Mississippi Valley Division, Regional
Planning and Environment Division South

Pearl River Basin, Mississippi Federal Flood Risk Managment Project

APPENDIX R-ECONOMICS

July 2025

Contents

List of Figures

List of Tables

SECTION 1 INTRODUCTION

This appendix contains the documentation of economic evaluation of the of the Pearl River ASA Validation Effort. This appendix was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. 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).

The HEC-FDA model version 1.4.3 was used to calculate the damages and benefits associated with residential and nonresidential structures and their contents along with associated vehicles and debris removal costs. The damages, benefits, and costs used in the analysis were calculated using FY 2025 price levels. The FY 2025 Federal discount rate of 3 percent was used to calculate interest during construction for the alternatives 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) throughout the 50-year period of analysis back to the 2032 (project base year).

1.1 Structure Inventory

There are 5,420 residential structures and 2,226 non-residential structures in the total structure inventory. The source of the inventory is the National Structure Inventory (NSI) version 2022 with modifications. RS Means data was used to calculate the depreciated replacement value of structures based on their effective age. 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.

1.2 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.

Table 1

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%
Eating and Recreation	80%	123%
Retail	80%	123%
Repair	80%	123%
Restaurant	80%	123%
Grocery	80%	123%
Professional	80%	123%
Warehouse	80%	123%

1.3 Structure Elevation and Uncertainty

Foundation heights were surveyed using a statistically significant windshield survey in Google Street View. Approximately 500 structures were surveyed. The foundation heights represent an average of the occupancy types surveyed.

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.

Table 2: Foundation Heights and Uncertainty by Occupancy Type

Occupancy Type	Foundation Height	Standard Deviation
1sty-Residential	1.1	0.9
2sty-Residential	0.5	0.2
Mobile Homes	1.5	0.6
Multi-Family Residence	0.75	0.3
Grocery	0.7	0.3
Eating and Recreation	0.6	0.3
Professional	0.6	0.5
Public	0.5	0.2
Repair	0.7	0.5
Retail	0.6	0.5
Warehouse	0.8	0.4

1.4 Depth-damage Functions and Content-to-Structure Value Ratios**.**

Long duration, freshwater depth-damage functions from the Donaldsonville to the Gulf study were used in this analysis. These functions were developed through expert elicitation for a feasibility study in southeast Louisiana. Since site-specific depth-damage relationships were not available for the Pearl River study area, the freshwater, long duration (average of one-week) depth-damage relationships developed by a panel of building, construction, restoration and insurance experts for the Donaldsonville to the Gulf, Louisiana feasibility study were used in the economic analysis for residential and non-residential structures. These relationships were deemed appropriate because the two study areas have similar riverine topography and hydrology and similar structure categories and occupancies. Both study areas are susceptible to flooding from riverine flooding associated with heavy rainfall events. Both areas also have a similar climate with a comparable propensity for mold development.

Content-to- structure value ratios (CSVRs) were developed based on the on-site interviews conducted as part of the Jefferson-Orleans, Donaldsonville to the Gulf, and Morganza to the Gulf evaluations. These interviews were conducted with the owners of a sample of structures from each of the three residential content categories and each of the eight non-residential content categories from each of the three evaluation areas.

A CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from the surveys. An average CSVR and standard deviation for each occupancy type was calculated as the average of the individual structure CSVRs.

Table 3: Content-to-Structure Value Ratios and Uncertainty by Occupancy Type

Occupancy Type	(CSVR,SD)
One-story	(0.69, 0.9)
Two-story	(0.67, 0.35)
Mobile home	(1.14, 0.79)
Eating and Recreation	(1.70, 2.93)
Groceries and Gas Stations	(1.34, 0.78)
Professional Buildings	(0.54, 0.54)
Public and Semi-Public Buildings	(0.55, 0.80)
Multi-Family Buildings	(0.28, 0.17)
Repair and Home Use	(2.36, 2.95)
Retail and Personal Services	(1.19, 1.05)
Warehouses and Contractor Services	(2.07. 3.25)

1.5 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.

To account for the cost/damage surrounding debris removal, 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 2025 price levels using the indexes provided by Gordian's 2025 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.

Table 4

Debris Removal Cost by Occupancy Type FY25 Price Level	
Occupancy Type	Freshwater
Mobile Home	$8,920
One-Story Pier Home	$9,235
One-Story Slab Home	$9,186
Two-Story Pier Home	$9,235
Two-Story Slab Home	$9,186
Multi-Family Residence	$13,745
Eating or Recreation Facility	$54,277
Professional Office	$55,370
Public Facility	$55,370
Retail Business	$55,024
Repair Facility	$54,142
Warehouse	$67,769

1.6 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 cost's 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.

1.7 VEHICLES

The average used car value of $32,065 as of December 2024 was assigned as the vehicle value associated with each single-family residential structure. Jackson, Mississippi, has an average of two vehicles per household. A 50% vehicle evacuation rate was used for this evaluation based on a six-hour warning time as presented in EGM 09-04. For multi-family structures, 25 vehicles were assigned with a 50% evacuation.

A triangular distribution was used to capture uncertainty in the vehicle value. For the high value, the average value of a new vehicle was used, $44,050, with a resulting maximum structure value error of 160%. For the low value, the ten-year depreciated value of an average new vehicle, $4,400, was used with a resulting minimum structure value error of 14%.

1.8 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.

1.9 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.

1.10 Study Area Reaches

The study area was divided into the twenty-four reach delineations shown in figure 1. These reaches were delineated based on hydrologic separability. The largest damage centers in the study area are reaches 5, 9, 12, 22, and 28.

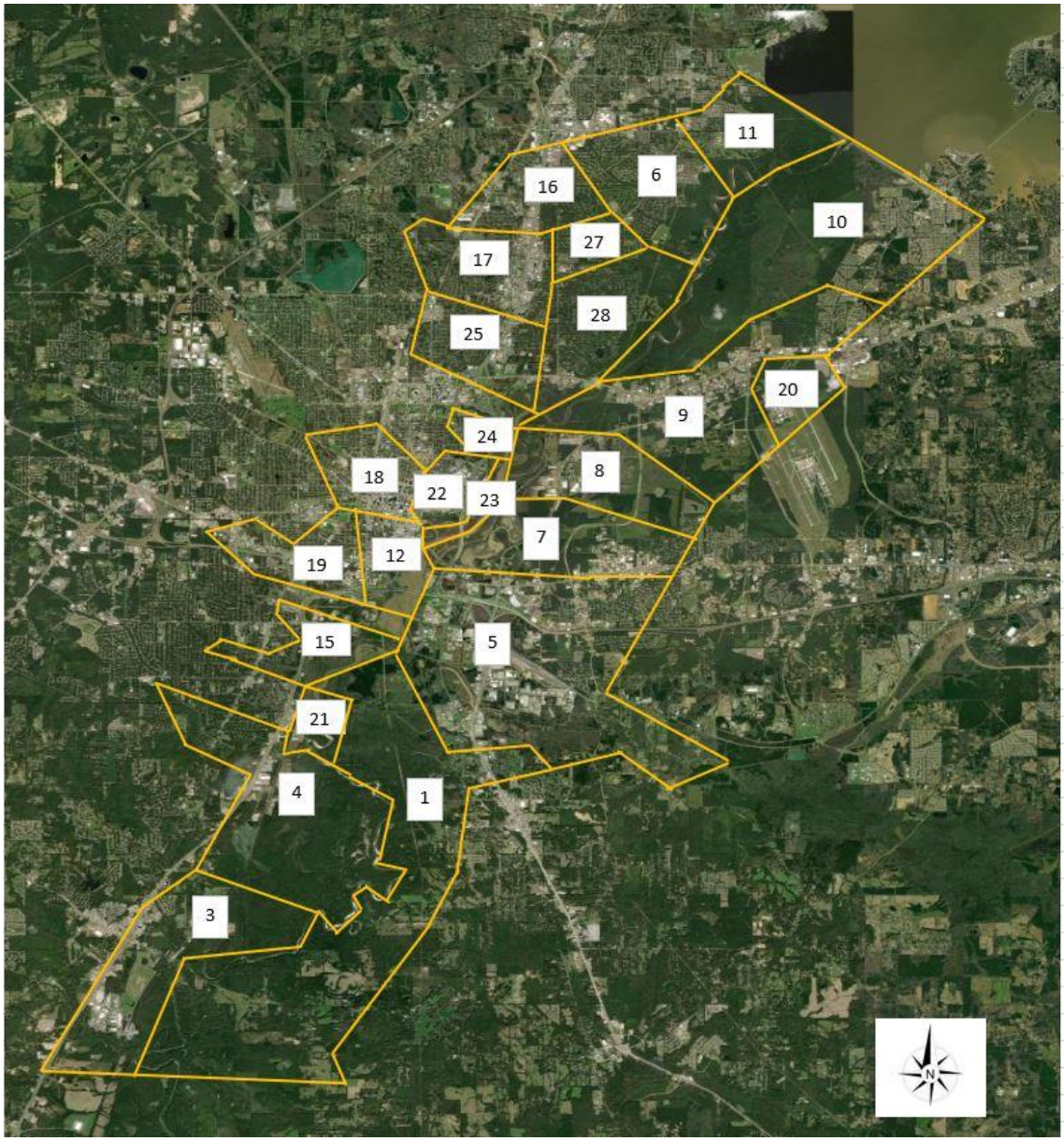

Figure 1: Study Area Reaches

1.11 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. 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.

1.12 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. Stages were provided for the 0.2, 0.1, 0.04, 0.02, 0.01, 0.005, and 0.002 AEP events. Due to the presence of extensive backwater effects throughout the study area, stage-discharge functions were not incorporated into the analysis.

1.13 Expected Annual Damages (EAD)

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. For this study effort, hydrologic conditions are estimated to remain relatively constant in the study area throughout the period of analysis, so EAD was only calculated for existing conditions.

1.14 Without-Project Damages

The expected annual damages (EAD) in the study area are estimated to be $23,804,000 under existing conditions. The EAD by category is shown in table 5. It should be noted that debris removal costs are included in the residential and nonresidential categories.

Table 5: Expected Annual Damages by Category, FY25 Price Level, $

Residential	Nonresidential	Auto	Total
5,164,000	16,018,000	1,622,000	22,804,000

Additional damage/cost categories are displayed in Table 6.

Table 6: Additional Annual Damages by Category, FY25 Price Level, $

Cleanup Costs	1,552,160
Emergency Cost	120,450
Water and Sewer Treatment Cost	365,000
Traffic Delay Cost	1,986,700
NFIP Operating Cost	79,830
Wastewater Treatment Plant	216,340
Transportation Infrastructure	816,400

Alternative A1: USACE Nonstructural Plan

An assessment of structures located in the 10 percent, 4 percent, 2 percent, and 1 percent AEP floodplains was performed for the portions of the study are subject to flooding from the main stem of the Pearl River and backwater flooding on the tributaries. Structure elevation and dry floodproofing were the measures considered for the nonstructural alternative. For the analysis, residential structures were to be elevated to the 1% AEP/BFE plus one foot, up to 13 feet above the ground, and nonresidential structures were to be floodproofed up to 3 feet above the ground. All nonstructural components would be implemented on a voluntary basis in cooperation with the property owner.

Table 7: Noncumulative Nonstructural Benefits for Study Area for Elevating and Floodproofing, FY25 Price Level and Discount Rate

	(10% AEP)	(4% AEP)	(2% AEP)	(1% AEP)
Project First Cost	$854,660	$15,377,200	$93,582,000	$293,590,500
Interest During Construction	$3,170	$57,027	$347,050	$1,088,790
Total Investment Cost	$857,830	$15,434,227	$93,929,050	$294,679,290
AA Investment Cost	$33,340	$599,860	$3,650,600	$11,452,860
Benefits EAD Reduced	$120,200	$707,670	$1,504,430	$1,636,650
Net Benefits	$86,860	$107,810	$(2,146,170)	$(9,816,210)
B/C Ratio	3.6	1.2	0.4	0.1

Based on an incremental floodplain analysis, the 10 percent and 4 percent incremental AEP floodplains were both economically justified. Approximately 54 structures, 28 residential and 26 nonresidential, are included in this cumulative 4 percent AEP floodplain. The cumulative results of the 4 percent AEP floodplain are displayed in Table 3-3. This nonstructural plan is referred to as Alternative A1.

Table 8: Summary of Results for the nonstructural component of Alternative A1, FY25 Price Level and Discount Rate

Project First Cost	$16,232,000
Interest During Construction	$60,000
Total Investment Cost	$16,292,000
AA Investment Cost	$633,200
Benefits EAD Reduced	$827,900
Net Benefits	$194,700
B/C Ratio	1.3

1.15 Development of Nonstructural Costs

Alternative A1 Nonstructural Costs: 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 1% AEP/ BFE, 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 (Table 3-1). 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. Using previous USACE nonstructural study costs, preconstruction, engineering, and design (PED) and construction management were accounted for by taking 12% and 9% of the construction costs respectively. Also, a contingency of 43% was added to the cost of implementation. This contingency was selected for use from another recent Feasibility Study consisting of nonstructural features with certified costs.

Table 9: Cost per Square Foot of Structure Raising by Occupancy Type and Number of Feet raised, FY 2025 Price Level

Ft. Elevated	1STY-SLAB	2STY-SLAB	1STY-PIER	2STY-PIER	MOBILE HOME
1	114	126	101	112	56
2	114	126	101	112	56
3	117	128	105	116	56
4	121	137	105	116	56
5	121	137	105	116	69
6	123	139	108	118	69
7	123	139	108	118	69
8	127	144	111	121	69
9	127	144	111	121	69
10	127	144	111	121	69
11	127	144	111	121	69
12	127	144	111	121	69
13	132	151	112	123	69

1.16 Alternative A1 Nonstructural Costs: Non-Residential Structures

The dry flood proofing feature 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 $152,200; between 20,000 and 100,000 square feet equaled $464,400; and greater than 100,000 square feet equaled $1,168,000. These costs were developed by contacting local contractors and were escalated to FY 2025 prices. PED and construction management were accounted for by taking 12% and 9% of the construction costs respectively. Also, a contingency of 43% was added to the cost of implementation.

Alternative A1

In addition to the nonstructural component, alternative A1 includes a local levee providing flood risk reduction to the Canton Club neighborhood.

Alternatives D1 and E1

Both alternatives D1 and E1 include channel improvements on the Pearl River, the construction of four local levees at Canton Club, McLeod, Caney Creek, and Richland, and improvements of the existing levee at the wastewater treatment plant. Alternative

D1 also includes the construction of a weir for the purpose of creating a lake for recreation purposes.

Costs

The total project costs for Alternatives D1 and E1 are shown below at a high and low-cost scenario. The range in these estimates reflects the estimated range in environmental mitigation cost. The construction schedule is currently estimated to be three years for both alternatives D1 and E1.

Table 10: Cost Estimate for Alternative D1, Low Cost

**** TOTAL PROJECT COST SUMMARY ****

Printed:5/31/2025
Page 1 of 11

PROJECT: Pearl River Feasibility - Alt D1 - Low
PROJECT NO:
LOCATION: Jackson, MS

DISTRICT: Vicksburg District
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/31/2025

This Estimate reflects the scope and schedule in report;

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2025 Effective Price Level Date: 1 OCT 24									
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 1-Oct-24 ($K)	TOTAL FIRST COST ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
02	RELOCATIONS	$4,637	$2,179	47.0%	$6,816	0.0%	$4,637	$2,179	$6,816	$0	$6,816	8.1%	$5,013	$2,356	$7,370
04	DAMS	$30,815	$14,483	47.0%	$45,298	0.0%	$30,815	$14,483	$45,298	$0	$45,298	29.4%	$39,873	$18,740	$58,613
06	FISH & WILDLIFE FACILITIES	$63,630	$29,906	47.0%	$93,536	0.0%	$63,630	$29,906	$93,536	$0	$93,536	19.8%	$76,232	$35,829	$112,061
09	CHANNELS & CANALS	$199,385	$93,711	47.0%	$293,096	0.0%	$199,385	$93,711	$293,096	$0	$293,096	19.8%	$238,871	$112,269	$351,140
11	LEVEES & FLOODWALLS	$71,163	$33,447	47.0%	$104,610	0.0%	$71,163	$33,447	$104,610	$0	$104,610	20.3%	$85,576	$40,221	$125,796
13	PUMPING PLANT	$30,707	$14,432	47.0%	$45,139	0.0%	$30,707	$14,432	$45,139	$0	$45,139	19.8%	$36,788	$17,290	$54,079
14	RECREATION FACILITIES	$3,935	$1,849	47.0%	$5,784	0.0%	$3,935	$1,849	$5,784	$0	$5,784	19.8%	$4,714	$2,216	$6,930
16	BANK STABILIZATION	$56,725	$26,661	47.0%	$83,385	0.0%	$56,725	$26,661	$83,385	$0	$83,385	19.7%	$67,877	$31,902	$99,779
	CONSTRUCTION ESTIMATE TOTALS:	$460,996	$216,668		$677,665	0.0%	$460,996	$216,668	$677,665	$0	$677,665	20.4%	$554,944	$260,824	$815,767
01	LANDS AND DAMAGES	$80,704	$20,176	25.0%	$100,880	0.0%	$80,704	$20,176	$100,880	$0	$100,880	8.1%	$87,238	$21,810	$109,048
30	PLANNING, ENGINEERING & DESIGN	$36,649	$17,225	47.0%	$53,874	0.0%	$36,649	$17,225	$53,874	$0	$53,874	10.5%	$40,509	$19,039	$59,548
31	CONSTRUCTION MANAGEMENT	$27,660	$13,000	47.0%	$40,660	0.0%	$27,660	$13,000	$40,660	$0	$40,660	24.5%	$34,449	$16,191	$50,640
	PROJECT COST TOTALS:	$606,009	$267,069	44.1%	$873,079		$606,009	$267,069	$873,079	$0	$873,079	18.5%	$717,140	$317,863	$1,035,003

Table 11: Cost Estimate for Alternative D1, High Cost

**** TOTAL PROJECT COST SUMMARY ****

Printed:5/31/2025
Page 1 of 11

PROJECT: Pearl River Feasibility - Alt D1 - High
PROJECT NO:
LOCATION: Jackson, MS

DISTRICT: Vicksburg District
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/31/2025

This Estimate reflects the scope and schedule in report;

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2025 Effective Price Level Date: 1 OCT 24									
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 1-Oct-24 ($K)	TOTAL FIRST COST ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
02	RELOCATIONS	$4,637	$2,179	47.0%	$6,816	0.0%	$4,637	$2,179	$6,816	$0	$6,816	8.1%	$5,013	$2,356	$7,370
04	DAMS	$30,815	$14,483	47.0%	$45,298	0.0%	$30,815	$14,483	$45,298	$0	$45,298	29.4%	$39,873	$18,740	$58,613
06	FISH & WILDLIFE FACILITIES	$90,356	$42,467	47.0%	$132,823	0.0%	$90,356	$42,467	$132,823	$0	$132,823	19.8%	$108,251	$50,878	$159,129
09	CHANNELS & CANALS	$199,385	$93,711	47.0%	$293,096	0.0%	$199,385	$93,711	$293,096	$0	$293,096	19.8%	$238,871	$112,269	$351,140
11	LEVEES & FLOODWALLS	$71,163	$33,447	47.0%	$104,610	0.0%	$71,163	$33,447	$104,610	$0	$104,610	20.3%	$85,576	$40,221	$125,796
13	PUMPING PLANT	$30,707	$14,432	47.0%	$45,139	0.0%	$30,707	$14,432	$45,139	$0	$45,139	19.8%	$36,788	$17,290	$54,079
14	RECREATION FACILITIES	$3,935	$1,849	47.0%	$5,784	0.0%	$3,935	$1,849	$5,784	$0	$5,784	19.8%	$4,714	$2,216	$6,930
16	BANK STABILIZATION	$56,725	$26,661	47.0%	$83,385	0.0%	$56,725	$26,661	$83,385	$0	$83,385	19.7%	$67,877	$31,902	$99,779
	CONSTRUCTION ESTIMATE TOTALS:	$487,722	$229,229		$716,952	0.0%	$487,722	$229,229	$716,952	$0	$716,952	20.3%	$586,963	$275,872	$862,835
01	LANDS AND DAMAGES	$80,704	$20,176	25.0%	$100,880	0.0%	$80,704	$20,176	$100,880	$0	$100,880	8.1%	$87,238	$21,810	$109,048
30	PLANNING, ENGINEERING & DESIGN	$38,774	$18,224	47.0%	$56,998	0.0%	$38,774	$18,224	$56,998	$0	$56,998	10.5%	$42,856	$20,143	$62,999
31	CONSTRUCTION MANAGEMENT	$29,263	$13,754	47.0%	$43,017	0.0%	$29,263	$13,754	$43,017	$0	$43,017	24.5%	$36,433	$17,123	$53,556
	PROJECT COST TOTALS:	$636,464	$281,383	44.2%	$917,847		$636,464	$281,383	$917,847	$0	$917,847	18.6%	$753,490	$334,948	$1,088,438

Table 12: Cost Estimate for Alternative E1, Low Cost

**** TOTAL PROJECT COST SUMMARY ****

Printed:5/31/2025
Page 1 of 11

PROJECT: Pearl River Feasibility - Alt E1 - Low
PROJECT NO:
LOCATION: Jackson, MS

DISTRICT: Vicksburg District
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/31/2025

This Estimate reflects the scope and schedule in report;

Civil Works Work Breakdown Structure		ESTIMATED|COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2025 Effective Price Level Date: 1 OCT 24									
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 1-Oct-24 ($K)	TOTAL FIRST COST ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
02	RELOCATIONS	$4,637	$2,226	48.0%	$6,863	0.0%	$4,637	$2,226	$6,863	$0	$6,863	8.1%	$5,013	$2,406	$7,420
04	DAMS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$52,095	$25,006	48.0%	$77,101	0.0%	$52,095	$25,006	$77,101	$0	$77,101	26.1%	$65,700	$31,536	$97,236
09	CHANNELS & CANALS	$199,721	$95,866	48.0%	$295,587	0.0%	$199,721	$95,866	$295,587	$0	$295,587	19.8%	$239,273	$114,851	$354,125
11	LEVEES & FLOODWALLS	$43,063	$20,670	48.0%	$63,733	0.0%	$43,063	$20,670	$63,733	$0	$63,733	16.4%	$50,137	$24,066	$74,203
13	PUMPING PLANT	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
14	RECREATION FACILITIES	$3,935	$1,889	48.0%	$5,823	0.0%	$3,935	$1,889	$5,823	$0	$5,823	26.1%	$4,962	$2,382	$7,344
16	BANK STABILIZATION	$56,725	$27,228	48.0%	$83,953	0.0%	$56,725	$27,228	$83,953	$0	$83,953	19.7%	$67,877	$32,581	$100,458
	CONSTRUCTION ESTIMATE TOTALS:	$360,175	$172,884		$533,060	0.0%	$360,175	$172,884	$533,060	$0	$533,060	20.2%	$432,963	$207,822	$640,785
01	LANDS AND DAMAGES	$80,704	$20,176	25.0%	$100,880	0.0%	$80,704	$20,176	$100,880	$0	$100,880	8.1%	$87,238	$21,810	$109,048
30	PLANNING, ENGINEERING & DESIGN	$28,634	$13,744	48.0%	$42,378	0.0%	$28,634	$13,744	$42,378	$0	$42,378	10.5%	$31,647	$15,190	$46,837
31	CONSTRUCTION MANAGEMENT	$21,611	$10,373	48.0%	$31,984	0.0%	$21,611	$10,373	$31,984	$0	$31,984	24.4%	$26,879	$12,902	$39,781
	PROJECT COST TOTALS:	$491,124	$217,178	44.2%	$708,301		$491,124	$217,178	$708,301	$0	$708,301	18.1%	$578,726	$257,724	$836,450

Table 13: Cost Estimate for Alternative E1, High Cost

**** TOTAL PROJECT COST SUMMARY ****

Printed:5/31/2025
Page 1 of 11

PROJECT: Pearl River Feasibility - Alt E1 - High
PROJECT NO:
LOCATION: Jackson, MS

DISTRICT: Vicksburg District
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 5/31/2025

This Estimate reflects the scope and schedule in report;

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2025 Effective Price Level Date: 1 OCT 24									
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 1-Oct-24 ($K)	TOTAL FIRST COST ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
02	RELOCATIONS	$4,637	$2,226	48.0%	$6,863	0.0%	$4,637	$2,226	$6,863	$0	$6,863	8.1%	$5,013	$2,406	$7,420
04	DAMS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$78,821	$37,834	48.0%	$116,655	0.0%	$78,821	$37,834	$116,655	$0	$116,655	26.1%	$99,405	$47,715	$147,120
09	CHANNELS & CANALS	$199,721	$95,866	48.0%	$295,587	0.0%	$199,721	$95,866	$295,587	$0	$295,587	19.8%	$239,273	$114,851	$354,125
11	LEVEES & FLOODWALLS	$43,063	$20,670	48.0%	$63,733	0.0%	$43,063	$20,670	$63,733	$0	$63,733	16.4%	$50,137	$24,066	$74,203
13	PUMPING PLANT	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
14	RECREATION FACILITIES	$3,935	$1,889	48.0%	$5,823	0.0%	$3,935	$1,889	$5,823	$0	$5,823	26.1%	$4,962	$2,382	$7,344
16	BANK STABILIZATION	$56,725	$27,228	48.0%	$83,953	0.0%	$56,725	$27,228	$83,953	$0	$83,953	19.7%	$67,877	$32,581	$100,458
	CONSTRUCTION ESTIMATE TOTALS:	$386,901	$185,713		$572,614	0.0%	$386,901	$185,713	$572,614	$0	$572,614	20.6%	$466,669	$224,001	$690,669
01	LANDS AND DAMAGES	$80,704	$20,176	25.0%	$100,880	0.0%	$80,704	$20,176	$100,880	$0	$100,880	8.1%	$87,238	$21,810	$109,048
30	PLANNING, ENGINEERING & DESIGN	$30,759	$14,764	48.0%	$45,523	0.0%	$30,759	$14,764	$45,523	$0	$45,523	10.6%	$34,004	$16,322	$50,326
31	CONSTRUCTION MANAGEMENT	$23,214	$11,143	48.0%	$34,357	0.0%	$23,214	$11,143	$34,357	$0	$34,357	24.9%	$28,987	$13,914	$42,901
	PROJECT COST TOTALS:	$521,578	$231,796	44.4%	$753,374		$521,578	$231,796	$753,374	$0	$753,374	18.5%	$616,898	$276,046	$892,945

1.17 Benefit Estimation

The itemized damages and benefits for alternatives D1 and E1 are shown below. USACE estimated the damages and benefits attributed to structures, contents, vehicles, and debris removal. The benefit categories of Cleanup Costs, Road and Bridge, Water and Sewer, the Wastewater Treatment Plant (WWTP), and Traffic were taken from the sponsor's report and escalated to the FY25 price level. The recreation benefits for alternatives D1 and E1 were updated using the latest Unit Day Values from EGM 25-04.

Table 14

Summary of Damages and Benefits Alternative E1 FY 25 Price Level				
Category	Without Project Damages	With Project Damages	Damages Reduced/Benefits	Benefit Percentage
Structures, Contents, Vehicles, Debris Removal	22,800,000	7,140,000	15,660,000	62.1%
Cleanup Costs	1,552,170	481,170	1,071,000	4.2%
Emergency Cost	120,450	37,340	83,110	0.3%
Water and Sewer Treatment Cost	364,960	113,140	251,820	1.0%
Traffic Delay Cost	1,986,720	130,810	1,855,910	7.4%
NFIP Operating Cost	79,830	7,170	72,660	0.3%
Wastewater Treatment Plant	216,340	0	216,340	0.9%
Transportation Infrastructure	816,450	253,100	563,350	2.2%
Recreation	0	0	5,439,000	21.6%
Total	27,936,920	8,162,730	25,213,190	100%

Table 15

Summary of Damages and Benefits Alternative D1 FY 25 Price Level				
Category	Without Project Damages	With Project Damages	Damages Reduced	Benefit Percentage
Structures, Contents, Vehicles, Debris Removal	22,800,000	7,140,000	15,640,000	62.0%
Cleanup Costs	1,552,170	481,170	1,071,000	4.2%
Emergency Cost	120,450	37,340	83,110	0.3%
Water and Sewer Treatment Cost	364,960	113,140	251,820	1.0%
Traffic Delay Cost	1,986,720	130,810	1,855,910	7.4%
NFIP Operating Cost	79,830	7,170	72,660	0.3%
Wastewater Treatment Plant	216,340	0	216,340	0.9%
Transportation Infrastructure	816,450	253,100	563,350	2.2%
Recreation	0	0	5,439,000	21.6%
Total	27,936,920	8,182,730	25,193,190	100%

1.18 Results

The summary of results is shown below for alternatives A1, D1, and E1. Of the three alternatives, only A1 produces positive net benefits. Although both alternatives D1 and E1 yield nearly fourteen times the benefits of A1, the estimated annual cost of these alternatives exceeds their annual benefits.

Table 16

Pearl River-Updated Summary of Results FY 25 Price Level and Discount Rate $					
	D1		E1		A1
	High Cost	Low Cost	High Cost	Low Cost	
Project First Cost	$917,847,000	$873,079,000	$753,374,000	$708,301,000	$22,256,860
Interest During Construction	$41,995,630	$39,947,300	$34,470,250	$32,408,000	$150,572
Total Investment Cost	$959,842,630	$913,026,300	$787,844,250	$740,709,000	$22,407,432
Average Annual Cost	$37,304,800	$35,485,200	$30,619,956	$28,788,020	$870,880
Average Annual O&M Cost	$730,000	$730,000	$197,000	$197,000	$20,340
Total AA Cost	$38,034,800	$36,215,200	$30,816,956	$28,985,020	$891,220
Damages Reduced	$19,746,640	$19,746,640	$19,766,090	$19,766,090	$1,847,870
Recreation Benefits	$5,438,700	$5,438,700	$5,438,700	$5,438,700	$0
Total Benefits	$25,185,340	$25,185,340	$25,204,790	$25,204,790	$1,847,870
Net Benefits	($12,849,460)	($11,029,860)	($5,612,166)	($3,780,230)	$956,650
BC Ratio	0.7	0.7	0.8	0.9	2.1

1.19 Residual Damages

Both Alternatives D1 and E1 reduce without-project damages by approximately 70%. Although A1 is very effective at reducing damages to the structures included in the plan, it only reduces without-project damages by less than 10% across the study area.

1.20 Incremental Analysis

Results for the FRM separable measures that comprise Alternatives D1, E1, and A1 are displayed in Table 15. Table 16 displays the incremental results for the recreation measures that are included in alternatives D1 and E1. The Canton Club levee is the only measure that yields positive net benefits, while the McLeod Levee falls just below unity.

Table 17: Incremental Analysis, D1 and E1, FY25 Price Level and Discount Rate, Low Cost, $1,000s

Error! Not a valid link.

Table 18: Incremental Analysis, D1 and E1, FY25 Price Level and Discount Rate, Low Cost, $1,000s

Increment	Without Project EAD/Residual EAD	Incremental Average Annual Benefits	Cumulative Average Annual Benefits	Incremental Average Annual Cost	Cumulative AAC	Incremental Net Benefits	Cumulative Net Benefits	Incremental Benefit-to-Cost Ratio (BCR)	Cumulative BCR
No Action	27,937	0	0	0	0	0	0	N/A	N/A
Channel Improvements	10,650	17,287	17,287	25,595	25,595	(8,308)	(8,308)	0.7	0.7
Canton Club Levee	9,630	1,020	18,307	245	25,840	775	(7,533)	4.2	0.7

WWTP	9,414	216	18,523	1069	26,909	(853)	(8,386)	0.2	0.7
McLeod Levee	8,171	1,243	19,766	1,367	28,276	(124)	(8,510)	0.9	0.7
Caney Creek Levee	8,108	63	19,829	206	28,482	(143)	(8,653)	0.3	0.7
Richland Levee	8,078	30	19,859	306	28,788	(276)	(8,929)	0.1	0.7
Total	N/A	19,859	19,859	28,788	28,788	(8,929)	(8,929)	0.7	0.7

Table 19: Incremental Analysis, A1, FY25 Price Level and Discount Rate, $1,000s**Error! Not a valid link.**

Table 20: Incremental Results for the Recreation Features of D1 and E1, FY25 Price Level and Discount Rate

Recreation Benefits	Average Annual Cost	Net Benefits	BCR
5,439	6,854	-1,415	0.8

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 various alternatives. The tables below show the expected annual benefits of Alternatives D1, E1, and A1 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 alternatives 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 21: Probability that Expected Annual Benefits Exceed Annual Costs, Alt A1, FY 2025 Price Level and discount rate, $1,000s

		Probability that Damages Reduced exceed indicated values				
A1	EAD Reduced	0.75	0.5	0.25	Average Annual Costs	Probability Benefits Exceed Costs
	$1,848	$869	$1,676	$2,558	$891	Between 50% and 75%
Net Benefits		($22)	$785	$1,667		
B/C Ratio		0.98	1.9	2.9		

Table 22: Probability that Expected Annual Benefits Exceed Annual Costs, Alt D1, Low Cost, FY 2025 Price Level and discount rate, $1,000s

		Probability that Damages Reduced exceed indicated values				
Alt D1	EAD Reduced	0.75	0.5	0.25	Average Annual Costs	Probability Benefits Exceed Costs
	$25,185	$13,563	$19,640	$32,055	$36,215	Less than 25%
Net Benefits		($22,652)	($16,575)	($4,160)		
B/C Ratio		0.4	0.5	0.9		

Table 23: Probability that Expected Annual Benefits Exceed Annual Costs, Alt D1, High Cost, FY 2025 Price Level and discount rate, $1,000s

		Probability that Damages Reduced exceed indicated values				
Alt D1	EAD Reduced	0.75	0.5	0.25	Average Annual Costs	Probability Benefits Exceed Costs
	$25,185	$13,563	$19,640	$32,055	$38,035	Less than 25%
Net Benefits		($24,472)	($18,395)	($5,980)		
B/C Ratio		0.4	0.5	0.8		

Table 24: Probability that Expected Annual Benefits Exceed Annual Costs, Alt E1, Low Cost, FY 2025 Price Level and discount rate, $1,000s

		Probability that Damages Reduced exceed indicated values				
Alt E1	EAD Reduced	0.75	0.5	0.25	Average Annual Costs	Probability Benefits Exceed Costs
	$25,205	$13,612	$19,732	$32,109	$28,985	Between 25% and 50%
Net Benefits		($15,373)	($9,253)	$3,124		
B/C Ratio		0.5	0.7	1.1		

Table 25: Probability that Expected Annual Benefits Exceed Annual Costs, Alt E1, High Cost, FY 2025 Price Level and discount rate, $1,000s

		Probability that Damages Reduced exceed indicated values				
Alt E1	EAD Reduced	0.75	0.5	0.25	Average Annual Costs	Probability Benefits Exceed Costs
	$25,205	$13,612	$19,732	$32,109	$30,817	Between 25% and 50%
Net Benefits		($17,205)	($11,085)	$1,292		
B/C Ratio		0.4	0.6	1.0		

1.21 Project Performance

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. 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 21 through 23 display the project performance results for each study area reach for the without-project condition and alternatives D1 and E1.

Table 26: Project Performance, Without-Project Condition

		Target Stage Annual Exceedance Probability		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach Name	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40 %	0.20 %
1	264.68	0.0142	0.0124	0.1169	0.3114	0.463	1	0.9998	0.8385	0.3629	0.2354	0.1804
2	279.2	0.0233	0.0231	0.2081	0.5034	0.6886	1	0.9279	0.4292	0.2576	0.1076	0.0564
3	260.6	0.245	0.2995	0.9716	1	1	0	0	0.0376	0.003	0	0
4	265.22	0.999	0.999	1	1	1	0	0	0	0	0	0
5	266.78	0.021	0.0217	0.1967	0.4817	0.6655	1	0.9582	0.4739	0.2782	0.1215	0.0665
6	279.1	0.0227	0.0229	0.2067	0.5007	0.6858	1	0.9371	0.4386	0.2519	0.1039	0.0543
7	263.02	0.999	0.999	1	1	1	0	0	0	0	0	0
8	265.5	0.999	0.999	1	1	1	0	0	0	0	0	0
9	276.22	0.0351	0.0368	0.3126	0.6752	0.8465	0.9957	0.5761	0.2813	0.1812	0.07	0.0371
10	282.01	0.7351	0.7343	1	1	1	0	0	0	0.292	0.0686	0.0288
11	279.74	0.0443	0.0456	0.3732	0.7537	0.9032	0.9996	0.4347	0.1964	0.1346	0.0459	0.0173
12	268.98	0.053	0.054	0.4258	0.8107	0.9376	0.9402	0.3357	0.146	0.0987	0.0414	0.0213
13	279.01	0.0309	0.0336	0.2892	0.6409	0.8186	0.9998	0.6337	0.3226	0.2044	0.0802	0.0386
14	274.6	0.999	0.999	1	1	1	0	0	0	0	0	0
15	267.12	0.0143	0.0124	0.1173	0.3122	0.4641	1	0.9998	0.8338	0.3634	0.2319	0.1761
16	282.4	0.999	0.999	1	1	1	0	0	0	0	0	0
17	279.9	0.0142	0.0125	0.1179	0.3136	0.4659	1	0.9998	0.8388	0.3784	0.2196	0.1506
18	260	0.999	0.999	1	1	1	0	0	0	0	0	0
19	269.14	0.0316	0.0344	0.2952	0.6499	0.8261	0.9998	0.6268	0.3059	0.1769	0.0728	0.0395
20	279.6	0.999	0.999	1	1	1	0	0	0	0	0	0
21	256	0.999	0.999	1	1	1	0	0	0	0	0	0
22	254	0.999	0.999	1	1	1	0	0	0	0	0	0
23	270.41	0.0544	0.0554	0.4345	0.8192	0.9422	0.995	0.2982	0.1208	0.0643	0.021	0.0107

24	276.45	0.0144	0.0124	0.1177	0.3131	0.4652	1	0.9997	0.8274	0.3538	0.2337	0.1854
25	275.91	0.0356	0.0376	0.3183	0.6833	0.8528	0.9998	0.5641	0.2739	0.1765	0.0677	0.0367
26	263.16	0.0539	0.0546	0.4299	0.8147	0.9398	0.9958	0.3119	0.1174	0.0768	0.0299	0.0131
27	277.5	0.0406	0.0422	0.3499	0.7253	0.8839	0.9998	0.4915	0.2272	0.1462	0.0534	0.0246
28	276.22	0.0352	0.0377	0.3189	0.6841	0.8535	0.9804	0.5738	0.2777	0.1787	0.0687	0.0373
29	267.13	0.0229	0.0235	0.2114	0.5095	0.695	1	0.9342	0.4286	0.2188	0.0933	0.0493
30	265.54	0.0126	0.0116	0.1099	0.2948	0.4413	1	0.9998	0.9075	0.4136	0.2673	0.2036

Table 27: Project Performance, Alternatives D1

		Target Stage Annual Exceedance Probability		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach Name	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%
1	264.68	0.0145	0.0126	0.1194	0.3172	0.4705	1	0.9998	0.8233	0.3429	0.2238	0.1423
2	279.2	0.0001	0.0001	0.001	0.003	0.005	1	0.9997	0.9997	0.9997	0.9997	0.9997
3	260.6	0.2508	0.3036	0.9732	1	1	0	0	0.0347	0.0026	0	0
4	265.22	0.999	0.999	1	1	1	0	0	0	0	0	0
5	266.78	0.0202	0.021	0.1914	0.4713	0.6543	1	0.9672	0.4976	0.3001	0.1163	0.0378
6	279.1	0.0059	0.0058	0.0568	0.161	0.2537	1	0.9998	0.9998	0.7609	0.3547	0.1999
7	263.02	0.999	0.999	1	1	1	0	0	0	0	0	0
8	265.5	0.999	0.999	1	1	1	0	0	0	0	0	0
9	276.22	0.0085	0.012	0.1139	0.3043	0.4538	0.9998	0.9764	0.8049	0.5483	0.2797	0.1166
10	282.01	0.7338	0.7337	1	1	1	0	0	0	0	0	0
11	279.74	0.0234	0.0239	0.2149	0.5162	0.7018	1	0.9269	0.4193	0.2149	0.0746	0.0238

12	268.98	0.0359	0.039	0.3282	0.6968	0.8632	0.9768	0.5582	0.2684	0.1733	0.0545	0.0145
13	279.01	0.0063	0.006	0.058	0.1641	0.2583	1	0.9997	0.9997	0.7295	0.3385	0.2297
14	274.6	0.999	0.999	1	1	1	0	0	0	0	0	0
15	267.12	0.0146	0.0127	0.1199	0.3183	0.472	1	0.9997	0.8185	0.3426	0.2192	0.1365
16	282.4	0.999	0.999	1	1	1	0	0	0	0	0	0
17	279.9	0.0035	0.0035	0.0346	0.1003	0.1615	1	0.9996	0.9996	0.9996	0.9996	0
18	260	0.999	0.999	1	1	1	0	0	0	0	0	0
19	269.14	0.0201	0.021	0.1911	0.4707	0.6536	1	0.9679	0.498	0.2987	0.1189	0.0422
20	279.6	0.999	0.999	1	1	1	0	0	0	0	0	0
21	256	0.999	0.999	1	1	1	0	0	0	0	0	0
22	254	0.999	0.999	1	1	1	0	0	0	0	0	0
23	270.41	0.0001	0.0001	0.001	0.003	0.005	1	0.9996	0.9996	0.9996	0.9996	0.9996
24	276.45	0.0035	0.0035	0.0346	0.1002	0.1613	1	0.9996	0.9996	0.9996	0.9996	0
25	275.91	0.0088	0.01	0.0958	0.2607	0.3955	1	0.9997	0.9856	0.5275	0.3297	0.1906
26	263.16	0.0001	0.0001	0.001	0.003	0.005	1	0.9995	0.9995	0.9995	0.9995	0.9995
27	277.5	0.0113	0.0112	0.106	0.2856	0.4291	1	0.9998	0.9497	0.4586	0.2736	0.1544
28	276.22	0.0085	0.0119	0.1131	0.3025	0.4514	0.9998	0.9766	0.8035	0.5473	0.2799	0.1183
29	270.24	0.0023	0.0023	0.0231	0.0677	0.1102	1	0.9995	0.9995	0.9995	0.9995	0
30	265.54	0.013	0.0119	0.1131	0.3024	0.4513	1	0.9997	0.8911	0.3911	0.2535	0.1584

Table 28: Project Performance, Alternatives E1

		Target Stage Annual Exceedance Probability		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach Name	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40 %	0.20 %
1	264.68	0.0147	0.0127	0.1199	0.3183	0.4719	1	0.9998	0.8176	0.343	0.2201	0.1402
2	279.2	0.0001	0.0001	0.001	0.003	0.005	1	0.9996	0.9996	0.9996	0.9996	0.9996
3	260.6	0.2508	0.2586	0.9499	0.9999	1	0	0	0	0	0	0
4	265.22	0.999	0.999	1	1	1	0	0	0	0	0	0
5	266.78	0.0202	0.021	0.1909	0.4703	0.6532	1	0.9675	0.5004	0.3059	0.119	0.0412
6	279.1	0.006	0.0059	0.0577	0.1633	0.257	1	0.9998	0.9998	0.7505	0.3449	0.1971
7	263.02	0.999	0.999	1	1	1	0	0	0	0	0	0
8	265.5	0.999	0.999	1	1	1	0	0	0	0	0	0
9	276.22	0.0086	0.0121	0.115	0.3068	0.4571	0.9998	0.9751	0.8008	0.5434	0.2756	0.1192
10	282.01	0.7338	0.7337	1	1	1	0	0	0	0	0	0
11	279.74	0.0236	0.024	0.216	0.518	0.7037	1	0.9238	0.4155	0.2121	0.0735	0.0235
12	268.98	0.0338	0.0367	0.3122	0.6747	0.8461	0.9826	0.5921	0.2886	0.1836	0.0609	0.0176
13	279.01	0.0064	0.006	0.0587	0.166	0.2611	1	0.9997	0.9997	0.7208	0.3302	0.2252
14	274.6	0.999	0.999	1	1	1	0	0	0	0	0	0
15	267.12	0.0147	0.0127	0.1204	0.3195	0.4735	1	0.9997	0.8128	0.3425	0.2156	0.1345
16	282.4	0.999	0.999	1	1	1	0	0	0	0	0	0
17	279.9	0.0036	0.0036	0.0354	0.1024	0.1648	1	0.9996	0.9996	0.9996	0.9996	0
18	260	0.999	0.999	1	1	1	0	0	0	0	0	0
19	269.14	0.0192	0.0204	0.1865	0.4616	0.6437	1	0.9728	0.5184	0.3213	0.1299	0.0499
20	279.6	0.999	0.999	1	1	1	0	0	0	0	0	0
21	256	0.999	0.999	1	1	1	0	0	0	0	0	0
22	254	0.999	0.999	1	1	1	0	0	0	0	0	0
23	270.41	0.0001	0.0001	0.001	0.003	0.005	1	0.9996	0.9996	0.9996	0.9996	0.9996
24	276.45	0.0024	0.0024	0.0237	0.0695	0.1131	1	0.9997	0.9997	0.9997	0.9997	0
25	275.91	0.0089	0.0101	0.0962	0.2618	0.3971	1	0.9997	0.9851	0.525	0.3246	0.1899

26	263.16	0.0001	0.0001	0.001	0.003	0.005	1	0.9997	0.9997	0.9997	0.9997	0.9997
27	277.5	0.0115	0.0113	0.1074	0.2887	0.4332	1	0.9997	0.9433	0.4501	0.2663	0.1529
28	276.22	0.0087	0.0121	0.1141	0.3048	0.4545	0.9998	0.9767	0.7996	0.5429	0.2757	0.1215
29	270.24	0.0025	0.0025	0.025	0.0731	0.1189	1	0.9996	0.9996	0.9996	0.9996	0
30	265.54	0.0131	0.012	0.1135	0.3032	0.4524	1	0.9997	0.8888	0.3917	0.2494	0.156

SECTION 2 RECREATION ADDENDUM

2.1 PEARL RIVER FRM: RECREATION BENEFITS FOR ALTERNATIVE D1 and E1

Recreation benefits are estimated in this analysis based on the User Day Value (UDV) methodology. The UDV methodology provides guidelines for assigning points to the value of the recreation experience. There are five criteria in the UDV methodology used to establish the value of the recreation experience. The five criteria are the quality of the recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental quality (Table 1). For each criterion, there are five judgment factors that provide the basis for determining the point value of the recreation experience offered by recreation facilities.

The following assessments of the judgment factors for each of the five criteria were used to assign point values for the recreation opportunities that would be provided by the recreation facilities of the CTO Alternatives.

The following assessments of the judgment factors were used for assigning point values for the five criteria outlined in Table 1.

- The CTO Alternatives proposed recreation facilities would provide an area specific, unique recreation opportunity afforded by the project setting. The site offers solitude and panoramic views in a growing metropolitan area and would provide specific recreation amenities for a growing metropolitan population that will experience increased demands. The multi-use recreation areas will provide panoramic view sheds. The point value range of 10 out of 30 in the judgment factor scale was assigned because of the several general activities and recreation experiences that would be offered by the proposed facilities in the relatively densely populated metropolitan area.
- The availability of opportunity range is based upon there being one or two similar recreation facilities within 1-hour travel time and none within 45 minutes travel time from the Project proposed recreation facilities. The score for this judgment factor was 14 out of 18.
- CTO Alternative proposed facilities carrying capacity point values are relatively high at 10 out of 14 because the proposed recreation facilities provide optimum

facilities to conduct activity at site potential. The general recreation values are based on the optimum use of the site potential, without overuse of the proposed recreation resources. Good water resources and access to them for environmental observation comprise a large part of the projected recreation resources use. According to the 2019-2024 Mississippi Statewide Comprehensive Outdoor Recreation Plan (MS SCORP), one of Mississippi's greater assets is a generally warm and pleasant climate. Most of the people engage in outdoor recreational activities throughout the 12 months of the year due to a climate classified as sub-tropical. Therefore, use is expected to occur throughout the 12 months of the calendar year.

- The accessibility range is based upon the availability of local highways, roads and streets in good condition that would provide access to the proposed recreation facilitates. The accessibility range is scored high at 16 out a possible 18 because there is good access with high standard roads to site, and the proposed facilities will provide good access within site.
- The environmental quality range is based on the aesthetic values of the Project environmental setting and the ease of correcting any limiting aesthetic factors. Any limiting aesthetic factors that currently exist would be eliminated by the project. The proposed site would possess panoramic views. The best aesthetics of CTO Alternative Project area would be views of the riverfront and shorelines. Due to the high aesthetic quality with no factors that lower environmental quality, the environmental quality range was scored at 13 out of 20.

The total point calculation for all five criteria is 63 points. Refer to Table 1.

Table 1. Guidelines for Assigning Points for General Recreation

Criteria	Judgment factors				
Recreation experience[1] **Total Points: 30**	Two general activities[2]	Several general activities	Several general activities; one high quality value activity[3]	Several general activities; more than one high quality high activity	Numerous high quality value activities; some general activities
Point Value: 10	0–4	5–10	11–16	17–23	24–30
Availability of opportunity[4] **Total Points: 18**	Several within 1-hour travel time; a few within 30 minutes travel time	Several within 1-hour travel time; none within 30 minutes travel time	One or two within 1-hour travel time; none within 45 minutes travel time	None within 1-hour travel time	None within 2-hour travel time
Point Value: 14	0–3	4–6	7–10	11–14	15–18
Carrying capacity[5] **Total Points: 14**	Minimum facility for development for public health and safety	Basic facility to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct. activity at site potential	Ultimate facilities to achieve intent of selected alternative
Point Value: 10	0–2	3–5	6–8	9–11	12–14
Accessibility **Total Points: 18**	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Point Value: 16	0–3	4–6	7–10	11–14	15–18
Environmental quality **Total Points: 20**	Low esthetic factors[6] that significantly lower quality[7]	Average esthetic quality: factors exist that lower quality to minor degree	Above average esthetic quality: any limiting factors can be reasonably rectified	High esthetic quality: no factors exist that lower quality	Outstanding esthetic quality: no factors exist that lower quality
Point Value: 13	0–2	3–6	7–10	11–15	16–20
Total Point Value					63

Source: Economics Guidance Memorandum, 25-04, Unit Day Method, Table 1: Guidelines for Assigning Points for General Recreation.

1. Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
2. General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
3. High quality value activities include those that are not common to the region and/or Nation, and that are usually of high quality.
4. Likelihood of success at fishing and hunting.
5. Value should be adjusted for overuse.
6. Major esthetic qualities to be considered include geology and topography, water, and vegetation.

7. Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

CONVERSION OF POINTS TO DOLLAR VALUE

The point values assigned were converted to dollar values based on the EGM 25-04, Unit Day Values for Recreation, 2025, which is based on ER 1105-2-100. Values provided for FY 2025 may be used to convert points to a UDV dollar amount if the point assignment method is used. The table was adjusted from Table K-3-1, Federal Register Vol. 44, No. 242, p. 72962, December 14, 1979, and the subsequent Table VIII-3-1 "Conversion of Points to Dollar Values," Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983, using the Consumer Price Index (CPI) factors published by the Bureau of Labor Statistics. The CPI basis of Table VIII-3-1 from Principles and Guidelines is July 1, 1982 (CPI value = 97.5). The FY 2025 CPI basis is September 2024 (CPI value = 315.301).

Table 4-2 displays the point value conversion to a unit day value in fiscal year 2025 (FY25) dollars. The 63 total points from Table 4-2 falls between the General Recreation Point values for 60 points and 70 points. The General Recreation Dollar Value for 60 points is $11.97 and for 70 points is $12.61. The difference between $11.97 and $12.61 is $0.64. The 63 total points represents 30 percent of the $0.64 difference. Therefore, 30 percent of the $0.64, or $0.19 was added to $11.97 to produce the UDV of $12.16 for the 63 General Recreation Point Value.

Table 2. Conversion of Points to Dollar Values

General Recreation Point Values	General Recreation Dollar Values
0	$5.17
10	$6.14
20	$6.79
30	$7.76
40	$9.70
50	$11.00
60	$11.97
70	$12.61
80	$13.91
90	$14.88
100	$15.52

Source: Economic Guidance Memorandum, 25-04, Unit Day Values for Recreation for Fiscal Year 2025.

2.2 Most Likely Participation-User Day Scenario

The MS ORP does not provide recreation user-day guidelines for resource based outdoor recreation activities. The capacity method is an Alternative method of estimating use according to USACE Economic Guidance Memorandum (EGM), 25-04, Unit Day Values for Recreation for Fiscal Year 2025: "The capacity procedure involves the estimation of annual recreation use under 'without project' and 'with project' conditions through the determination of resource or facility capacities (taking into consideration instantaneous rates of use, turnover rates, and weekly and seasonal patterns of use). Seasonal use patterns are dependent on climate and culture and probably account for the greatest variation in use estimates derived through this method. In general, annual use of outdoor recreation areas, particularly in rural locations and in areas with pronounced seasonal variation, is usually about 50 times the design load, which is the number of visitors to a recreation area or site on an average summer Sunday. In very inaccessible areas and in those known for more restricted seasonal use, the multiplier would be less; in urban settings or in areas with less pronounced seasonal use patterns, the multiplier would be greater. In any case, the actual estimate of use involves an analytical procedure using instantaneous capacities, daily turnover rates, and weekly and seasonal use patterns as specific data inputs."

"Because the capacity method does not involve the estimation of site-specific demand, its use is valid only when it has been otherwise determined that sufficient demand exists in the market area of project Alternatives to accommodate the calculated capacity. Its greatest potential is therefore in urban settings where sufficient demand obviously exists. Additionally, its use should be limited to small projects with (1) a facility orientation (as opposed to a resource attraction), and (2) restricted market areas that would tend to make the use of Alternative use estimating procedures less useful or efficient."

The guidance provided in EGM 25-04 to estimate reasonable user rate projections requires determination of resource or facility capacities and assumes that adequate demand exists. As mentioned in EGM 25-04, use is valid if it is determined that sufficient demand exists in the market area of project Alternatives to accommodate the calculated capacity. Its greatest potential is therefore in urban settings where sufficient demand obviously exists like the Pearl River Basin, MS, Federal Flood Risk Reduction Project. According to the Mississippi ORP, Mississippi's population and recreation demands continue to grow. Population projections show that state residents are increasingly living in urban counties or along the coast. The demand for recreation facilities is also rising quickly. In addition, demands for recreation are rising as the baby boomer generation ages and facilities fail to keep up with the growth. Four out of the top five recreation activities desired by residents include hiking & trails, camping, canoeing & kayaking, and picnicking. The recreation facilities proposed for the Channel Improvements in the CTO Alternatives would help address these needs.[1]

[1]Mississippi Statewide Comprehensive Outdoor Recreation Plan (SCORP) "Ensuring Mississippi's Outdoor Legacy" 2019-2024, August 9, 2019

According to the MS ORP, one of Mississippi's greater assets is a generally warm and pleasant climate. Most of the people engage in outdoor recreational activities throughout the 12 months of the year due to a climate classified as sub-tropical. Therefore, use is projected to occur throughout the 12 months of the calendar year, and 365 user days were selected as the number of days available annually for outdoor recreation for this analysis. Weekends account for 104 user days plus 11 Federal Holidays in Mississippi results in 115 days available for peak use. The remaining 250 user days for the rest of year are identified as off-peak use days. Daily turnover rates were estimated to be two per day for peak use days and one per day for off peak use days. The number of units provided times the daily turnover rate times the peak use days or off-peak use days provides the expected user days shown in Table 3.

The EGM for Unit Day Value states that the application of the selected value to estimated annual use over the project life, in the context of the with- and without-project framework of analysis, provides the estimate of recreation benefits. The starting point of the evaluation is the value in the without project condition. This report estimates that all the without project values for all criteria equals zero, because under without-project conditions the area is not very suitable for any recreation activities. The next step was the point evaluation of the with-project recreation facilities. The difference in points between the without-project and with-project conditions is the basis for the benefits.

2.3 Proposed Recreation Facilities

- Boat Ramp-Benefits per lane with "X" number of parking spots
- RV Camping- "X" number of pads with hook-ups, bath house, playground, etc.
- Tent Camping- "X" number of camp sites with bath house, playground, etc.
- Cabins
- Fishing Piers
- Nature/hiking trails-Benefits per foot/mile
- Wildlife Viewing

2.4 Assumptions

In this relatively densely populated urban setting, the multiplier is estimated as the instantaneous capacity. The estimation of use involves an analytical procedure using instantaneous capacities, daily turnover rates, and weekly and seasonal use patterns as specific data inputs. Instantaneous capacity was estimated as the design capacity of the recreation facilities. The instantaneous capacity is the expected number of users and is stated below. The following assumptions were made to estimate the recreation benefits that would accrue to the proposed recreation facilities. The calculations are summarized in Table 3.

Peak Activity Days per year are assumed to be Weekends and Federal Holidays equaling 115 days and Off-Peak Activity Days per year are the rest of the days of the year. For the boat ramps, RV camping, cabin rentals, and tent camping, half of the facility users would be couples, and half would be families of four resulting in the average number of users per occasion being three persons. Fishing, nature/hiking trails, and wildlife viewing were assumed to be individual users so the number of users per occasions was one.

Boat Ramp-Benefits per lane with “X” number of parking spots

- Peak Activity Days: Two boats per hour would launch or take out per day during 12-hour days, 24 launches/take outs X 3 persons per occasion = 72 users per day.
- Off Peak Activity Days: One boat per hour would launch or take out per day during 12-hour days, 12 launches/take outs X 3 persons = 36 users per day.

RV Camping - “X” number of pads with hook-ups, bath house, playground, etc.

- Peak Activity Days: One RV per day X 3 persons = 3 users per day.
- Off Peak Activity Days: One RV every other day or one-half RV per day 0.5 X 3 persons = 1.5 users per day.

Tent Camping- “X” number of camp sites with bath house, playground, etc.

- Peak Activity Days: One Camping Group per day X 3 persons = 3 users per day.
- Off Peak Activity Days: One Camping Group every other day or one-half Camping Group per day, 0.5 X 3 persons = 1.5 users per day.

Cabins

- Peak Activity Days: One Cabin Rental per day, 1 cabin X 3 persons = 3 users per day.
- Off Peak Activity Days: One Cabin Rental every other day or one-half Cabin Rental per day, 0.5 X 3 persons =1.5 users per day.

Fishing Pier (500 sq. ft.)

- Peak Activity Days: One person per 15 square feet per day, 500 sq. ft. /15 sq. ft. = 33 users per day.
- Off Peak Activity Days: One person per 30 square feet per day, 500 sq. ft. /30 sq. ft. = 17 users per day.

Nature/hiking trails-Benefits (1,500 linear ft.)

- Peak Activity Days: One person per 60 feet, 1,500 linear ft. /60 linear ft. = 25 users per day.
- Off Peak Activity Days: One person per 120 linear feet, 1,500/120 linear ft. = 13 users per day.

Wildlife Viewing (1,500 sq. ft.)

- Peak Activity Days: One person per 20 sq. ft., 1,500 sq. ft. / 20 = 75 users per day.
- Off Peak Activity Days: One person per 40 sq. ft., 1,500 sq. ft. /40 sq. ft. = 38 users per day.

Table 3. Most Likely Recreation Participation User Day Projection Scenario

Activity	Units Provided	Daily Turnover Rates	Average Number of Users per Occasion	User Days	Expected Number of Users
Boat Ramp-Benefits per lane with "X" number of parking spots	1	24 Peak Activity Days	3	115	8,280
Boat Ramp-Benefits per lane with "X" number of parking spots	1	12 Off Peak Activity Days	3	250	9,000
RV Camping- "X" number of pads with hook-ups, bath house, playground, etc.	1	1 Peak Activity Days	3	115	345
RV Camping- "X" number of pads with hook-ups, bath house, playground, etc.	1	0.5 Off Peak Activity Days	3	250	375
Tent Camping- "X" number of camp sites with bath house, playground, etc.	1	1 Peak Activity Days	3	115	345
Tent Camping- "X" number of camp sites with bath house, playground, etc.	1	0.5 Off Peak Activity Days	3	250	375
Cabins	1	1 Peak Activity Days	3	115	345
Cabins	1	0.5 Off Peak Activity Days	3	250	375
Fishing Piers	500 sq. ft.	1/15 sq. ft. Peak Activity Days	33	115	3,795
Fishing Piers	500 sq. ft.	1/30 ft. Off Peak Activity Days	17	250	4,250
Nature/hiking trails	1,500 linear ft.	1/60 linear ft. Peak Activity Days	25	115	2,875
Nature/hiking trails	1,500 linear ft.	1/120 linear ft. Off Peak Activity Days	13	250	3,250
Wildlife Viewing	1,500 sq. ft.	1/20 sq. ft. Off Peak Activity Days	75	115	8,625
Wildlife Viewing	1,500 sq. ft.	1/40 sq. ft. Off Peak Activity Days	38	250	9,500
Annual Recreation User Days Total					51,735

2.5 Calculation of Recreation Benefits

Recreation benefits were calculated using the User Day Value (UDV) and the capacity method as described in Appendix 4-Recreation Benefits. Based on the climate in the Study Area, the user days calculated based on 70 percent of capacity. The calculation of the recreation benefits is presented in the table below. Recreation facilities are proposed for Alternative C only and the estimated annual benefits are **$5,438,742**.

Implementation of this project will be subject to the non-Federal sponsor agreeing to comply with the applicable federal laws and policies prescribed in the model Partnership Agreement for Specifically Authorized Structural Flood Risk Management Projects.

Table 4. Calculation of Recreation Benefits

	Typical Unit	Unit Measure	Annual Users Per Unit	Annual Capacity	Proposed Units	User Day Value	Annual Benefit
Boat Ramps	1	lanes	17,280	0.7	6	$12.16	$882,524
RV, Tent, Cabin Camping	1	ea.	720	0.7	150	$12.16	$919,269
Fishing Piers	500	sq. ft.	8,045	0.7	6	$12.16	$410,874
Trails	1500	FT	6,125	0.7	53	$12.16	$2,763,208
Wildlife Viewing	1500	sq. ft.	18,125	0.7	3	$12.16	$462,840
Total Recreation Benefits							$5,438,742

(FY25 Price Level; EGM 25-04)

SECTION 3 PROBABILITY AND STAGE FUNCTION ADDENDUM

The stage-probability functions along with uncertainty for the major benefit centers in the study area for alternatives D and E are displayed with and without project below.

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.95000	276.977	276.913	276.945	277.010	277.042
0.90000	277.010	276.969	276.990	277.030	277.051
0.80000	277.050	277.011	277.030	277.069	277.088
0.70000	277.078	277.045	277.062	277.094	277.111
0.50000	277.125	277.095	277.110	277.128	277.130
0.47500	277.126	277.122	277.124	277.128	277.130
0.45000	277.126	277.122	277.124	277.129	277.131
0.42500	277.127	277.123	277.125	277.129	277.132
0.40000	277.128	277.124	277.126	277.130	277.132
0.37500	277.129	277.125	277.127	277.131	277.133
0.35000	277.130	277.125	277.127	277.132	277.134
0.32500	277.130	277.126	277.128	277.133	277.135
0.30000	277.131	277.127	277.129	277.133	277.136
0.27000	277.132	277.128	277.130	277.135	277.137
0.25000	277.133	277.128	277.131	277.135	277.138
0.22000	277.134	277.130	277.132	277.137	277.139
0.20000	277.135	277.130	277.132	277.139	277.142
0.17500	277.137	277.130	277.132	277.142	277.147
0.15000	277.139	277.130	277.134	277.144	277.149
0.12500	277.142	277.132	277.137	277.147	277.152
0.10000	277.145	277.135	277.140	277.150	277.155
0.09000	277.146	277.136	277.141	277.152	277.157
0.08000	277.148	277.137	277.142	277.153	277.159
0.07000	277.149	277.138	277.143	277.155	277.161
0.06000	277.151	277.139	277.145	277.157	277.163
0.05000	277.153	277.140	277.146	277.159	277.166
0.04000	277.155	277.140	277.146	278.709	280.263
0.03000	278.274	277.140	277.146	281.419	284.563
0.02000	279.762	277.141	277.147	282.799	285.837
0.01500	280.575	277.141	277.299	283.852	287.128
0.01000	281.668	277.141	278.380	284.956	288.244
0.00900	281.977	277.141	278.689	285.265	288.553
0.00800	282.319	277.141	279.031	285.607	288.895
0.00700	282.700	277.142	279.412	285.988	289.276
0.00600	283.132	277.142	279.844	286.420	289.708
0.00500	283.634	277.142	280.346	286.922	290.210
0.00400	284.096	277.520	280.808	287.384	290.672
0.00300	284.677	278.101	281.389	287.965	291.253
0.00200	285.467	278.891	282.179	288.755	292.043
0.00100	286.753	280.177	283.465	290.041	293.329
0.00050	287.967	281.391	284.679	291.255	294.543

Figure A2-1, Reach 2, Without-Project Condition

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.) -2 SD	-1 SD	+1 SD	+2 SD
0.95000	263.953	263.892	263.923	263.984	264.015
0.90000	263.984	263.946	263.965	264.004	264.023
0.80000	264.022	263.985	264.004	264.040	264.059
0.70000	264.049	264.018	264.034	264.065	264.080
0.50000	264.094	264.065	264.080	264.097	264.099
0.47500	264.095	264.091	264.093	264.097	264.099
0.45000	264.095	264.091	264.093	264.098	264.100
0.42500	264.096	264.092	264.094	264.098	264.101
0.40000	264.097	264.093	264.095	264.099	264.101
0.37500	264.098	264.094	264.096	264.100	264.102
0.35000	264.099	264.094	264.096	264.101	264.103
0.32500	264.099	264.095	264.097	264.102	264.104
0.30000	264.100	264.096	264.098	264.102	264.105
0.27000	264.101	264.097	264.099	264.104	264.106
0.25000	264.102	264.097	264.100	264.104	264.107
0.22000	264.103	264.099	264.101	264.105	264.108
0.20000	264.104	264.099	264.101	264.108	264.111
0.17500	264.106	264.099	264.101	264.111	264.116
0.15000	264.108	264.099	264.103	264.113	264.118
0.12500	264.111	264.101	264.106	264.116	264.121
0.10000	264.114	264.104	264.109	264.119	264.124
0.09000	264.115	264.105	264.110	264.121	264.126
0.08000	264.117	264.106	264.111	264.122	264.128
0.07000	264.118	264.107	264.112	264.124	264.130
0.06000	264.120	264.108	264.114	264.126	264.132
0.05000	264.122	264.109	264.115	264.128	264.135
0.04000	264.124	264.109	264.115	265.827	267.530
0.03000	265.351	264.109	264.115	268.798	271.248
0.02000	266.982	264.109	264.207	269.351	271.249
0.01500	267.453	264.110	265.555	269.351	271.249
0.01000	268.086	264.110	266.080	270.092	272.099
0.00900	268.309	264.296	266.302	270.315	272.322
0.00800	268.554	264.541	266.548	270.561	272.567
0.00700	268.829	264.816	266.822	270.835	272.841
0.00600	269.140	265.127	267.133	271.146	273.153
0.00500	269.501	265.488	267.495	271.507	273.514
0.00400	269.795	265.782	267.789	271.802	273.808
0.00300	270.165	266.152	268.158	272.171	274.178
0.00200	270.668	266.655	268.662	272.674	274.681
0.00100	271.487	267.474	269.480	273.493	275.500
0.00050	272.260	268.247	270.253	274.266	276.273

Figure A2-2, Reach 5, Without-Project Condition

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.) -2 SD	-1 SD	+1 SD	+2 SD
0.95000	268.607	268.545	268.576	268.638	268.669
0.90000	268.639	268.599	268.619	268.658	268.678
0.80000	268.677	268.640	268.658	268.695	268.714
0.70000	268.704	268.673	268.689	268.720	268.736
0.50000	268.750	268.673	268.689	268.823	268.896
0.47500	268.937	268.673	268.689	269.466	269.995
0.45000	269.124	268.673	268.689	269.655	270.185
0.42500	269.314	268.674	268.782	269.846	270.378
0.40000	269.505	268.674	268.970	270.040	270.575
0.37500	269.700	268.674	269.161	270.238	270.776
0.35000	269.898	268.812	269.355	270.441	270.985
0.32500	270.102	269.004	269.553	270.651	271.200
0.30000	270.313	269.196	269.754	270.871	271.430
0.27000	270.576	269.453	270.014	271.138	271.699
0.25000	270.760	269.596	270.178	271.342	271.923
0.22000	271.051	269.884	270.468	271.635	272.218
0.20000	271.258	269.884	270.530	271.986	272.715
0.17500	271.631	269.953	270.792	272.470	273.309
0.15000	272.039	270.292	271.165	272.912	273.785
0.12500	272.495	270.658	271.576	273.414	274.333
0.10000	273.021	270.890	271.955	274.087	275.152
0.09000	273.374	270.890	271.955	274.866	276.358
0.08000	273.758	270.890	272.212	275.304	276.850
0.07000	274.180	270.956	272.568	275.792	277.404
0.06000	274.652	271.263	272.957	276.346	278.041
0.05000	275.189	271.585	273.387	276.991	278.793
0.04000	275.821	271.659	273.740	277.902	279.983
0.03000	276.691	271.801	274.246	279.136	281.581
0.02000	277.848	272.508	275.178	280.518	283.188
0.01500	278.714	272.508	275.226	282.202	285.690
0.01000	279.877	272.929	276.403	283.351	286.825
0.00900	280.195	273.247	276.721	283.669	287.143
0.00800	280.546	273.598	277.072	284.020	287.494
0.00700	280.938	273.990	277.464	284.412	287.886
0.00600	281.383	274.435	277.909	284.857	288.331
0.00500	281.899	274.951	278.425	285.373	288.847
0.00400	282.325	275.377	278.851	285.799	289.273
0.00300	282.860	275.912	279.386	286.334	289.808
0.00200	283.589	276.641	280.115	287.063	290.537
0.00100	284.774	277.826	281.300	288.249	291.723
0.00050	285.894	278.946	282.420	289.368	292.842

Figure A2-3, Reach 9, Without-Project Condition

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.) -2 SD	-1 SD	+1 SD	+2 SD
0.95000	255.770	255.711	255.740	255.799	255.829
0.90000	255.800	255.762	255.781	255.819	255.838
0.80000	255.836	255.801	255.819	255.854	255.872
0.70000	255.863	255.832	255.848	255.878	255.893
0.50000	255.906	255.878	255.892	255.909	255.911
0.47500	255.907	255.903	255.905	255.909	255.911
0.45000	255.908	255.903	255.905	255.910	255.912
0.42500	255.908	255.904	255.906	255.910	255.912
0.40000	255.909	255.905	255.907	255.911	255.913
0.37500	255.910	255.905	255.908	255.912	255.914
0.35000	255.911	255.906	255.908	255.913	255.915
0.32500	255.911	255.907	255.909	255.914	255.916
0.30000	255.912	255.908	255.910	255.914	255.917
0.27000	255.913	255.909	255.911	255.916	255.918
0.25000	255.914	255.909	255.912	255.916	255.919
0.22000	255.915	255.911	255.913	255.917	255.920
0.20000	255.916	255.911	255.913	255.920	255.923
0.17500	255.918	255.911	255.913	255.923	255.928
0.15000	255.920	255.911	255.915	255.925	255.930
0.12500	255.923	255.913	255.918	255.928	255.933
0.10000	255.926	255.916	255.921	255.931	255.936
0.09000	255.927	255.917	255.922	255.933	255.938
0.08000	255.929	255.918	255.923	255.934	255.940
0.07000	255.930	255.919	255.924	255.936	255.942
0.06000	255.932	255.920	255.926	255.938	255.944
0.05000	255.934	255.921	255.927	255.940	255.947
0.04000	255.936	255.921	255.927	255.945	255.954
0.03000	255.940	255.921	255.928	255.952	255.964
0.02000	255.946	255.921	255.933	255.959	255.972
0.01500	255.950	255.922	255.933	255.967	255.985
0.01000	255.956	255.922	255.939	255.973	255.990
0.00900	255.958	255.923	255.940	255.975	255.992
0.00800	255.959	255.925	255.942	255.976	255.994
0.00700	255.961	255.927	255.944	255.978	255.995
0.00600	255.963	255.929	255.946	255.981	255.998
0.00500	255.966	255.932	255.949	255.983	256.000
0.00400	262.028	261.993	262.011	262.045	262.062
0.00300	269.638	269.604	269.621	269.655	269.672
0.00200	280.004	279.970	279.987	280.021	280.038
0.00100	296.866	296.832	296.849	296.883	296.900
0.00050	312.791	312.757	312.774	312.808	312.825

Figure A2-4, Reach 22, Without-Project Condition

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.) -2 SD	-1 SD	+1 SD	+2 SD
0.95000	269.013	268.950	268.982	269.044	269.075
0.90000	269.044	269.005	269.025	269.064	269.084
0.80000	269.083	269.045	269.064	269.101	269.120
0.70000	269.110	269.079	269.094	269.126	269.142
0.50000	269.156	269.127	269.141	269.159	269.161
0.47500	269.157	269.153	269.155	269.159	269.161
0.45000	269.158	269.153	269.155	269.160	269.162
0.42500	269.158	269.154	269.156	269.160	269.162
0.40000	269.159	269.155	269.157	269.161	269.163
0.37500	269.160	269.155	269.158	269.162	269.164
0.35000	269.161	269.156	269.158	269.163	269.165
0.32500	269.161	269.157	269.159	269.164	269.166
0.30000	269.162	269.158	269.160	269.164	269.167
0.27000	269.163	269.159	269.161	269.165	269.168
0.25000	269.164	269.159	269.162	269.166	269.169
0.22000	269.165	269.161	269.163	269.167	269.170
0.20000	269.166	269.161	269.163	270.184	271.201
0.17500	269.975	269.161	269.163	271.796	273.617
0.15000	270.861	269.161	269.163	272.756	274.652
0.12500	271.852	269.161	269.857	273.846	275.841
0.10000	272.993	269.360	271.177	274.809	276.364
0.09000	273.350	270.335	271.843	274.857	276.365
0.08000	273.738	270.614	272.176	275.300	276.862
0.07000	274.164	270.907	272.536	275.793	277.422
0.06000	274.641	271.217	272.929	276.353	278.065
0.05000	275.184	271.542	273.363	277.004	278.825
0.04000	275.822	271.626	273.724	277.920	280.018
0.03000	276.698	271.776	274.237	279.159	281.619
0.02000	277.862	272.517	275.190	280.534	283.207
0.01500	278.722	272.517	275.257	282.188	285.653
0.01000	279.878	273.003	276.440	283.316	286.753
0.00900	280.188	273.313	276.751	283.626	287.064
0.00800	280.530	273.655	277.093	283.968	287.406
0.00700	280.912	274.037	277.475	284.350	287.788
0.00600	281.346	274.471	277.908	284.784	288.221
0.00500	281.849	274.974	278.411	285.287	288.724
0.00400	282.253	275.378	278.816	285.691	289.129
0.00300	282.761	275.885	279.323	286.198	289.636
0.00200	283.452	276.577	280.014	286.890	290.327
0.00100	284.576	277.701	281.139	288.014	291.452
0.00050	285.638	278.763	282.201	289.076	292.514

Figure A2-5, Reach 28 Without-Project Condition

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.95000	276.977	276.913	276.945	277.010	277.042
0.90000	277.010	276.969	276.990	277.030	277.051
0.80000	277.050	277.011	277.030	277.069	277.088
0.70000	277.078	277.045	277.062	277.094	277.111
0.50000	277.125	277.095	277.110	277.128	277.130
0.47500	277.126	277.122	277.124	277.128	277.130
0.45000	277.126	277.122	277.124	277.129	277.131
0.42500	277.127	277.123	277.125	277.129	277.132
0.40000	277.128	277.124	277.126	277.130	277.132
0.37500	277.129	277.125	277.127	277.131	277.133
0.35000	277.130	277.125	277.127	277.132	277.134
0.32500	277.130	277.126	277.128	277.133	277.135
0.30000	277.131	277.127	277.129	277.133	277.136
0.27000	277.132	277.128	277.130	277.135	277.137
0.25000	277.133	277.128	277.131	277.135	277.138
0.22000	277.134	277.130	277.132	277.137	277.139
0.20000	277.135	277.130	277.132	277.139	277.142
0.17500	277.137	277.130	277.132	277.142	277.147
0.15000	277.139	277.130	277.134	277.144	277.149
0.12500	277.142	277.132	277.137	277.147	277.152
0.10000	277.145	277.135	277.140	277.150	277.155
0.09000	277.146	277.136	277.141	277.152	277.157
0.08000	277.148	277.137	277.142	277.153	277.159
0.07000	277.149	277.138	277.143	277.155	277.161
0.06000	277.151	277.139	277.145	277.157	277.163
0.05000	277.153	277.140	277.146	277.159	277.166
0.04000	277.155	277.140	277.146	277.164	277.173
0.03000	277.159	277.140	277.147	277.171	277.183
0.02000	277.165	277.141	277.152	277.178	277.191
0.01500	277.169	277.141	277.152	277.186	277.204
0.01000	277.175	277.141	277.158	277.192	277.209
0.00900	277.177	277.142	277.159	277.194	277.211
0.00800	277.178	277.144	277.161	277.195	277.213
0.00700	277.180	277.146	277.163	277.197	277.214
0.00600	277.182	277.148	277.165	277.200	277.217
0.00500	277.185	277.151	277.168	277.202	277.219
0.00400	277.188	277.153	277.170	277.205	277.222
0.00300	277.191	277.156	277.174	277.208	277.225
0.00200	277.195	277.161	277.178	277.212	277.229
0.00100	277.202	277.168	277.185	277.219	277.236
0.00050	277.209	277.174	277.192	277.226	277.243

Figure A2-6, Reach 2, Alternatives D1 and E1

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.95000	263.953	263.892	263.923	263.984	264.015
0.90000	263.984	263.946	263.965	264.004	264.023
0.80000	264.022	263.985	264.004	264.040	264.059
0.70000	264.049	264.018	264.034	264.065	264.080
0.50000	264.094	264.065	264.080	264.097	264.099
0.47500	264.095	264.091	264.093	264.097	264.099
0.45000	264.095	264.091	264.093	264.098	264.100
0.42500	264.096	264.092	264.094	264.098	264.101
0.40000	264.097	264.093	264.095	264.099	264.101
0.37500	264.098	264.094	264.096	264.100	264.102
0.35000	264.099	264.094	264.096	264.101	264.103
0.32500	264.099	264.095	264.097	264.102	264.104
0.30000	264.100	264.096	264.098	264.102	264.105
0.27000	264.101	264.097	264.099	264.104	264.106
0.25000	264.102	264.097	264.100	264.104	264.107
0.22000	264.103	264.099	264.101	264.105	264.108
0.20000	264.104	264.099	264.101	264.108	264.111
0.17500	264.106	264.099	264.101	264.111	264.116
0.15000	264.108	264.099	264.103	264.113	264.118
0.12500	264.111	264.101	264.106	264.116	264.121
0.10000	264.114	264.104	264.109	264.119	264.124
0.09000	264.115	264.105	264.110	264.121	264.126
0.08000	264.117	264.106	264.111	264.122	264.128
0.07000	264.118	264.107	264.112	264.124	264.130
0.06000	264.120	264.108	264.114	264.126	264.132
0.05000	264.122	264.109	264.115	264.128	264.135
0.04000	264.124	264.109	264.115	265.728	267.332
0.03000	265.279	264.109	264.115	268.525	271.534
0.02000	266.815	264.109	264.116	269.435	271.534
0.01500	267.336	264.110	265.237	269.435	271.534
0.01000	268.036	264.110	265.973	270.099	272.163
0.00900	268.216	264.110	266.153	270.279	272.342
0.00800	268.414	264.288	266.351	270.478	272.541
0.00700	268.636	264.509	266.572	270.699	272.762
0.00600	268.887	264.761	266.824	270.951	273.014
0.00500	269.179	265.052	267.116	271.242	273.306
0.00400	269.649	265.522	267.585	271.712	273.775
0.00300	270.238	266.111	268.175	272.301	274.365
0.00200	271.041	266.914	268.978	273.104	275.168
0.00100	272.347	268.221	270.284	274.410	276.474
0.00050	273.581	269.454	271.517	275.644	277.707

Figure A2-7, Reach 5, Alternatives D1 and E1

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.95000	268.607	268.545	268.576	268.638	268.669
0.90000	268.639	268.599	268.619	268.658	268.678
0.80000	268.677	268.640	268.658	268.695	268.714
0.70000	268.704	268.673	268.689	268.720	268.736
0.50000	268.750	268.721	268.735	268.753	268.755
0.47500	268.751	268.747	268.749	268.753	268.755
0.45000	268.751	268.747	268.749	268.754	268.756
0.42500	268.752	268.748	268.750	268.754	268.757
0.40000	268.753	268.749	268.751	268.755	268.757
0.37500	268.754	268.750	268.752	268.756	268.758
0.35000	268.755	268.750	268.752	268.757	268.759
0.32500	268.755	268.751	268.753	268.758	268.760
0.30000	268.756	268.752	268.754	268.758	268.761
0.27000	268.757	268.753	268.755	268.760	268.762
0.25000	268.758	268.753	268.756	268.760	268.763
0.22000	268.759	268.755	268.757	268.762	268.764
0.20000	268.760	268.755	268.757	268.764	268.767
0.17500	268.762	268.755	268.757	268.767	268.772
0.15000	268.764	268.755	268.759	268.769	268.774
0.12500	268.767	268.757	268.762	268.772	268.777
0.10000	268.770	268.757	268.762	269.297	269.825
0.09000	269.202	268.757	268.762	271.026	272.851
0.08000	269.672	268.757	268.762	271.562	273.453
0.07000	270.188	268.757	268.762	272.159	274.130
0.06000	270.764	268.758	268.762	272.836	274.908
0.05000	271.422	268.758	269.218	273.625	275.829
0.04000	272.194	268.758	270.014	274.374	276.555
0.03000	272.995	268.758	270.744	275.246	277.497
0.02000	274.060	269.309	271.684	276.436	278.811
0.01500	274.795	269.309	271.835	277.755	280.715
0.01000	275.782	269.845	272.813	278.751	281.719
0.00900	276.061	270.123	273.092	279.030	281.998
0.00800	276.368	270.431	273.399	279.337	282.306
0.00700	276.711	270.774	273.743	279.680	282.649
0.00600	277.101	271.163	274.132	280.070	283.038
0.00500	277.553	271.616	274.584	280.522	283.490
0.00400	278.288	272.351	275.319	281.257	284.226
0.00300	279.211	273.273	276.242	282.180	285.148
0.00200	280.468	274.531	277.499	283.437	286.405
0.00100	282.513	276.575	279.544	285.481	288.450
0.00050	284.444	278.506	281.475	287.413	290.381

Figure A2-8, Reach 9, Alternatives D1 and E1

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.95000	255.770	255.711	255.740	255.799	255.829
0.90000	255.800	255.762	255.781	255.819	255.838
0.80000	255.836	255.801	255.819	255.854	255.872
0.70000	255.863	255.832	255.848	255.878	255.893
0.50000	255.906	255.878	255.892	255.909	255.911
0.47500	255.907	255.903	255.905	255.909	255.911
0.45000	255.908	255.903	255.905	255.910	255.912
0.42500	255.908	255.904	255.906	255.910	255.912
0.40000	255.909	255.905	255.907	255.911	255.913
0.37500	255.910	255.905	255.908	255.912	255.914
0.35000	255.911	255.906	255.908	255.913	255.915
0.32500	255.911	255.907	255.909	255.914	255.916
0.30000	255.912	255.908	255.910	255.914	255.917
0.27000	255.913	255.909	255.911	255.916	255.918
0.25000	255.914	255.909	255.912	255.916	255.919
0.22000	255.915	255.911	255.913	255.917	255.920
0.20000	255.916	255.911	255.913	255.920	255.923
0.17500	255.918	255.911	255.913	255.923	255.928
0.15000	255.920	255.911	255.915	255.925	255.930
0.12500	255.923	255.913	255.918	255.928	255.933
0.10000	255.926	255.916	255.921	255.931	255.936
0.09000	255.927	255.917	255.922	255.933	255.938
0.08000	255.929	255.918	255.923	255.934	255.940
0.07000	255.930	255.919	255.924	255.936	255.942
0.06000	255.932	255.920	255.926	255.938	255.944
0.05000	255.934	255.921	255.927	255.940	255.947
0.04000	255.936	255.921	255.927	255.945	255.954
0.03000	255.940	255.921	255.928	255.952	255.964
0.02000	255.946	255.921	255.933	255.959	255.972
0.01500	255.950	255.922	255.933	255.967	255.985
0.01000	255.956	255.922	255.939	255.973	255.990
0.00900	255.958	255.923	255.940	255.975	255.992
0.00800	255.959	255.925	255.942	255.976	255.994
0.00700	255.961	255.927	255.944	255.978	255.995
0.00600	255.963	255.929	255.946	255.981	255.998
0.00500	255.966	255.932	255.949	255.983	256.000
0.00400	255.969	255.934	255.951	255.986	256.003
0.00300	255.972	255.937	255.955	255.989	256.006
0.00200	255.976	255.942	255.959	255.993	256.010
0.00100	255.983	255.949	255.966	256.000	256.017
0.00050	255.990	255.955	255.973	256.007	256.024

Figure A2-9, Reach 22, Alternatives D1 and E1

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.95000	269.013	268.950	268.982	269.044	269.075
0.90000	269.044	269.005	269.025	269.064	269.084
0.80000	269.083	269.045	269.064	269.101	269.120
0.70000	269.110	269.079	269.094	269.126	269.142
0.50000	269.156	269.127	269.141	269.159	269.161
0.47500	269.157	269.153	269.155	269.159	269.161
0.45000	269.158	269.153	269.155	269.160	269.162
0.42500	269.158	269.154	269.156	269.160	269.162
0.40000	269.159	269.155	269.157	269.161	269.163
0.37500	269.160	269.155	269.158	269.162	269.164
0.35000	269.161	269.156	269.158	269.163	269.165
0.32500	269.161	269.157	269.159	269.164	269.166
0.30000	269.162	269.158	269.160	269.164	269.167
0.27000	269.163	269.159	269.161	269.165	269.168
0.25000	269.164	269.159	269.162	269.166	269.169
0.22000	269.165	269.161	269.163	269.167	269.170
0.20000	269.166	269.161	269.163	269.170	269.173
0.17500	269.168	269.161	269.163	269.173	269.178
0.15000	269.170	269.161	269.165	269.175	269.180
0.12500	269.173	269.163	269.168	269.178	269.183
0.10000	269.176	269.163	269.168	269.641	270.107
0.09000	269.557	269.163	269.168	271.165	272.773
0.08000	269.971	269.163	269.168	271.637	273.304
0.07000	270.426	269.163	269.168	272.163	273.901
0.06000	270.934	269.164	269.168	272.760	274.586
0.05000	271.513	269.164	269.571	273.455	275.398
0.04000	272.194	269.164	270.138	274.250	276.306
0.03000	272.997	269.164	270.741	275.252	277.508
0.02000	274.064	269.298	271.681	276.447	278.830
0.01500	274.802	269.298	271.828	277.776	280.750
0.01000	275.794	269.830	272.812	278.776	281.758
0.00900	276.074	270.110	273.092	279.056	282.038
0.00800	276.382	270.418	273.400	279.365	282.347
0.00700	276.727	270.763	273.745	279.709	282.691
0.00600	277.118	271.154	274.136	280.100	283.082
0.00500	277.572	271.608	274.590	280.554	283.536
0.00400	278.301	272.337	275.319	281.283	284.265
0.00300	279.216	273.252	276.234	282.198	285.180
0.00200	280.462	274.498	277.480	283.444	286.426
0.00100	282.489	276.525	279.507	285.471	288.453
0.00050	284.404	278.440	281.422	287.386	290.368

Figure A2-10, Reach 28, Alternatives D1 and E1

SECTION 4 DOCUMENTATION OF ADDITIONAL BENEFIT CATEGORIES ADDENDUM

4.1 Emergency Cost

A flooded community typically incurs a variety of flood-related costs not associated with structural damages. The emergency costs incurred by the Federal, state, and local governments immediately prior to, during and after the storm event are designed to eliminate or reduce the immediate threat to life, public health, or safety.

The emergency costs incurred by state and local governments include the increased police and fire personnel costs; costs of emergency measures such as evacuation of hospitals; flood fighting costs such as pumps, sandbags, and other levee enhancement measures and flood fight personnel; and restoration of private, commercial, and public properties. The damage values were estimated from prior flood fighting efforts and related operations costs. The included line items are the costs of pumping out floodwaters, setting up barricades, sandbagging structures, and the increased operations of police officers and fire fighters. These costs are estimated to have an expected value of $120,450 under existing conditions. The benefits from reduction of government emergency costs are estimated to be $83,110 for alternatives D1 and E1 based on the approximate 70% damage reduction to residential and commercial structures. This is a result of flood fighting, evacuations, pumping, and emergency personnel cost being greatly reduced due to the reduction in flood risk.

4.2 Cleanup Costs

Data developed by the New Orleans District were used to estimate the residential cleanup costs incurred by residential households immediately following a storm event. Included in this category are the costs of interior clean up and dehumidifying the property, and the opportunity cost for the time spent by the resident meeting with the adjustors and contractors and inspecting the repairs. While the rebuilding process will likely last longer than one year, the cleanup and reoccupation costs are based only on the actual hours estimated to be spent by residents on these activities. Since all residents affected by a flood were assumed to stay in the Jackson area, no travel costs were included in this estimate.

The estimated costs incurred by residents to clean up and gut their inundated properties were based on interviews with contractors and repair personnel in the planning area. The tasks involved in this cost category include obtaining permits, employing dehumidifiers, gutting the interior of the structure, sanitizing the salvageable items, and removing mold. The cleanup and gutting costs have an estimated expected value of $1,336,400 under existing conditions. With Alternatives D1 and E1 in place, these costs are estimated to be reduced by $917,000.

During their period of evacuation, homeowners will devote many hours applying for governmental assistance, filing insurance claims, scheduling appointments, meeting with insurance adjustors and contractors, and supervising repair work. The opportunity cost associated with the time spent completing these tasks can be measured by the average hourly wage for residents in the Study Area. Based on the New Orleans District

data, residents of inundated structures spent an average of 100 hours completing these tasks. The average nonagricultural wage rate in the Study Area was estimated to be $18.60 per hour. Thus, the total opportunity cost for each resident whose property was inundated was determined to be $215,700. The benefits for opportunity of time cost reduction are estimated to be $152,600 for Alternatives D1 and E1.

4.3 FIA Operating Cost

When a flood damage reduction project removes residential structures from the annual 1% exceedance probability flood event floodplain, the owners are no longer required, by law, to have flood insurance. Since there is still some risk of flooding some owners may determine that it is in their best interest to maintain the insurance. For the purpose of this study, it was assumed that 90 percent of residences within the annual 1% exceedance probability flood event floodplain currently have flood insurance and that 75 percent of the residential structures that are no longer in the annual 1% exceedance probability flood event floodplain under with project conditions will no longer maintain flood insurance. This reduction in the number of policies will reduce the cost of operating the flood insurance program. Since the Corps of Engineers has not published FIA Operating Costs since FY 2006, the costs for that year of $192 per policy was used to calculate this benefit category. The expected value of these operating cost under existing conditions are estimated to be approximately $80,000. These costs are estimated to be reduced by approximately $73,000.

4.4 Road and Bridge Damage

The overall analysis of transportation facility losses involved determining the number of units adversely impacted by frequency and the application of these data to a loss per unit value for various types of facilities involved. Road profiles from mobile Lidar, aerial photographs, topographic maps, hydrologic data, and a delineation of the area affected were utilized in this analysis. To calculate these damages, stage-frequency and stage-damage curves were developed for each area. The evaluation also incorporated data from interviews with local officials.

The type, location, and number of miles of streets, roads, etc., affected were based on analysis of current mobile Lidar and aerial photographs on which the impacted area was delineated. Under existing conditions, local roads begin to experience flooding impacts at the 20% chance flood event. Arterial roads (those with average daily traffic counts over 10,000) begin experiencing flooding impacts at the 4% chance flood event. Flood impacts to interstates and highways begin to occur at the annual 1% exceedance probability flood event.

The loss value per mile of road was derived through contacts with the street maintenance personnel and county highway officials in the project area. These officials are very familiar with all aspects of highway/bridge construction, repair, and maintenance cost including those associated with historical flood damage. The evaluated actual cost included estimates of asphalt overlay and minimum patching for roads along with bridge repairs for larger events.

The unit cost to repair roads vary by type. Local Streets have a cost of $90,000 per mile; state highways have a cost of $120,000 per mile; and interstates have a cost of $150,000 per mile. The total number of miles damaged varies by frequency event. These road repairs consist of cleanup, sweeping, drainage repair, patching, and overlay as required.

The number of miles of roads flooded by the annual 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% exceedance probability flood events were derived by delineating these events based on recent mobile Lidar.

The expected annual damages to the transportation infrastructure were estimated to be $816,400 for existing conditions. The reduction in damages to the transportation infrastructure are estimated to be $563,300 for Alternatives D1 and E1.

4.5 Traffic Rerouting Costs

Traffic disruption is a major damage during large flood events in the Jackson Metropolitan area. When streets, roads, and highways are flooded they must be closed, and traffic must be rerouted. Traffic rerouting costs include the increased operating costs of increased mileage caused by the detour and the value of time caused by the increased distance and increased traffic congestion. The streets, roads, and highways subject to flooding; average daily traffic count; percent of traffic that is cars; percent that is trucks; length of detour; and time required for detour were provided by the Mississippi Department of Transportation.

The 2024 IRS mileage rate for work of $0.67 per mile was used as the operating cost for cars and an operating cost of $2.25 per mile obtained from http://thetruckerreport.com was used for trucks. The value of time was calculated based on the recommendations of IWR Report 91-R-12, Value of Time Saved For Use In Corps Planning Studies, A Review Of The Literature And Recommendations by David J. Hill and David A. Moser, Ph.D., October 1991 and in accordance with Table B-4 of ER 1105-2-100, Appendix D, Amendment #1, 30 June 2004. A median family income of $60,085 for the Jackson Metropolitan Area for 2024.

(U.S. Census Bureau, 2017 American Community Survey 1-Year Estimates) was used in the analysis. Also, 70% of car vehicular traffic was assumed to be job-related, 10% was assumed to be recreational, and 20% was categorized as ‘other,’ *i.e.,* driving children to school or trips to the grocery/doctor/etc. All of the traffic from trucks was assumed to be work-related. Further, 75% of the trucks were assumed to have one occupant while the remaining 25% were assumed to have two occupants.

It was assumed that no streets would significantly flood and require a detour at events more frequent than a 25-year event. For a 25-year event, only minor local streets would flood lasting for a duration of two days. For a 50-year event, the Eubanks section of Lakeland drive would begin to flood as well for a duration of 5 days. For a 100-year event, all the streets shown would flood for a duration of seven days. For a 200-year event, all the streets shown would flood for a duration of 8 days. And for a 500-year event, all the streets would flood for a duration of 9 days. With the channel improvements in place, only the minor local streets and Highway 90 would continue to flood and require a detour.

The expected value of the traffic delay costs is estimated to be $1,986,700 under existing conditions. The estimated reduction in these costs due to the reduction in detours are estimated to be $1,847,900 for the Alternatives D1 and E1.

4.6 Waste Water Treatment Cost

In addition to damages caused by compromise of the Wastewater Treatment Levee discussed below, additional cost of damages caused by flood waters was estimated. The major damage during flood events is the additional cost of treatment and pumping of the floodwaters entering the wastewater system. The main interceptor that runs along the Pearl River experiences infiltration from the river when the floodwaters leave the channel. This river water that infiltrates the system must be treated at a cost of $4.20 per 1000 gallons. The gallons of river water infiltration vary by frequency event. The 2-year event results in an estimated 10,000 gallons of water infiltration per day for a total of 5 days. The 5-year event results in an estimated 20,000 gallons of water infiltration per day for 7 days. The 10-year and 25-year events result in an estimated 40,000 gallons of water infiltration per day for 7 days. The 50-year through the 200-year events results in an estimated 40,000 gallons of water infiltration per day for 10 days. And the 500-year event results in an estimated 40,000 gallons of water infiltration per day for 15 days. The resulting probability-damage curve yields a without project expected value of $364,960. Alternatives D1 and E1 reduce structure damages occurring in the study are by approximately 70%. This percentage was applied to the expected value of the treatment cost as a proxy for estimating the reduction in additional treatment cost, resulting in a cost reduction of $200,700.

4.7 Wastewater Treatment Plant

Flood damages and project benefits were determined for the Savanna Street Wastewater Treatment Plant. The WWTP is the wastewater treatment facility for the Jackson Metropolitan Area serving the cities of Jackson, Ridgeland, and Brandon. The treatment plant is currently protected by a non-federal ring levee.

The estimated replacement cost of the WWTP is $820 million. The city of Jackson currently accounts for approximately 48% depreciation on the existing wastewater treatment plant. Applying the existing depreciation rate to the replacement cost yields a depreciated replacement cost of $426 million. Based on damages that occurred in the 1979 flood of record, it is estimated that a breach of the existing ring levee would result in damages that would be approximately equivalent to 50% of the existing structure value. Based on the system response curve below. The expected annual damages associated with the breaching of the ring levee would be approximately $216,400. With the levee improvements, it is estimated that these damages would no longer occur.

Table 1: Aggregated System Response Curve for Ring Levee surrounding the Savanna Street Wastewater Treatment Plant.

Return Interval	Stage	Probability of Failure
10	265	0.0025
25	267	0.0075
50	268	0.0125
100	269	0.0175
200	270	0.025
500	272	0.0275