0.0137	0.0132	0.004	0.0013
7	4.9	0.1787	0.1765	0.8565	0.997	0.9999	0.085	0.0295	0.0141	0.0123	0.0032	0.0005
8	6.7	0.0822	0.0921	0.6196	0.945	0.992	0.7917	0.0229	0.0065	0.0022	0.0005	0.0002
9	5.66	0.1	0.12	0.7215	0.9784	0.9983	0.1036	0.0055	0.0019	0.0008	0.0002	0.0001
10	5.18	0.1987	0.1991	0.8914	0.9987	1	0.0433	0.0071	0.0029	0.0018	0.0003	0
18	6	0.1246	0.1221	0.728	0.9799	0.9985	0.3343	0.0604	0.0264	0.0256	0.0064	0.0021
19	6.09	0.1339	0.133	0.76	0.9862	0.9992	0.1676	0.0573	0.009	0.0174	0.0063	0.0017
20	6.37	0.0992	0.1133	0.6996	0.9729	0.9976	0.2993	0.0192	0.0058	0.0033	0.0008	0.0002
21	8.44	0.4685	0.4683	0.9982	1	1	0.0737	0.0203	0.0062	0.0028	0.0008	0.0003
22	6.2	0.3929	0.392	0.9931	1	1	0	0.0001	0	0.0002	0.0001	0
23	6.15	0.105	0.1043	0.6678	0.9633	0.996	0.4808	0.0897	0.0336	0.0242	0.0054	0.0024
24	6.12	0.106	0.1054	0.6717	0.9646	0.9962	0.4658	0.0848	0.0305	0.0219	0.005	0.002
25	6.01	0.106	0.1059	0.6734	0.9651	0.9963	0.4617	0.0849	0.0302	0.0216	0.0046	0.0017
26	6.41	0.3637	0.3651	0.9894	1	1	0.0002	0.0006	0.0003	0	0	0
27	6.14	0.1063	0.106	0.674	0.9653	0.9963	0.4745	0.0782	0.0266	0.0197	0.004	0.0016
28	5.99	0.1048	0.1048	0.6696	0.9639	0.9961	0.4659	0.088	0.0331	0.024	0.0053	0.0024
29	6.08	0.0994	0.1068	0.6768	0.9662	0.9965	0.4306	0.0534	0.0184	0.0087	0.002	0.0007

30	5.67	0.1957	0.1957	0.8868	0.9985	1	0.0482	0.0073	0.004	0.0037	0.0019	0.0005
31	5.88	0.1044	0.1047	0.6692	0.9638	0.996	0.479	0.0766	0.0302	0.0258	0.006	0.002
32	5.71	0.1164	0.1143	0.7031	0.9738	0.9977	0.3918	0.068	0.0286	0.0265	0.0066	0.0023
33	6.9	0.1	0.119	0.7182	0.9776	0.9982	0.0755	0.0639	0.0252	0.0133	0.0038	0.0014
34	6.28	0.1051	0.1053	0.6715	0.9645	0.9962	0.4691	0.0734	0.0308	0.0284	0.0071	0.0021
35	6.95	0.056	0.0559	0.4372	0.8217	0.9435	0.9842	0.3056	0.1322	0.0922	0.0255	0.0084
36	6.07	0.1106	0.1094	0.686	0.969	0.9969	0.4304	0.075	0.032	0.0298	0.0073	0.0023
37	6.15	0.1166	0.1151	0.7055	0.9745	0.9978	0.3865	0.0635	0.0261	0.0242	0.0058	0.0019
38	7.3	0.1	0.1079	0.6807	0.9675	0.9967	0.3833	0.1335	0.082	0.042	0.0116	0.0038
39	6.7	0.104	0.105	0.6701	0.9641	0.9961	0.4736	0.0659	0.0252	0.0211	0.0045	0.0014
40	6.68	0.1056	0.1058	0.6731	0.9651	0.9963	0.466	0.0653	0.0261	0.0224	0.0049	0.0016
45	37.3	0.999	0.999	1	1	1	0	0	0	0	0	0
50	75.7	0.999	0.999	1	1	1	0	0	0	0	0	0
51	44.24	0.2041	0.2057	0.9	0.999	1	0.0342	0.0032	0.0032	0.0029	0	0
52	35.6	0.999	0.999	1	1	1	0	0	0	0	0	0
53	18.98	0.4167	0.4094	0.9948	1	1	0	0	0	0	0	0
54	27	0.999	0.999	1	1	1	0	0	0	0	0	0
55	31.6	0.999	0.999	1	1	1	0	0	0	0	0	0
56	16.5	0.999	0.999	1	1	1	0	0	0	0	0	0
57	15.92	0.999	0.999	1	1	1	0	0	0	0	0	0
58	48.97	0.4239	0.4164	0.9954	1	1	0	0	0	0	0	0
59	36.7	0.999	0.999	1	1	1	0	0	0	0	0	0
60	25.1	0.999	0.999	1	1	1	0	0	0	0	0	0
61	15.56	0.2131	0.2137	0.9096	0.9993	1	0.0299	0.0029	0	0.0008	0	0
62	48.97	0.3062	0.3035	0.9731	1	1	0.0038	0	0	0.0001	0	0
63	30.9	0.999	0.999	1	1	1	0	0	0	0	0	0
64	83.4	0.999	0.999	1	1	1	0	0	0	0	0	0
65	45.34	0.4369	0.4266	0.9962	1	1	0	0	0	0	0	0

66	30.94	0.367	0.3645	0.9892	1	1	0	0	0	0.0001	0.0001	0.0004
67	24.2	0.999	0.999	1	1	1	0	0	0	0	0	0
68	13	0.999	0.999	1	1	1	0	0	0	0	0	0
69	22.1	0.999	0.999	1	1	1	0	0	0	0	0	0
70	69.73	0.999	0.999	1	1	1	0	0	0	0	0	0
71	36.2	0.999	0.999	1	1	1	0	0	0	0	0	0
72	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
73	15.6	0.999	0.999	1	1	1	0	0	0	0	0	0
74	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
75	24.9	0.999	0.999	1	1	1	0	0	0	0	0	0
76	21.9	0.999	0.999	1	1	1	0	0	0	0	0	0
77	46.62	0.999	0.999	1	1	1	0	0	0	0	0	0
78	148.7	0.999	0.999	1	1	1	0	0	0	0	0	0
79	65.56	0.999	0.999	1	1	1	0	0	0	0	0	0
80	83.75	0.999	0.999	1	1	1	0	0	0	0	0	0
81	47.5	0.999	0.999	1	1	1	0	0	0	0	0	0
82	59.24	0.2722	0.2692	0.9566	0.9999	1	0.0099	0.0024	0.0022	0.0019	0	0
83	23.2	0.999	0.999	1	1	1	0	0	0	0	0	0
84	35	0.999	0.999	1	1	1	0	0	0	0	0	0
85	9.5	0.4995	0.5474	0.9996	1	1	0	0	0	0	0	0
1M	26.88	0.3023	0.3027	0.9728	1	1	0.0022	0.0008	0.001	0.0013	0.0015	0.0017
2M	26.28	0.2994	0.2982	0.971	1	1	0.0037	0.0009	0.0005	0.0012	0.0015	0.0015
3M	25.81	0.2994	0.2989	0.9713	1	1	0.0029	0.0005	0.0004	0.0006	0.001	0.0012
4M	16.07	0.2	0.2321	0.9287	0.9996	1	0	0	0.1225	0.0234	0	0
5M	14.6	0.2	0.234	0.9304	0.9997	1	0	0	0.1242	0.0234	0	0

Table 7-5, Project Performance, With-Project Condition, 2032

				Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
1	13.5	0.0002	0.0009	0.0087	0.0258	0.0426	0.9997	0.9997	0.9997	0.9874	0.9483	0.8921
2	14	0.0001	0.0003	0.003	0.0088	0.0147	0.9998	0.9998	0.9998	0.9994	0.9945	0.9778
3	16	0.0001	0.0003	0.0026	0.0078	0.013	0.9997	0.9997	0.9997	0.9997	0.9997	0.9991
4	13.5	0.0001	0.0005	0.0046	0.0137	0.0227	0.9997	0.9997	0.9997	0.9965	0.9807	0.9484
5	13.5	0.0002	0.0007	0.0073	0.0217	0.036	0.9997	0.9997	0.9998	0.9908	0.9598	0.9111
6	13.5	0.0001	0.0005	0.0048	0.0143	0.0237	0.9997	0.9997	0.9997	0.9964	0.9795	0.9462
7	13.5	0.0001	0.0003	0.0027	0.0079	0.0132	0.9997	0.9997	0.9997	0.9994	0.9958	0.9834
8	16	0.0004	0.0014	0.0134	0.0398	0.0654	0.9997	0.9997	0.9991	0.9735	0.907	0.8246
9	16	0.0005	0.0022	0.022	0.0645	0.1052	0.9999	0.9998	0.994	0.9364	0.8309	0.7293
10	16	0.0001	0.0004	0.0037	0.0111	0.0184	0.9997	0.9997	0.9998	0.9997	0.9993	0.9975
18	6	0.1246	0.1221	0.728	0.9799	0.9985	0.3343	0.0604	0.0264	0.0256	0.0064	0.0021
19	6.09	0.1339	0.133	0.76	0.9862	0.9992	0.1676	0.0573	0.009	0.0174	0.0063	0.0017
20	6.37	0.0992	0.1133	0.6996	0.9729	0.9976	0.2993	0.0192	0.0058	0.0033	0.0008	0.0002
21	8.44	0.4685	0.4686	0.9982	1	1	0.0738	0.0203	0.0061	0.0027	0.0007	0.0003
22	6.2	0.3929	0.3931	0.9932	1	1	0	0.0002	0	0.0004	0.0001	0
23	6.15	0.105	0.1045	0.6684	0.9635	0.996	0.4825	0.0874	0.0317	0.0229	0.0052	0.002
24	6.12	0.106	0.1059	0.6736	0.9652	0.9963	0.4618	0.0822	0.0288	0.0204	0.0045	0.0017
25	6.01	0.106	0.1059	0.6734	0.9651	0.9963	0.4617	0.0849	0.0302	0.0216	0.0046	0.0017
26	6.41	0.3637	0.3651	0.9894	1	1	0.0002	0.0006	0.0003	0	0	0
27	6.14	0.1063	0.106	0.674	0.9653	0.9963	0.4745	0.0782	0.0266	0.0197	0.004	0.0016
28	5.99	0.1048	0.1048	0.6696	0.9639	0.9961	0.4659	0.088	0.0331	0.024	0.0053	0.0024
29	6.08	0.0994	0.1068	0.6768	0.9662	0.9965	0.4306	0.0534	0.0184	0.0087	0.002	0.0007
30	5.92	0.1322	0.13	0.7516	0.9847	0.9991	0.2741	0.0146	0.0072	0.007	0.0026	0.0008

31	5.88	0.1044	0.1047	0.6692	0.9638	0.996	0.479	0.0766	0.0302	0.0258	0.006	0.002
32	5.71	0.1164	0.1143	0.7031	0.9738	0.9977	0.3918	0.068	0.0286	0.0265	0.0066	0.0023
33	6.9	0.1	0.119	0.7182	0.9776	0.9982	0.0755	0.0639	0.0252	0.0133	0.0038	0.0014
34	6.28	0.1051	0.1053	0.6715	0.9645	0.9962	0.4691	0.0734	0.0308	0.0284	0.0071	0.0021
35	6.95	0.056	0.0559	0.4372	0.8217	0.9435	0.9842	0.3056	0.1322	0.0922	0.0255	0.0084
36	6.07	0.1106	0.1094	0.686	0.969	0.9969	0.4304	0.075	0.032	0.0298	0.0073	0.0023
37	6.15	0.1166	0.1151	0.7055	0.9745	0.9978	0.3865	0.0635	0.0261	0.0242	0.0058	0.0019
38	7.3	0.1	0.1079	0.6807	0.9675	0.9967	0.3833	0.1335	0.082	0.042	0.0116	0.0038
39	6.7	0.104	0.105	0.6701	0.9641	0.9961	0.4736	0.0659	0.0252	0.0211	0.0045	0.0014
40	6.68	0.1056	0.1058	0.6731	0.9651	0.9963	0.466	0.0653	0.0261	0.0224	0.0049	0.0016
45	37.3	0.999	0.999	1	1	1	0	0	0	0	0	0
50	75.7	0.999	0.999	1	1	1	0	0	0	0	0	0
51	44.24	0.2041	0.2064	0.9009	0.999	1	0.0324	0.0029	0.0028	0.0026	0	0
52	35.6	0.999	0.999	1	1	1	0	0	0	0	0	0
53	18.98	0.4167	0.4094	0.9948	1	1	0	0	0	0	0	0
54	27	0.999	0.999	1	1	1	0	0	0	0	0	0
55	31.6	0.999	0.999	1	1	1	0	0	0	0	0	0
56	16.5	0.999	0.999	1	1	1	0	0	0	0	0	0
57	15.92	0.999	0.999	1	1	1	0	0	0	0	0	0
58	48.97	0.4235	0.416	0.9954	1	1	0	0	0	0	0	0
59	36.7	0.999	0.999	1	1	1	0	0	0	0	0	0
60	25.1	0.999	0.999	1	1	1	0	0	0	0	0	0
61	15.56	0.2134	0.2142	0.9102	0.9993	1	0.0282	0.0026	0	0.0007	0	0
62	48.97	0.3062	0.3048	0.9736	1	1	0.0034	0	0	0.0002	0	0
63	30.9	0.999	0.999	1	1	1	0	0	0	0	0	0
64	83.4	0.999	0.999	1	1	1	0	0	0	0	0	0
65	45.34	0.4372	0.4269	0.9962	1	1	0	0	0	0	0	0
66	30.94	0.3655	0.3629	0.989	1	1	0	0	0	0.0001	0.0001	0.0004

67	24.2	0.999	0.999	1	1	1	0	0	0	0	0	0
68	13	0.999	0.999	1	1	1	0	0	0	0	0	0
69	22.1	0.999	0.999	1	1	1	0	0	0	0	0	0
70	69.73	0.999	0.999	1	1	1	0	0	0	0	0	0
71	36.2	0.999	0.999	1	1	1	0	0	0	0	0	0
72	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
73	15.6	0.999	0.999	1	1	1	0	0	0	0	0	0
74	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
75	24.9	0.999	0.999	1	1	1	0	0	0	0	0	0
76	21.9	0.999	0.999	1	1	1	0	0	0	0	0	0
77	46.62	0.999	0.999	1	1	1	0	0	0	0	0	0
78	148.7	0.999	0.999	1	1	1	0	0	0	0	0	0
79	65.56	0.999	0.999	1	1	1	0	0	0	0	0	0
80	83.75	0.999	0.999	1	1	1	0	0	0	0	0	0
81	47.5	0.999	0.999	1	1	1	0	0	0	0	0	0
82	59.24	0.2721	0.2694	0.9567	0.9999	1	0.0094	0.0021	0.0019	0.0017	0	0
83	23.2	0.999	0.999	1	1	1	0	0	0	0	0	0
84	35	0.999	0.999	1	1	1	0	0	0	0	0	0
85	9.5	0.4995	0.5475	0.9996	1	1	0	0	0	0	0	0
1M	26.88	0.0163	0.0136	0.1282	0.3375	0.4965	0.9998	0.999	0.6887	0.3614	0.1698	0.0971
2M	26.28	0.0088	0.0095	0.0909	0.2488	0.3792	0.9997	0.9258	0.9819	0.5201	0.3915	0.3289
3M	25.81	0.0079	0.0078	0.0755	0.2099	0.3247	0.9999	0.9996	0.9996	0.6012	0.2397	0.1173
4M	16.07	0.2	0.2321	0.9287	0.9996	1	0	0	0.1225	0.0234	0	0
5M	14.6	0.2	0.234	0.9304	0.9997	1	0	0	0.1242	0.0234	0	0

Table 7-4, Project Performance, Without Project Condition, 2082

				Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
1	6.66	0.1987	0.1987	0.8909	0.9987	1	0.0439	0.0141	0.0058	0.0046	0.0011	0.0003
2	6.46	0.1987	0.1973	0.8889	0.9986	1	0.046	0.025	0.0212	0.0072	0.0078	0.0026
3	8.33	0.1979	0.1989	0.8911	0.9987	1	0.0078	0	0	0	0	0
4	7.44	0.1989	0.1981	0.8901	0.9987	1	0.0454	0.0179	0.0088	0.0082	0.0023	0.0005
5	6.81	0.2006	0.1999	0.8924	0.9988	1	0.0452	0.0125	0.0052	0.0044	0.0012	0.0003
6	7.19	0.1995	0.1986	0.8908	0.9987	1	0.046	0.0172	0.0084	0.0077	0.0028	0.0006
7	7.36	0.2006	0.1996	0.8921	0.9987	1	0.0447	0.0064	0.0039	0.0039	0.0006	0
8	6.7	0.0822	0.0921	0.6196	0.945	0.992	0.7916	0.014	0.0035	0.0001	0	0
9	7.03	0.1973	0.1959	0.887	0.9986	1	0.0499	0.0526	0.0231	0.007	0.0015	0.0016
10	6.88	0.1987	0.1994	0.8918	0.9987	1	0.0441	0.0038	0.0019	0.001	0.0002	0
18	6	0.4652	0.4639	0.998	1	1	0	0	0	0	0	0
19	9.09	0.421	0.4223	0.9959	1	1	0	0.0915	0.0572	0.0293	0.0078	0.0026
20	6.36	0.0999	0.1192	0.7188	0.9778	0.9982	0.0768	0.0003	0.0001	0.0001	0	0
21	8.44	0.4685	0.4672	0.9982	1	1	0.0776	0.0028	0.0009	0.0004	0.0001	0
22	7	0.5485	0.5468	0.9996	1	1	0	0	0	0	0	0
23	6.15	0.5346	0.5329	0.9995	1	1	0	0	0	0	0	0
24	6.12	0.4016	0.4017	0.9941	1	1	0	0	0.0001	0.0001	0	0
25	5.08	0.6006	0.5997	0.9999	1	1	0	0	0	0	0	0
26	4.91	0.9595	0.9473	1	1	1	0	0	0	0	0	0
27	6.14	0.6474	0.6463	1	1	1	0	0	0	0	0	0
28	5.99	0.2662	0.2655	0.9543	0.9999	1	0.0053	0.003	0.0021	0.0007	0	0
29	9.1	0.1	0.12	0.7215	0.9784	0.9983	0.4676	0.0208	0.0077	0.0039	0.001	0.0004
30	7.25	0.6143	0.6134	0.9999	1	1	0	0.0125	0	0	0	0

31	5.88	0.579	0.5772	0.9998	1	1	0	0	0	0	0	0
32	5.71	0.4779	0.4765	0.9985	1	1	0	0	0	0	0	0
33	7.67	0.5	0.4997	0.999	1	1	0	0	0	0.0009	0.0009	0
34	6.28	0.5631	0.5613	0.9997	1	1	0	0	0	0	0	0
35	6.95	0.476	0.4758	0.9984	1	1	0	0	0	0	0	0
36	6.07	0.4728	0.4715	0.9983	1	1	0	0	0	0	0	0
37	6.21	0.4755	0.4753	0.9984	1	1	0	0	0	0	0	0
38	8.79	0.6262	0.6241	0.9999	1	1	0.1914	0.0124	0.0039	0.0023	0.0006	0.0002
39	6.7	0.5036	0.5033	0.9991	1	1	0	0	0	0	0	0
40	6.68	0.4365	0.4353	0.9967	1	1	0	0	0	0	0	0
45	37.3	0.999	0.999	1	1	1	0	0	0	0	0	0
50	75.7	0.999	0.999	1	1	1	0	0	0	0	0	0
51	44.24	0.2041	0.2057	0.9	0.999	1	0.0342	0.0032	0.0032	0.0029	0	0
52	35.6	0.999	0.999	1	1	1	0	0	0	0	0	0
53	18.98	0.4167	0.4094	0.9948	1	1	0	0	0	0	0	0
54	27	0.999	0.999	1	1	1	0	0	0	0	0	0
55	31.6	0.999	0.999	1	1	1	0	0	0	0	0	0
56	16.5	0.999	0.999	1	1	1	0	0	0	0	0	0
57	15.92	0.999	0.999	1	1	1	0	0	0	0	0	0
58	48.97	0.4239	0.4164	0.9954	1	1	0	0	0	0	0	0
59	36.7	0.999	0.999	1	1	1	0	0	0	0	0	0
60	25.1	0.999	0.999	1	1	1	0	0	0	0	0	0
61	15.56	0.2131	0.2137	0.9096	0.9993	1	0.0299	0.0029	0	0.0008	0	0
62	48.97	0.3062	0.3035	0.9731	1	1	0.0038	0	0	0.0001	0	0
63	30.9	0.999	0.999	1	1	1	0	0	0	0	0	0
64	83.4	0.999	0.999	1	1	1	0	0	0	0	0	0
65	45.34	0.4369	0.4266	0.9962	1	1	0	0	0	0	0	0
66	30.94	0.367	0.3645	0.9892	1	1	0	0	0	0.0001	0.0001	0.0004

67	24.2	0.999	0.999	1	1	1	0	0	0	0	0	0
68	13	0.999	0.999	1	1	1	0	0	0	0	0	0
69	22.1	0.999	0.999	1	1	1	0	0	0	0	0	0
70	69.73	0.999	0.999	1	1	1	0	0	0	0	0	0
71	36.2	0.999	0.999	1	1	1	0	0	0	0	0	0
72	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
73	15.6	0.999	0.999	1	1	1	0	0	0	0	0	0
74	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
75	24.9	0.999	0.999	1	1	1	0	0	0	0	0	0
76	21.9	0.999	0.999	1	1	1	0	0	0	0	0	0
77	46.62	0.999	0.999	1	1	1	0	0	0	0	0	0
78	148.7	0.999	0.999	1	1	1	0	0	0	0	0	0
79	65.56	0.999	0.999	1	1	1	0	0	0	0	0	0
80	83.75	0.999	0.999	1	1	1	0	0	0	0	0	0
81	47.5	0.999	0.999	1	1	1	0	0	0	0	0	0
82	59.24	0.2722	0.2692	0.9566	0.9999	1	0.0099	0.0024	0.0022	0.0019	0	0
83	23.2	0.999	0.999	1	1	1	0	0	0	0	0	0
84	35	0.999	0.999	1	1	1	0	0	0	0	0	0
85	9.5	0.4995	0.5474	0.9996	1	1	0	0	0	0	0	0
1M	26.88	0.3023	0.3027	0.9728	1	1	0.0022	0.0008	0.001	0.0013	0.0015	0.0017
2M	26.28	0.2994	0.2982	0.971	1	1	0.0037	0.0009	0.0005	0.0012	0.0015	0.0015
3M	25.81	0.2994	0.2989	0.9713	1	1	0.0029	0.0005	0.0004	0.0006	0.001	0.0012
4M	16.07	0.2	0.2321	0.9287	0.9996	1	0	0	0.1225	0.0234	0	0
5M	14.6	0.2	0.234	0.9304	0.9997	1	0	0	0.1242	0.0234	0	0

Table 7-5, Project Performance, With-Project Condition, 2082

				Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
1	17.5	0.0001	0.0004	0.0039	0.0116	0.0192	0.9997	0.9997	0.9997	0.9994	0.9962	0.9889
2	17.5	0.0001	0.0003	0.0031	0.0094	0.0155	0.9997	0.9997	0.9997	0.9997	0.9994	0.997
3	20	0.0001	0.0001	0.001	0.003	0.005	1	0.9995	0.9995	0.9995	0.9995	0.9995
4	17.5	0.0001	0.0004	0.0035	0.0106	0.0175	0.9997	0.9997	0.9997	0.9997	0.9993	0.9973
5	17.5	0.0001	0.0004	0.0044	0.013	0.0216	0.9997	0.9997	0.9997	0.9997	0.9982	0.994
6	17.5	0.0001	0.0004	0.0036	0.0109	0.018	0.9997	0.9997	0.9997	0.9997	0.999	0.9963
7	17.5	0.0001	0.0001	0.0015	0.0044	0.0073	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
8	20	0.0001	0.0005	0.0046	0.0137	0.0228	0.9997	1	1	0.9988	0.9926	0.9796
9	20	0.0001	0.0007	0.0067	0.0201	0.0332	0.9998	0.9998	0.9999	0.9952	0.9777	0.9494
10	20	0.0001	0.0002	0.0021	0.0062	0.0103	0.9997	0.9997	0.9999	0.9997	0.9997	0.9997
18	6	0.4652	0.4651	0.9981	1	1	0	0	0	0	0	0
19	9.09	0.421	0.4223	0.9959	1	1	0	0.0915	0.0572	0.0293	0.0078	0.0026
20	6.36	0.0999	0.1192	0.7188	0.9778	0.9982	0.0768	0.0003	0.0001	0.0001	0	0
21	8.44	0.4685	0.4683	0.9982	1	1	0.0767	0.0028	0.0008	0.0004	0.0001	0
22	7	0.5485	0.5468	0.9996	1	1	0	0	0	0	0	0
23	6.15	0.5346	0.5329	0.9995	1	1	0	0	0	0	0	0
24	6.12	0.4016	0.402	0.9942	1	1	0	0	0.0001	0.0001	0	0
25	5.08	0.6006	0.5997	0.9999	1	1	0	0	0	0	0	0
26	4.91	0.9595	0.9473	1	1	1	0	0	0	0	0	0
27	6.14	0.6474	0.6463	1	1	1	0	0	0	0	0	0
28	5.99	0.2662	0.2655	0.9543	0.9999	1	0.0053	0.003	0.0021	0.0007	0	0
29	9.1	0.1	0.12	0.7215	0.9784	0.9983	0.4676	0.0208	0.0077	0.0039	0.001	0.0004
30	7.25	0.6143	0.6134	0.9999	1	1	0	0.0125	0	0	0	0

31	5.88	0.579	0.5772	0.9998	1	1	0	0	0	0	0	0
32	5.71	0.4779	0.4765	0.9985	1	1	0	0	0	0	0	0
33	7.69	0.4767	0.4765	0.9985	1	1	0	0	0	0.0011	0.0011	0
34	6.28	0.5631	0.5613	0.9997	1	1	0	0	0	0	0	0
35	6.95	0.476	0.4758	0.9984	1	1	0	0	0	0	0	0
36	6.07	0.4728	0.4726	0.9983	1	1	0	0	0	0	0	0
37	6.21	0.4755	0.4753	0.9984	1	1	0	0	0	0	0	0
38	8.79	0.6262	0.6252	0.9999	1	1	0.1889	0.0121	0.0039	0.0024	0.0006	0.0002
39	6.7	0.5036	0.5033	0.9991	1	1	0	0	0	0	0	0
40	6.68	0.4365	0.4353	0.9967	1	1	0	0	0	0	0	0
45	37.3	0.999	0.999	1	1	1	0	0	0	0	0	0
50	75.7	0.999	0.999	1	1	1	0	0	0	0	0	0
51	44.24	0.2041	0.2064	0.9009	0.999	1	0.0324	0.0029	0.0028	0.0026	0	0
52	35.6	0.999	0.999	1	1	1	0	0	0	0	0	0
53	18.98	0.4167	0.4094	0.9948	1	1	0	0	0	0	0	0
54	27	0.999	0.999	1	1	1	0	0	0	0	0	0
55	31.6	0.999	0.999	1	1	1	0	0	0	0	0	0
56	16.5	0.999	0.999	1	1	1	0	0	0	0	0	0
57	15.92	0.999	0.999	1	1	1	0	0	0	0	0	0
58	48.97	0.4235	0.416	0.9954	1	1	0	0	0	0	0	0
59	36.7	0.999	0.999	1	1	1	0	0	0	0	0	0
60	25.1	0.999	0.999	1	1	1	0	0	0	0	0	0
61	15.56	0.2134	0.2142	0.9102	0.9993	1	0.0282	0.0026	0	0.0007	0	0
62	48.97	0.3062	0.3048	0.9736	1	1	0.0034	0	0	0.0002	0	0
63	30.9	0.999	0.999	1	1	1	0	0	0	0	0	0
64	83.4	0.999	0.999	1	1	1	0	0	0	0	0	0
65	45.34	0.4372	0.4269	0.9962	1	1	0	0	0	0	0	0
66	30.94	0.3655	0.3629	0.989	1	1	0	0	0	0.0001	0.0001	0.0004

67	24.2	0.999	0.999	1	1	1	0	0	0	0	0	0
68	13	0.999	0.999	1	1	1	0	0	0	0	0	0
69	22.1	0.999	0.999	1	1	1	0	0	0	0	0	0
70	69.73	0.999	0.999	1	1	1	0	0	0	0	0	0
71	36.2	0.999	0.999	1	1	1	0	0	0	0	0	0
72	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
73	15.6	0.999	0.999	1	1	1	0	0	0	0	0	0
74	18.95	0.999	0.999	1	1	1	0	0	0	0	0	0
75	24.9	0.999	0.999	1	1	1	0	0	0	0	0	0
76	21.9	0.999	0.999	1	1	1	0	0	0	0	0	0
77	46.62	0.999	0.999	1	1	1	0	0	0	0	0	0
78	148.7	0.999	0.999	1	1	1	0	0	0	0	0	0
79	65.56	0.999	0.999	1	1	1	0	0	0	0	0	0
80	83.75	0.999	0.999	1	1	1	0	0	0	0	0	0
81	47.5	0.999	0.999	1	1	1	0	0	0	0	0	0
82	59.24	0.2721	0.2694	0.9567	0.9999	1	0.0094	0.0021	0.0019	0.0017	0	0
83	23.2	0.999	0.999	1	1	1	0	0	0	0	0	0
84	35	0.999	0.999	1	1	1	0	0	0	0	0	0
85	9.5	0.4995	0.5475	0.9996	1	1	0	0	0	0	0	0
1M	26.88	0.0163	0.0136	0.1282	0.3375	0.4965	0.9998	0.999	0.6887	0.3614	0.1698	0.0971
2M	26.28	0.0088	0.0095	0.0909	0.2488	0.3792	0.9997	0.9258	0.9819	0.5201	0.3915	0.3289
3M	25.81	0.0079	0.0078	0.0755	0.2099	0.3247	0.9999	0.9996	0.9996	0.6012	0.2397	0.1173
4M	16.07	0.2	0.2321	0.9287	0.9996	1	0	0	0.1225	0.0234	0	0
5M	14.6	0.2	0.234	0.9304	0.9997	1	0	0	0.1242	0.0234	0	0

SECTION 8
Regional Economic Development (RED)

8.1 GENERAL

The regional economic development (RED) account addresses the impacts that the U.S. Army Corps of Engineers (USACE) expenditures associated with the construction of a coastal storm risk management system will have on the levels of income, output, and employment throughout the region. These impacts are not included in the NED analysis but can still be used by decision makers as part of their investment decision process.

This RED analysis employs input-output economic analysis, which measures the interdependence among industries and workers in an economy. This analysis uses a matrix representation of a regional economy to predict the effect that changes in one industry will have on other industries. The greater the interdependence among industry sectors, the larger the multiplier effect on the economy. Changes to government spending drive the input-output model to project new levels of sales (output), value added gross regional product (GRP), employment, and income for each industry.

Regional economic system (RECONS) Version 2 was the specific input-output model used to estimate the regional economic development impacts of the Recommended Plan. The USACE Institute for Water Resources, Louis Berger, and Michigan State University developed the regional economic impact modeling tool, RECONS, that provides estimates of jobs and other economic measures, such as labor income, value added, and sales that are supported by USACE programs, projects, and activities. This modeling tool automates calculations and generates estimates of jobs, labor income, value added, and sales using IMPLAN®'s multipliers and ratios, customized impact areas for USACE project locations, and customized spending profiles for USACE projects, business lines, and work activities. RECONS allows the USACE to evaluate the regional economic impact and contribution associated with USACE expenditures, activities, and infrastructure.

8.2 DESCRIPTION OF METRICS

"Output" is the sum total of transactions that take place as a result of the construction project, including both value added and intermediate goods purchased in the economy. "Labor income" includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income. "Value added" or "gross regional product" represents the value-added output of the study regions. This metric captures all final goods and services produced in the study areas because of the existence of the project. It is different from output in the sense that one dollar of a final good or service may have multiple transactions associated with it. "Jobs" is the estimated worker-years of labor required to build the project.

8.3 ASSUMPTIONS

Input-output analysis rests on the following assumptions. The production functions of industries have constant returns to scale, so if output is to increase, inputs will increase in the same proportion. Industries face no supply constraints; they have access to all the materials they can use. Industries have a fixed commodity input structure; they will not substitute any commodities or services used in the production of output in response to price changes. Industries produce their commodities in fixed proportions, so an industry will not increase production of a commodity without increasing production in every other commodity it produces. Furthermore, it is assumed that industries use the same technology to produce all their commodities. The economic impacts results are presented for the entire period of analysis, aggregated for all 50 years for output, labor income, and value added. The number of jobs is presented as an average across all years included in the period of analysis.

8.4 RESULTS

The Optimized TSP is comprised of three measures, the West and South Slidell levee and floodwall, the Mile Branch channel improvements, and the elevation and floodproofing of structures. Each of the measures is presented separately.

For the West and South Slidell Levee and Floodwall System, expenditures are estimated to be $2,440,973,000. Of this total expenditure, $2,219,412,264 will be captured within the study area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in the following tables. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures of $2,440,973,000 support a total of 740 average annual, full-time equivalent jobs, $2,232,742,907 in labor income, $2,524,037,966 in value added, and $4,112,532,502 in economic output in the local impact area. More broadly, these expenditures support 1020 average annual, full-time equivalent jobs, $3,310,191,601 in labor income, $4,104,289,101 in value added, and $6,806,716,800 in economic output in the nation. Table F:8-1 summarizes these results.

Table F:8-1. Regional Economic Development (RED) Summary for the West and South Slidell Levee and Floodwall System

Area	Output	Jobs*	Labor Income	Value Added
Local				
Direct Impact	$2,219,412,264	505	$1,606,683,533	$1,462,181,013
Secondary Impact	$1,893,120,238	235	$626,059,375	$1,061,856,953
Total Impact	$4,112,532,502	740	$2,232,742,907	$2,524,037,966
State				
Direct Impact	$2,331,560,812	576	$1,826,483,378	$1,602,061,631

Secondary Impact	$2,367,881,842	278	$754,458,665	$1,320,902,540
Total Impact	$4,699,442,654	853	$2,580,942,043	$2,922,964,171
US				
Direct Impact	$2,415,105,510	599	$1,901,147,647	$1,701,368,649
Secondary Impact	$4,391,611,291	422	$1,409,043,954	$2,402,920,452
Total Impact	$6,806,716,800	1020	$3,310,191,601	$4,104,289,101

* Jobs are presented in average annual, full-time equivalence (FTE)

For the Mile Branch channel improvements, expenditures are estimated to be $77,002,000. Of this total expenditure, $67,413,497 will be captured within the local impact area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in the following tables. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures of $77,002,000 support a total of 22 average annual, full-time equivalent jobs, $66,154,528 in labor income, $74,203,702 in value added, and $124,790,106 in economic output in the local impact area. More broadly, these expenditures support 31 average annual, full-time equivalent jobs, $102,080,415 in labor income, $127,564,200 in value added, and $216,530,715 in economic output in the nation. Table F:8-2 summarizes these results.

Table F:8-2. RED Summary for the Mile Branch Channel Improvements

Area	Output	Jobs*	Labor Income	Value Added
Local				
Direct Impact	$67,413,497	15	$47,880,317	$42,275,475
Secondary Impact	$57,376,609	7	$18,274,211	$31,928,227
Total Impact	$124,790,106	22	$66,154,528	$74,203,702
State				
Direct Impact	$70,862,292	17	$54,965,773	$46,301,703
Secondary Impact	$73,027,149	8	$22,402,738	$40,424,843
Total Impact	$143,889,441	26	$77,368,512	$86,726,546
US				
Direct Impact	$75,703,707	18	$57,724,072	$50,907,527
Secondary Impact	$140,827,007	13	$44,356,343	$76,656,673
Total Impact	$216,530,715	31	$102,080,415	$127,564,200

* Jobs are presented in average annual, full-time equivalence (FTE)

For the nonstructural plan, expenditures are estimated to be $1,934,084,000. Of this total expenditure, $1,531,085,009 will be captured within the local impact area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in the following tables. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures of $1,934,084,000 support a total of 430 average annual, full-time equivalent jobs, $1,387,503,061 in labor income, $1,633,118,773 in value added, and $2,759,491,813 in economic output in the local impact area. More broadly, these expenditures support 664 average annual, full-time equivalent jobs, $2,424,878,759 in labor income, $3,097,067,965 in value added, and $5,200,780,639 in economic output in the nation. Table F:8-3 summarizes these results.

Table F:8-3. RED Summary for the Nonstructural Plan

Area	Output	Jobs*	Labor Income	Value Added
Local				
Direct Impact	$1,531,085,009	276	$996,857,892	$957,565,145
Secondary Impact	$1,228,406,804	154	$390,645,169	$675,553,628
Total Impact	$2,759,491,813	430	$1,387,503,061	$1,633,118,773
State				
Direct Impact	$1,651,881,781	312	$1,191,054,939	$1,107,210,463
Secondary Impact	$1,559,809,227	183	$482,082,740	$861,277,124
Total Impact	$3,211,691,008	495	$1,673,137,679	$1,968,487,587
US				
Direct Impact	$1,861,922,843	350	$1,353,887,980	$1,266,033,975
Secondary Impact	$3,338,857,796	313	$1,070,990,779	$1,831,033,991
Total Impact	$5,200,780,639	664	$2,424,878,759	$3,097,067,965

* Jobs are presented in average annual, full-time equivalence (FTE)

SECTION 9

Other Social Effects (OSE) and Environmental Quality (EQ)

The Justice 40 Initiative

To assist the Administration in achieving the Justice40 Initiative goals, USACE must use investments as the metric to measure benefits, essentially providing that 40 percent of USACE investments in climate and critical clean water and waste infrastructure would benefit disadvantaged communities. USACE will strive to achieve the 40 percent goal under Justice40 Initiative. In the Interim Implementation Guidance for the Justice40 Initiative, dated 20 July, 2021; and MEMORANDUM FOR COMMANDING GENERAL, U.S. ARMY CORPS OF ENGINEERS SUBJECT: Implementation of Environmental Justice and the Justice40 Initiative (Justice40 Interim Guidance) dated 15 March 2022, the federal government established the goal that 40 percent of the overall benefits of certain Federal investments, flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution.

Climate and Economic Justice Screening Tool (CEJST). The CEQ's recently released CEJST was used to identify disadvantaged communities in the study area. In the CEJST database, the CEQ identifies Census Tracts throughout the nation that meet its definition of a disadvantaged community. The purpose of the tool is to help Federal agencies identify disadvantaged communities that are marginalized, underserved, and overburdened by pollution. The current version of the CEJST provides socioeconomic, environmental, and climate information to identify and inform decisions that may affect these communities. The CEJST identifies disadvantaged communities through publicly available, nationally consistent datasets.

Forty-six percent of the benefits provided by the West and South Slidell levee and floodwall system and sixty-eight percent of the benefits provided by the channel improvements in Mile Branch accrue to these disadvantaged communities. Four percent of the benefits provided by the nonstructural plan accrue to disadvantaged communities. The low percentage of benefits under the non-structural plan is primarily due to community locations. Most of these communities are located either in northern areas of the parish that are not subject to frequent flooding, or they are located in the parts of the parish that would benefit from the levee system in Slidell. The disadvantaged communities where nonstructural measures would be applied are in largely rural areas that are more sparsely developed and have lower flood risk. Overall, approximately 20 percent of the benefits provided by the Optimized TSP accrue to disadvantaged communities.

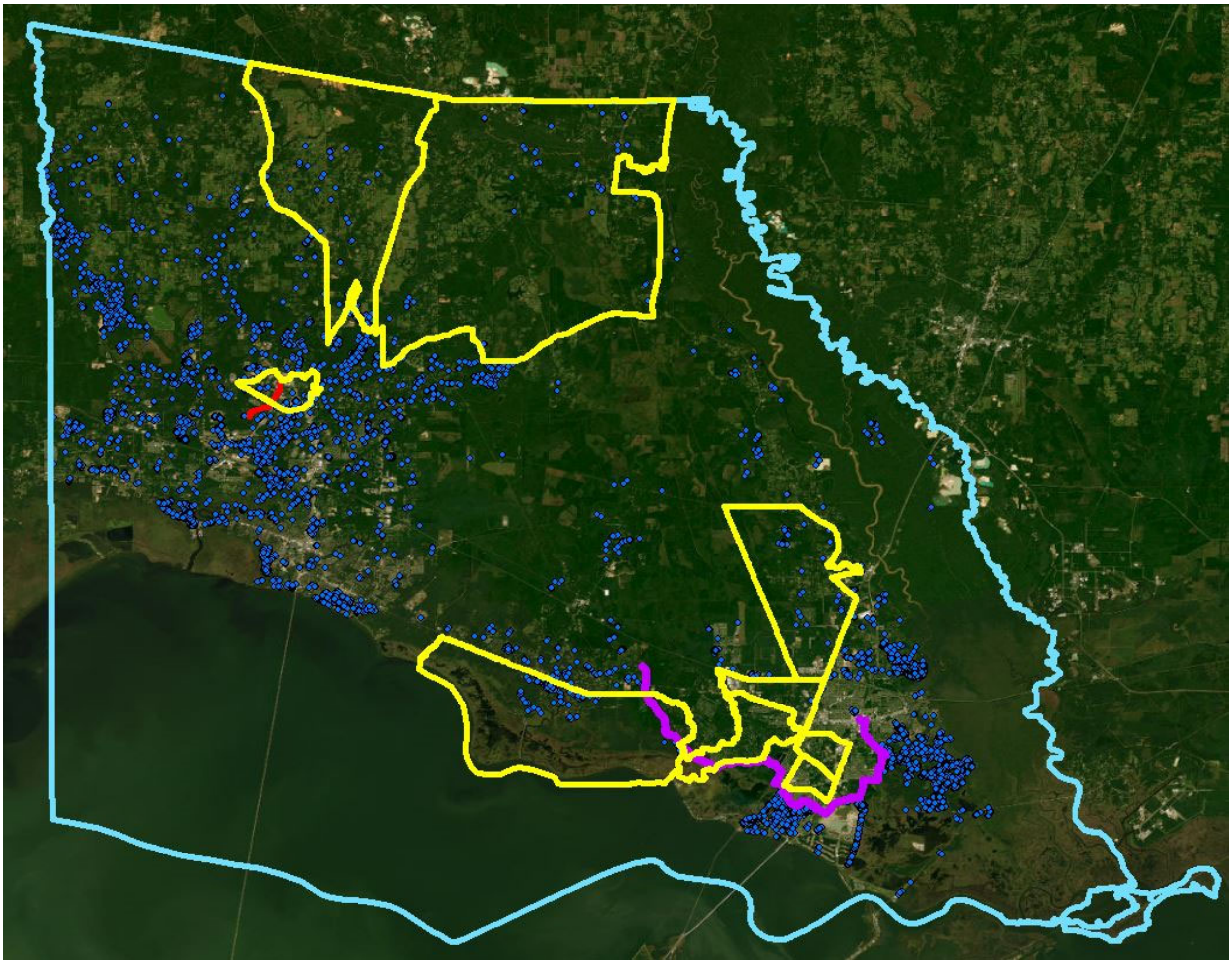


Figure F:9-1. Justice 40 Disadvantaged Communities in St. Tammany Parish and Features of the Optimized TSP

Social Vulnerability Index (SOVI) Summary

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

Several factors have been shown to contribute to an area's vulnerability/resiliency, including poverty, racial/ethnic composition, educational attainment, and proportion of the population over the age of 65. The social vulnerability index used in this study was developed by the

Center for Disease Control (CDC) which utilized 2020 American Community Survey data. The CDC's Social Vulnerability Index (SVI) measures the relative vulnerability of every U.S. Census tract. The SVI ranks 16 social factors including unemployment, minority status, and disability and then further groups these factors into four related themes. Each census tract receives a rating for each theme as well as an overall theme. The four themes include socioeconomic status, household composition and disability, minority status and language, and housing type and transportation. Tracts are rated as percentile ranking values ranging from 0 to 1, with higher values representing greater vulnerability. The CDC flags census tracts with an overall SVI rating greater than or equal to 0.9 as high vulnerability to hazards.

Of the 59 census tracts in the study area, three census tracts were flagged as "high vulnerability". Census tract 408.07 and 409 are located in Slidell, Louisiana with an overall SVI score of 0.95 for both. Census tract 405.01 is located in Covington, Louisiana with an overall SVI score of 0.91. Of the 6,410 structures in the area, 355 have an SVI score above 0.90. The majority of SVI scores in this study area are below the 65th percentile with only four census tracts ranging from 0.68 to 0.76, located in the southeast portion of the study area in the North Slidell/McClane area. Overall, most of the study area does not have an especially high vulnerability to natural disasters. Additionally, with the two structural components in the study area, risk of flood damages can be further reduced. The Mile Branch Channel Improvements, located in Covington, Louisiana, runs through census tract 405.01. The South Slidell and West Slidell Levee and Floodwall System crosses the northwest portion of census tract 408.07. With these structural components crossing through highly socially vulnerable areas, the two census tracts can greatly benefit from the reduction in flood damages.

Environmental Quality (EQ) Summary

The Environmental Quality (EQ) account is an assessment of favorable or unfavorable ecological, aesthetic and cultural or natural resources changes. The analysis was conducted with the participation of agencies, local governments, and stakeholders through an on-going and engaging series of scoping meetings, public input meetings, agency and stakeholder meetings, and on-site meetings, and will continue through the Preconstruction Engineering and Design (PED) study phase and coordination of the project through State and Agency reviews.

EQ impacts related to the construction of Mile Branch are expected to be temporary and non- significant related to terrestrial habitat with some additional impacts to aquatic waterbottom habitat during construction, which are being compensated for with creation of a backwater area off of Mile Branch. Riparian habitat impacts are included in the developed mitigation plan.

The West Slidell levee is expected to result in EQ impacts on Big Branch Wildlife Refuge and Bayou Liberty Louisiana Scenic Waterway but they would be offset by the anticipated land swap and nature based designs for the floodgate at Bayou Liberty. Compensatory mitigation is incorporated into the RP for the impacts to marsh and pine savanna habitat. The nonstructural portion of the RP is expected to have minimal and temporary EQ impacts.

SECTION 10

F-1-Life Safety Annex

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

For the study, the Slidell levee feature of the Recommended Plan was modeled using the LSRI software. The results of which show an LSRI value of 6.682 meaning if this project were not built, then this area would experience an average annual life loss of 6.682 people per year. To arrive at these values, the maximum storm surge event the levee is designed to protect against, 15 feet, was used. The LifeSim model allowed for 8 to 24 hours of warning time before the first structure got wet. The population of the study area was developed using the default NSI 2022 values.

The inputs used in modelling the LSRI for the South and West Slidell levee and floodwall feature of the Optimized TSP are discussed in more detail in the Sections below.

10.0 INTRODUCTION

The software itself requires three different types of inputs in order to create a life-safety risk indicator value: a study area with structure inventory, a flood scenario with H&H inputs, and life-risk inputs such as hazard advance notice. Each input will be discussed further in subsequent Sections.

11.0 STUDY AREA AND STRUCTURE INVENTORY

The area protected by the West and South Slidell Levee and Floodwall System.

Day Population: 55,599

Night Population: 58,695

Number of Structures: 20,888

Total Property Value ($1000s): 9,800,333

These values are pulled directly from NSI 2022 and aggregated. The circles on the map of the study area are just structures that the software automatically groups based on proximity.

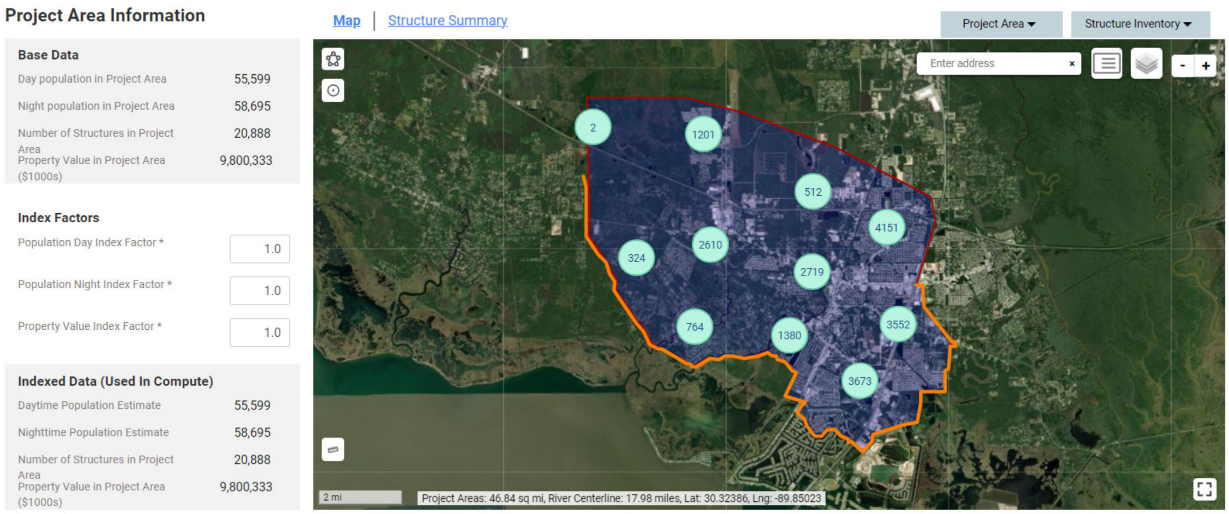


Figure F:1-1, Population Summary

12.0 INUNDATION AND H&H INPUTS

The second input is a flood scenario. For the coastal areas within the study area, a coastal surge event equal to the proposed design of the levee was chosen (15 feet) as the PDT was trying to find the life-risk reduction benefits should the levee be built. The model runs a simplified version of 2D HEC-RAS. The orange line, shown in the 2nd picture in this Section, represents where the water is coming from. Since it is a coastal model, the model assumes that water will come perpendicular from the orange line. The river width and floodplain multiplier boxes are greyed out as they are specific to riverine models.

Once the line is drawn, the model then imports 10-meter USGS elevation data and processes it. After that, a simple hydrograph is created by the user using inputs from H&H.

For a coastal storm surge event:

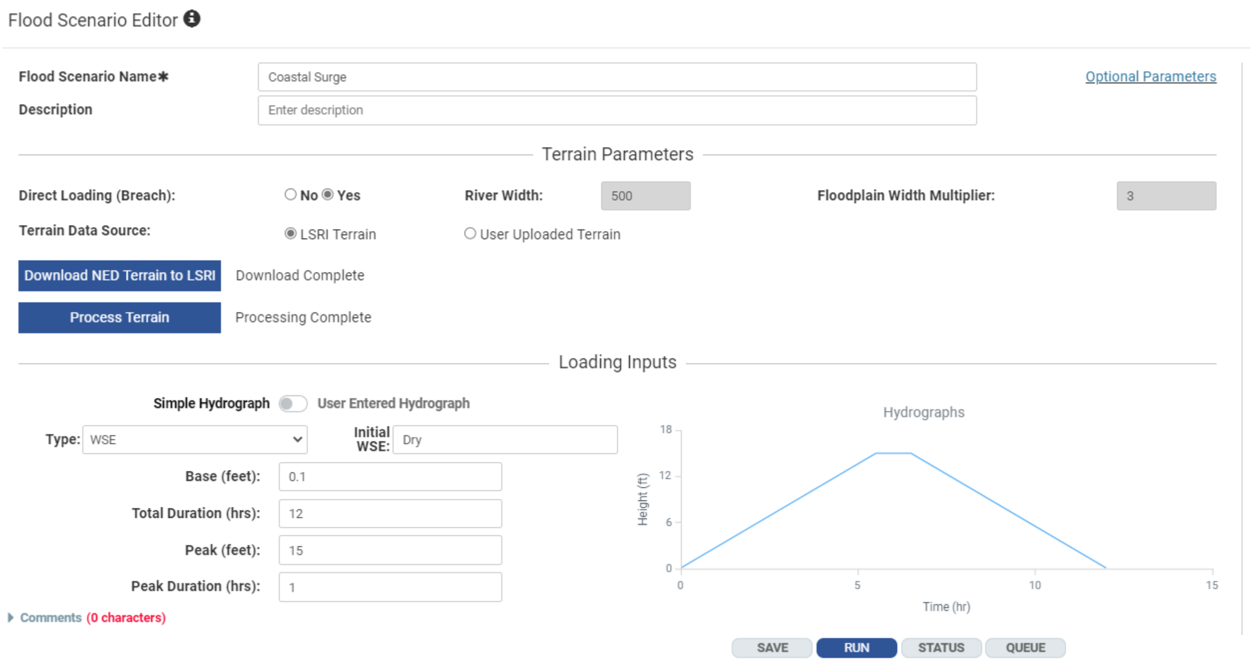
Base (feet):0.1

Total Duration (hrs.): 12

Peak (feet): 15

Peak Duration (hrs.): 1

The resulting inundation is also shown in the 2nd picture in this Section.



Below is the inundation map produced from the simplified RAS model. The deep red the color, the deeper the depths.

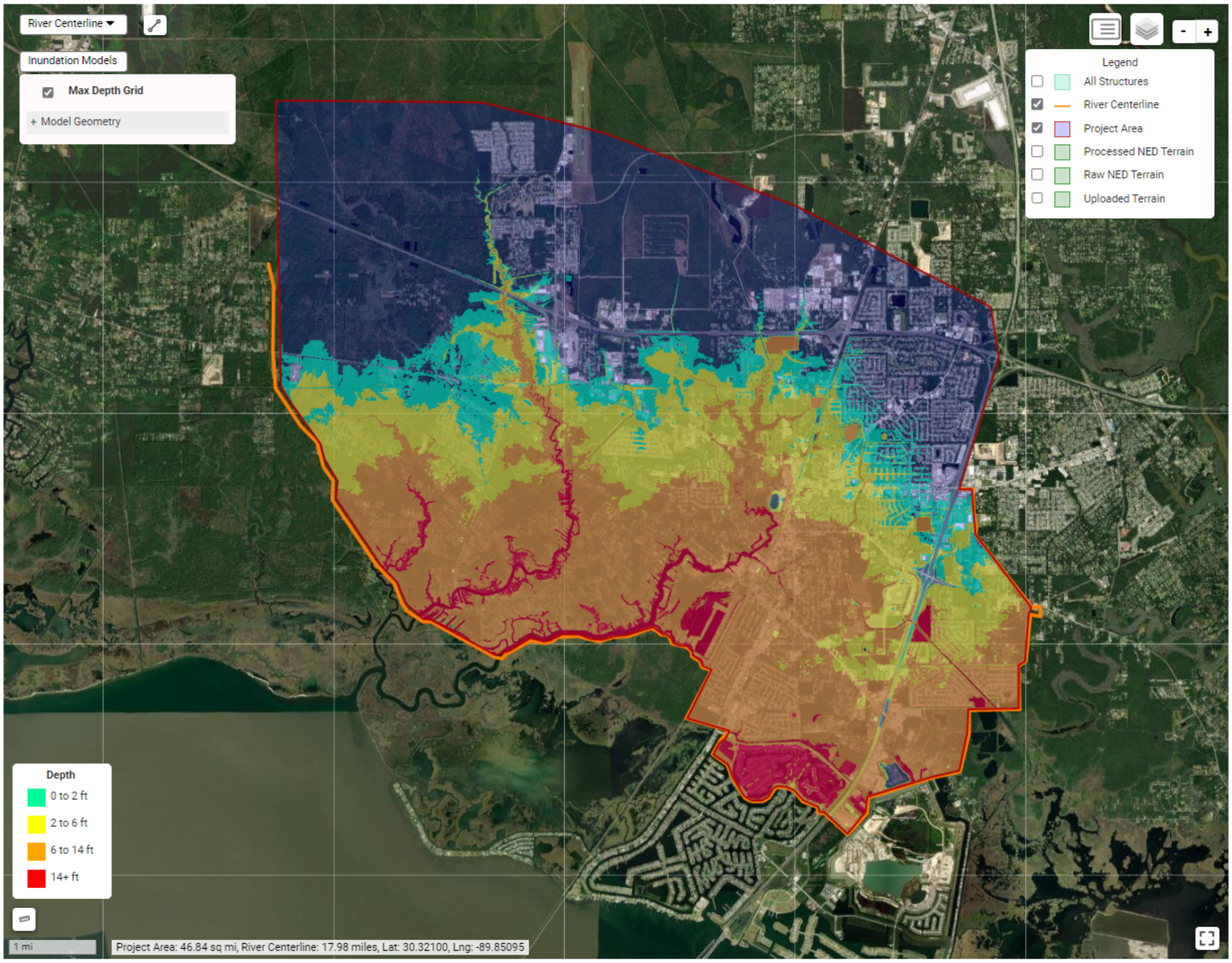


Figure F:1-2, Inundation Map

13.0 SIMPLIFIED LIFESIM INPUTS

The final set of inputs for LSRI are the LifeSim Compute inputs.

For the study, the final set of inputs are listed as:

Evacuation Planning: Flood Specific

Community Awareness: Generally Aware

Flood Warning Effectiveness: Fast

Hazard Advanced Warning: Long

Below are the different input selections and their corresponding definition.

Evacuation Planning

• Flood Specific – The local EMA maintains a warning and/or evacuation plan for the community that contains specific information about the content of a message that would be provided in the case of a flood emergency. That content includes a description of the flood threat, specific information on the locations at risk, what actions the public should take and how to take them (which evacuation routes to take), when the at-risk population should start and complete those actions, and why taking those actions is a good idea. Also, a successful recent evacuation regardless of evacuation plan detail could lead to an acceptable rating.

• All Hazards – The local EMA maintains a warning or evacuation plan for the threatened community, but it does not have message templates or directions that would suggest the information defined under the Acceptable rating would be provided to the public in a timely manner.

• None or Outdated – An evacuation plan does not exist for the threatened community.

• Unknown

Community Awareness

• Very Aware – The community is very aware that it could be impacted by flooding. It has either happened recently or it is often a topic in local media. Local flood agencies routinely provide public education opportunities related to flooding, and they strive to increase awareness and preparedness in the community.

• Generally Aware – The community is generally aware that it is vulnerable to flooding, but there is no ongoing public awareness or education effort to improve flood awareness.

• Unaware – The community is generally unaware that it could be impacted by a flood event.

• Unknown (must be unknown if Evacuation Planning is "Unknown" and vice-versa)

Flood Warning Effectiveness

• Fast – The community's EMA has a written warning plan and standard operating procedures for issuing warnings. Responsibility for issuing a warning is clearly defined, warning thresholds are in place that relate the flood threat to the recommended public protective action, and SOP drills are regularly conducted. Additionally, the EMA has access to multiple warning systems or channels (e.g., auto-dial telephones, Wireless Emergency Alert, sirens, etc.) that would be use in the case of a major flood event.

• Medium – The community's EMA has an emergency evacuation plan with general guidance on warning procedures. However, roles are not clearly defined, and SOP drills are not conducted regularly. The warning process relies primarily on emergency responders to spread the warning. The procedures are reviewed and updated at regular intervals.

• Slow – An emergency action plan does not exist or has not been updated at regular intervals. Flood warning procedures do not exist or are outdated.

Hazard Advanced Notice

- Very Short – 0 to 2 hours
- Short – 2 to 4 hours
- Moderate – Moderate 4 to 8 hours
- Long – 8 to 24 hours
- Very Long – 24-48 hours

Once these inputs are selected and run, it will run 1000 iterations of LifeSim with uncertainty sampling. Below are the inputs selected for the study area.

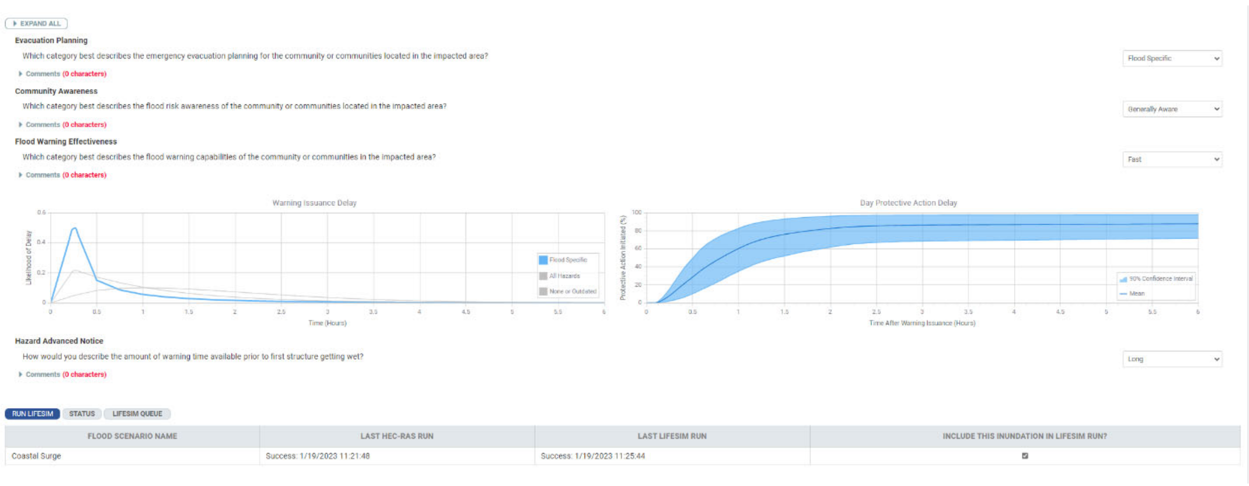


FIGURE F:1-3, LIFESIM INPUTS

14.0 CONSEQUENCE RESULTS

The consequence results for the Slidell levee feature of the Recommended Plan are as follows:

Parameter	Day	Night
PAR	39,416	39,416
Exposed Population	2,602	2,595

% of PAR Exposed	6.60%	6.58%
Median Life Loss	123	123
Fatality Rate	4.73%	4.74%
Mean Life Loss (Exposure Weighted)	136.37	
Mean Life Loss as % of PAR	0.35%	
Weighted Fatality Rate (% of Exposed PAR)	4.66%	
Property Damages	$3.22B	
# Structures Inundated	14,094	

Table F:1-1, Consequence Results

Below is a map of the study area with each hexagon representing an area of life-risk during the day ranging from zero, which is the green color, to one or more. The areas of deep red are areas with at least one simulated life-loss event. The deeper the red, the more life-risk.

Essentially what the software is doing is assigning a life-loss value to a specific structure based on the results of the LifeSim model. Within each hexagon there are many structures, and their aggregate value of life-loss determines what color the hexagon will be. The greater the life-loss, the deeper red the color.

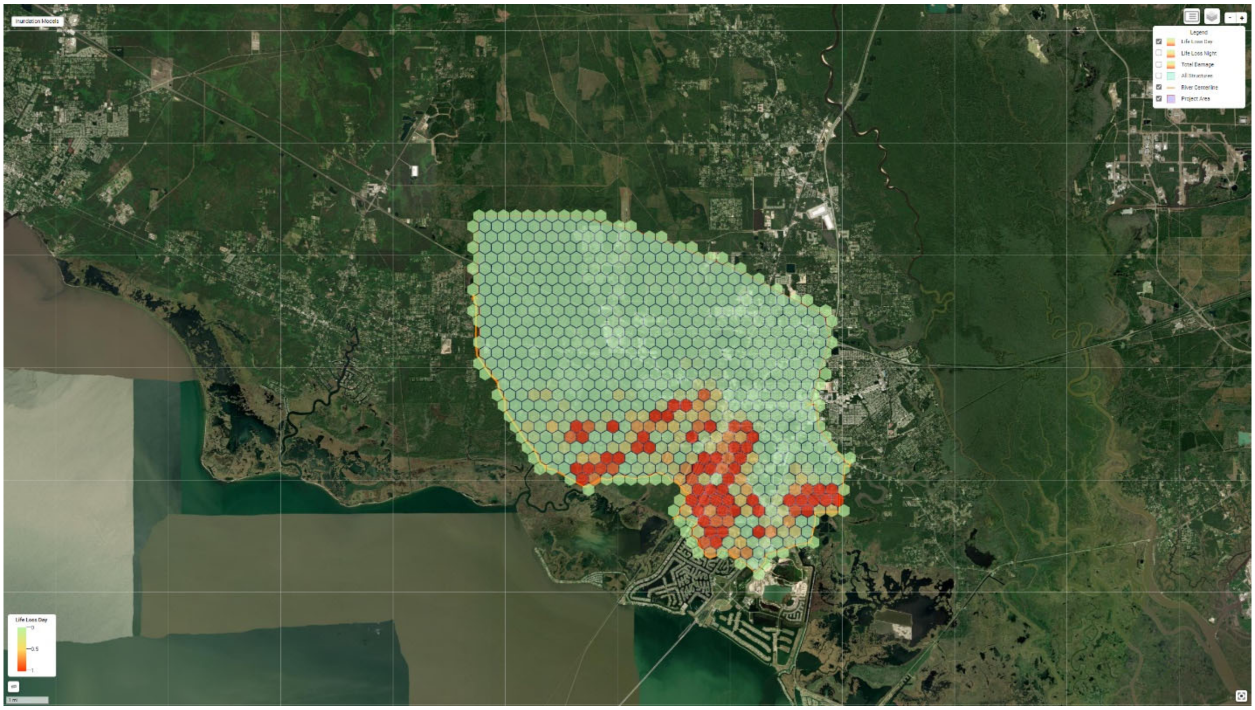


Figure F:1-4, Areas of Life Risk During the Day

Below is a map of the study area with each hexagon representing an area of life-risk during the night ranging from zero, which is the green color, to one or more. The areas of deep red are areas with at least one simulated life-loss event. The deeper the red, the more life-risk.

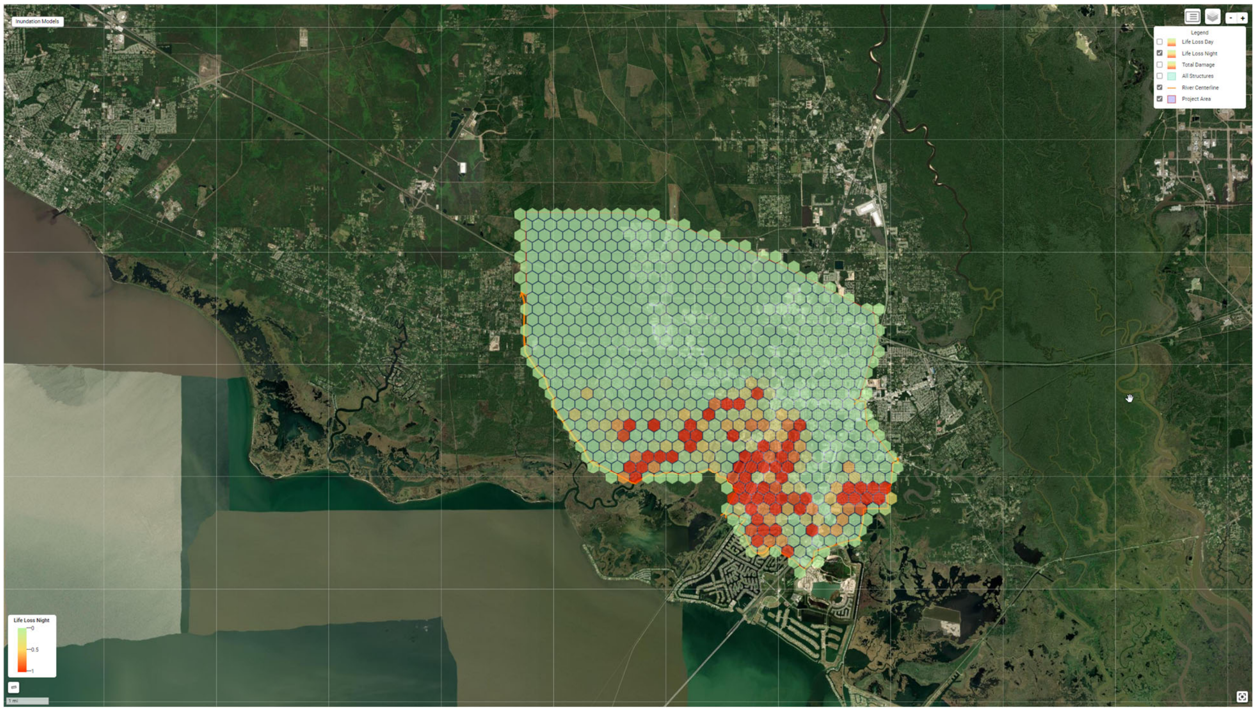


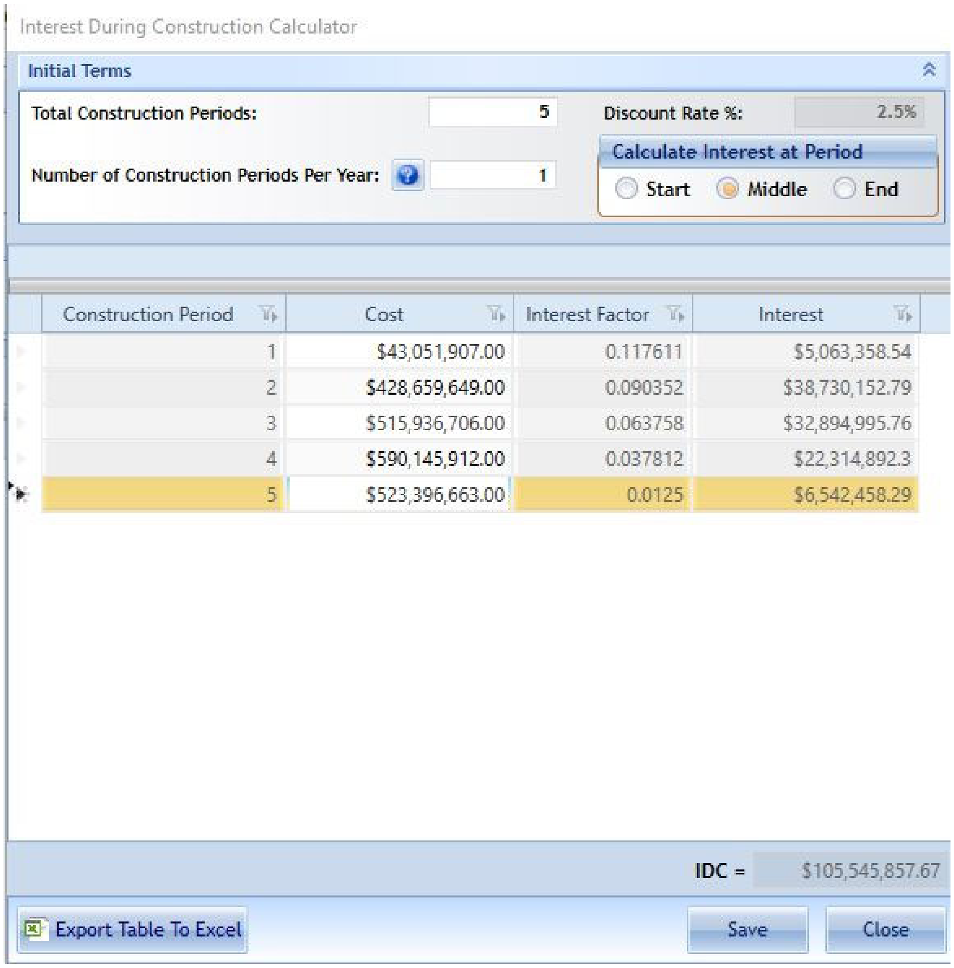
Figure F:1-5, Areas of Life Risk during the Night

Section 11

Additional Data

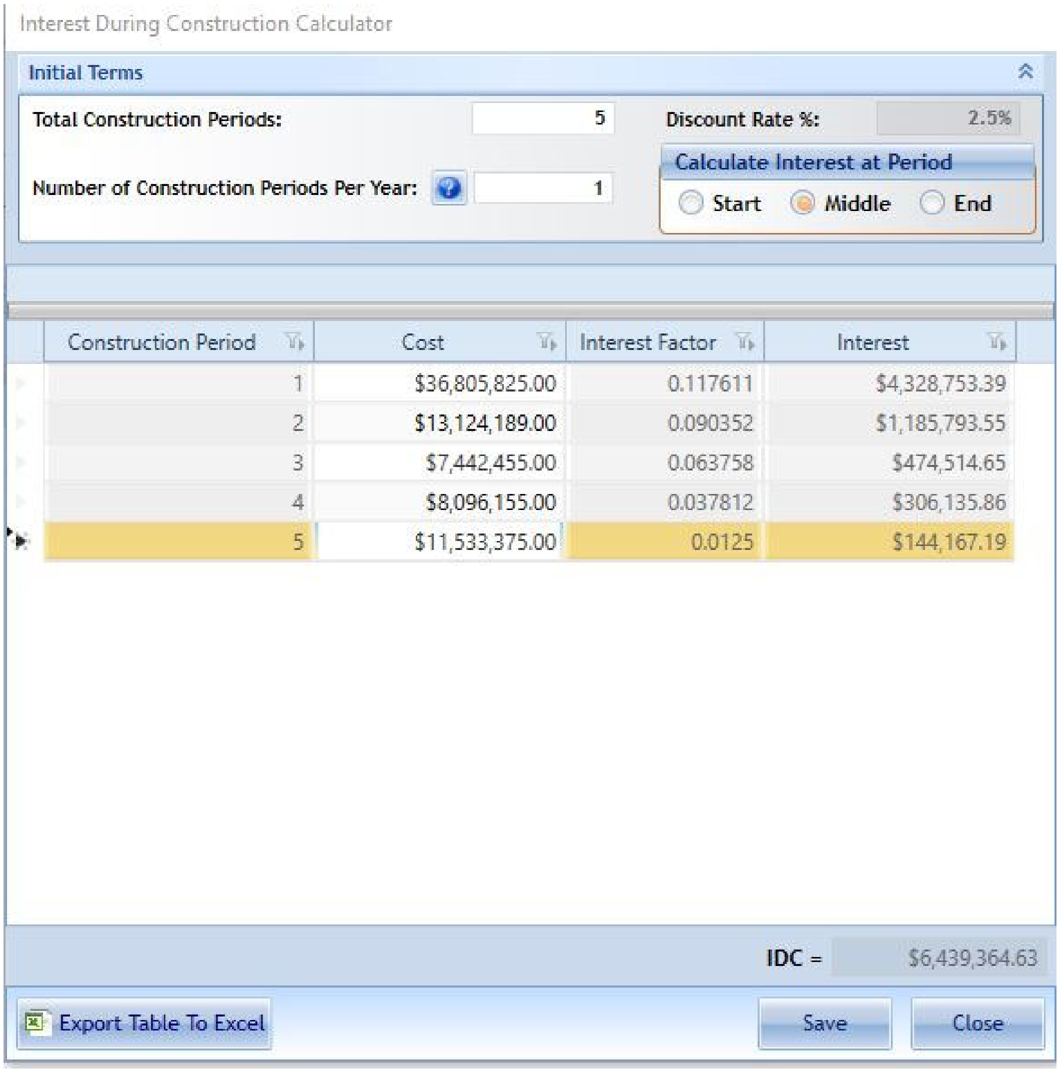
11.1 Interest During Construction-Screen Captures

The West and South Slidell Levee and Floodwall System



Construction Period	Cost	Interest Factor	Interest
1	$43,051,907.00	0.117611	$5,063,358.54
2	$428,659,649.00	0.090352	$38,730,152.79
3	$515,936,706.00	0.063758	$32,894,995.76
4	$590,145,912.00	0.037812	$22,314,892.3
5	$523,396,663.00	0.0125	$6,542,458.29

The Channel Improvements at Mile Branch



Interest During Construction Calculator

Initial Terms

Total Construction Periods: 5

Discount Rate %: 2.5%

Number of Construction Periods Per Year: 1

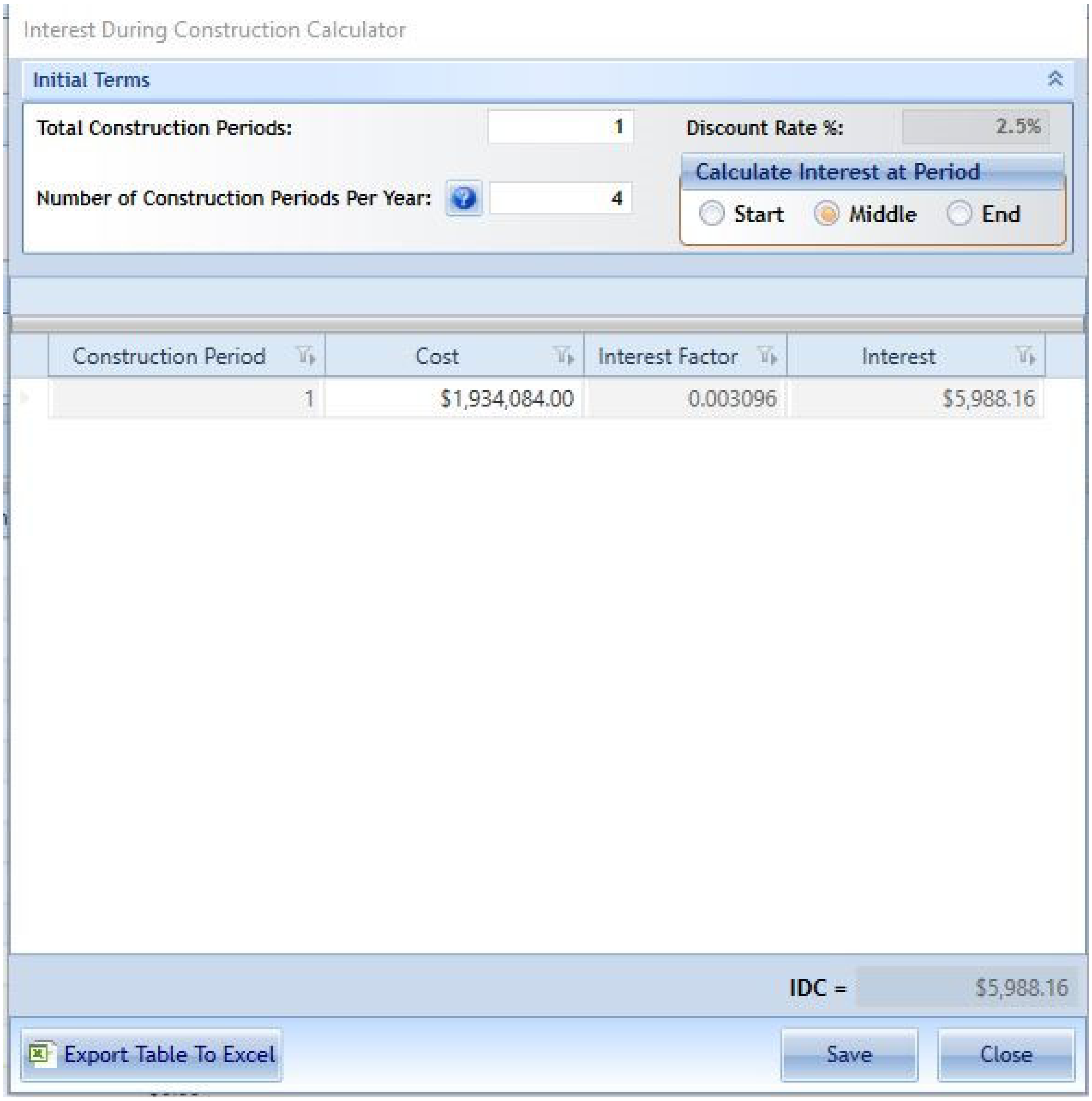
Calculate Interest at Period: Start / Middle (selected) / End

Construction Period	Cost	Interest Factor	Interest
1	$36,805,825.00	0.117611	$4,328,753.39
2	$13,124,189.00	0.090352	$1,185,793.55
3	$7,442,455.00	0.063758	$474,514.65
4	$8,096,155.00	0.037812	$306,135.86
5	$11,533,375.00	0.0125	$144,167.19

IDC = $6,439,364.63

Export Table To Excel | Save | Close

The Nonstructural Plan



11.2 Select Stage-Damage Functions

Without Project

Reach 1, Com, 2032,

Stage	Damage	SD
4	0	0
5	147	16
6	201	44
7	275	24
8	535	196
9	4,862	1,230
10	10,525	2,394
11	17,603	3,409
12	20,042	3,673
13	21,113	3,870
14	21,874	3,998
15	26,155	4,539
16	81,090	10,865

Without Project

Reach 2, Com, 2032

Stage	Damage	SD
4	0	0
5	12,418	3,028
6	80,273	14,006
7	148,557	18,853
8	198,540	20,828
9	245,924	23,098
10	283,603	24,708
11	295,143	25,132
12	302,590	25,411
13	308,864	25,516
14	314,921	25,571
15	329,930	25,834
16	344,880	26,492

Without Project

Reach 3, Com, 2032

Stage	Damage	SD
3	0	0
4	2,679	1,029
5	14,458	2,731
6	70,198	9,709
7	155,566	14,995
8	205,233	17,205
9	231,697	18,298
10	253,105	19,092
11	266,546	19,376
12	270,172	19,423
13	273,707	19,498
14	294,744	20,194
15	421,249	25,149
16	471,235	27,247

Without Project

Reach 5, Com, 2032

Stage	Damage	SD
4	0	0
5	7,604	2,256
6	14,595	3,088
7	22,685	3,617
8	37,653	4,617
9	58,869	6,328
10	66,334	6,746
11	69,772	6,962
12	72,186	7,107
13	74,008	7,144
14	75,544	7,157
15	85,708	8,763
16	154,437	17,344

Without Project

Reach 7, Com, 2032

Stage	Damage	SD
4	0	0
5	6,763	2,212
6	17,078	3,799
7	36,184	7,223
8	105,920	14,957
9	118,561	16,028
10	121,143	16,207
11	122,217	16,266
12	123,134	16,277
13	125,377	16,297
14	130,861	16,331
15	138,665	16,523
16	144,642	16,600

Without Project

Reach 9, Com, 2032

Stage	Damage	SD
5	0	0
6	1,195	690
7	10,615	4,854
8	22,013	7,511
9	55,650	13,930
10	107,850	20,662
11	123,834	22,797
12	133,660	24,379
13	140,761	25,612
14	146,397	26,357
15	148,159	26,442
16	149,247	26,447

Without Project

Reach 1, Res, 2032

Stage	Damage	SD
4	0	0
5	1010	296
6	1535	341
7	2284	386
8	6506	690
9	16820	1042
10	29545	1414
11	43066	1505
12	50510	1478
13	55640	1359
14	59714	1207
15	70655	1560
16	105377	1865

Without Project

Reach 2, Res, 2032

Stage	Damage	SD
4	0	0
5	17,986	1,335
6	76,099	2,306
7	138,182	2,977
8	211,723	3,298
9	268,339	3,469
10	315,600	3,363
11	344,182	3,143
12	365,199	2,827
13	379,511	2,574
14	392,893	2,534
15	411,370	2,557
16	427,615	2,594

Without Project

Reach 3, Res, 2032

Stage	Damage	SD
3	0	0
4	2,237	487
5	13,015	947
6	38,958	1,427
7	60,759	1,621
8	79,169	1,702
9	92,494	1,641
10	103,229	1,505
11	110,700	1,325
12	115,312	1,179
13	118,905	1,148
14	133,155	1,593
15	166,141	1,757
16	181,884	1,813

Without Project

Reach 5, Res, 2032

Stage	Damage	SD
4	0	0
5	11,105	1,052
6	22,784	1,194
7	41,986	1,656
8	82,691	2,324
9	154,987	3,041
10	208,124	3,389
11	258,953	3,734
12	321,329	4,016
13	390,309	3,965
14	451,457	3,825
15	533,107	4,387
16	689,143	4,894
17	780,001	4,934

Without Project

Reach 7, Res, 2032

Stage	Damage	SD
4	0	0
5	60,191	2,525
6	118,104	3,122
7	179,079	3,580
8	249,215	3,537
9	280,843	3,079
10	305,056	2,770
11	323,770	2,625
12	339,539	2,557
13	351,859	2,540
14	368,151	2,646
15	391,720	2,811
16	408,227	2,837

Without Project

Reach 9, Res, 2032

Stage	Damage	SD
5	0	0
6	69,232	2,599
7	140,023	3,314
8	196,792	3,652
9	251,526	3,980
10	312,176	4,218
11	374,564	4,314
12	430,890	4,166
13	472,839	3,816
14	503,151	3,387
15	522,665	3,107
16	538,689	3,001

Without Project

Reach 1, Com, 2082

Stage	Damage	SD
4	0	0
5	160	32
6	232	37
7	267	22
8	306	22
9	329	25
10	4162	1139
11	17741	3425
12	20172	3691
13	21237	3896
14	21912	4001
15	22188	4010
16	81090	10865
17	25889	4374
18	79651	10675
19	104795	13105
20	111641	14027

Without Project

Reach 2, Com, 2082

Stage	Damage	SD
4	0	0
5	1,263	3,028
6	19,461	14,006
7	43,687	18,853
8	97,655	12,096
9	197,386	19,529
10	284,420	24,744
11	295,820	25,099
12	302,364	25,411
13	308,247	25,514
14	313,216	25,550
15	323,013	25,733
16	336,534	26,375

17	355,266	26,749
18	371,152	26,861
19	381,724	26,956

Without Project

Reach 3, Com, 2082

Stage	Damage	SD
3	0	0
4	263	469
5	8,363	2,456
6	82,575	11,048
7	154,885	15,233
8	181,986	16,623
9	194,041	17,446
10	229,469	18,684
11	258,713	19,318
12	269,808	19,412
13	273,695	19,497
14	281,252	19,658
15	294,056	19,779
16	317,421	20,299
17	438,672	25,095

Without Project

Reach 5, Com, 2082

Stage	Damage	SD
4	0	0
5	9,698	2,541
6	18,028	3,304
7	24,130	3,694
8	29,665	4,203
9	35,494	4,950
10	57,033	6,261
11	69,879	6,968
12	72,539	7,117
13	74,218	7,148
14	75,673	7,159

15	77,451	7,177
16	79,637	7,210
17	90,046	8,659
18	158,327	17,256
19	181,961	21,083

Without Project

Reach 7, Com, 2082

Stage	Damage	SD
4	0	0
5	9,848	3,146
6	23,897	5,258
7	37,665	7,383
8	44,804	8,411
9	48,033	8,837
10	118,923	16,158
11	122,108	16,265
12	123,111	16,277
13	125,293	16,296
14	130,445	16,327
15	133,631	16,412
16	137,587	16,462
17	143,815	16,555
18	148,527	16,600

Without Project

Reach 9, Com, 2082

Stage	Damage	SD
5	0	0
6	328	82
7	2,843	2,078
8	11,877	6,240
9	59,813	12,130
10	79,881	14,015
11	122,134	21,711
12	137,505	25,063
13	143,945	26,093

14	147,148	26,412
15	148,290	26,444
16	149,530	26,448
17	151,809	26,458
18	158,013	26,497
19	163,291	26,485
20	183,047	26,851

Without Project

Reach 1, Res, 2082

Stage	Damage	SD
4	0	0
5	263	247
6	733	337
7	1445	382
8	2456	368
9	3237	274
10	15521	1105
11	42221	1499
12	49955	1465
13	55302	1347
14	59178	1165
15	61443	1037
16	63257	1019
17	72281	1481
18	107038	1879
19	124601	1832
20	134097	1831

Without Project

Reach 2, Res, 2082

Stage	Damage	SD
4	0	0
5	703	271
6	11,172	843
7	20,416	910
8	89,005	1,969

9	268,339	3,469
10	315,600	3,363
11	345,205	3,091
12	363,342	2,845
13	377,010	2,607
14	387,780	2,453
15	398,217	2,415
16	412,618	2,489
17	433,254	2,590
18	449,316	2,606
19	460,339	2,600
20	466,763	2,548

Without Project

Reach 3, Res, 2082

Stage	Damage	SD
3	0	0
4	727	286
5	8,923	933
6	29,565	1,282
7	38,213	1,331
8	53,923	1,341
9	60,627	1,227
10	96,766	1,399
11	108,730	1,337
12	114,871	1,189
13	118,171	1,148
14	121,186	1,100
15	126,032	1,143
16	139,793	1,557
17	172,275	1,770
18	186,948	1,805

Without Project

Reach 5, Res, 2082

Stage	Damage	SD
4	0	0
5	12,948	1,269
6	27,634	1,589
7	40,897	1,671
8	52,146	1,747
9	65,392	1,972
10	150,050	3,266
11	257,021	3,778
12	324,869	4,034
13	395,253	3,961
14	449,633	3,714
15	487,775	3,368
16	514,772	3,218
17	573,539	4,062
18	720,125	4,793
19	807,486	4,897

Without Project

Reach 7, Res, 2082

Stage	Damage	SD
4	0	0
5	66,914	2,894
6	125,081	3,248
7	163,230	3,414
8	190,562	3,297
9	214,809	2,914
10	278,872	2,824
11	305,810	2,587
12	327,113	2,617
13	346,145	2,559
14	360,957	2,525
15	375,267	2,507
16	386,954	2,569

17	402,334	2,765
18	414,297	2,789

Without Project

Reach 9, Res, 2082

Stage	Damage	SD
5	0	0
6	1,200	462
7	148,835	2,780
8	199,055	3,176
9	344,469	4,070
10	398,311	4,053
11	442,949	3,959
12	474,421	3,719
13	495,339	3,453
14	511,861	3,226
15	526,881	3,076
16	543,703	3,006
17	561,989	2,982
18	579,822	3,001
19	600,915	3,204
20	692,218	4,479

With Project

Reach 1, Com, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0

14	21874	3998
15	26155	4539
16	81090	10865

With Project

Reach 2, Com, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	329,930	25,834
16	344,880	26,492
17	359,944	26,809
18	373,841	26,900

With Project

Reach 3, Com, 2032

Stage	Damage	SD
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0

14	0	0
15	0	0
16	471,235	27,247
17	492,398	27,999

With Project

Reach 5, Com, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	75,544	7,157
15	85,708	8,763
16	154,437	17,344
17	178,273	21,124

With Project

Reach 7, Com, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0

14	130,861	16,331
15	138,665	16,523
16	144,642	16,600

With Project

Reach 9, Com, 2032

Stage	Damage	SD
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	151,258	26,453
18	157,246	26,498
19	194,713	27,189

With Project

Reach 1, Res, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0

14	59714	1207
15	70655	1560
16	105377	1865

With Project

Reach 2, Res, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	411,370	2,557
16	427,615	2,594
17	442,689	2,599
18	455,818	2,561

With Project

Reach 3, Res, 2032

Stage	Damage	SD
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0

12	0	0
13	0	0
14	0	0
15	0	0
16	181,884	1,813
17	192,884	1,786

With Project

Reach 5, Res, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	451,457	3,825
15	533,107	4,387
16	689,143	4,894
17	780,001	4,934

With Project

Reach 7, Res, 2032

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0

13	0	0
14	368,151	2,646
15	391,720	2,811
16	408,227	2,837

With Project

Reach 9, Res, 2032

Stage	Damage	SD
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	558,041	3,015
18	598,079	3,680
19	723,364	4,545
20	798,282	4,583
21	841,670	4,623
22	873,685	4,296
23	896,427	3,905

With Project

Reach 1, Com, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0

9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	25889	4374
18	79651	10675
19	104795	13105
20	111641	14027

With Project

Reach 2, Com, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	355,266	26,749
18	371,152	26,861
19	381,724	26,956

With Project

Reach 3, Com, 2082

Stage	Damage	SD
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	438,672	25,095

With Project

Reach 5, Com, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	90,046	8,659
18	158,327	17,256

19	181,961	21,083

With Project

Reach 7, Com, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	143,815	16,555
18	148,527	16,600

With Project

Reach 9, Com, 2082

Stage	Damage	SD
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	151,809	26,458

18	158,013	26,497
19	163,291	26,485
20	183,047	26,851

With Project

Reach 1, Res, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	72281	1481
18	107038	1879
19	124601	1832
20	134097	1831

With Project

Reach 2, Res, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0

12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	433,254	2,590
18	449,316	2,606
19	460,339	2,600
20	466,763	2,548

With Project

Reach 3, Res, 2082

Stage	Damage	SD
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	172,275	1,770
18	186,948	1,805

With Project

Reach 5, Res, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0

8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	573,539	4,062
18	720,125	4,793
19	807,486	4,897

With Project

Reach 7, Res, 2082

Stage	Damage	SD
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	402,334	2,765
18	414,297	2,789

With Project

Reach 9, Res, 2082

Stage	Damage	SD

5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	579,822	3,001
19	600,915	3,204
20	692,218	4,479

Section 12

Cost Certification Addendum and the Recommended Plan

Prior to the identification of the Recommended Plan and the completion of the analysis, the certified cost estimate of the measures comprising the Optimized TSP were released. The updated results are summarized in Table 12.1. Due to increases in compensatory mitigation cost and implementation contingencies, the Mile Branch Channel Improvements Measure is no longer economically justified and was screened from the Optimized TSP. Table 12.1-2 displays the updated results for the Recommended Plan without the inclusion of the Channel Improvements at Mile Branch. The price level of the damages and benefits was escalated to FY24 and recalculated using the FY24 Federal Discount Rate. The Updated Total Project Cost Sheets displaying the certified cost of these measures are displayed in Figures 12.1-1 through 12.1-3. The Recommended Plan is displayed in Figure 12.1-4.

Table 12.1-1

Net Benefit Summary of the Optimized TSP FY24 Price Level and Discount Rate, $1,000s			
Measure	**Slidell Levee and Floodwall**	**Nonstructural**	**Mile Branch Channel Improvements**
Project First Cost	$2,881,740	$3,012,488	$88,350
Interest During Construction	$136,083	$10,233	$7,908
Total Investment Cost	$3,017,823	$3,022,721	$96,258
AA Investment Costs	$107,443	$111,964	$3,566
AA O&M Costs	$7,753	$0	$166
Total AA Costs	$115,196	$111,964	$3,732
Without Project EAD	$537,780	$537,780	$537,780
EAD Reduced Benefits	$159,036	$213,455	$3,428
Net Benefits	$43,840	$101,491	-304
B/C Ratio	1.4	1.9	0.9

Table 12.1-2

Net Benefit Summary of the Recommended Plan FY24 Price Level and Discount Rate, $1,000s			
Measure	**Slidell Levee and Floodwall**	**Nonstructural**	**Recommended Plan**
Project First Cost	$2,881,740	$3,012,488	$5,894,228
Interest During Construction	$136,083	$10,233	$146,316
Total Investment Cost	$3,017,823	$3,022,721	$6,040,544
AA Investment Costs	$107,443	$111,964	$219,407
AA O&M Costs	$7,753	$0	$7,753
Total AA Costs	$115,196	$111,964	$227,160
Without Project EAD	$537,780	$537,780	$537,780
EAD Reduced Benefits	$159,036	$213,455	$372,491
Net Benefits	$43,840	$101,491	$145,331
B/C Ratio	1.4	1.9	1.6

Figure 12.1-1, Mile Branch TPCS

Civil Works Work Breakdown Structure		ESTIMATED COST			
		Estimate Prepared:			7-Nov-23
		Effective Price Level:			1-Oct-23
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)
A	*B*	*C*	*D*	*E*	*F*
	Mile Branch				
02	RELOCATIONS	$678	$373	55.0%	$1,050
06	FISH & WILDLIFE FACILITIES	$6,929	$3,811	55.0%	$10,741
06	FISH & WILDLIFE FACILITIES	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	55.0%	$0
13	PUMPING PLANT	$0	$0	55.0%	$0
15	FLOODWAY CONTROL & DIVERSION STRUCTURE	$0	$0	55.0%	$0
08	ROADS, RAILROADS & BRIDGES	$12,363	$6,800	55.0%	$19,163
09	CHANNELS & CANALS	$9,713	$5,342	55.0%	$15,056
	CONSTRUCTION ESTIMATE TOTALS:	$29,684	$16,326	55.0%	**$46,010**
01	LANDS AND DAMAGES	$22,278	$5,569	25.0%	$27,847
30	PLANNING, ENGINEERING & DESIGN				
1.5%	Project Management	$445	$245	55.0%	$690
1.0%	Planning & Environmental Compliance	$297	$163	55.0%	$460
12.0%	Engineering & Design	$3,562	$1,959	55.0%	$5,521
1.0%	Reviews, ATRs, IEPRs, VE	$297	$163	55.0%	$460
0.5%	Life Cycle Updates (cost, schedule, risks)	$148	$82	55.0%	$230
0.5%	Contracting & Reprographics	$148	$82	55.0%	$230
2.0%	Engineering During Construction	$594	$327	55.0%	$920
1.0%	Planning During Construction	$297	$163	55.0%	$460
0.5%	Adaptive Management & Monitoring	$148	$82	55.0%	$230
0.5%	Project Operations	$148	$82	55.0%	$230
31	CONSTRUCTION MANAGEMENT				
10.0%	Construction Management	$2,968	$1,633	55.0%	$4,601
0.5%	Project Operation:	$148	$82	55.0%	$230
0.5%	Project Management	$148	$82	55.0%	$230
	CONTRACT COST TOTALS:	$61,312	$27,038		**$88,350**

Figure 12.1-2, Slidell Levee TPCS

Civil Works Work Breakdown Structure		ESTIMATED COST			
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F
02	RELOCATIONS	$21,299	$10,863	51.0%	$32,162
06	FISH & WILDLIFE FACILITIES	$45,108	$23,005	51.0%	$68,114
06	FISH & WILDLIFE FACILITIES	$12,312	$6,279	51.0%	$18,591
11	LEVEES & FLOODWALLS	$142,687	$72,770	51.0%	$215,457
11	LEVEES & FLOODWALLS	$49,572	$25,282	51.0%	$74,853
11	LEVEES & FLOODWALLS	$54,980	$28,040	51.0%	$83,020
11	LEVEES & FLOODWALLS	$47,106	$24,024	51.0%	$71,131
11	LEVEES & FLOODWALLS	$33,863	$17,270	51.0%	$51,132
11	LEVEES & FLOODWALLS	$284,115	$144,899	51.0%	$429,013
11	LEVEES & FLOODWALLS	$41,989	$21,415	51.0%	$63,404
13	PUMPING PLANT	$604,016	$308,048	51.0%	$912,064
15	FLOODWAY CONTROL & DIVERSION STRUCTURE	$87,227	$44,486	51.0%	$131,713
08	ROADS, RAILROADS & BRIDGES	$0	$0	-	$0
09	CHANNELS & CANALS	$0	$0	-	$0
19	BUILDINGS, GROUNDS & UTILITIES	$0	$0	-	$0
18	CULTURAL RESOURCE PRESERVATION	$0	$0	-	$0
	CONSTRUCTION ESTIMATE TOTALS:	$1,424,274	$726,380	51%	$2,150,654
01	LANDS AND DAMAGES	$42,904	$10,726	25.0%	$53,630
30	PLANNING, ENGINEERING & DESIGN	$291,976	$148,908	51.0%	$440,884
31	CONSTRUCTION MANAGEMENT	$156,670	$79,902	51.0%	$236,572
	PROJECT COST TOTALS:	$1,915,825	$965,916	50.4%	$2,881,740

Figure 12.1-3, Nonstructural Plan TPCS

Civil Works Work Breakdown Structure		ESTIMATED COST			
		Estimate Prepared:			7-Nov-23
		Effective Price Level:			1-Oct-23
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*
	Non-Structural				
02	RELOCATIONS	$0	$0	0.0%	$0
06	FISH & WILDLIFE FACILITIES	$0	$0	0.0%	$0
06	FISH & WILDLIFE FACILITIES	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
11	LEVEES & FLOODWALLS	$0	$0	0.0%	$0
13	PUMPING PLANT	$0	$0	0.0%	$0
15	FLOODWAY CONTROL & DIVERSION STRUCTURE	$0	$0	0.0%	$0
08	ROADS, RAILROADS & BRIDGES	$0	$0	0.0%	$0
09	CHANNELS & CANALS	$0	$0	0.0%	$0
19	BUILDINGS, GROUNDS & UTILITIES	$1,605,522	$690,374	43.0%	$2,295,896
18	CULTURAL RESOURCE PRESERVATION	$13,523	$5,815	43.0%	$19,338
	CONSTRUCTION ESTIMATE TOTALS:	$1,619,044.7492	$696,189	43.0%	**$2,315,234**
01	LANDS AND DAMAGES	$150,322	$37,581	25.0%	$187,903
30	PLANNING, ENGINEERING & DESIGN				
2.5%	Project Management	$40,476	$17,405	43.0%	$57,881
1.0%	Planning & Environmental Compliance	$16,190	$6,962	43.0%	$23,152
4.5%	Engineering & Design	$72,857	$31,329	43.0%	$104,186
1.0%	Reviews, ATRs, IEPRs, VE	$16,190	$6,962	43.0%	$23,152
1.0%	Life Cycle Updates (cost, schedule, risks)	$16,190	$6,962	43.0%	$23,152
1.0%	Contracting & Reprographics	$16,190	$6,962	43.0%	$23,152
2.0%	Engineering During Construction	$32,381	$13,924	43.0%	$46,305
1.0%	Planning During Construction	$16,190	$6,962	43.0%	$23,152
0.0%	Adaptive Management & Monitoring	$0	$0	43.0%	$0
0.0%	Project Operations	$0	$0	43.0%	$0
31	CONSTRUCTION MANAGEMENT				
5.5%	Construction Management	$89,047	$38,290	43.0%	$127,338
1.0%	Project Operation:	$16,190	$6,962	43.0%	$23,152
1.5%	Project Management	$24,286	$10,443	43.0%	$34,729
	CONTRACT COST TOTALS:	$2,125,557	$886,931		**$3,012,488**

Figure 12.1-4, The Recommended Plan