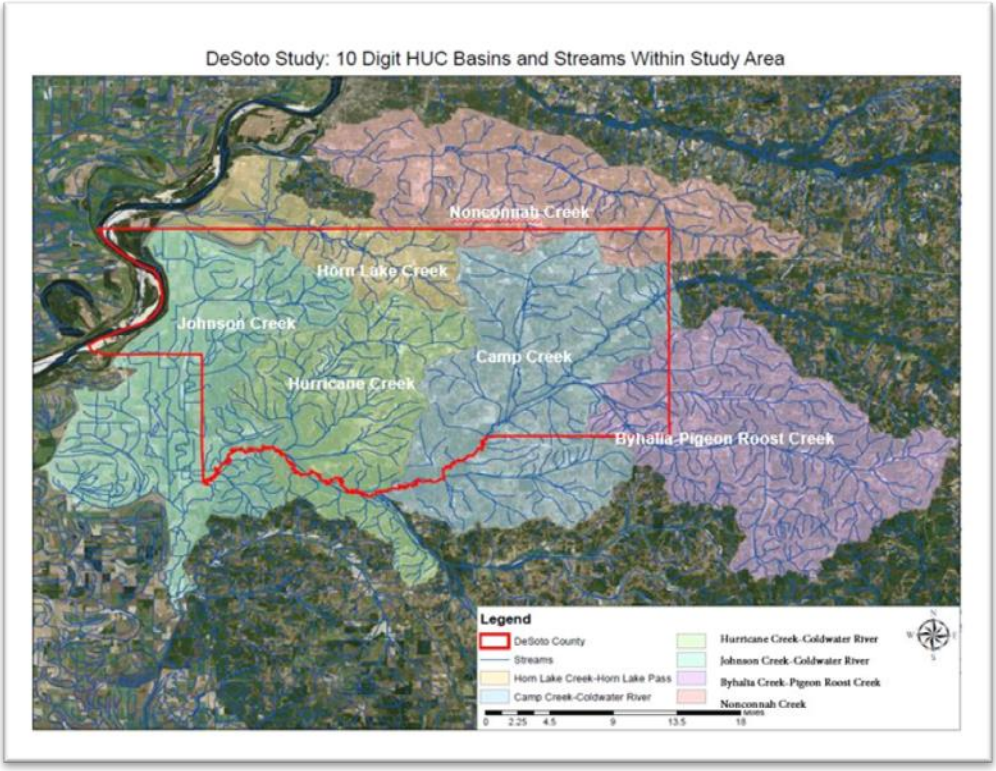
MEMPHIS METROPOLITAN STORMWATER-NORTH DESOTO FEASIBILITY STUDY, DESOTO COUNTY MISSISSIPPI



APPENDIX L-ECONOMICS

U.S. Army Corps of Engineers
Mississippi Valley Division
Memphis District
167 N. Main St.
Memphis, TN 38103-1894

July 2023

REVISED FEASIBILITY REPORT

FINAL Economics Appendix

TABLE OF CONTENTS

Contents

LIST OF TABLES

LIST OF FIGURES

1.0 BACKGROUND INFORMATION

1.1 INTRODUCTION

This appendix presents an economic evaluation of the riverine flood risk management measures for the DeSoto County Feasibility Study. The evaluation area includes multiple watersheds within DeSoto County, Mississippi. The report was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Risk Assessment for Flood Risk Management Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm 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 economic appendix consists of a description of the methodology used to analyze the damages and benefits across the National Economic Development (NED), Regional Economic Development (RED), and Other Social Effects (OSE) accounts for comparison of proposed alternatives. Estimated project costs provided by the USACE Memphis District Cost Engineering Brach are incorporated into the analysis to weigh against the benefits (reduction in damages). The damages and costs were calculated using FY 2023 price levels. Costs were annualized using the FY 2023 Federal discount rate of 2.5 percent and a period of analysis of 50 years with the year 2029 as the base year. The annual damage and benefit estimates were compared to the annual construction costs and the associated OMRR&R costs for each of the project measures.

NED Benefit Categories Considered

The NED procedure manuals for riverine and urban areas recognize four primary categories of benefits for flood risk management measures: inundation reduction, intensification, location, and employment benefits. The majority of the benefits attributable to a project measure generally result from the reduction of actual or potential damages caused by inundation. Inundation reduction includes the reduction of physical damages to structures, contents, and vehicles and indirect losses to the national economy.

Physical Flood Damage Reduction

Physical flood damage reduction benefits include the decrease in potential damages to residential and non-residential structures, their contents, and the privately owned vehicles associated with these structures.

NED Benefit Categories Not Considered

The following NED benefit categories were not addressed in this economic appendix prior to selection of a Recommended Plan include the following:

- Indirect losses to the national economy as a result of disruptions in the production of goods and services by industries affected by the storm or riverine flooding
- Increased cost of operations for industrial facilities following a flood event relative to normal business operations
- Physical loss of agricultural crops grown to be sold for commercial profit
- Emergency Cost Reduction
- Traffic Detour Transit Delay Reduction

Regional Economic Development

When the economic activity lost in a flooded region can be transferred to another area or region in the national economy, these losses cannot be included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the RED account. The input-output macroeconomic model RECONS can be used to address the impacts of the construction spending associated with the project alternatives and is used on this project.

Other Social Effects

The other social effects (OSE) account includes impacts to life safety, vulnerable populations, local economic vitality, and community optimism. Impacts on these topics are a natural outcome of civil works projects and are most commonly qualitatively discussed in the OSE account. Life loss modeling software such as HEC-LifeSim has the ability to quantify loss of life for a given alternative to determine if life safety risk decreases or is induced as a result of federal investment. The OSE account is addressed in Sections 6 and 7 of this appendix.

1.2 DESCRIPTION OF THE STUDY AREA

Geographic Location

North DeSoto County is located on the border of Southern Tennessee and Northern Mississippi and includes the cities of Horn Lake, Southaven, Olive Branch, and Hernando. An inventory of residential and non-residential structures was developed using the National Structure Inventory (NSI) version 2.0 for the portions of the county impacted by riverine flooding associated with the future without project condition. Figure L: 1-1 shows the structure inventory and the boundary of the county.

The study area initially included the entire county, but after applying the effective Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), the economics team found a limited number of structures exposed to riverine flood hazards. At the time of the Tentatively Selected Plan (TSP) Milestone, the study area was modified to include two major basins for further analysis: Horn Lake and Coldwater. Horn Lake includes the streams of Horn Lake Creek, Rocky

Creek, Cow Pen Creek, and Lateral D. Coldwater includes the streams of Coldwater, Camp, Licks, and Nolehoe. Other streams such as Hurricane, Short Fork, Pigeon Roost, Red Banks, Short Fork, Short, and Bean Patch were analyzed, but no flood-prone structures existed at the time of that analysis. The structure inventory at this time is indicated by the green and yellow dots in Figure L: 1-1 and was limited to the structures in Horn Lake and Coldwater basins which experienced inundation at the 0.002 Annual Exceedance Probability (AEP) event without a project in place. Information about the analysis done on the focused array is available upon request.

After the TSP Milestone, refinements were made to the study area based on the results of two-dimensional hydraulic modeling, which showed no justified alternatives in Coldwater basin. Since the only alternatives moved forward from the focused array to the final array were located in Horn Lake basin, the study area was limited to that basin. The final structure inventory is indicated by the green dots in Figure L: 1:1 and includes all structures within Horn Lake basin which are inundated at the 0.002 AEP event in the without project condition.

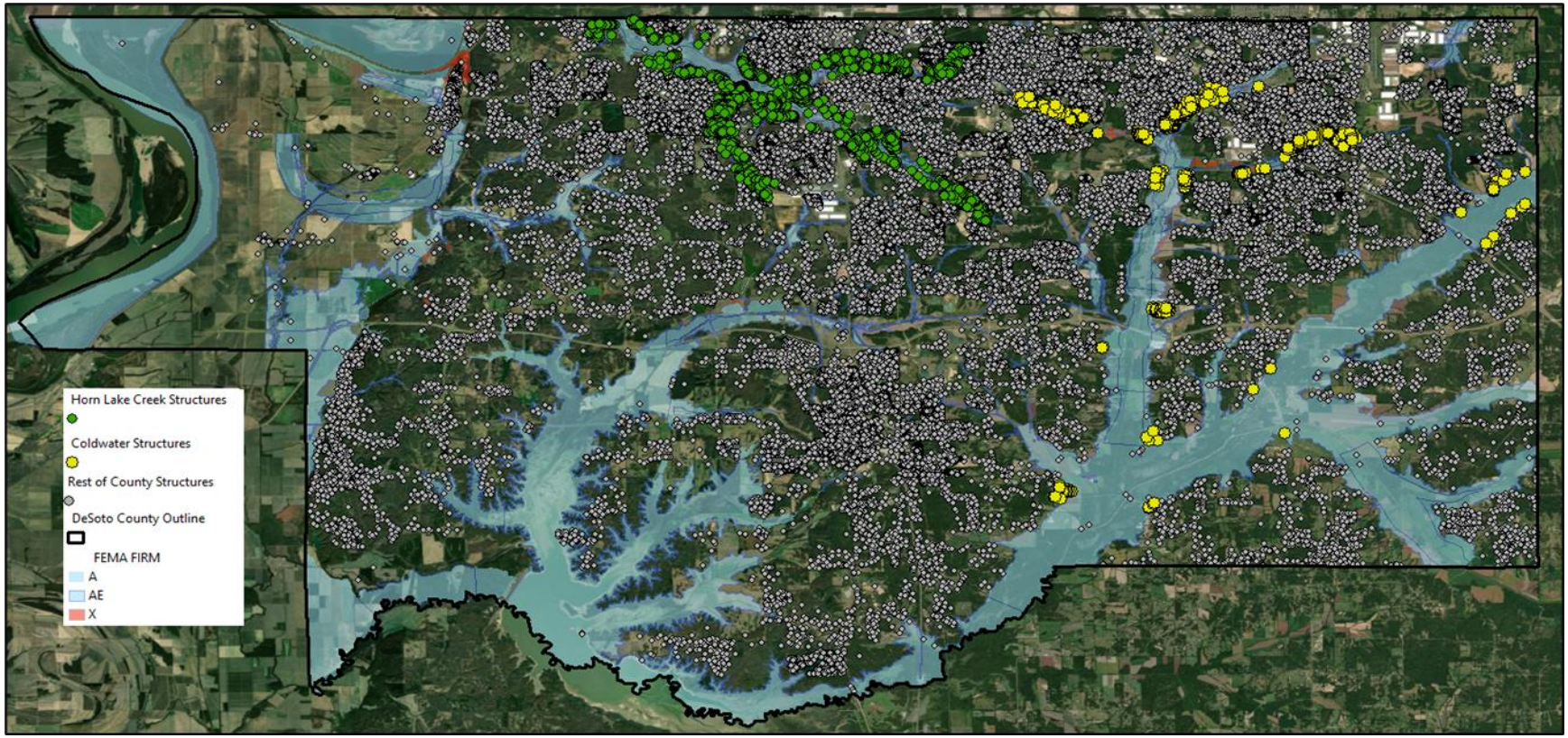


Figure L: 1-1 North DeSoto County Boundary and Structure Inventory

The hydraulic engineer divided the study area into reaches, which are geographic areas that experience similar hydraulic conditions. These reaches were further broken down in areas with high concentrations of structures. Some reaches are small, indicating rapidly changing hydraulic conditions across the study area. Other reaches are larger, indicating more consistent water surface profiles. Structures are assigned reaches based on geographical location. Figure L: 1-2 shows the study area reach boundaries.

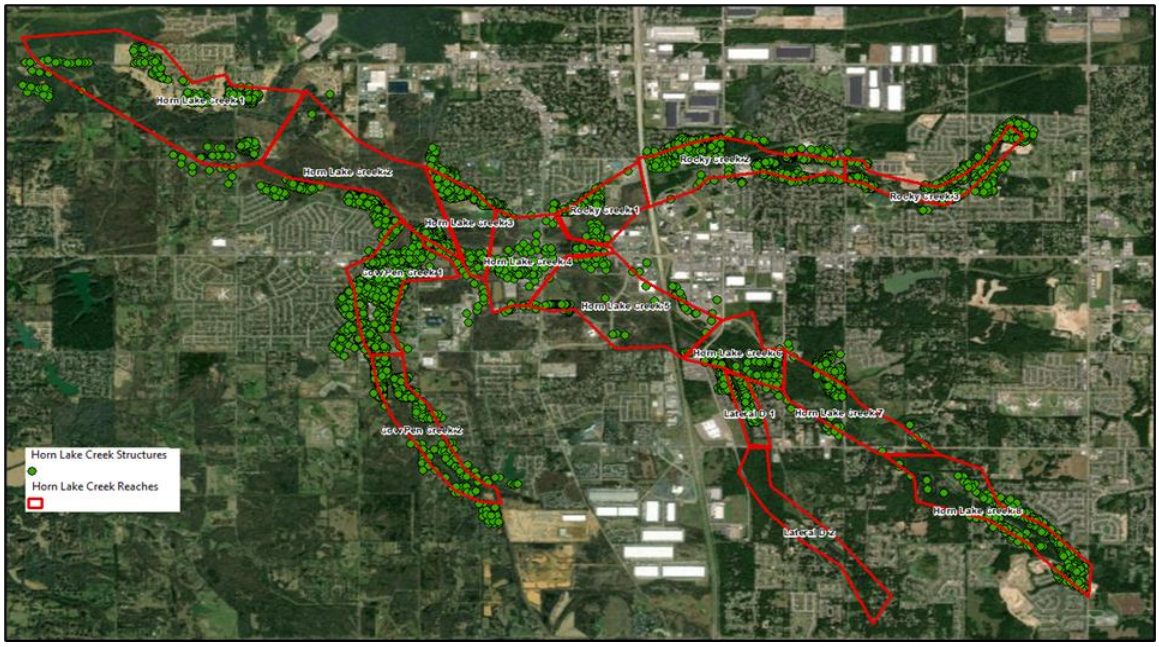


Figure L: 1-2 Study Area Reaches

Table L: 1-1 shows how many residential and non-residential structures are in each reach's inventory as well as their associated values. Table L: 1-2 shows how many vehicles are in each reach's inventory as well as their associated values. The methodology for the structure inventory creation and valuation is described more in Section 2.2 of this appendix.

Table L: 1-1 Structure Count and Value by Reach

(2023 Price Level; $ Thousands)

Reach	Structure Count			Structure Values		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
Horn Lake 1	114	6	120	$27,966	$6,854	$34,820
Horn Lake 2	119	0	119	$21,265	$0	$21,265
Horn Lake 3	180	20	200	$27,908	$15,092	$43,000
Horn Lake 4	5	78	83	$3,402	$116,185	$119,587
Horn Lake 5	12	17	29	$2,410	$36,041	$38,451
Horn Lake 6	110	1	111	$71,751	$184	$71,934
Horn Lake 7	90	0	90	$20,360	$0	$20,360
Horn Lake 8	128	0	128	$25,996	$0	$25,996
Horn Lake Creek Total	**758**	**122**	**880**	**$201,058**	**$174,356**	**$375,413**
Cow Pen Creek 1	740	18	758	$184,606	$19,859	$204,465
Cow Pen Creek 2	300	0	300	$52,528	$0	$52,528
Cow Pen Creek Total	**1,040**	**18**	**1,058**	**$237,134**	**$19,859**	**$256,993**
Lateral D 1	154	2	156	$30,432	$1,531	$31,963
Lateral D Creek Total	**154**	**2**	**156**	**$30,432**	**$1,531**	**$31,963**
Rocky Creek 1	47	6	53	$15,381	$6,420	$21,800
Rocky Creek 2	400	11	411	$94,532	$21,697	$116,229
Rocky Creek 3	162	2	164	$35,165	$1,413	$36,578
Rocky Creek Total	**609**	**19**	**628**	**$145,078**	**$29,530**	**$174,608**
Study Area Total	**2,561**	**161**	**2,722**	**$613,703**	**$225,275**	**$838,976**

Table L: 1-2 Vehicle Count and Value by Reach

(2023 Price Level; $ Thousands)

Reach	Vehicle Count	Vehicle Values
Horn Lake 1	114	$1,866
Horn Lake 2	119	$1,948
Horn Lake 3	180	$2,946
Horn Lake 4	5	$82
Horn Lake 5	12	$196
Horn Lake 6	110	$1,801
Horn Lake 7	90	$1,474
Horn Lake 8	128	$2,095
Horn Lake Creek Total	**758**	**$12,407**
Cow Pen Creek 1	740	$12,112
Cow Pen Creek 2	300	$4,910
Cow Pen Creek Total	**1,040**	**$17,022**
Lateral D 1	154	$2,520
Lateral D Creek Total	**154**	**$2,520**
Rocky Creek 1	47	$769
Rocky Creek 2	400	$6,547
Rocky Creek 3	162	$2,652
Rocky Creek Total	**609**	**$9,968**
Study Area Total	**2,561**	**$41,917**

Land Use

As shown in Table L: 1-3, 18 percent of DeSoto County is currently developed land. The rest of the land use is split between agricultural land, which includes pasture and hay, and undeveloped land. Undeveloped land is primarily classified as forest, wetlands, and shrubs.

Table L: 1-3 Land Use in DeSoto County, MS

Land Class Name	Percentage
Developed Land	18%
Agricultural Land	36%
Undeveloped Land	46%
Total	100%

Source: USGS National Land Cover Database

1.3 SOCIOECONOMIC SETTING

The socioeconomic setting for DeSoto County and Mississippi is reflected in the following section that includes statistics associated with population, households, employment, payroll, and per capita income and provides reviewers with a comparison of the study area (DeSoto County) with the state (Mississippi). While the study area does not reflect the entire county, it does account for the municipalities of Southaven, Olive Branch, and Horn Lake, which represents 67% of the population according to 2017 Census Bureau estimates. This section assumes that DeSoto County socioeconomic statistics reflect the study area.

Population, Number of Households, and Employment

Table L: 1-4 shows the population trend in DeSoto County and in the State of Mississippi from 1970 to 2010 and projections through 2040. DeSoto County has rapidly grown since 1990 and is forecast to continue growing through 2040. Total number of households also shows a steady increasing trend from 1970 to 2010 and projections through 2040. The 2000 and 2010 estimates for population, number of households and employment are from the U.S. Census and the projections were developed by Moody's Analytics (ECCA) Forecast, which has projections to the year 2045.

Table L: 1-4 Historical and Projected Population

(Thousands)

Area	1970	1980	1990	2000	2010	2020	2030	2040
DeSoto County	36	54	69	109	162	188	218	246
Mississippi	2,221	2,527	2,579	2,848	2,970	3,010	3,080	3,155

Source: U.S. Census Bureau (BOC); Moody's Analytics (ECCA) Forecast

Table L: 1-5 Historical and Projected Households

(Thousands)

Area	1970	1980	1990	2000	2010	2020	2030	2040
DeSoto County	9	16	24	39	58	69	84	98
Mississippi	638	829	913	1,050	1,118	1,177	1,248	1,311

Source: U.S. Census Bureau (BOC); Moody's Analytics (ECCA) Forecast

Table L: 1-6 shows the growth of non-farm payroll over the last four decades and projections through 2040. Total non-farm payroll employment is the number of paid US workers in all businesses, excluding those who work for farms, serve in the military, volunteer for nonprofit organizations, and perform unpaid work in their own household. Self-employed, unincorporated individuals are excluded as well. The leading employment sectors for DeSoto County are Trade, Transportation and Utilities; Leisure and Hospitality; Government; and Education & Health Services. Tables L: 1-7 and L: 1-8 show the Labor Force, Employment, Unemployment, and Unemployment Rate for DeSoto County and the State of Mississippi, respectively. DeSoto County has consistently had a lower unemployment rate than the State of Mississippi. The labor force shows a steady increase over the period and projected through 2040.

Table L: 1-6 DeSoto County Non-farm Employment

(Thousands)

Sector	1970	1980	1990	2000	2010	2020	2030	2040
Natural Resources and Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0.2	0.7	1.0	1.9	1.9	2.3	2.8	3.5
Manufacturing	2.7	3.8	6.2	7.1	3.7	4.6	5.0	5.5
Trade; Transportation; and Utilities	1.1	2.6	5.1	9.1	14.3	20.7	24.6	28.9
Information	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4
Financial Activities	0.4	0.5	0.7	1.1	1.6	1.6	2.0	2.3
Professional and Business Services	0.5	0.8	1.9	3.1	4.0	6.9	8.8	11.2
Education & Health Services	0.1	0.3	1.2	2.6	5.6	7.3	9.1	11.2
Leisure and Hospitality	0.5	0.8	1.5	4.0	7.0	10.3	12.9	16.0
Other Services (except Public Administration)	0.2	0.2	0.4	1.2	1.4	1.8	2.1	2.3
Government	1.6	2.1	2.4	3.8	6.8	7.6	8.9	10.2
Total Nonfarm payroll	**7.3**	**11.8**	**20.5**	**34.1**	**46.4**	**63.3**	**76.5**	**91.5**

Source: U.S. Bureau of Labor Statistics: Census of Employment & Wages (QCEW - ES202); Moody's Analytics (ECCA) Forecast

Table L: 1-7 DeSoto County Employment

(Thousands)

Category	1990	2000	2010	2020	2030	2040
Labor Force	37.4	59.2	79.6	89.1	103.1	119.8
Employment	35.4	57.8	73.7	84.9	98.0	114.0
Unemployment	2.0	1.4	5.9	4.2	5.0	5.8
Unemployment Rate	5.3%	2.4%	7.5%	4.8%	4.9%	4.8%

Source: BLS; Moody's Analytics (ECCA) Forecast

Table L: 1-8 State of Mississippi Employment

(Thousands)

Category	1990	2000	2010	2020	2030	2040
Labor Force	1,184.0	1,319.3	1,306.6	1,269.7	1,312.4	1,389.7
Employment	1,094.0	1,248.2	1,170.9	1,187.3	1,224.2	1,296.8
Unemployment	89.9	71.0	135.7	82.3	88.3	92.9
Unemployment Rate	7.6%	5.4%	10.4%	6.5%	6.7%	6.7%

Source: BLS; Moody's Analytics (ECCA) Forecast

Income

Table L: 1-9 shows the actual and projected per capita personal income levels for DeSoto County from 1970 through 2040.

Table L: 1-9 DeSoto County per Capita Income

($ Thousands)

1970	1980	1990	2000	2010	2020	2030	2040
3.0	8.4	16.7	26.5	31.7	41.2	52.6	69.4

Source: U.S. Census Bureau (BOC); Moody's Analytics (ECCA) Forecast

Compliance with Policy Guidance Letter (PGL) 25 and Executive Order 11988

Based on the socioeconomic data, DeSoto County has experienced significant population, employment, and income growth since 1990 and forecasts show this growth is expected to continue. Given continued growth, it is expected that development will continue to occur in the study area with or without riverine flood risk management measures and will not conflict with PGL 25 and EO 11988, which states that the primary objective of a flood risk management project is to protect existing development, rather than to make undeveloped land available for more valuable uses. However, the overall growth rate is anticipated to be the same with or without the project in place. Thus, the project will not induce development, but would rather reduce the risk of the population being displaced after a major riverine flood event.

1.4 FEMA FLOOD INSURANCE RATE MAPS (FIRMS)

Flood insurance rate maps from FEMA were utilized in this study to help evaluate flood risk in riverine areas. The effective date of the FIRM maps varies throughout the study area from June 2007 to May 2014.

The FEMA FIRMs were utilized during the plan formulation process to compare and calibrate the existing condition hydraulic data. The effective base flood elevations were utilized when formulating the nonstructural methodology regarding elevating residential structures. Figure L: 1-3 shows the effective riverine floodplains for DeSoto County.

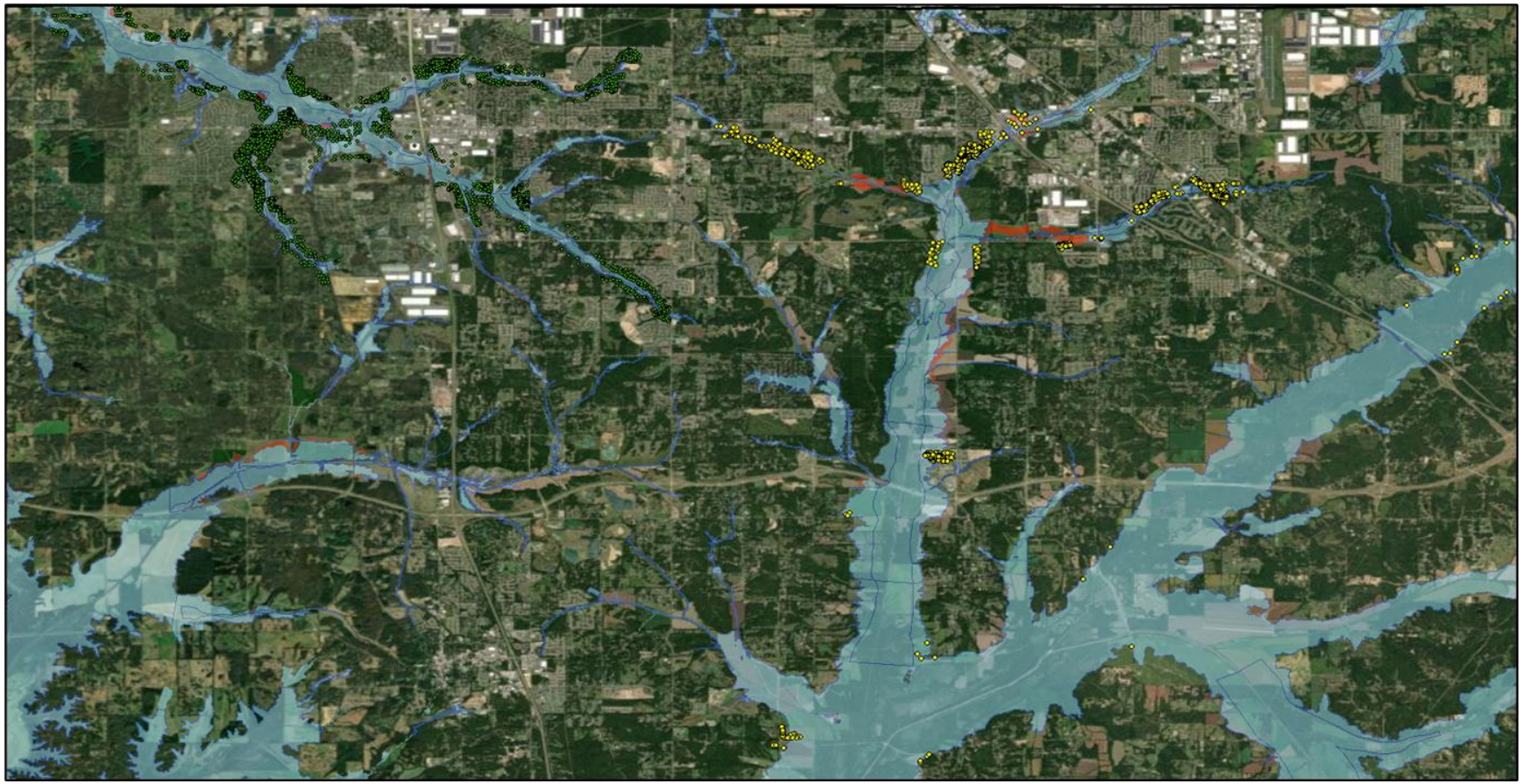


Figure L: 1-3 DeSoto County FEMA FIRM

1.5 RECENT FLOOD HISTORY

Flood risk management problems result from altered headwater hydrology which have caused major damaging floods in May 2010, May 2011, September 2014, and March 2016 in the study area. DeSoto County received a Presidential Disaster Declaration in 2011. Flooding in September 2014 prompted a State of Emergency declaration, the Coast Guard responded to evacuate trapped residents, and the U.S. Small Business Administration provided federal assistance afterwards. Since 1994, three lives have been lost in DeSoto County due to flooding. Flooding inundates major transportation corridors and neighborhoods, isolates communities, damages public infrastructure and development (residential, commercial, and industrial), and threatens life safety. Repeated flooding occurs within the Cities of Horn Lake, Southaven, Olive Branch, and Hernando. Drainage of headwaters from rainfall events cause flooding of residential and nonresidential structures downstream in the vicinity of the study area. The landscape has been heavily developed. Critical infrastructure, roads, schools, and medical facilities are at risk of flooding and the inundation of roads during flood events causes safety issues countywide.

The purpose of the FRM component is to evaluate opportunities to reduce the risks of flooding to the public; and commercial and residential property; and critical infrastructure. The FRM component also addresses road closures impacting access to critical infrastructure, and life safety risks resulting from flooding.

Aquatic ecosystem degradation in DeSoto County include reduced and degraded bottomland hardwood forested (BLH) and in-stream habitat largely due to development encroachments, channel alterations and channel bed degradation. Development in DeSoto County has occurred over the decades as population has increased resulting in residential expansion and an increase in commercial activity. The channel bed degradation exists as a result of head-cutting, increased flows and erosion. Increased runoff from development is causing channel instability, scouring, and degrading aquatic habitat. Channel alterations in the DeSoto County watersheds have caused a decline in the ability of streams and adjacent lands to support the requisite functions for fish and wildlife. Most bottomland hardwoods have been cleared and wetlands are isolated or drained.

The purpose of the aquatic ecosystem restoration (AER) component is to evaluate opportunities to reduce or arrest the uncontrolled down-cutting of the channel beds and subsequent channel widening, erosion, sedimentation; replace and improve in-stream habitat along with reforestation of stream corridors to restore BLH habitat structure and function.

1.6 CRITICAL INFRASTRUCTURE

The critical infrastructure identified within the North DeSoto study area is comparable to other study areas of similar economic characteristics. There are

no significant industries within the study area that influence the existing condition critical infrastructure inventory. The critical infrastructure present includes hospitals, schools, electric substations, and emergency services (fire, police, EMS).

The structure inventory developed for the North DeSoto study area included all applicable critical infrastructure that has a damageable footprint with an associated depth-damage curve available. Excluded critical infrastructure from the structure inventory included electric substations and some wastewater treatment plants because no depth damage functions were available for those structure types. Figure L: 1-4 shows the critical infrastructure inventory for the study area overlaid with the current FEMA flood mapping (0.01 and 0.002 AEP flood boundaries).

As shown in these figures, the only critical infrastructure threatened by the 0.01 or 0.002 AEP floodwaters are a few schools and an electric substation. The schools at risk are the Horn Lake Elementary School, located along Cow Pen Creek, and Concorde Career College, located along Rocky Creek. Recent channel improvements have reduced the flood risk to Horn Lake Elementary School. However, the egress routes to both the north and south of the school are modeled to be inundated to the point that egress vehicle traffic would be impeded, leading to limited evacuation routes through the residential neighborhood to the east.

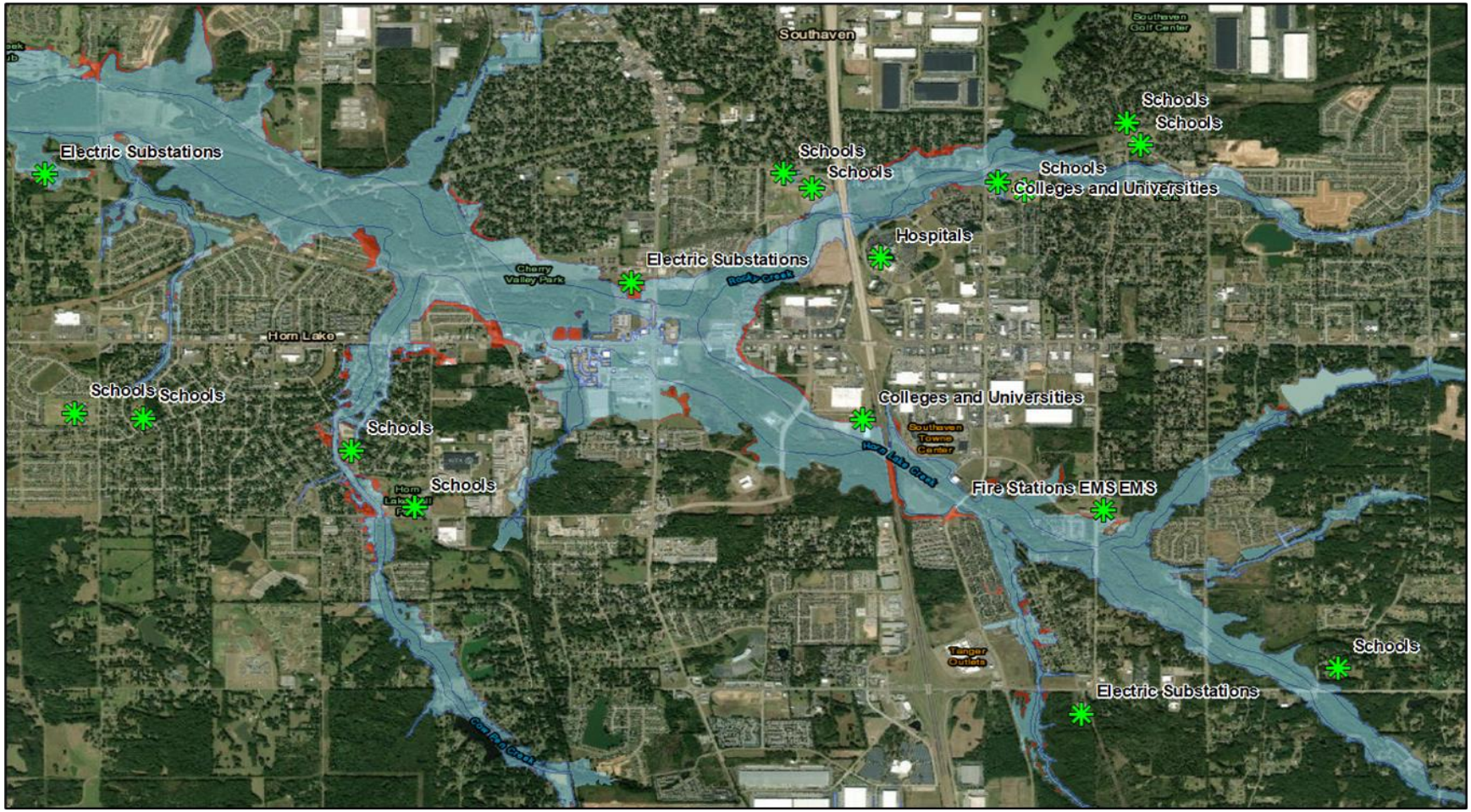


Figure L: 1-4 Study Area Critical Infrastructure

1.7 SCOPE OF THE STUDY

Problem Description

The study area includes both rural and urban areas that are encroaching floodplain boundaries. While there is limited available open space to be developed within the floodplain, the fringe and upland areas continue to be converted to impervious surfaces, leading to increased discharges to streams.

Project Alternatives

At the beginning of this study, a total of 26 management measures were initially identified as options to reduce the risk of riverine flooding in either Horn Lake Creek or Coldwater Basins. Out of the 26 management measures, 18 plans were identified, and 6 alternatives were created that optimized the costs and benefits of the individual measures within each alternative. Those measures were carried forward to the focused array of alternatives, which are shown in Table L: 1-10.

Table L: 1-10 Focused Array of Alternatives

Measures Included	Plan Name
Existing Without Project Condition	Existing Condition
25YR Horn Lake Creek Basin Nonstructural Aggregation	Horn Lake Basin 25YR
50YR Horn Lake Creek Basin Nonstructural Aggregation	Horn Lake Basin 50YR
100YR Horn Lake Creek Basin Nonstructural Aggregation	Horn Lake Basin 100YR
2005 Feasibility Report Design Features	Horn Lake Basin Plan 7
Rocky Creek Detention	Horn Lake Basin Plan 9
Horn Lake Creek Detention at Elmore	Horn Lake Basin Plan 10
Lateral D Detention	Horn Lake Basin Plan 11
Cow Pen Creek Detention	Horn Lake Basin Plan 12
Horn Lake Creek Levee Without Channel Enlargement	Horn Lake Basin Plan 14
Horn Lake Creek Bullfrog Corner Levee with Horn Lake Detention	Horn Lake Basin Plan 16
Bullfrog Corner Levee with Detention on Rocky, Lateral D, Cow Pen, and Horn Lake Creeks	Horn Lake Basin Plan 17
Horn Lake Creek Channel Enlargement (RM 18.86 – 19.41)	Horn Lake Basin Plan 18
Detention on Rocky, Lateral D, Cow Pen, and Horn Lake Creeks	Horn Lake Basin Plan 19
Detention on Rocky, Lateral D, and Cow Pen Creeks	Horn Lake Basin Plan 20
Horn Lake Creek Channel Enlargement with Detention on Rocky, Lateral D, Cow Pen Creeks	Horn Lake Basin Plan 21
Extended Horn Lake Channel Enlargement	Horn Lake Basin Plan 22
Extended Horn Lake Channel Enlargement with Lateral D Detention	Horn Lake Basin Plan 23
Extended Horn Lake Channel Enlargement with Cow Pen Detention	Horn Lake Basin Plan 24
Extended Horn Lake Channel Enlargement with Rocky Detention	Horn Lake Basin Plan 25
Extended Horn Lake Channel Enlargement with Cow Pen and Lateral D Detention	Horn Lake Basin Plan 26
Extended Horn Lake Channel Enlargement with Cow Pen, Lateral D, and Rocky Detention	Horn Lake Basin Plan 27
25YR Coldwater Basin Nonstructural Aggregation	Coldwater Basin 25YR
50YR Coldwater Basin Nonstructural Aggregation	Coldwater Basin 50YR
100YR Coldwater Basin Nonstructural Aggregation	Coldwater Basin 100YR

Of the 18 plans within the focused array, 5 were carried forward to the final array based on the updated one-dimensional/two-dimensional hydraulic modeling results. Since no justified plans were identified within the Coldwater Basin, the study area was altered to be limited to just the Horn Lake Basin for the remainder of the study.

The plans evaluated in the final array are shown in Table L: 1-11.

Table L: 1-11 Final Array of Alternatives

Measures Included	Plan Name
Existing Without Project Condition	Existing Condition
Extended Horn Lake Creek Channel Enlargement	5a
Extended Horn Lake Channel Enlargement with Lateral D Detention	6a
Extended Horn Lake Channel Enlargement with Cow Pen, Lateral D, and Rocky Detention	7
Levee and Floodwall System	8a
Levee and Floodwall System with Nonstructural	8b

The plans in the final array table above are briefly described below. More information about the individual plans, including imagery of locations, can be found in Section 4 of the Main Report.

Existing Condition. Existing Condition. This is the no action plan. No flood risk reduction would occur.

Plan 5a – Extended Horn Lake Creek Channel Enlargement. A channel enlargement along Horn Lake Creek would be constructed downstream of Goodman Road in Horn Lake, Mississippi.

Plan 6a – Extended Channel Enlargement and Lateral D Detention. The plan's extended channel enlargement measure is the same as described above in Plan 5a and is combined with the top performing detention basin, located on the Lateral D tributary to Horn Lake Creek in Southaven, Mississippi.

Plan 7 – Extended Channel Enlargement, Lateral D, Cow Pen, Rocky Detentions. This plan includes all components of Plan 6a with the addition of detention basins located on Rocky Creek at Elmore Road in Southaven, Mississippi and on Cow Pen Creek south of the intersection of Nail and Hurt Roads in Horn Lake, Mississippi.

Plan 8a – Levee and Floodwall System. This plan includes a levee and floodwall system to provide risk reduction for structures on the left-bank of Horn Lake Creek downstream of Goodman Rd in Horn Lake, Mississippi. The levee would run adjacent to US Hwy. 51 with an average height of 5 feet. Where development makes a levee infeasible, flood risk reduction would transition to a floodwall.

Plan 8b – Levee and Floodwall System with Nonstructural. This plan includes the levee and floodwall from Plan 8a combined with dry-floodproofing of 35 structures to provide risk management for structures on the right-bank of Horn Lake Creek downstream of Goodman Rd in Horn Lake, Mississippi. This plan addresses residual damages to Bullfrog Corner seen in plan 8a. The nonstructural dry floodproofing measures would benefit 21 commercial structures and 14 residential (apartments) structures located on the east side of Hwy 51 and Goodman Road. During less frequent events the parking lot surrounding the apartments may flood and cars could be impacted.

2.0 ECONOMIC AND ENGINEERING INPUTS TO THE HEC-FDA MODEL

2.1 HEC-FDA MODEL

Model Overview

The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.4.3 Corps-certified model was used to calculate the damages and benefits for the North DeSoto County evaluation. The economic and engineering inputs necessary for the model to calculate damages for the project base year (2029) and future year (2079) include the existing condition structure and vehicle inventory, contents-to-structure value ratios, first floor and ground elevations, depth-damage relationships, and without-project and with-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.

The following economic inputs section is divided into four primary components:

1) **Structure Inventory** – discusses methodology, structural value estimation, content-to-structure value ratios, vehicle value estimation, and flood related damages and costs

2) **Elevation Data & Sampling** – discusses ground surface elevation, foundation heights, first floor elevations, and sampling structural attributes

3) **Structure Inventory Uncertainty** – discusses the uncertainty distributions surrounding structure values, content-to-structure value ratios, vehicle values, flood related damages and costs and square footage values, and how the distributions were generated

4) **Depth Damage Relationships** – discusses the depth damage relationships, uncertainty and how the distributions were generated

2.2 ECONOMIC INPUTS TO THE HEC-FDA MODEL

Structure Inventory

A structure inventory of residential and non-residential structures for the North DeSoto study area was obtained using the National Structure Inventory (NSI), version 2.0. NSI was originally created by USACE to simplify the GIS pre-

processing workflow for the Modeling Mapping and Consequence Production Center (MMC) and was recently upgraded to version 2 using upgraded data sources and algorithms. The NSI 2.0 database was significantly improved through various techniques further described in subsequent sections.

NSI 2.0 sources its structural attribute data from tax assessed parcel data (available through CoreLogic), business location data available through Esri/Infogroup, and HAZUS (where other datasets were unavailable). NSI 2.0 data is not an exact representation of reality, but rather contains many county-level, state-level, or regional assumptions applied to individual structures, often by random assignment. As such, while county or other large aggregations of structures will be accurate on average, individual structure characteristics may not be accurate. Although these and other accuracy issues exist, the NSI 2.0 dataset functions as an available common and consistent standard for the United States. The chief advantage of NSI 2.0 over other national datasets is its spatial accuracy, which is a significant improvement over the census block level accuracy that NSI 1.0 relied on.

While the population of the study area is growing and is expected to continue growing in the future, future development was not included in the structure inventory. Structures built within the study area in the future are expected to be compliant with flood plain regulations with first floor elevations high enough to not incur damages that would significantly impact this study's plan formulation or Recommended Plan selection.

Occupancy Types

The NSI 2.0 database comes with its own list of occupancy types, which describes the type of structure more than simply residential or non-residential. Occupancy types are important because they eventually are used to assign depth-damage relationships to determine the rate at which a structure is damaged given a depth of water. The North DeSoto Feasibility study utilized these three different occupancy type sources:

1. **NSI 2.0** – these occupancy type descriptions came with the original NSI 2.0 data and were the starting point for the study. The NSI 2.0 occupancy types were verified during sampling that was performed, especially in areas where high existing condition damages exist, such as Bullfrog Corner.

2. **RSMeans** – to estimate costs per square foot for structures, the NSI 2.0 occupancy types were converted to RSMeans occupancy types. In general, there was a unique RSMeans occupancy type to match to each NSI 2.0 occupancy type, but certain structures were generalized, such as multi-occupancy apartment buildings. Professional judgment was used when combining occupancy types based on how the structure would be damaged.

3. **Depth-Damage Relationships** – Neither the NSI 2.0 nor RSMeans occupancy types matched the occupancy types required to use the depth-damage relationships that were selected for the local flooding conditions found in the North DeSoto study area. Professional judgment was used again to sort each structure type into the most representative occupancy type offered by the depth damage relationships.

Table L: 2-1 shows the conversion process of moving structures through the three different occupancy types. Further descriptions of each occupancy type can be found in subsequent sections of the report.

Table L: 2-1 Occupancy Type Conversions

RS Means	NSI 2.0	Depth-Damage
Post Frame Barn	AGR1	Barn
Store, Retail	COM1	Retail
Warehouse	COM2	StorageCom/StorageInd
Garage, Service Station	COM3	StorageCom
Office, 1 Story	COM4	OfficeCom
Bank	COM5	OfficeCom
Hospital, 2-3 Story	COM6	Pub2
Medical Office, 1 Story	COM7	OfficeCom
Restaurant	COM8	Restaurant
School, Elementary	EDU1	School
Office, 1 Story	GOV1	Pub2
Police Station	GOV2	Pub2
Office, 1 Story	IND6	OfficeInd
1 Story Residential	RES1-1SNB	Oreswoutbsmt
2 Story Residential	RES1-2SNB	Treswoutbsmt
Mobile Home	RES2	MobHome
1 Story Residential	RES3A	Apt1
Apartment, 1-3 Story	RES3B	Apt1
Apartment, 1-3 Story	RES3C	Apt1
Apartment, 1-3 Story	RES3D	Apt1
Apartment, 1-3 Story	RES3E	Apt1
Motel, 1 Story	RES4	Apt1

Structure Values

As previously identified in the description of NSI 2.0, the national database has limitations and oversimplifications that lead to unacceptable levels of uncertainty for a feasibility-level study. To overcome the limitations and reduce uncertainty, RSMeans was used to reevaluate the depreciated replacement values and multiple statistically significant samples were performed to ensure an accurate representation of structural attributes. This process is further described in the “Sample Structural Attributes” section. While the initial valuation occurred at the beginning of the study, the structure inventory has since been indexed to reflect a 2023 price level for the most recent damage analysis.

Application of RSMeans – Residential Structures

The 2022 RSMeans Square Foot Costs Data catalog was used to assign a depreciated replacement cost per square foot value to residential structures. The RSMeans system of valuation provides the user the ability to customize the following primary items: exterior wall type, build quality, additions, depreciation, and regional factors.

- Exterior Wall Type – Replacement costs per square foot were provided for four exterior walls types (wood frame, brick veneer, stucco, or masonry) and an average cost per square foot for the four exterior wall types was computed since an approximately even mix of exterior wall types were observed during surveys using Google Street View.

- Build Quality – Build quality of a structure helps determine how high the starting cost per square foot should be for structures. Based on surveys using Google Street View, it was determined that the characteristics of the structures in the area were consistent with those of the average build quality (economy and luxury/custom homes existed but were in the minority).

- Depreciation – Depreciation of a structure is based on the observed condition (effective age) of the structure and can be described as the structure's wear and tear since it was constructed or last rehabilitated. Based on surveys using Google Street View, it was determined that the average condition of residential structures in the area was 20 years old. Therefore structure values were depreciated on average 20 percent based on the RSMeans depreciation schedule. See the "Structure Value Uncertainty" section on how uncertainty in observed condition impacts the uncertainty surrounding structure values.

- Region – A regional adjustment factor was applied to the cost per square foot consistent with the Memphis, Tennessee area. Memphis was the closest adjustment factor to the North DeSoto study area and was applied to the depreciated cost per square foot.

- Additions – RSMeans allows for users to enter additional structural features that may be present beyond the default features. Based on surveys using Google Street View, it was determined that a half-bath and attached one-car garage was appropriate to add for both one-story and two-story residential structures. This adjustment represented approximately a 10 percent increase in the base cost per square foot estimate.

Application of RSMeans – Non-residential Structures

The 2022 RSMeans Square Foot Costs Data catalog was used to assign a depreciated replacement cost per square foot value to non-residential structures. The

RSMeans system of valuation provides the user the ability to customize the following primary items: exterior wall type, additions, depreciation, and regional factors.

- Exterior Wall Type - Replacement costs per square foot were provided for six exterior wall types (decorative concrete with steel frame and with bearing walls frame, face brick with concrete block back-up with steel frame and with bearing walls frame, metal sandwich panel with steel frame, and precast concrete panel with bearing walls frame), and an average cost per square foot for the six exterior wall types was computed since an approximately even mix of exterior wall types were observed during the surveys.

- Depreciation – Depreciation of a structure is based on the observed condition (effective age) of the structure and can be described as the structure's wear and tear since it was constructed or last rehabilitated. Based on surveys using Google Street View, it was determined that the average condition of non-residential structures in the area was 20 years old. Therefore structure values were depreciated on average 25 percent based on RSMeans depreciation schedule. See the "Structure Value Uncertainty" on how uncertainty in observed condition impacts the uncertainty surrounding structure values.

- Region - A regional adjustment factor was applied to the cost per square foot consistent with the Memphis, Tennessee area. Memphis was the closest adjustment factor to the North DeSoto study area and was applied to the depreciated cost per square foot.

- Additions – RSMeans allows for users to enter additional structural features that may be present beyond the default features. No additional features were added to non-residential structures.

The formula to determine depreciated replacement value for structures is simplified as follows:

$$Avg.Cost\ per\ sq\ ft * Avg.depreciation\ factor * \ Regional\ adjustment\ factor$$

The mean final cost per square foot by occupancy type was then applied to every structure in the inventory to determine depreciated replacement values. The square footage for each of the individual residential structures was multiplied by the size-specific depreciated cost per square foot for the average construction class to obtain a total depreciated cost. Finally, the Marshall and Swift Valuation Service was used to calculate a depreciated replacement cost per square foot for the manufactured or mobile homes in the area since mobile homes are not included in the RSMeans catalog.

Square Foot Estimation

Square foot estimates were sampled using structures within the inventory boundary. Microsoft Building Footprints were utilized to improve the data source of the square foot estimate. Microsoft Building Footprints is a GIS outline of each structure generated from an algorithm that recognizes building pixels on aerial imagery and converts the building pixels into polygons. While Microsoft estimates that the error of such estimates is only 1.15 percent, the pixels detected include the overhang of the roof, and therefore overestimate the square footage for buildings with eaves. Historical USACE studies using Microsoft Building Footprints have used GIS measurement techniques to determine that the overestimation is approximately 10 percent to 20 percent. Square foot estimates for North DeSoto were reduced by 20 percent to account for roof overhang. Additional adjustments using professional judgement were made to account for occupancy types with more than one story since the footprints only measure a single floor.

A sensitivity analysis was conducted to determine whether adjustments to square footage estimates should be made to account for garages. Ultimately, this was determined to be unnecessary due to structure value estimates being nearly identical when garages were accounted for versus when they were not. For a typical one-story residential structure with a garage, the garage amounts to approximately 15 percent of the total square footage. When accounting for this reduction in square footage and then adding the value of a one-car attached garage according to RSMeans, the structure value differences were less than 3 percent. Therefore no adjustments were made to the structure inventory square footage estimates to account for garages.

Final square footage estimates per building footprint were spatially joined to the underlying structure points in ArcGIS Pro. Each occupancy type received an average square footage estimate based on the individual structures included within that occupancy type.

Table L: 2-2 shows the structure count and distribution of square foot estimates for each of the RSMeans and NSI 2.0 occupancy types. This tableshows the results of the RSMeans valuation analysis, which is the triangular distribution of cost per square foot by occupancy type. More information on RSMeans triangular distribution is provided in subsequent sections.

Table L: 2-2 RSMeans Structure Inventory Statistics

Occupancy Type (NSI 2.0 - RSMeans)	Count	Average Square Feet	Cost per Square Foot		
			Minimum	Most Likely	Maximum
AGR1 - Post Frame Barn	8	3,900	$29	$36	$44
COM1 - Store, Retail	107	12,900	$70	$88	$108
COM3 - Garage, Parking	1	11,500	$44	$55	$67
COM2 - Warehouse	53	9,900	$66	$82	$101
COM3 - Garage, Service Station	86	5,200	$115	$144	$176
COM4 - Office, 1 Story	120	13,101	$92	$115	$141
COM5 - Bank	9	4,300	$135	$169	$208
COM6 - Hospital, 2-3 Story	5	127,900	$177	$221	$271
COM7 - Medical Office, 1 Story	25	7,300	$104	$130	$160
COM8 - Restaurant	48	9,800	$112	$140	$172
EDU1 - School, Elementary	6	77,100	$96	$120	$147
GOV2 - Police Station	1	2,800	$154	$192	$236
IND1-4 - Factory, 1 Story	11	7,001	$75	$94	$116
REL1 - Church	22	30,700	$94	$118	$145
RES1-1SNB - 1 Story Residential	3,166	1,387	$72	$105	$122
RES1-2SNB - 2 Story Residential	1,726	2,854	$55	$80	$93
RES1-2SNB - Bi-Level Residential	126	1,333	$70	$102	$118
RES2 - Mobile Home	16	1,300	$24	$50	$73
RES3 - Apartment, 1-3 Story	42	9,669	$105	$131	$161
RES4 - Motel, 1 Story	6	18,600	$76	$95	$117
RES6 - Nursing Home	2	13,300	$122	$153	$188

Structure Inventory Uncertainty

The uncertainty surrounding the residential structure values includes the depreciation percentage applied based on the effective age and condition of the structures as well as the four exterior wall types. A triangular probability distribution was developed for residential structures using the following RSMeans information:

- Minimum Depreciation – Effective Age: 10 Years & Good Condition
- Most Likely Depreciation – Effective Age: 20 Years & Average Condition
- Maximum Depreciation – Effective Age: 30 Years & Poor Condition

Effective age for this uncertainty analysis was defined as the average observed age of a structure as recorded during the Street View survey. 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 exterior wall type and occupancy category. 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 was developed for non-residential structures using the following RSMeans information:

- Minimum Depreciation – Effective Age: 10 Years & Masonry on Masonry/Steel
- Most Likely Depreciation – Effective Age: 20 Years & Masonry on Wood
- Maximum Depreciation – Effective Age: 30 Years & Frame

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 L: 2-3 shows the minimum and maximum percentages of the most-likely structure values assigned to the various structure categories.

Table L: 2-3 RSMeans Structure Value Uncertainty Factors

RSMeans Occupancy Type	RSMeans Cost per Square Foot Factor		
	Minimum	Most Likely	Maximum
Non-Residential	80%	100%	123%
1-Story Residential	69%	100%	116%
2-Story Residential	69%	100%	116%
Mobile Home	48%	100%	147%

Square Footage Uncertainty

For each occupancy type, an average square footage value was calculated and applied through the entire study area inventory. The values were calculated using GIS measuring techniques and applying a square footage reduction of 20 percent to account for roof overhang. Additional adjustments using professional judgement were made to account for occupancy types with more than one story since the footprints only measure a single floor.

The Microsoft Building Footprints do include attached garage footprints. A sensitivity analysis was run on the structure inventory to observe if the addition of the garage square footage had an affect on the structure value estimates. There was no significant difference found between the estimates. Therefore, the original structure inventory was used which includes the garage footprints.

Residential and Non-Residential Content-to-Structure Value Ratios

Based on Economic Guidance Memorandum (EGM), 04-01, dated 10 October 2003, a content-to-structure value ratio (CSVR) of 100 percent was applied to all of the residential structures in the structure inventory and the error associated with CSVR was set to zero. The EGM states that the 100 percent CSVR is to be used with the generic depth-damage relationships developed for residential structures, which were also used for this study.

The content-to-structure value ratios (CSVRs) applied to the non-residential structure occupancies were taken from the 1996 Jefferson-Orleans report titled, “Depth-Damage Relationships for Structures, Contents, and Vehicles and

Content-to-Structure Value Ratios (CSVRs) in Support of the Jefferson and Orleans Flood Control Feasibility Studies." The study contracted with Gulf Engineers and Consultants (GEC) to develop unique depth-damage relationships and CSVRs for non-residential structures.

Content-to-Structure Value Ratio Uncertainty

For each occupancy type, a mean CSVR and a standard deviation was calculated and entered into the HEC-FDA model using the information gathered from the Jefferson-Orleans study. A normal distribution was used to describe the uncertainty surrounding the CSVR for each content category. The expected CSVR percentage values and standard deviations for each of the occupancy types are shown in Table L:2-4.

Table L: 2-4 Content-to-Structure Value Ratios and Uncertainty

Category	Occupancy	Description	CSVR	Standard Deviation
Agricultural	Barn	Wood Frame Barn	200%	5.0%
Commercial	OfficeCom	Commercial Office Building	43%	13.8%
	Restaurant	Non-Fast Food Restaurant	114%	48.2%
	Retail	Furniture Retail Store	142%	93.2%
	StorageCom	Warehouse Non-Refrigerated	168%	98.3%
Industrial	OfficeInd	Industrial Office Building	168%	98.3%
Public	Pub2	Public Property	114%	71.5%
	School	School	114%	71.5%
Residential	Apt1	One-Story Apartment on Slab (5 to 20-unit)	37%	14.3%
	MobHome	Mobile Home	114%	79.0%
	Oreswoutbsmt	One Story Residential Without Basement	100%	0.0%
	Treswoutbsmt	Two or More Story Residential Without Basement	100%	0.0%

Vehicle Inventory Values

Based on 2017 Census information for the Memphis area, there are an average of 1.76 vehicles associated with each household (owner occupied housing or rental unit). According to the Southeast Louisiana Evacuation Behavioral Report published in 2006 following Hurricanes Katrina and Rita, approximately 70 percent of privately owned vehicles are used for evacuation during storm events. The remaining 30 percent of the privately owned vehicles remain parked at the residences and are subject to flood damages. According to the CarGurus Intelligence Report, the average value of a used car was $31,000 as of October 2022. Since only those vehicles not used for evacuation can be included in the damage calculations, an adjusted average vehicle value of $16,368 ($31,000 x 1.76 x 0.30) was assigned to each individual residential automobile structure record in the HEC-FDA model. Only vehicles associated with residential structures were included in the analysis. Vehicles associated with non-residential properties were not included in the evaluation.

Vehicle Value Uncertainty

The uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function. The average value of a used car, $19,700, was used as the most-likely value. The average value of a new

vehicle, $33,560, before taxes, license, and shipping charges was used as the maximum value, while the average 10-year depreciation value of a vehicle, $3,000 was used as the minimum value. It should be noted that the values used for computing uncertainty are from when the study began and were not indexed. The percentages were developed for the most-likely, minimum, and the maximum values with the most-likely equal to 100 percent, and the minimum and the maximum values as percentages of the most-likely value (minimum=16%, most-likely=100%, maximum=180%). These percentages were entered into the HEC-FDA model as a triangular probability distribution to represent the uncertainty surrounding the vehicle value.

Elevation Data & Sampling

Elevation data associated with the ground surface, foundation heights, and first floors of structures are critical to the economic analysis and feasibility of studies. Given the low resolution of foundation height data provided with the NSI 2.0 database, a statistically significant sample was calculated to inform a survey to improve the estimates associated with foundation and subsequent first floor elevations. The sample was also utilized to measure a hand-full of other structural attributes, detailed later in this section.

Three Google Street View surveys were conducted:

1. The first was a preliminarily survey completed prior to calculating the formula in Figure L:2-1 to determine the standard deviation of the average residential and non-residential structures foundation height (S).

2. Once the standard deviation was estimated, it was entered into the formula in Figure L:2-1 to determine how many structures to sample based on the designated stratification.

3. The final survey was conducted to refine the existing inventory and improve accuracy of individual structural attributes.

The first (preliminary) survey in Google Street view was conducted using a baseline of regional averages for the inputs into the statistically significant sample formula. The primary assumption included the maximum and minimum foundation height expected by occupancy type. In the case of North DeSoto County, 85 structures were sampled, which included 27 residential, 24 pubic, 10 commercial, and 24 industrial structures. The information gathered from the preliminary survey, such as the range (max – min) of foundation heights by construction category (S) informed how many additional structures would need to be sampled to meet the statistically significant threshold based on the Z-Value and allowable error used in the formula shown in Figure L:2-1.

The second survey resulted in adding an additional 28 residential (19 one-story, 5 two-story, 4 apartments), 28 commercial, 14 public, and 4 industrial structures to the sample count already identified in the first (preliminary) survey. The sample was randomly generated using a GIS-based sampling design tool developed by the National Oceanic and Atmospheric Administration (NOAA) to generate a geographically random sample of structures split between the occupancy types.

A third Google Street View survey was conducted on approximately 500 structures to collect data on foundation height, structure type, and structure placement.

$$n = \left(\frac{Z * S}{E}\right)^2 \text{, where}$$

n = Sample size

Z = Z-Value (1.96)

$$S = \frac{Foundation\ Height_{High} - Foundation\ Height_{Low}}{6}$$

E = Allowable error (0.20 feet)

Figure L: 2-1 Statistically Significant Sample Size Formula

The allowable error within the formula deviated from 0.20 feet but was limited to 20 percent to 30 percent of the standard deviation of the foundation height to reduce the amount of uncertainty in the structural attributes being sampled.

The standard deviation of the final survey was compared to the preliminary survey and verified that the number of structures sampled exceeded the minimum calculated in the formula. The variables sampled included:

- Foundation height – measured from the bottom of the front door to adjacent ground, each step was assumed to be 8 inches
- Foundation type – designated as either slab on grade or crawlspace
- Story count – measured as either one- or two or more-story height
- Existing condition – qualitative judgment of the condition of the exterior of the structure condition
- Verification of occupancy type – confirmation of the occupancy being one of the 10 occupancy types
- Square footage – approximated square footage to be compared with estimates provided by Microsoft building footprints

Ground Surface Elevations

Topographical data based on Light Detection and Ranging (LiDAR) data using NAVD 88 vertical datum was processed by the United States Geological Survey (USGS) and provided in a 4-meter resolution raster format. The 4-meter LiDAR data were used to assign ground elevations to structures, vehicles, and roadways. This terrain data was utilized by the Memphis H&H engineers to develop the H&H model, which was provided to the economist as water surface depth above ground surface for georeferenced points throughout the study area.

First Floor Elevations

The ground elevation was added to the height of the foundation of the structure above the ground in order to obtain the first floor elevation of each structure in the study area. Vehicles were assigned to the ground elevation of the adjacent residential structures and did not include adjustments for foundation heights.

Elevation Uncertainty

There are two sources of uncertainty surrounding the first floor elevations: the use of the LiDAR data for the ground surface elevations, and the measurement error associated with the structure foundation heights above ground elevation. A third source of uncertainty, the instrument error of Google Street View survey, has not been quantified prior to the final report. The error surrounding the LiDAR data was determined to be plus or minus 0.5895 feet at the 95 percent level of confidence. This uncertainty was normally distributed with a mean of zero and a standard deviation of 0.3 feet.

The uncertainty surrounding the foundation heights for the residential and commercial structures was estimated by calculating the standard deviations surrounding the sampled mean values. An overall weighted average standard deviation for the four structure groups was computed for each structure category.

The standard deviations for the ground elevations and foundation heights were combined, which resulted in a 0.35 feet standard deviation for residential slab and crawlspace structures. For commercial structures, the combined standard deviation was calculated to be 0.36 feet for slab structures. For industrial structures, the combined standard deviation was calculated to be 0.58 feet for slab structures. For public structures, the combined standard deviation was calculated to be 0.48 feet for slab structures Table L:2-5 displays the calculations used to combine the uncertainty surrounding the ground elevations with uncertainty surrounding the foundation height elevations to derive the uncertainty surrounding the first floor elevations of residential, commercial, public, and industrial structures.

Table L: 2-5 First Floor Stage Uncertainty Standard Deviation Calculation

Ground Elevation - LiDAR		
(conversion cm to inches to feet)		
+/- 18 cm @ 95% confidence		18cm
	x	0.393
z = (x - u)/ std. dev.		7.074in
	÷	12
1.96 = (0.5895 - 0)/ std.dev.		0.5895ft
0.3007 = std.dev.		

Foundation Height Elevation (shown in feet)			
Residential	Commercial	Public	Industrial
0.72	0.4	0.58	0.47

Combined First Floor Elevation (shown in feet)				
Residential	Commercial	Public	Industrial	
Slab	All	All	All	
0.3	0.3	0.3	0.3	ground elevation std. dev.
0.09	0.09	0.09	0.09	ground elevation std. dev. squared
0.18	0.2	0.38	0.5	1st floor elevation std dev.
0.03	0.04	0.14	0.25	1st floor elevation std. dev. squared
0.12	0.13	0.23	0.34	Sum of Squared
0.35	**0.36**	**0.48**	**0.58**	**Square Root of Sum of Squared = Combined Standard Deviation**

Depth-Damage Relationships

Each occupancy type has its own depth-percent of value damaged curves for structure and contents. The USACE generic depth-damage relationships for one-story and two-story residential structures with no basement from the Economic Guidance Memorandum (EGM), 04-01, dated 10 October 2003, were used in the analysis.

Site-specific non-residential depth-damage relationships were not available for the North DeSoto County study area. The depth-damage functions for non-residential structures were based on the data presented from the Jefferson-Orleans study conducted by GEC. The short-duration, freshwater relationships were used for this analysis. These relationships were deemed appropriate for North DeSoto due to similarities in the structure types and the study areas' geography.

The vehicle depth-damage functions were based on the generic depth-damage curves from EGM, 09-04, Generic Depth-Damage Relationships for Vehicles, dated 22 June 2009. Based on low-clearance to high-clearance ratios used in HEC-LifeSim of 50/50, a weighted average depth-damage function was created using Sedan and Truck (pickups) generic values. The weighted average curve better represents a mean value for estimating vehicle damages within the study area.

Depth-damage relationships indicate the percentage of the total structure value that would be damaged at various depths of flooding. For residential structures, damage percentages were provided at each one-foot increment from two feet below the first-floor elevation to 16 feet above the first-floor elevation for the structural components and the content components. For non-residential structures, damage percentages were determined for each one-half foot increment from one-half foot below first floor elevation to two feet above first floor, and for each one-foot increment from 2 feet to 15 feet above first floor elevation. Vehicle damage relationships were provided from one-half foot above the ground to 10 feet above the ground.

Uncertainty Surrounding Depth-Damage Relationships

For residential structures, a normal distribution with a standard deviation for each damage percentage provided at the various increments of flooding was used to determine the uncertainty surrounding the generic depth-damage relationships used for residential structures and vehicles. This information for residential structures was also sourced from EGM 04-01. For non-residential structures, the Jefferson-Orleans study was utilized to source a normal distribution.

2.3 ENGINEERING INPUTS TO THE HEC-FDA MODEL

Stage-Probability Relationships

Engineers utilized the Hydrologic Engineering Center's River Analysis System (HEC-RAS) software to provide inputs for the HEC-FDA model. Prior to the study's Tentatively Selected Plan (TSP) milestone, stage-probability relationships were generated in a one-dimensional HEC-RAS model and provided in a geospatial depth-grid format for the base year (2029) without-project and with-project conditions for all plans in the focused array. After the TSP milestone, a refined combined one-dimensional/two-dimensional hydraulic model was created and provided stage-probability relationships in a raster format for the base year without-project and with-project analysis of the plans in the final array. This model also produced stage-probability relationships reflecting the future condition (2079) for the without-project condition and with-project condition for analysis of the Recommended Plan.

Structural measures, including the levee and floodwall, were incorporated into the HEC-RAS model instead of implementing a top of levee by reach in the HEC-FDA model. As such, there were no engineering inputs related to the structural measures needed for the HEC-FDA model. More information about the hydraulic modeling can be found in Appendix G.

The HEC-RAS model provided water surface profiles for eight annual exceedance probability (AEP) events ranging from the 0.99 (1-year) to the 0.002 (500-year) events. The depth grid or raster values were extracted to the structures in the structure inventory for the 0.99 (1-year), 0.50 (2-year), 0.20 (5-year), 0.10 (10-year), 0.04 (25-year), 0.02 (50-year), 0.01 (100-year), and 0.002 (500-year) events.

Uncertainty Surrounding the Stage-Probability Relationships

A 20-year equivalent record length was used to quantify the uncertainty surrounding the stage-probability relationships for each study area reach. This record length is based on the historical gage data available to engineers to inform hydraulic modeling in these basins. Based on this equivalent record length, the HEC-FDA model calculated the confidence limits surrounding the stage-probability functions. This is discussed further in Section 3.3 of this appendix.

3.0 NATIONAL ECONOMIC DEVELOPMENT (NED) FLOOD DAMAGE AND BENEFIT CALCULATIONS

3.1 HEC-FDA MODEL CALCULATIONS

The HEC-FDA model was utilized to evaluate flood damages using risk-based analysis. Damages were reported for all structures and vehicles inventoried in each of the 15 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 stage-damage relationships. The model also used an equivalent record length provided by hydraulic engineers for the basin determine the hydrologic uncertainty surrounding the stage-probability relationships.

The possible occurrences of each variable were derived through the use of 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.

Stage-Damage Relationships with Uncertainty

The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study area reach under base year (2029) without-project and with-project conditions for each alternative in the focused and final arrays. The base year (2029) and future year (2079) without-project and with-project conditions were modeled for the Recommended Plan. The possible occurrences of each economic variable were derived through the use of Monte Carlo simulation. A total of 1,000 iterations were executed in the model for the stage-damage relationships. 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.

Stage-Probability Relationships with Uncertainty

The HEC-FDA model used an equivalent record length of 20 years for each study area reach to generate a stage-probability relationship with uncertainty for the without-project condition through the use of graphical analysis. 20 years was selected by the hydraulic engineer to represent the length of records analyzed

during the calibration process that the hydraulic model underwent. The model used the eight stage-probability events together with the equivalent record length to define the full range of the stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided.

3.2 WITHOUT-PROJECT EXPECTED ANNUAL DAMAGES

The model used 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 model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without-project alternative, the expected annual damages (EAD) were totaled for each study area reach to obtain the total without-project EAD under base year (2029) and future year (2079) conditions. Tables L: 3-1 and L: 3-2 show the without project damages by reach and damage category for both the base year and future year.

Table L: 3-1 Expected Annual Damages in the Base Year Without Project Condition by Stream and Reach
(2023 Price Level; $ Thousands)

Stream	Reach	Agricultural	Auto	Commercial	Industrial	Public	Residential	Total
Cow Pen Creek	21	$0	$24	$12	$1	$9	$395	$440
	22	$0	$6	$0	$0	$0	$78	$84
	Total	$0	$30	$12	$1	$9	$473	$525
Horn Lake Creek	11	$0	$1	$73	$0	$0	$14	$88
	12	$0	$0	$0	$0	$0	$0	$0
	13	$0	$3	$275	$0	$39	$13	$330
	14	$0	$3	$1,714	$175	$0	$14	$1,906
	15	$0	$0	$155	$0	$0	$0	$155
	16	$0	$5	$0	$3	$0	$412	$421
	17	$0	$0	$0	$0	$0	$0	$0
	18	$0	$0	$0	$0	$0	$0	$0
	Total	$0	$12	$2,217	$178	$39	$453	$2,900
Lateral D	31	$0	$1	$0	$0	$0	$19	$20
	Total	$0	$1	$0	$0	$0	$19	$20
Rocky Creek	41	$0	$1	$1	$0	$0	$8	$9
	42	$0	$13	$6	$0	$0	$221	$240
	43	$0	$7	$6	$0	$0	$203	$215
	Total	$0	$20	$13	$0	$0	$431	$464
							Study Area Total	$3,909

Table L: 3-2 Expected Annual Damages in the Future Year Without Project Condition by Stream and Reach
(2023 Price Level; $ Thousands)

Stream	Reach	Agricultural	Auto	Commercial	Industrial	Public	Residential	Total
Cow Pen Creek	21	$0	$41	$31	$1	$18	$613	$704
	22	$0	$13	$0	$0	$0	$168	$181
	Total	$0	$55	$31	$1	$18	$780	$885
Horn Lake Creek	11	$0	$3	$125	$0	$0	$29	$157
	12	$0	$0	$0	$0	$0	$0	$0
	13	$0	$3	$290	$0	$43	$15	$351
	14	$0	$3	$1,857	$189	$0	$15	$2,064
	15	$0	$0	$204	$0	$0	$0	$204
	16	$0	$8	$0	$7	$0	$680	$694
	17	$0	$0	$0	$0	$0	$0	$0
	18	$0	$0	$0	$0	$0	$0	$0
	Total	$0	$16	$2,477	$196	$43	$739	$3,470
Lateral D	31	$0	$2	$0	$0	$0	$32	$34
	Total	$0	$2	$0	$0	$0	$32	$34
Rocky Creek	41	$0	$1	$1	$0	$0	$11	$13
	42	$0	$18	$8	$0	$0	$311	$338
	43	$0	$7	$6	$0	$0	$205	$218
	Total	$0	$27	$15	$0	$0	$527	$569
							Study Area Total	$4,957

Tables L: 3-3 and L: 3-4 display the number of structures that are damaged by each annual exceedance probability event and the structural dollar damage in the base year and future year without-project conditions. These values were taken from the HEC-FDA structure detail output, and therefore the expected damage calculations are derived from point estimates of the most-likely or mean values for the variables used in the expected damages calculations, without uncertainty.

Table L: 3-3 Structures Damaged by Stream and Probability Event in the Without Project Condition

Annual Exceedance Probability (AEP)	Residential	Non-Residential	Total
Base Year			
0.99 (1 yr.)	0	0	0
0.50 (2 yr.)	0	0	0
0.20 (5 yr.)	38	16	54
0.10 (10 yr.)	62	21	83
0.04 (25 yr.)	148	37	185
0.02 (50 yr.)	232	52	284
0.01 (100 yr.)	336	71	407
0.002 (500 yr.)	632	96	728
Future Year			
0.99 (1 yr.)	0	0	0
0.50 (2 yr.)	0	0	0
0.20 (5 yr.)	57	17	74
0.10 (10 yr.)	112	26	138
0.04 (25 yr.)	221	45	266
0.02 (50 yr.)	335	62	397
0.01 (100 yr.)	466	77	543
0.002 (500 yr.)	742	102	844

Table L: 3-4 Structure Damage by Probability Event in the Without Project Condition

(2023 Price Level; $ Thousands)

Annual Exceedance Probability (AEP)	Residential	Non-Residential	Total
Base Year			
0.99 (1 yr.)	$0	$0	$0
0.50 (2 yr.)	$0	$0	$0
0.20 (5 yr.)	$1,343	$1,901	$3,244
0.10 (10 yr.)	$2,098	$2,605	$4,703
0.04 (25 yr.)	$4,538	$3,844	$8,383
0.02 (50 yr.)	$8,442	$5,546	$13,988
0.01 (100 yr.)	$13,383	$8,027	$21,411
0.002 (500 yr.)	$29,214	$13,862	$43,077
Future Year			
0.99 (1 yr.)	$0	$0	$0
0.50 (2 yr.)	$0	$0	$0
0.20 (5 yr.)	$1,829	$2,078	$3,907
0.10 (10 yr.)	$3,507	$2,900	$6,407
0.04 (25 yr.)	$8,170	$4,529	$12,698
0.02 (50 yr.)	$13,353	$6,756	$20,109
0.01 (100 yr.)	$20,160	$9,266	$29,426
0.002 (500 yr.)	$36,080	$15,482	$51,562

Structure Inventory Adjustments for High Frequency Inundation

Adjustments were made to the structure inventory to reflect the most-likely future without-project and with-project conditions more accurately. It was assumed that structures being flooded every other year would most likely be raised or otherwise mitigated regardless of federal intervention. As such, the foundation heights of all structure records with first-floor elevations lower than the without-project 0.5 (2-year) AEP event were edited. These foundation heights were adjusted so the 0.5 AEP event would not result in structural damages. Since damages begin below the first-floor elevation, the foundation height was set to the 0.5 AEP event depth plus three feet. This adjustment is consistent with the FEMA floodplain regulations that require residents to rebuild above the base flood elevation after a structure receives greater than 50 percent damage to the structural components as a result of a flood.

3.3 EXPECTED AND EQUIVALENT ANNUAL DAMAGES

Each of the final array's plans were run through HEC-FDA to compute damages for the without-project and with-project conditions. Table L: 3-5 shows the expected annual damages by structure category, damages reduced, and residual damages for each plan in the final array. Table L: 3-6 shows equivalent annual damages.

Table L: 3-5 Final Array Expected Annual Damages by Plan and Damage Category
(2023 Price Level; $ Thousands)

Plan Name	FDA Damage Category					Total
	Auto	Commercial	Industrial	Public	Residential	
Base Year						
Without	$63	$2,241	$179	$48	$1,377	$3,909
Final 5a	$53	$1,936	$157	$44	$973	$3,163
Final 6a	$54	$2,032	$162	$39	$1,014	$3,302
Final 7	$41	$1,582	$115	$46	$679	$2,463
Final 8a	$56	$680	$4	$9	$1,314	$2,064
Final 8b	$56	$205	$4	$9	$1,307	$1,582
Future Year						
Without	$99	$2,523	$197	$60	$2,078	$4,957
Final 5a	***	***	***	***	***	***
Final 6a	***	***	***	***	***	***
Final 7	***	***	***	***	***	***
Final 8a	$82	$923	$9	$18	$1,972	$3,005
Final 8b	$82	$295	$9	$18	$1,964	$2,369

Note: Plans 5a, 6a,and 7 were screened before future condition hydraulics were created

Table L: 3-6 Final Array Equivalent Annual Damages by Plan and Damage Category
(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Plan Name	FDA Damage Category					Total
	Auto	Commercial	Industrial	Public	Residential	
Without	$77	$2,351	$186	$53	$1,650	$4,317
Final 5a	*****	*****	*****	*****	*****	*****
Final 6a	*****	*****	*****	*****	*****	*****
Final 7	*****	*****	*****	*****	*****	*****
Final 8a	$66	$775	$6	$12	$1,571	$2,431
Final 8b	$66	$240	$6	$12	$1,563	$1,888

Note: Plans 5a, 6a,and 7 were screened before future condition hydraulics were created

Table L:3-7 shows the expected annual damages and benefits by plan with confidence intervals. Table L: 3-8 shows equivalent annual damages and benefits by plan. The confidence intervals show the chance that the benefits will be greater than the amount indicated. For example, “There is a 25 percent chance that the equivalent annual benefits of Final 8b will be greater than $3.4 million.”

Table L: 3-7 Final Array Expected Annual Damages and Benefits by Plan

(2023 Price Levels; $ Thousands)

Plan Name	Expected Annual Damages		Expected Annual Benefits	Probability Damaged Reduced Exceeds Indicated Values		
	Without Project	With Project		0.75	0.5	0.25
Base Year						
Without	$3,909	$3,909	$0	$0	$0	$0
Final 5a	$3,909	$3,163	$746	$370	$679	$1,026
Final 6a	$3,909	$3,302	$607	($1)	$447	$1,011
Final 7	$3,909	$2,463	$1,445	$708	$1,311	$2,006
Final 8a	$3,909	$2,064	$1,845	$992	$1,656	$2,420
Final 8b	$3,909	$1,582	$2,327	$1,091	$1,976	$3,121
Future Year						
Without	$4,957	$4,957	$0	$0	$0	$0
Final 5a	***	***	***	***	***	***
Final 6a	***	***	***	***	***	***
Final 7	***	***	***	***	***	***
Final 8a	$4,957	$3,005	$1,952	$957	$1,686	$2,662
Final 8b	$4,957	$2,369	$2,589	$1,129	$2,153	$3,588

Note: Plans 5a, 6a,and 7 were screened before future condition hydraulics were created

Table L: 3-8 Final Array Equivalent Annual Damages and Benefits by Plan

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Plan Name	Equivalent Annual Damages		Equivalent Annual Benefits	Probability Damaged Reduced Exceeds Indicated Values		
	Without Project	With Project		0.75	0.5	0.25
Without	$4,317	$4,317	$0	$0	$0	$0
Final 5a	*****	*****	*****	*****	*****	*****
Final 6a	*****	*****	*****	*****	*****	*****
Final 7	*****	*****	*****	*****	*****	*****
Final 8a	$4,317	$2,431	$1,887	$749	$1,668	$2,730
Final 8b	$4,317	$1,888	$2,429	$1,021	$2,045	$3,388

Note: Plans 5a, 6a,and 7 were screened before future condition hydraulics were created

4.0 PROJECT COSTS

Construction Schedule

For the purposes of computing interest during construction (IDC), construction of the nonstructural components of the plans is scheduled to be conducted in the fourth quarter of 2028. The construction period of three months is designated by Planning Bulletin (PB) 2019-03, and is not a complete construction schedule required to fully implement the nonstructural measures. Construction of channel enlargement and detention basins are expected to last two years and can be constructed concurrently. The construction of the levee is expected to last one year.

Structural Costs

Structural cost estimates for the final array were developed by the Memphis District Cost Engineering Branch and were commensurate with a level 4 cost estimate. An abbreviated cost risk analysis was completed to determine the contingencies used for all structural and nonstructural measures.

Interest during construction was calculated for all structural measures using a mid-year payment schedule and the FY 2023 discount rate of 2.5%. All costs for the Recommended Plan and NED plan were provided at 2023 price levels. Other plans in the final array were provided at 2022 price levels and were calculated using the FY2022 discount rate of 2.25%.

Nonstructural Costs – Elevation & Floodproofing

Nonstructural cost estimates for the final array were developed through a joint effort between Economics, Real Estate, and Cost Engineering Branches. A 36% contingency was applied to all nonstructural cost estimates to represent the uncertainty regarding the cost and schedule risk of these measures.

Interest during construction was calculated for each of the nonstructural alternatives and assumed the construction period lasted three months, as provided by the USACE National Nonstructural Committee BPG 2020-01_Rev1. Interest during construction was calculated on a mid-period annual basis payment schedule and 2.5% discount rate.

Real estate costs were included in the nonstructural analysis, which included costs associated with relocation assistance and administrative costs. A 20% contingency was applied to the real estate costs, which is separate from the contingency applied to the square foot cost estimates for elevation and floodproofing. A detailed cost analysis can be found in Appendix J.

Annual Project Costs

Life cycle cost estimates were provided for the nonstructural measures. The initial construction costs (first costs) and the schedule of expenditures were used to determine the interest during construction and gross investment cost at the end of the installation period (2029). The FY 2023 Federal interest rate of 2.5 percent was used to discount the costs to the base year and then amortize the costs over the 50-year period of analysis. Table L: 4-1 shows the schedule of construction cost items by year and plan. Table L: 4-2 summarizes the costs associated with each of the plans in the final array.

Table L: 4-1 Final Array Construction Cost Placement

Year	Analysis Year	Final 5a	Final 6a	Final 7a	Final 8a	Final 8b*
2025	-3					
2026	-2		PED + Lands and Damages + Mitigation + Relocations	PED + Lands and Damages + Mitigation + Relocations		
2027	-1	PED + Lands and Damages + Mitigation + Relocations	PED + Lands and Damages + Mitigation + Relocations + Channels and Canals + Floodway Control and Diversion + Construction Management	PED + Lands and Damages + Mitigation + Relocations + Channels and Canals + Floodway Control and Diversion + Construction Management	PED + Lands and Damages + Relocations	PED + Lands and Damages + Relocations
2028	0	Channels and Canals + Construction Management	Channels and Canals + Floodway Control and Diversion + Construction Management	Channels and Canals + Floodway Control and Diversion + Construction Management	Levees and Floodwalls + Buildings, Grounds, and Utilities + Construction Management	Levees and Floodwalls + Buildings, Grounds, and Utilities + Construction Management + Nonstructural
2029	1					

Note: For the purposes of calculating interest during construction, all nonstructural costs are placed in the 4th Quarter of 2028

Table L:4-2 Summary of Costs for Final Array
(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Final Array	**Final 5a***	**Final 6a***	**Final 7***	**Final 8a**	**Final 8b**
Construction First Cost	$5,828	$20,278	$60,251	$6,904	$25,788
Interest During Construction	$108	$536	$1,663	$155	$244
Total Construction Cost	$5,936	$20,814	$61,914	$7,059	$26,031
Average Annual Total Construction Cost	$199	$698	$2,075	$249	$918
Average Annual OMRR&R Cost	$367	$691	$1,352	$26	$26
Total Average Annual Cost	$565	$1,388	$3,428	$275	$944

* Note: Costs for Final 5a, Final 6a, and Final 7 are in 2022 Price Level and 2.25% Discount Rate

Reference:
Final Array 5a – Extended Channel Enlargement
Final Array 6a – Extended Channel Enlargement and Lateral D Detention
Final Array 7 – Extended Channel Enlargement, Cow Pen, Rocky, Lateral D Detentions
Final Array 8a – Levee and Floodwall
Final Array 8b – Levee and Floodwall + Nonstructural

Addendum A contains amortization tables with more specific details on how costs were annualized. The schedule of Operations, Maintenance, Relocations, Rehabilitation, and Repair (OMRR&R) costs associated with each of the structural measures can also be found in the addendum.

5.0 RESULTS OF THE ECONOMIC ANALYSIS

5.1 NET BENEFIT ANALYSIS

Calculation of Net Benefits

The expected or equivalent annual benefits attributable to the final array of measures were compared to the annual costs to develop a benefit-to-cost ratio for the measures. The net benefits for the measures were calculated by subtracting the annual costs from the annual benefits. The net benefits were used to determine the economic justification of the project measures. Table L:5-1 shows the net benefits and benefit-cost ratios (BCRs) for the final array. The National Economic Development (NED) plan is the one that reasonably maximizes net benefits. The NED plan is Final 8a, which is the levee and floodwall.

Table L:5-1 Final Array Net Benefits and Benefit-Cost Ratios

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Plan	Final Array			
	Total Average Annual Cost	Total Annual Benefits	Net Benefits	BCR
Final 5a*	$565	$746	$180	1.32
Final 6a*	$1,388	$607	($781)	0.44
Final 7*	$3,428	$1,445	($1,982)	0.42
Final 8a	$275	$1,887	$1,612	6.86
Final 8b	$944	$2,429	$1,485	2.57

Note: Plans 5a, 6a,and 7 were screened before future condition hydraulics were created. Costs for these plans are at 2022 Price Level and 2.25% Discount Rate

Reference:

Final Array 5a – Extended Channel Enlargement
Final Array 6a – Extended Channel Enlargement and Lateral D Detention
Final Array 7 – Extended Channel Enlargement, Cow Pen, Rocky, Lateral D Detentions
Final Array 8a – Levee and Floodwall
Final Array 8b – Levee and Floodwall + Nonstructural

The recommended FRM plan is Final 8b, which is a levee and floodwall with nonstructural mitigation in the form of floodproofing 35 commercial structures at Bullfrog Corner. The Recommended Plan is not the NED plan, in accordance with USACE Policy ER 1105-2-100 2-3(f)(1) an NED policy exception has been submitted to the Assistant Secretary of the Army for Civil Works (ASA CW). The ASA CW may grant an exception when there are overriding reasons for selecting another plan based upon comprehensive benefits. Plan 8b provides benefits that exceed those in plan 8a by maximizing the other social effects (OSE) account, namely by providing an increment of resiliency thorough floodproofing. Plan 8b provides the best level of comprehensive

flood risk management to Desoto County. Final 8b will hereto be referenced as the Recommended Plan. Table L:5-2 below shows the cost and benefit summary of the Recommended Plan.

Table L:5-2. Summary of the NED and Recommended Plans

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Item	NED Plan Final 8a	Recommended Plan Final 8b
Equivalent Annual Without Project Damages	$4,317	$4,317
Residual Damages With Project	$2,431	$1,888
Total Equivalent Annual Benefits	$1,887	$2,429
First Costs	$6,904	$25,788
Interest During Construction	$155	$244
Average Annual Total Construction Costs	$249	$918
Average Annual Operation & Maintenance Costs	$26	$26
Total Average Annual Project Costs	$275	$944
Benefit-Cost Ratio	6.86	2.57
Equivalent Annual Net Benefits	$1,612	$1,485

Figure L: 5-1 shows inundation mapping at Bullfrog Corner for the future 0.01 AEP event without the levee and floodwall in plans Final 8a and Final 8b and with the levee and floodwall in place. The red oval on the with-project condition displays the location of the nonstructural component for the Recommended Plan Final 8b.

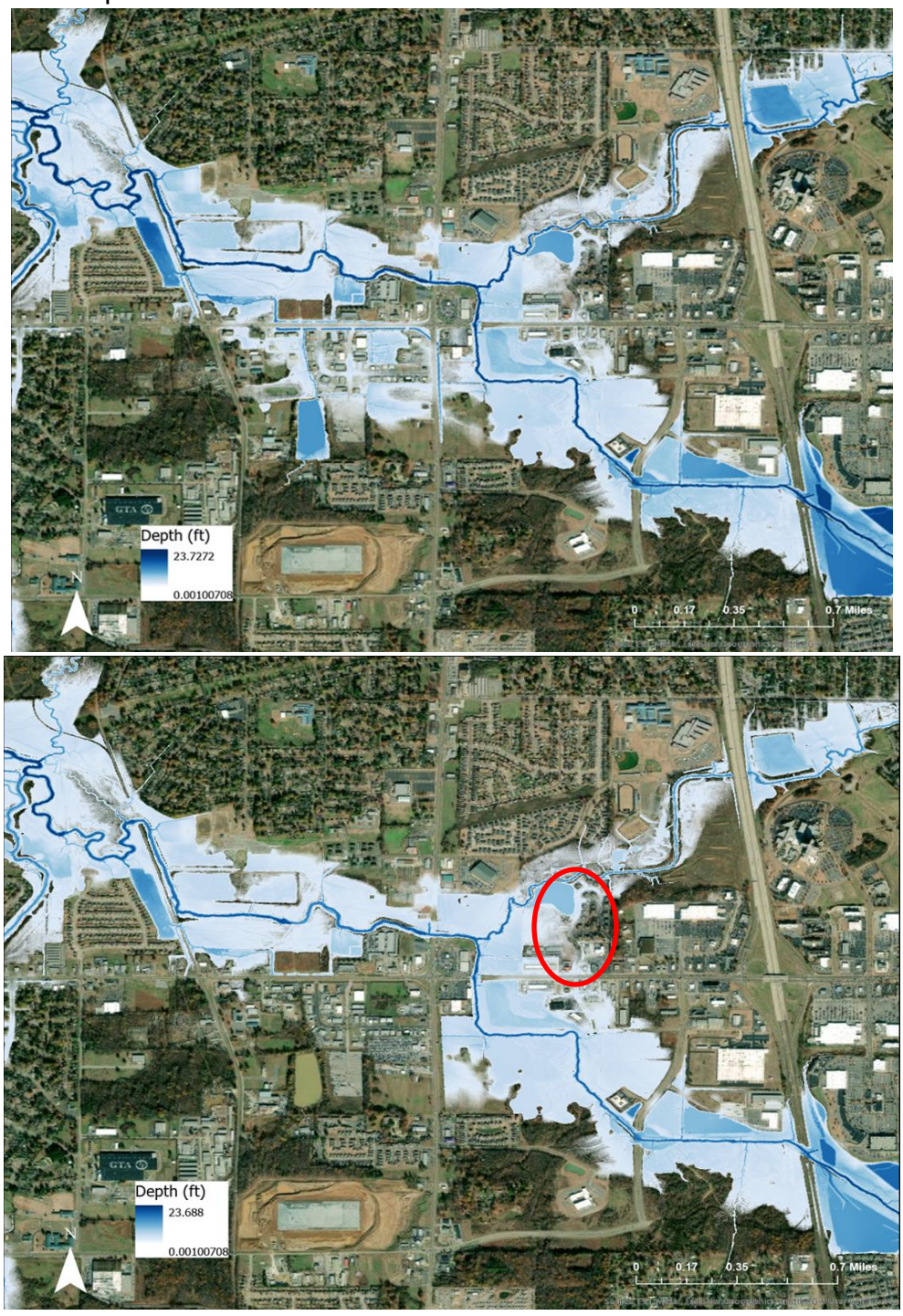


Figure 5-1 Inundation Mapping for Without-Project and With-Project Conditions in the Future 0.01 AEP Event

Levee Optimization

In compliance with ER 1105-2-100, a levee optimization is necessary to investigate what size yields greatest net NED benefits. During the Planning, Engineering and Development (PED) phase of the study, a full incremental economic analysis of the levee will be conducted with the improved hydraulic modeling. The Main Report lists the risks associated with the deferment of optimization into PED and how optimization results will be conveyed to decision makers and the public.

Incremental Justification

Table L: 5-3 below shows the benefit-cost summaries of the NED plan (which is the levee component of the Recommended Plan), the nonstructural component of the Recommended Plan, and the full Recommended Plan.

Table L:5-3 Incremental Analysis of Recommended Plan Measures

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Recommended Plan Components				Recommended Plan (Alternative 8b)	
NED Plan (Alternative 8a)		Nonstructural Component			
Total Project Costs		**Total Project Costs**		**Total Project Costs**	
First Cost	$6,904	First Cost	$18,128	First Cost	$25,788
Interest During Construction	$155	Interest During Construction	$76	Interest During Construction	$244
Total Investment Cost	$7,059	Total Investment Cost	$18,204	Total Investment Cost	$26,031
Estimated Annual Costs		**Estimated Annual Costs**		**Estimated Annual Costs**	
Annualized Construction Costs	$249	Annualized Construction Costs	$642	Annualized Construction Costs	$918
Annual OMRR&R	$26	Annual OMRR&R	0	Annual OMRR&R	$26
Total Annual Costs	$275	Total Annual Costs	$642	Total Annual Costs	$944
Average Annual Benefits		**Average Annual Benefits**		**Average Annual Benefits**	
Total Equivalent Annual Benefits	$1,887	Total Equivalent Annual Benefits	$193	Total Equivalent Annual Benefits	$2,429
Net Annual Benefits	$1,612	Net Annual Benefits	($449)	Net Annual Benefits	$1,485
Benefit to Cost Ratio	6.86	Benefit to Cost Ratio	0.30	Benefit to Cost Ratio	2.57

Nonstructural Participation Rate Sensitivity Analysis

The nonstructural component of the Recommended Plan involves a total of 35 structures to be dry floodproofed within an area east of Bullfrog Corner along Goodman Road. All 35 structures are grouped within a half mile radius or adjacent to a high trafficked commercial area. Of the 35 structures, 14 are residential apartment buildings and the other 21 are commercial retail and storage buildings. As it relates to willingness to voluntarily mitigate using dry floodproofing, it is assumed that the group of 14 apartment buildings will have a strong possibility of not participating. This due to the structure being recently constructed and not expected to experience inundation until between the 0.5% (200YR) and 0.2% (500YR) AEP events, and at those events flood depths are expected to be less than one foot relative to first floor. Additionally, all 14 apartment buildings are within a single parcel ownership. It is not expected that the owner would voluntarily be willing to cost share more than $1,000,000 in nonstructural related costs to mitigate infrequent flooding.

The rest of the 21 commercial structures do have mixed ownership with the exception of a 6 building storage complex, which has a single owner. The commercial structures are more

floodprone relative to the apartment buildings and are expected to be inundated starting at the 4% (25YR) AEP event with depths around 0.5 feet. While the commercial structures are also newer construction, the active threat of flooding may motivate owners to voluntarily mitigate. With that said, there remains the possibility that the commercial structures do not voluntarily mitigate due to impacts to building aesthetics, high expense, and inconvenience. A sensitivity analysis was run through HEC-FDA for three different participation rates. The participation rates included 0% participation, 60% participation (only floodproofing of commercial structures), and 100% participation.The results of the sensitivity analysis can be found in Table L:5-4 below.

Table L:5-4 Nonstructural Participation Rate Sensitivity Analysis

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Floodproofing of No Structures		Floodproofing of Only Commercial Structures		Floodproofing of All Structures	
0% Participation		**60% Participation**		**100% Participation (Alternative 8b)**	
Total Project Costs		**Total Project Costs**		**Total Project Costs**	
First Cost	$6,904	First Cost	$16,000	First Cost	$25,788
Interest During Construction	$155	Interest During Construction	$235	Interest During Construction	$244
Total Investment Cost	$7,059	Total Investment Cost	$16,235	Total Investment Cost	$26,031
Estimated Annual Costs		**Estimated Annual Costs**		**Estimated Annual Costs**	
Annualized Construction Costs	$249	Annualized Construction Costs	$544	Annualized Construction Costs	$918
Annual OMRR&R	$26	Annual OMRR&R	$26	Annual OMRR&R	$26
Total Annual Costs	$275	Total Annual Costs	$570	Total Annual Costs	$944
Average Annual Benefits		**Average Annual Benefits**		**Average Annual Benefits**	
Total Equivalent Annual Benefits	$1,887	Total Equivalent Annual Benefits	$2,315	Total Equivalent Annual Benefits	$2,429
Net Annual Benefits	$1,612	Net Annual Benefits	$1,745	Net Annual Benefits	$1,485
Benefit to Cost Ratio	6.86	Benefit to Cost Ratio	4.06	Benefit to Cost Ratio	2.57

5.2 RISK ANALYSIS

Benefit Exceedance Probability Relationship

The HEC-FDA model incorporates the uncertainty surrounding the economic and engineering inputs to generate results that can be used to assess the performance of proposed plans. The HEC-FDA model was used to calculate the expected or equivalent annual without-project and with-project damages and the damages reduced for each of the project alternatives. Table L:5-5 shows the mean equivalent annual benefits and the benefits at the 75, 50, and 25 percentiles for the Recommended Plan. These percentiles reflect the percentage chance that the benefits will be greater than or equal to the indicated values. The table indicates the percent chance that the equivalent annual benefits will exceed the expected annual costs therefore the benefit cost ratio is greater than one and the net benefits are positive.

Table L:5-4 can be interpreted as there is a 75% chance that the equivalent annual damages reduced (annual benefits) of the Recommended Plan will exceed $1,021,000, and therefore a 75% chance that the BCR will exceed 0.97.

Table L: 5-5. Probability Benefits Exceed Costs

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Metric	75%	50%	Mean	25%
NED Plan - Final 8a				
Total Average Annual Cost	$275	$275	$275	$275
Total Equivalent Annual Benefits	$749	$1,668	$1,887	$2,730
Net Benefits	$474	$1,394	$1,612	$2,455
BCR	2.72	6.07	6.86	9.93
Recommended Plan - Final 8b				
Total Average Annual Cost	$944	$944	$944	$944
Total Equivalent Annual Benefits	$1,021	$2,045	$2,429	$3,388
Net Benefits	$77	$1,102	$1,485	$2,444
BCR	1.08	2.17	2.57	3.59

Project Performance

Project performance is traditionally measured using HEC-FDA model inputs that include long-term Annual Exceedance Probability (AEP) and the conditional non-exceedance probability, or assurance, values for various flood events. The model provided a target stage to assess project performance for each study area reach for the analysis years, 2029 and 2079, for the without-project condition and for the Recommended Plan. For each study area reach, the target stage was set by default at the elevation where the model calculated five percent residual damages for the 0.01 AEP (100-year) event in the without-project condition for the base year and the future year.

Project performance is an important indicator for both without project and with project conditions. Project performance can help communicate the effectiveness of the NED Plan and Recommended Plan, providing an estimate of how it will perform. The nonstructural component of the Recommended Plan is unable to be included within project performance and therefore the discussion narrative and tables in this section apply to both the NED Plan and the Recommended Plan. The section is focused on the levee and floodwall as the with project condition, and Reach 13, which is the primary area where risk is reduced from the levee.

The HEC-FDA model calculated a median AEP and an expected AEP associated with the target stage in each reach for the without project and with project conditions. These numbers represent 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. In Reach 13, there is a 21 percent to 24 percent chance that the target stage of 2.028 feet will be exceeded in any given year in the base year without project condition. With project, this drops to 0.2 percent to 0.7 percent. We see very similar percentages in the future year.

Table L: 5-6. Base Year Target Stage Annual Exceedance Probability

Stream Name	Study Area Reach	Target Stage	Without Project		With Project	
			Median	Expected	Median	Expected
Cow Pen Creek	21	1.142	0.205	0.21	0.206	0.211
	22	0.649	0.159	0.16	0.16	0.161
Horn Lake Creek	11	0.33	0.106	0.105	0.111	0.109
	12	0.001	0.999	0.999	0.99	0.99
	13	2.028	0.211	0.237	0.002	0.007
	14	2.219	0.208	0.221	0.27	0.284
	15	0.042	0.091	0.094	0.181	0.164
	16	1.362	0.187	0.193	0.166	0.175
	17	0.001	0.999	0.999	0.99	0.99
	18	0.001	0.999	0.999	0.99	0.99
Lateral D	31	0.279	0.277	0.272	0.214	0.214
Rocky Creek	41	0.522	0.041	0.044	0.09	0.093
	42	1.339	0.164	0.169	0.072	0.075
	43	0.613	0.213	0.214	0.196	0.199

Table L: 5-7. Future Year Target Stage Annual Exceedance Probability

Stream Name	Study Area Reach	Target Stage	Without Project		With Project	
			Median	Expected	Median	Expected
Cow Pen Creek	21	1.272	0.218	0.23	0.221	0.234
	22	1.069	0.198	0.203	0.2	0.205
Horn Lake Creek	11	0.3	0.182	0.167	0.18	0.164
	12	0.001	0.999	0.999	0.99	0.99
	13	2.032	0.213	0.241	0	0.003
	14	2.318	0.207	0.218	0.277	0.289
	15	0.138	0.12	0.114	0.19	0.176
	16	1.806	0.128	0.143	0.144	0.159
	17	0.001	0.999	0.999	0.99	0.99
	18	0.001	0.999	0.999	0.99	0.99
Lateral D	31	0.643	0.229	0.232	0.239	0.243
Rocky Creek	41	0.719	0.042	0.046	0.1	0.1
	42	1.805	0.104	0.113	0.05	0.056
	43	0.613	0.204	0.207	0.208	0.211

The Long Term Exceedance Probability (LTEP), also referred to as Long-Term Risk in the tables below, can be defined as the likelihood of the target stage being exceeded at least once over the specified period. Reach 13 LTEP for the base year without project condition indicates that over a 10-year period, there is a 93 percent chance that Horn Lake Creek will exceed the target stage of 2.028 feet in Reach 13. Over a 30-year period, there is a 100 percent chance that Horn Lake Creek will exceed the target stage

in Reach 13. With the levee in place, there is a 6 percent chance the target stage will be exceeded in a 10-year period in Reach 13. Over a 30-year period, there is a 17 percent chance of that target stage being exceeded in Reach 13.

Table L: 5-8. Base Year Long-Term Risk

Stream Name	Study Area Reach	Target Stage	Without Project			With Project		
			10 years	30 years	50 years	10 years	30 years	50 years
Cow Pen Creek	21	1.142	0.905	0.999	1	0.906	0.999	1
	22	0.649	0.826	0.995	1	0.827	0.995	1
Horn Lake Creek	11	0.33	0.669	0.964	0.996	0.684	0.968	0.997
	12	0.001	1	1	1	1	1	1
	13	2.028	0.933	1	1	0.063	0.178	0.279
	14	2.219	0.918	0.999	1	0.964	1	1
	15	0.042	0.628	0.949	0.993	0.834	0.995	1
	16	1.362	0.883	0.998	1	0.853	0.997	1
	17	0.001	1	1	1	1	1	1
	18	0.001	1	1	1	1	1	1
Lateral D	31	0.279	0.958	1	1	0.909	0.999	1
Rocky Creek	41	0.522	0.365	0.744	0.897	0.624	0.947	0.992
	42	1.339	0.844	0.996	1	0.543	0.905	0.98
	43	0.613	0.91	0.999	1	0.891	0.999	1

Table L: 5-9. Future Year Long-Term Risk

Stream Name	Study Area Reach	Target Stage	Without Project			With Project		
			10 years	30 years	50 years	10 years	30 years	50 years
Cow Pen Creek	21	1.272	0.926	1	1	0.93	1	1
	22	1.069	0.896	0.999	1	0.899	0.999	1
Horn Lake Creek	11	0.3	0.839	0.996	1	0.833	0.995	1
	12	0.001	1	1	1	1	1	1
	13	2.032	0.936	1	1	0.026	0.077	0.126
	14	2.318	0.914	0.999	1	0.967	1	1
	15	0.138	0.703	0.974	0.998	0.856	0.997	1
	16	1.806	0.785	0.99	1	0.822	0.994	1
	17	0.001	1	1	1	1	1	1
	18	0.001	1	1	1	1	1	1
Lateral D	31	0.643	0.929	1	1	0.938	1	1
Rocky Creek	41	0.719	0.377	0.759	0.906	0.653	0.958	0.995
	42	1.805	0.699	0.973	0.998	0.437	0.821	0.943
	43	0.613	0.901	0.999	1	0.907	0.999	1

The Assurance, or Conditional Non-Exceedance Probability, is the chance that the target stage will not be exceeded given the occurrence of a specific flood event. As such, the inverse of the values provided can be considered the chance that the target stage will be exceeded given the occurrence of a specific flood event. Without the

project in place, there is a 99.7 percent chance that the target stage of 2.028 feet will be exceeded by a 0.02 AEP event in Reach 13 in the base year. The levee and floodwall can be expected to pass the 0.02 AEP event with 99.9 percent assurance in Reach 13 in the base year. The levee will pass the 0.01 AEP event with 70.2 percent assurance and the 0.004 AEP event with 57 percent assurance.

It should be noted that due to the flatness of the water surface profiles and uncertainty surrounding them, the model's output for the more frequent events are less an indicator of the project's performance and more an indicator of model noise. This makes the 0.1 AEP and 0.04 AEP event probabilities inaccurate. This specific output of the model is much more accurate when the levee module of the HEC-FDA model is utilized for leveed reaches.

Table L: 5-10. Base Year Conditional Non-Exceedance Probability by Events

Stream Name	Study Area Reach	Target Stage	0.1 AEP		0.04 AEP		0.02 AEP	
			WO	WP	WO	WP	WO	WP
Cow Pen Creek	21	1.142	0.114	0.112	0.038	0.042	0.033	0.037
	22	0.649	0.245	0.244	0.093	0.095	0.06	0.064
Horn Lake Creek	11	0.33	0.473	0.445	0.17	0.158	0.119	0.108
	12	0.001	0	0	0	0.434	0	0.124
	13	2.028	0.013	0.568	0.005	0.568	0.003	0.999
	14	2.219	0.071	0.001	0.022	0.001	0.018	0.001
	15	0.042	0.412	0.168	0	0.047	0	0.026
	16	1.362	0.158	0.224	0.05	0.085	0.045	0.061
	17	0.001	0	0	0	0.434	0	0.124
	18	0.001	0	0	0	0.434	0	0.124
Lateral D	31	0.279	0.07	0.115	0.023	0.035	0.021	0.031
Rocky Creek	41	0.522	0.991	0.562	0.492	0.189	0.308	0.111
	42	1.339	0.23	0.684	0.087	0.286	0.082	0.188
	43	0.613	0.115	0.13	0.021	0.021	0.009	0.007

Table L: 5-11. Base Year Conditional Non-Exceedance Probability by Events (Continued)

Stream Name	Study Area Reach	Target Stage	0.01 AEP		0.004 AEP		0.002 AEP	
			WO	WP	WO	WP	WO	WP
Cow Pen Creek	21	1.142	0.03	0.032	0.026	0.03	0.019	0.021
	22	0.649	0.045	0.045	0.02	0.02	0.01	0.01
Horn Lake Creek	11	0.33	0.113	0.103	0.063	0.06	0.036	0.034
	12	0.001	0	0.005	0	0.003	0	0.002
	13	2.028	0.002	0.702	0.002	0.571	0.012	0.476
	14	2.219	0.01	0.001	0.009	0.001	0.005	0
	15	0.042	0.054	0.02	0.028	0.012	0.016	0.006
	16	1.362	0.041	0.056	0.038	0.053	0.028	0.035
	17	0.001	0	0.005	0	0.003	0	0.002
	18	0.001	0	0.005	0	0.003	0	0.002
Lateral D	31	0.279	0.019	0.028	0.017	0.026	0.016	0.025
Rocky Creek	41	0.522	0.236	0.104	0.148	0.085	0.087	0.05
	42	1.339	0.076	0.159	0.062	0.151	0.044	0.145
	43	0.613	0.008	0.007	0.007	0.006	0.004	0.005

Table L: 5-12. Future Year Conditional Non-Exceedance Probability by Events

Stream Name	Study Area Reach	Target Stage	0.1 AEP		0.04 AEP		0.02 AEP	
			WO	WP	WO	WP	WO	WP
Cow Pen Creek	21	1.272	0.062	0.052	0.026	0.023	0.024	0.021
	22	1.069	0.124	0.118	0.032	0.031	0.023	0.023
Horn Lake Creek	11	0.3	0.174	0.174	0.055	0.054	0.05	0.051
	12	0.001	0	0	0	0.434	0	0.124
	13	2.032	0.007	0.569	0.003	1	0.002	0.999
	14	2.318	0.077	0	0.023	0	0.019	0
	15	0.138	0.409	0.143	0.15	0.043	0.074	0.037
	16	1.806	0.344	0.284	0.114	0.094	0.1	0.084
	17	0.001	0	0	0	0.434	0	0.124
	18	0.001	0	0	0	0.434	0	0.124
Lateral D	31	0.643	0.081	0.068	0.025	0.025	0.023	0.023
Rocky Creek	41	0.719	0.912	0.498	0.481	0.18	0.312	0.143
	42	1.805	0.48	0.829	0.175	0.423	0.16	0.284
	43	0.613	0.115	0.106	0.022	0.013	0.011	0.003

Table L: 5-13. Future Year Conditional Non-Exceedance Probability by Events (Continued)

Stream Name	Study Area Reach	Target Stage	0.01 AEP		0.004 AEP		0.002 AEP	
			WO	WP	WO	WP	WO	WP
Cow Pen Creek	21	1.272	0.02	0.017	0.019	0.016	0.018	0.015
	22	1.069	0.021	0.021	0.012	0.011	0.006	0.006
Horn Lake Creek	11	0.3	0.045	0.046	0.022	0.023	0.011	0.012
	12	0.001	0	0.005	0	0.003	0	0.002
	13	2.032	0.02	0.891	0.006	0.803	0.007	0.721
	14	2.318	0.016	0	0.015	0	0.007	0
	15	0.138	0.104	0.033	0.058	0.03	0.031	0.015
	16	1.806	0.094	0.076	0.074	0.061	0.039	0.035
	17	0.001	0	0.005	0	0.003	0	0.002
	18	0.001	0	0.005	0	0.003	0	0.002
Lateral D	31	0.643	0.02	0.02	0.019	0.018	0.016	0.015
Rocky Creek	41	0.719	0.26	0.135	0.159	0.102	0.097	0.056
	42	1.805	0.139	0.237	0.091	0.151	0.053	0.088
	43	0.613	0.008	0.002	0.007	0.002	0.003	0.002

Residual Risk

The flood risk that remains in the floodplain after the proposed alternatives are implemented is known as the residual flood risk. Table L:5-14 shows the damages without the project in place, the residual damages with the project in place, and the benefits for the NED and Recommended Plans.

Table L:5-14 Equivalent Annual Residual Damages
(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Stream	Reach	NED Plan (8a)			Recommended Plan (8b)		
		Without Project	Residual Damages	Benefits	Without Project Damages	Residual Damages	Benefits
Cow Pen Creek	21	$543	$569	($26)	$543	$569	($26)
	22	$122	$123	($1)	$122	$123	($1)
	Total	$665	$692	($27)	$665	$692	($27)
Horn Lake Creek	11	$115	$111	$4	$115	$111	$4
	12	$0	$0	$0	$0	$0	$0
	13	$338	$15	$324	$338	$15	$324
	14	$1,967	$369	$1,598	$1,967	$69	$1,898
	15	$174	$277	($103)	$174	$43	$131
	16	$527	$571	($44)	$527	$571	($44)
	17	$0	$0	$0	$0	$0	$0
	18	$0	$0	$0	$0	$0	$0
	Total	$3,122	$1,342	$1,780	$3,122	$809	$2,313
Lateral D	31	$26	$26	($1)	$26	$26	($1)
	Total	$26	$26	($1)	$26	$26	($1)
Rocky Creek	41	$11	$13	($2)	$11	$4	$6
	42	$278	$137	$141	$278	$137	$141
	43	$216	$220	($3)	$216	$220	($3)
	Total	$505	$370	$135	$505	$361	$143
Total		$4,317	$2,431	$1,887	$4,317	$1,888	$2,429

6.0 OTHER SOCIAL EFFECTS (OSE) ANALYSIS

An analysis was completed investigating the impact of the base year without project condition. The results were gathered using the Climate and Economic Justic Screening Tool and the Center for Disease Control Social Vulnerability Index. The screening tool indicated that there were 4 intersections between reaches and disadvantaged communities.

6.1 CLIMATE AND ECONOMIC JUSTICE SCREENING TOOL

The Climate and Economic Justice Screening Tool (CEJST) was developed by the Council on Environmental Quality to help identify disadvantaged communities as part of the Justice 40 initiative. The CEJST provides data on socioeconomic, environmental, and climate information on a census tract level that can help inform decisions that may affect disadvantaged communities. Figure L:6-1 shows the census tracts in the North Desoto study area along with the study area reaches. There are three census tracts in the North Desoto study area that are flagged as disadvantaged communities in the CEJST tool. The reaches that intersect with disadvantaged communities are Cow Pen 21, Horn Creek 13, Horn Creek 14, and small portion of Rocky Creek 41.

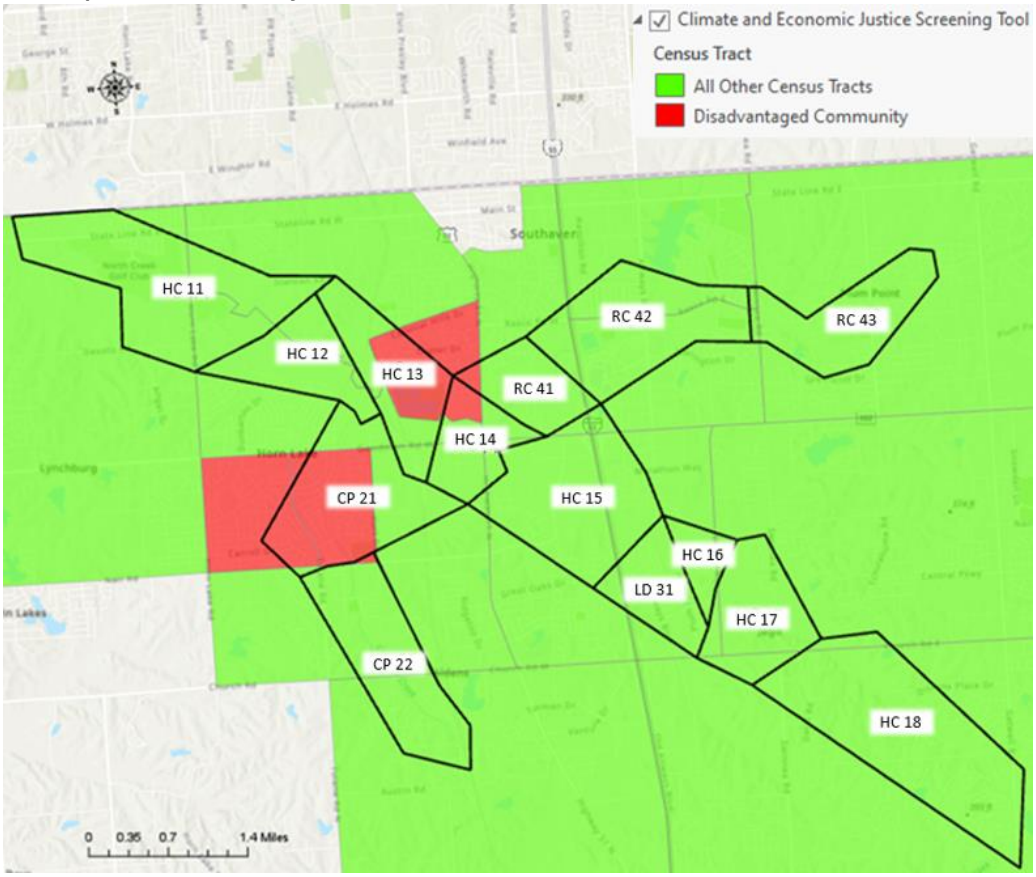


Figure L:6-1. Climate and Economic Justice Screening Tool

6.2 CENTER FOR DISEASE CONTROL SOCIAL VULNERABILITY INDEX

The Center for Disease Control's Social Vulnerability Index (SVI) uses for 14 different social and economic factors to evaluate a community's ability to respond to a natural disaster. The CDC's SVI considers any census tract with an overall rating of social vulnerability in the 90% or higher as an area with high social vulnerability. Areas with high social vulnerability experience increased consequences of a natural disaster that make it harder to evacuate and more difficult to access recovery services after a disaster. There are no census blocks in the North Desoto study area that fall into the high social vulnerability category. There are three census tracts that have a moderate to high social vulnerability rating. Figure L:6-2 shows the social vulnerability in the North Desoto study area. Portions of Cow Pen 21, Horn Creek 13, Horn Creek 14, and Rocky Creek 41 are fall into that moderate to high social vulnerability rating.

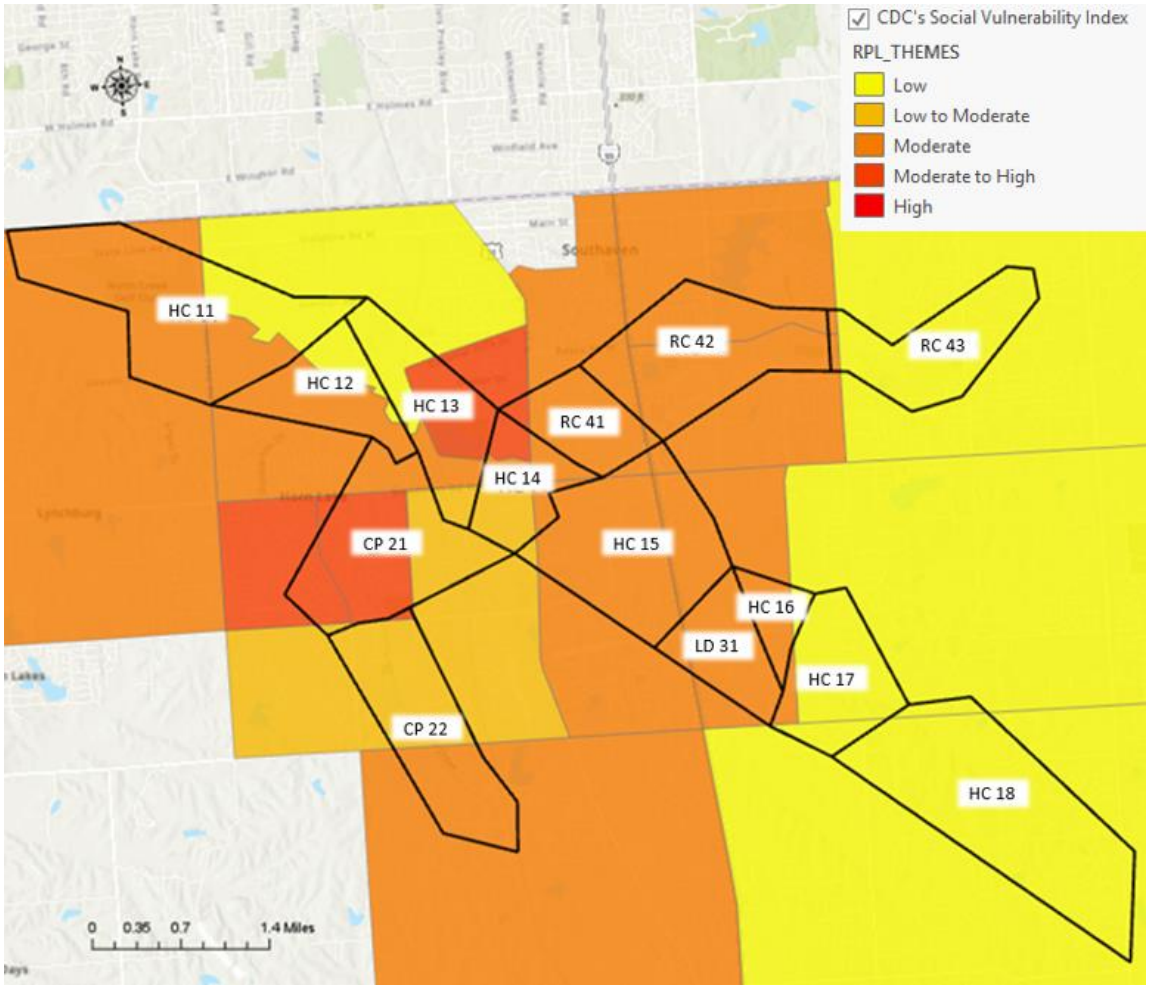


Figure L:6-2. CDC Social Vulnerability Index

The area directly upstream of the levee and floodwall in the NED and Recommended Plans is flagged as experiencing moderate social vulnerability according to SVI. The three census

tracts flagged as disadvantaged by the CEJST and flagged as having moderate to high social vulnerability by the SVI remain are all located downstream of the levee and floodwall.

6.3 LIFE SAFETY

A risk assessment was conducted on the base year without project condition and the base year with-levee condition found in the NED and Recommended Plans using LifeSim. Estimates of life loss were generated using HEC-LifeSim for without-project, breach, and non-breach inundation scenarios. Life loss in the with-project condition (breach and non-breach) is less than the without-project condition, so there is unlikely to be any additional risk of life loss from the levee and floodwall. In addition, incremental life loss is approximately zero, suggesting little-to-no additional risk of life loss due to failure of the levee and floodwall. Appendix E contains the full Life Safety analysis.

Floodprone Structure Analysis

Multiple windshield surveys within the study area found that the average residential structure was built or rehabilitated within the last 30 years and tends to be in good condition. Residential structures are a mixture between one story and two-story structures. Non-residential structures follow the same trend and as a result, there are opportunities for vertical evacuation and given the urban area, ample evacuation routes exist.

Flood depths relative to first floor elevation within the study area max out at about 2.7 feet during the 0.04 AEP, about 3 feet during the 0.01 AEP, and about 4 feet during the 0.002 AEP event, according to the one-dimensional/two-dimensional hydraulic model. With these depths, overland velocities on structures are expected to be limited to between one and three feet per second, according to the hydraulic model. Referencing Figure L:6-3 that shows the structural stability threshold, a combined depth times velocity force of 3 feet and 12 feet per second squared would not lead to a structural collapse. Based on this, this report concludes that life safety inside structures is minimal and therefore none of the structural alternatives reduce the risk of life loss in structures enough to impact plan selection. According to Figure L:6-3, velocities on structures would have to exceed 8 feet per second for structural collapse to become a concern. Figures L:6-4 – L:6-6 show flood depths on structures in the without project base year condition for the 0.04, 0.01, and 0.002 AEP events.

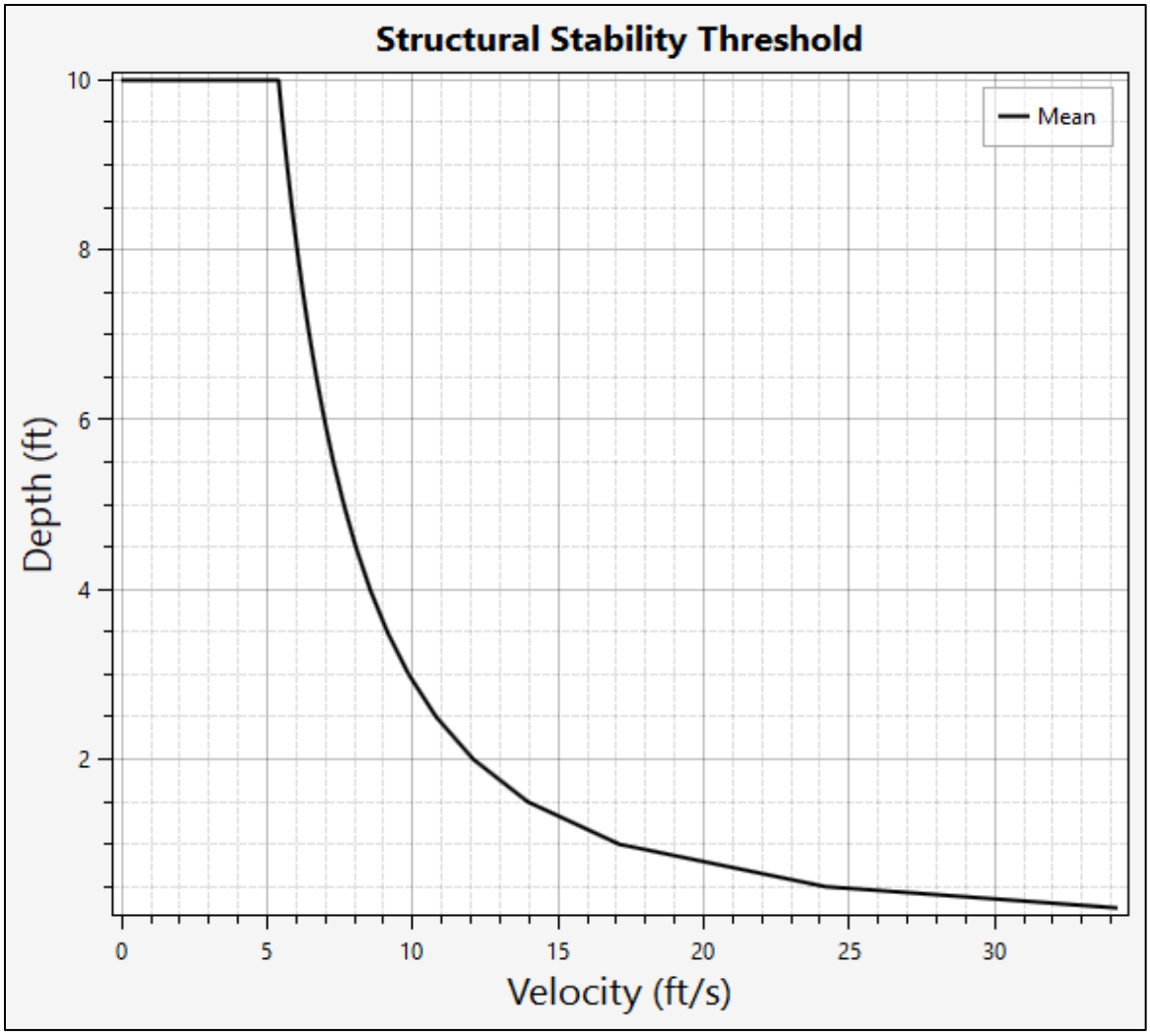


Figure L: 6-3 HEC-LifeSim One-story Residential Wood Frame Stability Function

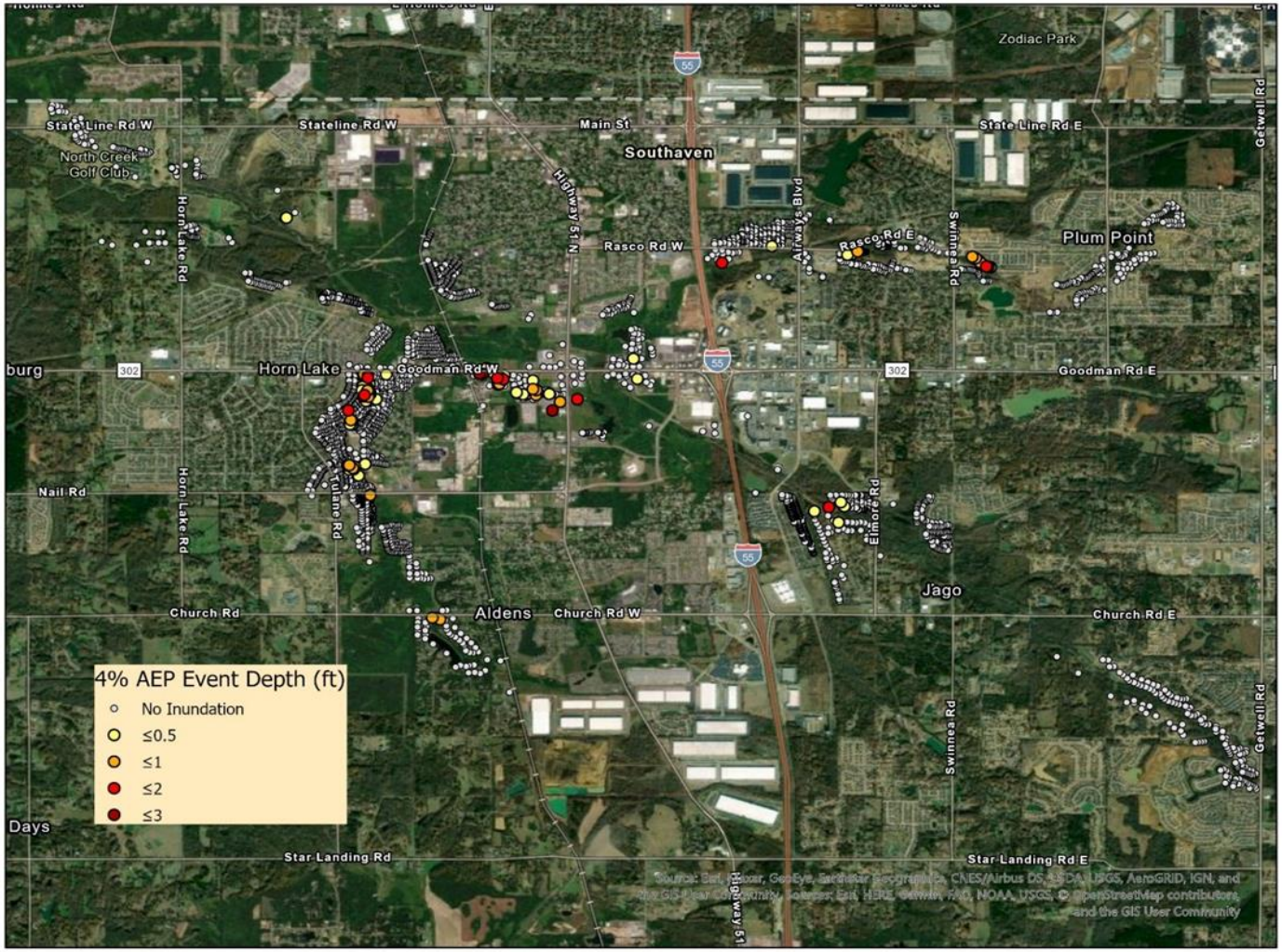


Figure L: 6-4 Existing Condition 0.04 AEP Depths on Structures in Base Year

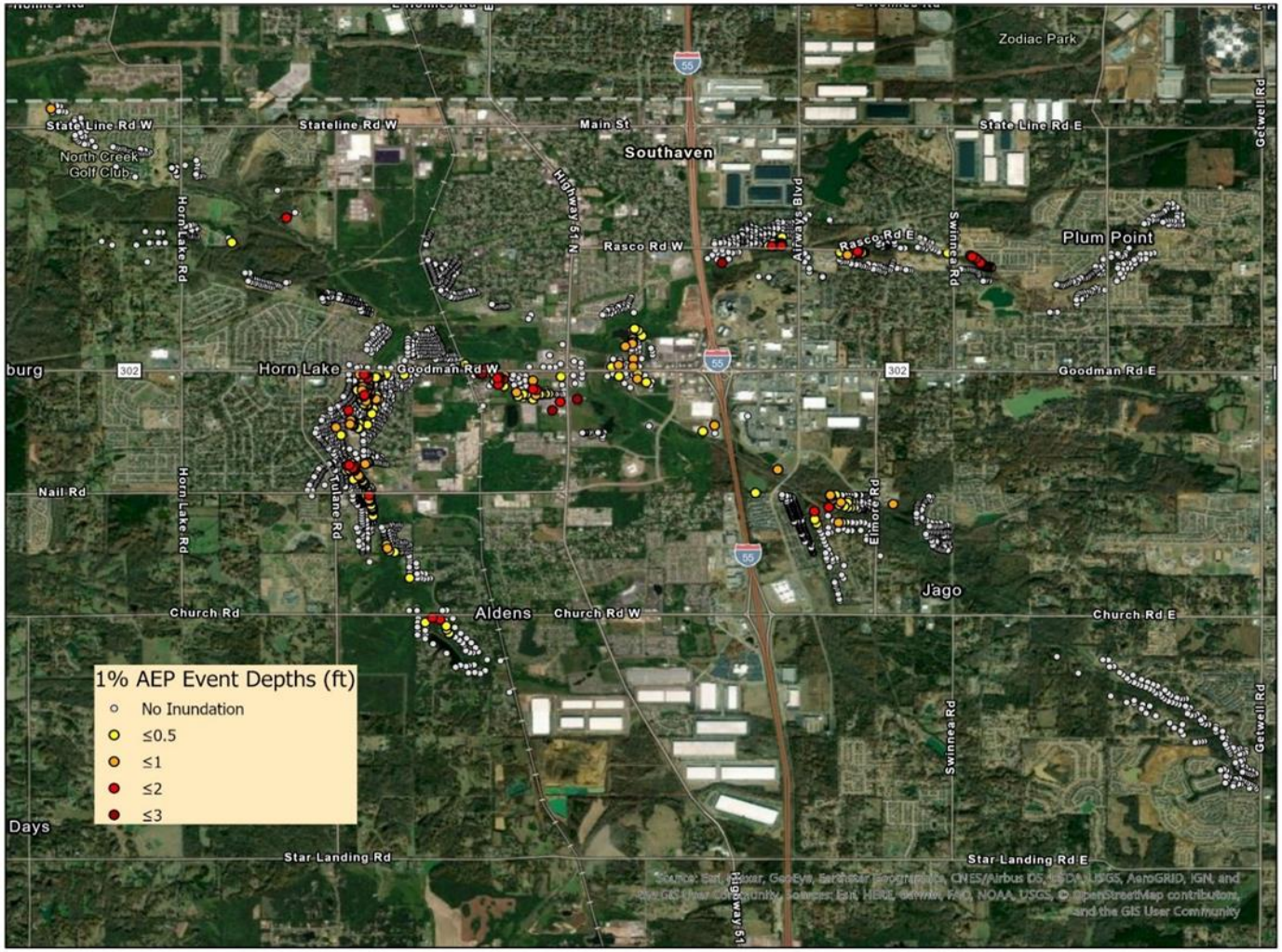


Figure L: 6-5 Existing Condition 0.01 AEP Depths on Structures in Base Year

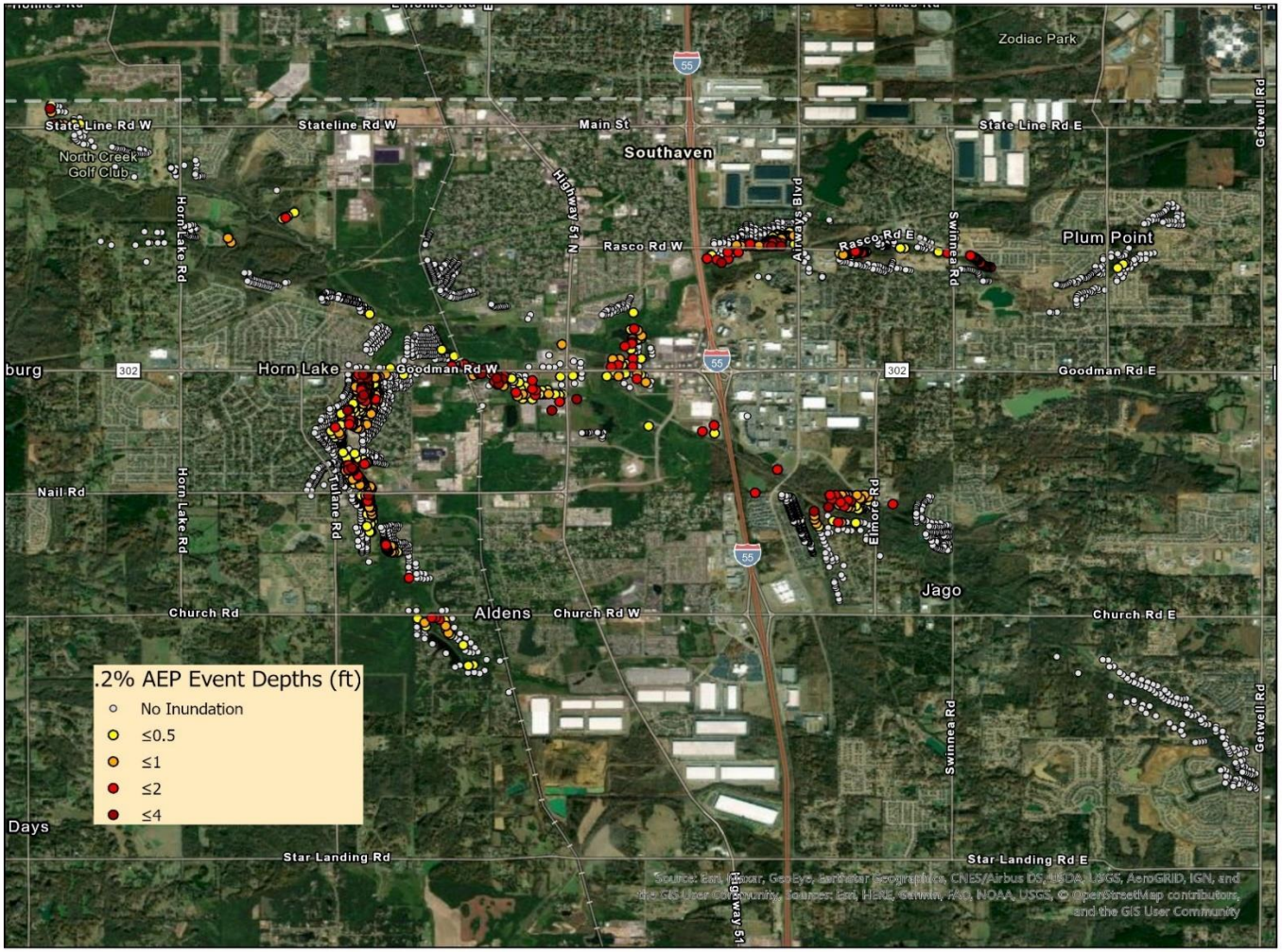


Figure L: 6-6 Existing Condition 0.002 AEP Depths on Structures in Base Year

6.4 COMPLIANCE WITH SECTION 308 OF WRDA 1990

Section 308 of the Water Resource Development Act (WRDA) 1990 limits structures built or substantially improved after July 1, 1991, in designated floodplains not elevated to the 0.01 AEP flood elevation from being included in the benefit base of the economic analysis.

To ensure compliance with the act, the county assessed parcel data provided by DeSoto County was reviewed with reliance on the year-built attribute field. For parcels inside the designated floodplain with a year built post-1991, structures were flagged for further analysis. Flagged structures were evaluated for ground surface elevation, foundation heights, and first floor elevations to determine if the structures were properly built above the base flood elevation. The study found that while not all structures flagged were built above the effective (current) base flood elevation, they were built to the base flood elevation that was in effect at the time of construction. As a result, there are structures within the HEC-FDA model that were built post-1991 that met all local floodplain ordinances at the time of construction and were outside the floodplain for the known flood risk at the time. Some of these flagged structures currently receive flooding prior to a 0.01 AEP flood event, but damages are limited to less frequent events given prior effective FIRM maps being enforced by local officials.

While not part of the Community Rating System (CRS), DeSoto County and its floodprone communities currently do not have any National Flood Insurance Program (NFIP) issues and to this reports knowledge, has never been suspended from the NFIP program. This report assumes that all communities are actively enforcing development within the floodplain to the locally authorized standards. See Table L:6-1 for a summary of CRS/NFIP status.

Table L:6-1 Community Rating System and NFIP Status

Community Name	CRS Community	NFIP Issue	Initial Compliance Date	Initial FIRM
Unincorporated DeSoto	No	No	1990	1990
Horn Lake	No	No	1990	1990
Southaven	No	No	1987	1987
Olive Branch	No	No	1987	1987

7.0 REGIONAL ECONOMIC DEVELOPMENT (RED) ANALYSIS

When the economic activity lost in a flooded region can be transferred to another area or region in the national economy, these losses cannot be included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the RED account. The input-output macroeconomic model RECONS can be used to address the impacts of the construction spending associated with the project alternatives. The RECONS 2.0 model utilizes a total construction cost of a project that is attributable to contracts being awarded to complete the construction of the project. This cost excludes USACE labor associated with planning, engineering, and design, as well as economic costs like interest during construction. The costs also include real estate and cultural resources costs since this disbursement of federal funds are expected to be spent within the region of the study area. An example of this would be using Uniform Relocation Act funding to pay a tenant to temporarily relocate to a hotel while their home is being elevated. Overall, Plan 7 generates the highest economic activity on local, state, and national level with a total impact of $49,660,000 and 637.9 jobs to the local economy.

The project first cost input into the RECONS model for Plan 5a (Extended Channel Enlargement) was $5,828,000, which excludes environmental costs, real estate costs, cultural costs, and IDC. Of the total expenditures identified, 71.8 percent will be captured within the local study area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in Tables L:7-1 and 7-2. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $5,828,000 support a total of 63.0 full-time equivalent jobs, $4,208,316 in labor income, $4,905,008 in the gross regional product, and $8,204,638 in economic output in the local impact area. More broadly, these expenditures support 100.9 full-time equivalent jobs, $7,155,677 in labor income, $9,314,256 in the gross regional product, and $15,671,579 in economic output in the nation.

Table L: 7-1 Plan 5a RECONS Impacts to Local, State, and National Economies (2022 Price Level)

Area	Local Capture	Output	Jobs	Labor Income	Value Added
		Local			
Direct Impact		$4,181,959	39.5	$2,844,365	$2,632,266
Secondary Impact		$4,022,680	23.5	$1,363,951	$2,272,742
Total Impact	$4,181,959	$8,204,638	63	$4,208,316	$4,905,008
		State			
Direct Impact		$4,709,235	44.2	$3,290,621	$3,117,022
Secondary Impact		$4,628,128	26.7	$1,542,686	$2,584,098
Total Impact	$4,709,235	$9,337,363	70.9	$4,833,307	$5,701,120
		National			
Direct Impact		$5,610,556	52.8	$3,928,447	$3,796,778
Secondary Impact		$10,061,023	48.1	$3,227,230	$5,517,478
Total Impact	$5,610,556	$15,671,579	100.90	$7,155,677	$9,314,256

Table L: 7-2 Plan 5a RECONS Impacts to Specific Industries in the Local Economy (2022 Price Level)

IMPLAN Sectors	Industries	Output	Jobs*	Labor Income	Value Added
Direct Impacts					
29	Sand and gravel mining	$ 14,774	0.1	$ 2,890	$ 4,862
52	Construction of new power and communication structures	$ 58,278	0.4	$ 24,696	$ 30,281
54	Construction of new highways and streets	$ 58,274	0.3	$ 21,635	$ 26,400
55	Construction of new commercial structures, including farm structures	$ 58,219	0.4	$ 29,285	$ 31,384
56	Construction of other new nonresidential structures	$ 989,171	12.2	$ 869,970	$ 367,627
57	Construction of new single-family residential structures	$ 58,280	0.4	$ 27,457	$ 32,852
203	Cement manufacturing	$ 33,031	0.1	$ 2,908	$ 6,821
215	Iron and steel mills and ferroalloy manufacturing	$ 4,358	-	$ 353	$ 611
269	All other industrial machinery manufacturing	$ 239	-	$ 38	$ 53
331	Switchgear and switchboard apparatus manufacturing	$ 782	-	$ 180	$ 310
395	Wholesale - Machinery, equipment, and supplies	$ 3,993	-	$ 1,327	$ 2,450
400	Wholesale - Other nondurable goods merchant wholesalers	$ 57,141	0.2	$ 14,807	$ 32,928
401	Wholesale - Wholesale electronic markets and agents and brokers	$ 13,257	0.1	$ 19,430	$ 12,046
414	Air transportation	$ 264	-	$ 57	$ 193
415	Rail transportation	$ 12,686	-	$ 2,932	$ 6,324
416	Water transportation	$ 552	-	$ 75	$ 139
417	Truck transportation	$ 48,345	0.3	$ 19,564	$ 23,104
444	Insurance carriers, except direct life	$ 29,678	-	$ 3,947	$ 13,343
453	Commercial and industrial machinery and equipment rental and leasing	$ 131,638	0.4	$ 35,451	$ 81,705
457	Architectural, engineering, and related services	$ 451,251	2.4	$ 191,743	$ 232,418
463	Environmental and other technical consulting services	$ 20,502	0.2	$ 14,131	$ 11,893
470	Office administrative services	$ 389,824	6.7	$ 322,294	$ 98,230
515	Commercial and industrial machinery and equipment repair and maintenance	$ 348,703	2.2	$ 174,449	$ 217,572
544	* Employment and payroll of federal govt, non-military	$ 874,200	3.9	$ 540,228	$ 874,200
5,001	Private Labor	$ 524,520	9.3	$ 524,520	$ 524,520
	Direct Impact	**$4,181,959**	**39.5**	**$2,844,365**	**$2,632,266**
	Secondary Impact	**$4,022,680**	**23.5**	**$1,363,951**	**$2,272,742**
	Total Impact	**$8,204,638**	**63.0**	**$4,208,316**	**$4,905,008**

The project first cost input into the RECONS model for Plan 6a (Extended Channel Enlargement + Lateral D Detention) was $20,278,000, which excludes environmental costs, real estate costs, cultural costs, and IDC. Of the total expenditures identified, 71.8 percent will be captured within the local study area. The remainder of the expenditures will be captured within the state or national level. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in Tables L:7-3 and 7-4. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $20,278,000 support a total of 219.2 full-time equivalent jobs, $14,642,455 in labor income, $17,066,531 in the gross regional product, and $28,547,298 in economic output in the local impact area. More broadly, these expenditures support 351.0 full-time equivalent jobs, $24,897,533 in labor income, $32,408,114 in the gross regional product, and $54,527,844 in economic output in the nation.

Table L: 7-3 Plan 6a RECONS Impacts to Local, State, and National Economies (2022 Price Level)

Area	**Local Capture**	**Output**	**Jobs**	**Labor Income**	**Value Added**
		Local			
Direct Impact		$14,550,748	137.5	$9,896,713	$9,158,732
Secondary Impact		$13,996,551	81.7	$4,745,743	$7,907,799
Total Impact	$14,550,748	$28,547,298	219.2	$14,642,455	$17,066,531
		State			
Direct Impact		$16,385,358	153.8	$11,449,419	$10,845,396
Secondary Impact		$16,103,153	93	$5,367,638	$8,991,135
Total Impact	$16,385,358	$32,488,511	246.8	$16,817,057	$19,836,531
		National			
Direct Impact		$19,521,423	183.6	$13,668,677	$13,210,547
Secondary Impact		$35,006,421	167.5	$11,228,856	$19,197,567
Total Impact	$19,521,423	$54,527,844	351.00	$24,897,533	$32,408,114

Table L: 7-4 Plan 6a RECONS Impacts to Specific Industries in the Local Economy (2022 Price Level)

IMPLAN Sectors	Industries	Output	Jobs*	Labor Income	Value Added
Direct Impacts					
29	Sand and gravel mining	$ 51,403	0.4	$ 10,057	$ 16,917
52	Construction of new power and communication structures	$ 202,774	1.2	$ 85,927	$ 105,359
54	Construction of new highways and streets	$ 202,760	1.0	$ 75,276	$ 91,855
55	Construction of new commercial structures, including farm structures	$ 202,568	1.5	$ 101,895	$ 109,197
56	Construction of other new nonresidential structures	$ 3,441,730	42.4	$ 3,026,981	$ 1,279,124
57	Construction of new single-family residential structures	$ 202,780	1.3	$ 95,534	$ 114,307
203	Cement manufacturing	$ 114,928	0.2	$ 10,118	$ 23,734
215	Iron and steel mills and ferroalloy manufacturing	$ 15,164	-	$ 1,228	$ 2,127
269	All other industrial machinery manufacturing	$ 830	-	$ 130	$ 184
331	Switchgear and switchboard apparatus manufacturing	$ 2,721	-	$ 628	$ 1,078
395	Wholesale - Machinery, equipment, and supplies	$ 13,894	-	$ 4,616	$ 8,524
400	Wholesale - Other nondurable goods merchant wholesalers	$ 198,817	0.6	$ 51,519	$ 114,571
401	Wholesale - Wholesale electronic markets and agents and brokers	$ 46,127	0.5	$ 67,605	$ 41,914
414	Air transportation	$ 919	-	$ 197	$ 673
415	Rail transportation	$ 44,138	0.1	$ 10,203	$ 22,005
416	Water transportation	$ 1,920	-	$ 262	$ 482
417	Truck transportation	$ 168,212	0.9	$ 68,072	$ 80,388
444	Insurance carriers, except direct life	$ 103,262	0.1	$ 13,733	$ 46,424
453	Commercial and industrial machinery and equipment rental and leasing	$ 458,023	1.3	$ 123,349	$ 284,285
457	Architectural, engineering, and related services	$ 1,570,086	8.3	$ 667,151	$ 808,677
463	Environmental and other technical consulting services	$ 71,335	0.8	$ 49,167	$ 41,382
470	Office administrative services	$ 1,356,356	23.1	$ 1,121,392	$ 341,784
515	Commercial and industrial machinery and equipment repair and maintenance	$ 1,213,280	7.5	$ 606,981	$ 757,022
544	* Employment and payroll of federal govt, non-military	$ 3,041,700	13.7	$ 1,879,673	$ 3,041,700
5,001	Private Labor	$ 1,825,020	32.5	$ 1,825,020	$ 1,825,020
	Direct Impact	**$14,550,748**	**137.5**	**$9,896,713**	**$9,158,732**
	Secondary Impact	**$13,996,551**	**81.7**	**$4,745,743**	**$7,907,799**
	Total Impact	**$28,547,298**	**219.2**	**$14,642,455**	**$17,066,531**

The project first cost input into the RECONS model for Plan 7 (Extended Channel Enlargement + 4 Detention Basins [2D]) was $60,251,000, which excludes environmental costs, real estate costs, cultural costs, and IDC. Of this the total expenditures identified, 71.8 percent will be captured within the local study area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in Table L: 7-5 and 7-6. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $60,251,000 support a total of 651.3 full-time equivalent jobs, $43,506,390 in labor income, $50,708,925 in the gross regional product, and $84,821,150 in economic output in the local impact area. More broadly, these expenditures support 1,043.0 full-time equivalent jobs, $73,976,787 in labor income, $96,292,598 in the gross regional product, and $162,015,835 in economic output in the nation.

Table L: 7-5 Plan 7 RECONS Impacts to Local, State, and National Economies (2022 Price Level)

Area	Local Capture	Output	Jobs	Labor Income	Value Added
		Local			
Direct Impact		$43,233,903	408.5	$29,405,604	$27,212,880
Secondary Impact		$41,587,247	242.8	$14,100,786	$23,496,045
Total Impact	$43,233,903	$84,821,150	651.3	$43,506,390	$50,708,925
		State			
Direct Impact		$48,684,989	456.9	$34,019,081	$32,224,378
Secondary Impact		$47,846,487	276.4	$15,948,592	$26,714,908
Total Impact	$48,684,989	$96,531,476	733.3	$49,967,673	$58,939,286
		National			
Direct Impact		$58,003,020	545.5	$40,613,052	$39,251,834
Secondary Impact		$104,012,815	497.5	$33,363,735	$57,040,764
Total Impact	$58,003,020	$162,015,835	1,043.00	$73,976,787	$96,292,598

Table L: 7-6 Plan 7 RECONS Impacts to Specific Industries in the Local Economy (2022 Price Level)

IMPLAN Sectors	Industries	Output	Jobs*	Labor Income	Value Added
	Direct Impacts				
29	Sand and gravel mining	$ 152,732	1.1	$ 29,880	$ 50,266
52	Construction of new power and communication structures	$ 602,492	3.6	$ 255,309	$ 313,049
54	Construction of new highways and streets	$ 602,450	3.1	$ 223,665	$ 272,924
55	Construction of new commercial structures, including farm structures	$ 601,879	4.4	$ 302,754	$ 324,452
56	Construction of other new nonresidential structures	$ 10,226,238	126.0	$ 8,993,916	$ 3,800,596
57	Construction of new single-family residential structures	$ 602,509	4.0	$ 283,856	$ 339,634
203	Cement manufacturing	$ 341,480	0.6	$ 30,062	$ 70,519
215	Iron and steel mills and ferroalloy manufacturing	$ 45,055	0.1	$ 3,648	$ 6,320
269	All other industrial machinery manufacturing	$ 2,466	-	$ 388	$ 546
331	Switchgear and switchboard apparatus manufacturing	$ 8,086	-	$ 1,865	$ 3,202
395	Wholesale - Machinery, equipment, and supplies	$ 41,283	0.1	$ 13,715	$ 25,326
400	Wholesale - Other nondurable goods merchant wholesalers	$ 590,734	1.7	$ 153,074	$ 340,418
401	Wholesale - Wholesale electronic markets and agents and brokers	$ 137,055	1.4	$ 200,872	$ 124,537
414	Air transportation	$ 2,731	-	$ 586	$ 2,000
415	Rail transportation	$ 131,145	0.2	$ 30,315	$ 65,382
416	Water transportation	$ 5,705	-	$ 780	$ 1,433
417	Truck transportation	$ 499,801	2.6	$ 202,257	$ 238,854
444	Insurance carriers, except direct life	$ 306,818	0.4	$ 40,805	$ 137,938
453	Commercial and industrial machinery and equipment rental and leasing	$ 1,360,901	4.0	$ 366,501	$ 844,682
457	Architectural, engineering, and related services	$ 4,665,117	24.8	$ 1,982,272	$ 2,402,780
463	Environmental and other technical consulting services	$ 211,955	2.4	$ 146,088	$ 122,955
470	Office administrative services	$ 4,030,073	68.7	$ 3,331,936	$ 1,015,526
515	Commercial and industrial machinery and equipment repair and maintenance	$ 3,604,958	22.3	$ 1,803,492	$ 2,249,301
544	* Employment and payroll of federal govt, non-military	$ 9,037,650	40.5	$ 5,584,978	$ 9,037,650
5,001	Private Labor	$ 5,422,590	96.5	$ 5,422,590	$ 5,422,590
	Direct Impact	**$43,233,903**	**408.5**	**$29,405,604**	**$27,212,880**
	Secondary Impact	**$41,587,247**	**242.8**	**$14,100,786**	**$23,496,045**
	Total Impact	**$84,821,150**	**651.3**	**$43,506,390**	**$50,708,925**

The project first cost input into the RECONS model for the Levee-Floodwall plan (Plan 8a) was $10,691,000, which excludes environmental costs, real estate costs, cultural costs, and IDC. Of this the total expenditures identified, 71.8 percent will be captured within the local study area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in Tables L:7-7 and 7-8. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $10,691,000 support a total of 115.6 full-time equivalent jobs, $7,719,819 in labor income, $8,997,844 in the gross regional product, and $15,050,753 in economic output in the local impact area. More broadly, these expenditures support 185.1 full-time equivalent jobs, $13,126,518 in labor income, $17,086,259 in the gross regional product, and $28,748,258 in economic output in the nation.

Table L: 7-7 Plan 8a RECONS Impacts to Local, State, and National Economies (2023 Price Level)

Area	**Local Capture**	**Output**	**Jobs**	**Labor Income**	**Value Added**
		Local			
Direct Impact		$7,671,469	72.5	$5,217,761	$4,828,682
Secondary Impact		$7,379,284	43.1	$2,502,058	$4,169,163
Total Impact	$7,671,469	$15,050,753	115.6	$7,719,819	$8,997,844
		State			
Direct Impact		$8,638,715	81.1	$6,036,381	$5,717,927
Secondary Impact		$8,489,930	49.1	$2,829,935	$4,740,321
Total Impact	$8,638,715	$17,128,645	130.1	$8,866,316	$10,458,248
		National			
Direct Impact		$10,292,116	96.8	$7,206,422	$6,964,886
Secondary Impact		$18,456,142	88.3	$5,920,096	$10,121,372
Total Impact	$10,292,116	$28,748,258	185.10	$13,126,518	$17,086,259

Table L: 7-8 Plan 8a RECONS Impacts to Specific Industries in the Local Economy

(2023 Price Level)

IMPLAN Sectors	Industries	Output	Jobs*	Labor Income	Value Added
	Direct Impacts				
29	Sand and gravel mining	$ 27,101	0.2	$ 5,302	$ 8,919
52	Construction of new power and communication structures	$ 106,907	0.6	$ 45,302	$ 55,548
54	Construction of new highways and streets	$ 106,899	0.6	$ 39,687	$ 48,428
55	Construction of new commercial structures, including farm structures	$ 106,798	0.8	$ 53,721	$ 57,571
56	Construction of other new nonresidential structures	$ 1,814,554	22.4	$ 1,595,890	$ 674,382
57	Construction of new single-family residential structures	$ 106,910	0.7	$ 50,368	$ 60,265
203	Cement manufacturing	$ 60,593	0.1	$ 5,334	$ 12,513
215	Iron and steel mills and ferroalloy manufacturing	$ 7,995	-	$ 647	$ 1,121
269	All other industrial machinery manufacturing	$ 438	-	$ 69	$ 97
331	Switchgear and switchboard apparatus manufacturing	$ 1,435	-	$ 331	$ 568
395	Wholesale - Machinery, equipment, and supplies	$ 7,325	-	$ 2,434	$ 4,494
400	Wholesale - Other nondurable goods merchant wholesalers	$ 104,820	0.3	$ 27,162	$ 60,404
401	Wholesale - Wholesale electronic markets and agents and brokers	$ 24,319	0.3	$ 35,643	$ 22,098
414	Air transportation	$ 485	-	$ 104	$ 355
415	Rail transportation	$ 23,271	-	$ 5,379	$ 11,601
416	Water transportation	$ 1,012	-	$ 138	$ 254
417	Truck transportation	$ 88,685	0.5	$ 35,889	$ 42,382
444	Insurance carriers, except direct life	$ 54,442	0.1	$ 7,241	$ 24,476
453	Commercial and industrial machinery and equipment rental and leasing	$ 241,480	0.7	$ 65,032	$ 149,881
457	Architectural, engineering, and related services	$ 827,783	4.4	$ 351,736	$ 426,352
463	Environmental and other technical consulting services	$ 37,609	0.4	$ 25,922	$ 21,817
470	Office administrative services	$ 715,100	12.2	$ 591,222	$ 180,196
515	Commercial and industrial machinery and equipment repair and maintenance	$ 639,667	4.0	$ 320,014	$ 399,118
544	* Employment and payroll of federal govt, non-military	$ 1,603,650	7.2	$ 991,004	$ 1,603,650
5,001	Private Labor	$ 962,190	17.1	$ 962,190	$ 962,190
	Direct Impact	**$7,671,469**	**72.5**	**$5,217,761**	**$4,828,682**
	Secondary Impact	**$7,379,284**	**43.1**	**$2,502,058**	**$4,169,163**
	Total Impact	**$15,050,753**	**115.6**	**$7,719,819**	**$8,997,844**
	* Jobs are presented in full-time equivalence (FTE)				

The project first cost input into the RECONS model for the Levee and Floodwall + dry floodproofing 14 residential apartment buildings and 21 commercial structures plan (Plan 8b) was $28,819,000, which excludes environmental costs, real estate costs, cultural costs, and

IDC. Of this the total expenditures identified, 71.8 percent will be captured within the local study area. The remainder of the expenditures will be captured within the state or national level. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in Tables L: 7-9 and 7-10. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $28,819,000 support a total of 311.5 full-time equivalent jobs, $20,809,790 in labor income, $24,254,876 in the gross regional product, and $40,571,289 in economic output in the local impact area. More broadly, these expenditures support 498.9 full-time equivalent jobs, $35,384,259 in labor income, $46,058,263 in the gross regional product, and $77,494,720 in economic output in the nation.

Table L: 7-9 Plan 8b RECONS Impacts to Local, State, and National Economies (2023 Price Level)

Area	Local Capture	Output	Jobs	Labor Income	Value Added
		Local			
Direct Impact		$20,679,455	195.4	$14,065,162	$13,016,348
Secondary Impact		$19,891,834	116.2	$6,744,628	$11,238,528
Total Impact	$20,679,455	$40,571,289	311.5	$20,809,790	$24,254,876
		State			
Direct Impact		$23,286,795	218.5	$16,271,861	$15,413,427
Secondary Impact		$22,885,727	132.2	$7,628,462	$12,778,160
Total Impact	$23,286,795	$46,172,522	350.7	$23,900,323	$28,191,587
		National			
Direct Impact		$27,743,756	260.9	$19,425,861	$18,774,769
Secondary Impact		$49,750,964	238	$15,958,399	$27,283,494
Total Impact	$27,743,756	$77,494,720	498.9	$35,384,259	$46,058,263

Table L: 7-10 Plan 8b RECONS Impacts to Specific Industries in the Local Economy (2023 Price Level)

IMPLAN Sectors	Industries	Output	Jobs*	Labor Income	Value Added
	Direct Impacts				
29	Sand and gravel mining	$ 73,054	0.5	$ 14,292	$ 24,043
52	Construction of new power and communication structures	$ 288,181	1.7	$ 122,119	$ 149,736
54	Construction of new highways and streets	$ 288,162	1.5	$ 106,982	$ 130,544
55	Construction of new commercial structures, including farm structures	$ 287,888	2.1	$ 144,812	$ 155,191
56	Construction of other new nonresidential structures	$ 4,891,370	60.2	$ 4,301,931	$ 1,817,885
57	Construction of new single-family residential structures	$ 288,190	1.9	$ 135,773	$ 162,452
203	Cement manufacturing	$ 163,335	0.3	$ 14,379	$ 33,730
215	Iron and steel mills and ferroalloy manufacturing	$ 21,550	-	$ 1,745	$ 3,023
269	All other industrial machinery manufacturing	$ 1,180	-	$ 185	$ 261
331	Switchgear and switchboard apparatus manufacturing	$ 3,868	-	$ 892	$ 1,532
395	Wholesale - Machinery, equipment, and supplies	$ 19,746	0.1	$ 6,560	$ 12,114
400	Wholesale - Other nondurable goods merchant wholesalers	$ 282,557	0.8	$ 73,218	$ 162,827
401	Wholesale - Wholesale electronic markets and agents and brokers	$ 65,556	0.7	$ 96,080	$ 59,568
414	Air transportation	$ 1,306	-	$ 280	$ 957
415	Rail transportation	$ 62,729	0.1	$ 14,500	$ 31,273
416	Water transportation	$ 2,729	-	$ 373	$ 685
417	Truck transportation	$ 239,063	1.3	$ 96,743	$ 114,247
444	Insurance carriers, except direct life	$ 146,756	0.2	$ 19,518	$ 65,978
453	Commercial and industrial machinery and equipment rental and leasing	$ 650,940	1.9	$ 175,303	$ 404,024
457	Architectural, engineering, and related services	$ 2,231,399	11.8	$ 948,152	$ 1,149,288
463	Environmental and other technical consulting services	$ 101,381	1.2	$ 69,876	$ 58,811
470	Office administrative services	$ 1,927,647	32.9	$ 1,593,717	$ 485,742
515	Commercial and industrial machinery and equipment repair and maintenance	$ 1,724,308	10.7	$ 862,639	$ 1,075,876
544	* Employment and payroll of federal govt, non-military	$ 4,322,850	19.4	$ 2,671,383	$ 4,322,850
5,001	Private Labor	$ 2,593,710	46.1	$ 2,593,710	$ 2,593,710
	Direct Impact	**$20,679,455**	**195.4**	**$14,065,162**	**$13,016,348**
	Secondary Impact	**$19,891,834**	**116.2**	**$6,744,628**	**$11,238,528**
	Total Impact	**$40,571,289**	**311.5**	**$20,809,790**	**$24,254,876**

8.0 NATIONAL ENVIRONMENTAL RESTORATION (NER) ANALYSIS

8.1 INTRODUCTION

General

USACE guidance requires a cost effectiveness analysis and an incremental cost analysis (CE/ICA) for recommended environmental restoration and mitigation plans. A cost effectiveness analysis is conducted to ensure that the least cost solution is identified for each possible level of environmental output. An incremental cost analysis of the solutions is conducted to reveal changes in costs of increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the nonmonetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analysis are valuable tools to assist in decision making. This appendix presents the results of the cost effectiveness and incremental cost analysis of North DeSoto County, Mississippi. While the study area was narrowed down to Horn Lake Basin for the purposes of the FRM analysis, the study area for the environmental analysis remained the entire county. As such, all mention of "study area" in this section of the appendix refers to the entirety of North DeSoto County.

8.2 METHODOLOGY

The project was evaluated using guidance documents and software prepared by the USACE's Institute for Water Resources (IWR). IWR – Planning Suite Software Version 2.0 was used to automate steps in the cost effectiveness and incremental cost analysis. Much of the text of this appendix was borrowed from the IWR Report (IWR 94-PS-2), Cost Effectiveness Analysis for Environmental Planning: Nine Easy Steps (Orth, 1994). The cost effectiveness and incremental cost analysis procedures are presented in nine steps, which are grouped into four tasks listed below.

A. Formulation of Combinations
   - Step 1. Display outputs and costs
   - Step 2. Identify combinable management features
   - Step 3. Calculate outputs and costs of combinations

B. Cost Effectiveness Analysis
   - Step 4. Eliminate economically inefficient solutions
   - Step 5. Eliminate economically ineffective solutions

C. Development of Incremental Cost Curve
   - Step 6. Calculate average costs
   - Step 7. Recalculate average costs for additional outputs

D. Incremental Cost Analysis
   - Step 8. Calculate incremental costs
   - Step 9. Compare successive outputs and incremental costs

The results of these analyses are not fully displayed within the economic appendix, but the CE/ICA analysis is summarized as graphs and tables on the following pages of this section. They allow decision makers to progressively compare alternative levels of environmental outputs and ask if the next level is “worth it”: that is, is the additional environmental output in the next level worth the additional monetary costs? It is important to note that these analyses will not usually lead, and are not intended to lead, to a single best solution as in economic benefit-cost analyses. They will improve the quality of decision making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternative methods to produce environmental outputs. The results though do not tell the entire story, as each of the creeks analyzed have environmentally technical significance that was not fully quantified by the environmental model.

The NER analysis considered the existing biological conditions of seventeen different streams within the county as shown in Figure L: 8-1. Initial discussions with USACE team members in Vicksburg and partners at Engineer Research and Development Center (ERDC) indicated that the Coldwater River is a stable channel and as such does not require bank stabilization, which is the primary ER objective of this study. This allowed the PDT to screen this stream. Evaluations of Cow Pen Creek, Rocky Creek, Pigeon Roost and Byhalia identified that these streams were either stable or agraddational. Streams that were aggregational or stable were also screened because they were found to not meet the primary objective which is to restore and protect aquatic and riparian ecosystems by decreasing channel slopes and stabilizing bank lines which will improve transport of stream flows and sediment over a 50 period of analysis.

Ecosystem restoration management measures were developed for the remaining eleven streams through a brainstorming process led by team’s environmental lead along with partners at ERDC. Alternative plans were identified using a channel stability assessment completed by ERDC. This method uses existing LiDAR data to assess the stream corridor conditions based on analysis of the longitudinal profile and cross-sections. This method allowed the PDT to undertake a rapid watershed assessment approach for planning based on geomorphic and engineering principles.

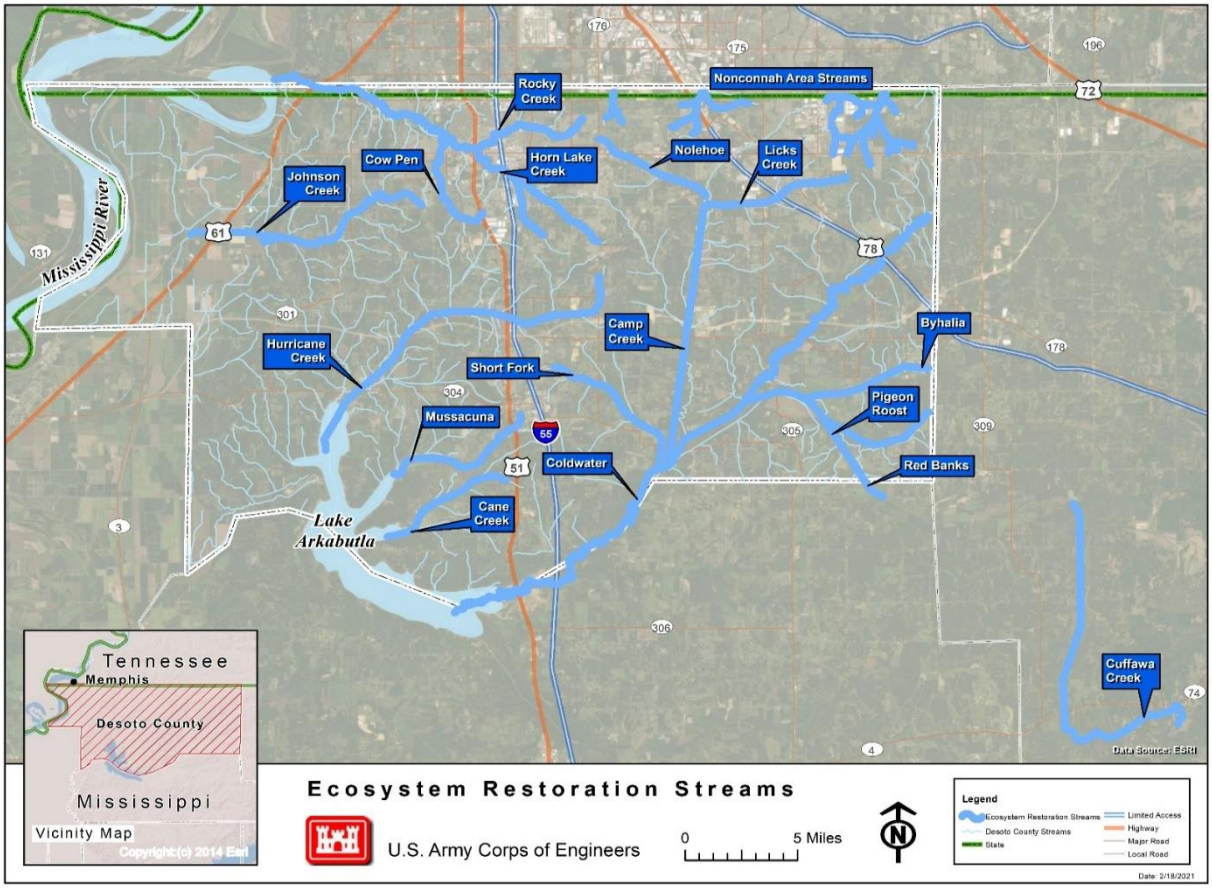


Figure L:8-1. DeSoto County Streams Evaluated for Ecosystem Restoration

The ER management measures were developed and correlated to the ecosystem restoration objectives. Included were measures that were thought to best address the stream stability, erosion, and ecosystem degradation concerns in the study area. The measures were then evaluated by a screening process based on the planning objectives, constraints, as well as the opportunities and problems of the study/project area. Ten measures (Table L: 8-1) were evaluated including both terrestrial and in stream features.

Table L:8-1 Ecosystem Restoration Measures Evaluated

Type	Measure ID	Description	Location	Screened (S) or Retained (R)
Grade Control	ER-1	Low Drop Structures	All streams	R
	ER-2	High Drop Structures	All Streams	S
Bank Stabilization	ER-3	Riser pipes	All streams	R
	ER-4	Lateral stabilization with stone to protection	All streams	R
	ER-5	Rip Rap	All streams	R
Terrestrial Habitat Construction	ER-6	Riparian Buffer Strips	All streams	R
	ER-7	Constructed Habitat	All streams	S
In stream maintenance	ER-8	Clearing and Snagging	Hurricane, Johnson, Horn Lake Creek	S
In stream habitat Construction	ER-9	Streambank terracing	All streams	S
	ER-10	In-line detention	Horn Lake Basin	R

The ERDC team developed a hydrogeomorphic model that utilizes physical stream attributes to assess ecosystem restoration benefits gained from the stabilization of streams. This model received a one-time model certification for the study. The Stream Condition Index or SCI model was formulated, tested, and refined to: determine existing conditions, identify problems in the watershed, prioritize of stream segments for restoration, recommend structural and non-structural restoration designs, and provide numerical assessment of alternatives for planning purposes. Using metrics to characterize the hydro-geomorphology, water quality, plant habitat and animal habitat of the stream reaches, the SCI model can show ecosystem restoration benefits gained from bank stabilization projects. An initial array of alternatives was identified utilizing bank stabilization systems identified by the ERDC geomorphology team along with riparian buffer strips of varying sizes and locations. Riparian acreages were determined using National Land Cover Data mapping within 100-m of a stream. Categories assumed to be reforestable include cultivated crops, barren land, hay/pasture, herbaceous, and shrub/scrub.

The following five ecosystem restoration alternatives were initially considered for application to each of the eleven streams for evaluation:

Alternative 1. Grade control alone
Alternative 2. Riparian restoration alone, at the maximum quantity identified by NLCD data
Alternative 3. Grade control + maximum riparian acreage restored
Alternative 4. Grade control + riparian immediately adjacent to grade control
Alternative 5. Grade control + 25% of riparian acreage available adjacent to grade control

However, after discussing alternatives 1 and 2 as a team it was determined that alternative 2-riparian restoration alone and alternative 3-maximum riparian identified by national land cover data (NLCD) would both be screened across the county. While riparian restoration alone provides a significant number of AAHUs initially the PDT determined this would not be a complete plan because channel and bank stabilization are needed in these highly incised streams and degraded streams. Likewise, maximum riparian restoration along with grade control (Alternative 3) was screened because while the land cover data illustrated this quantity land could be available for reforestation, the likelihood of acquiring this maximum amount was determined to be very low.

The cost efficiency and incremental costs were evaluated on the remaining three alternatives for each of the eleven streams using the USACE-certified IWR Planning Suite II (Version 2.0.9). With 11 streams and three alternatives per stream, this means that millions of combinations were analyzed. The tool identified only those cost-effective alternatives and those alternatives were then evaluated with the CE/ICA tool together, as well as grouped by basin.

Construction first costs (including contingency) were annualized at the FY23 federal discount rate of 2.5 percent over the 50 year period of analysis for the environmental restoration features. Interest during construction assumed a one-year construction duration using the same interest rate. Table L: 8-2 shows the cost summary, average annual costs, and benefits for each of the alternatives input into the CE/ICA model.

Table L: 8-2 Environmental Restoration Costs Annual Costs and Benefits of the Final Array of Environmental Restoration Alternatives

(2023 Price Level;$ Thousands; 2.5% Discount Rate)

Stream	Alt #	Grade Control Structures	Riparian Acres	AAHUs	Construction with Contingency	Interest During Construction	Annualized OMRR&R	Total Average Annual Cost	Average Annual Cost per AAHU
Camp Creek	CP-1	7	0	22	$3,589	$45	$27	$155	$7
	CP-4	7	47	53	$4,747	$59	$27	$196	$4
	CP-5b	7	39	48	$4,683	$58	$27	$194	$4
Horn Lake Creek	HLC-1	14	0	41	$8,760	$109	$58	$371	$9
	HLC-4	14	17	53	$8,657	$108	$58	$367	$7
	HLC-5b	14	20	55	$8,943	$111	$58	$377	$7
Johnson Creek	JC-1	11	0	18	$4,889	$61	$34	$209	$12
	JC-4	11	43	48	$6,092	$76	$34	$251	$5
	JC-5b	11	49	52	$6,092	$76	$34	$251	$5
Cane Creek	CN-1	9	0	3	$3,075	$38	$24	$134	$45
	CN-4	9	6	7	$4,063	$50	$24	$169	$24
	CN-5b	9	26	21	$3,770	$47	$24	$158	$8
Hurricane Creek	HC-1	9	0	5	$4,397	$55	$27	$184	$37
	HC-4	9	62	52	$5,901	$73	$27	$238	$5
	HC-5b	9	64	53	$5,935	$74	$27	$239	$5
Lick Creek	LC-1	3	0	3	$1,319	$16	$16	$63	$21
	LC-4	3	11	8	$1,716	$21	$16	$77	$10
	LC-5b	3	14	10	$1,748	$22	$16	$78	$8
Mussacana Creek	MC-1	3	0	3	$1,706	$21	$17	$78	$26
	MC-4	3	9	9	$2,334	$29	$17	$101	$11
	MC-5b	3	23	16	$2,333	$29	$17	$101	$6
Nonconnah Creek	NoN-1	7	0	1	$2,124	$26	$19	$95	$95
	NoN-4	7	5	5	$2,674	$33	$19	$115	$23
	NoN-5b	7	20	12	$2,682	$33	$19	$115	$10
Nolehoe Creek	NL-1	11	0	26	$4,711	$59	$32	$200	$8
	NL-4	11	18	38	$5,224	$65	$32	$219	$6
	NL-5b	11	13	35	$5,167	$64	$32	$217	$6
Short Fork	SF-1	9	0	5	$2,549	$32	$24	$115	$23
	SF-4	9	12	14	$3,122	$39	$24	$136	$10
	SF-5b	9	42	34	$3,598	$45	$24	$153	$4
Red Banks	RB-1	5	0	9	$2,446	$30	$27	$114	$13
	RB-4	5	24	25	$3,090	$38	$27	$137	$5
	RB-5b	5	19	21	$2,677	$33	$27	$122	$6

Addendum B contains amortization tables with more specific details on the schedule of Operations, Maintenance, Relocations, Rehabilitation, and Repair (OMRR&R) costs associated with each of the streams.

8.3 RESULTS

There are 33 different independent alternatives, where each one could be combined with each other, or a combination of each other creeks to form millions of potential plans. Within the CE/ICA model, the option was selected to only compute alternatives that the model has determined as being cost effective in order to save computation time.

The CE/ICA model was set up and ran in the following formats:

1) Each creek is an individual alternative
2) Each basin is an individual alternative
3) The county is an individual alternative

The PDT decided that the most detailed and informative model set up was running as a county, meaning every creek had an opportunity to join with other creeks to form the most cost-effective plan. During this set up, a constraint was added so that the combined cost-effective plan could not have multiple alternatives within the same creek. In this setup, if a creek did not have any individual cost-effective runs, it would not show up in the Cost Effective or Best Buy results since it was not a requirement that all creeks be included in the final plan.

The resulting CE/ICA model simulation found 13 best buy plans and 179 cost effective plans. Once the plans are identified, the model uses incremental costing. Incremental cost is the additional cost incurred by selecting one alternative over another and is computed by subtracting the cost of one alternative from another. The Best Buy plans are the plans that provide the greatest increase in output for the increase in cost. Figure L:8-2 shows the CE/ICA cartesian plot that shows the incremental increase in costs and benefits as additional creeks are added to the plan.

Federal planning for water resources development is conducted in accordance with the requirements of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The P&G provides a decision rule for selecting a Recommended Plan where both outputs and costs are featured in dollars. This rule states: “The alternative plan with the greatest net economic benefit consistent with protecting the Nation’s environment (National Economic Development Plan, NED Plan) is to be selected… (Paragraph 1.10.2)”. There is no similar rule for plan selection where the outputs are not featured in dollars, as is the case in planning for ecosystem restoration. In the absences of such a decision-making rule, cost-effectiveness and incremental cost analysis helps to better understand the consequences of the preferred plan in relation to other choices.

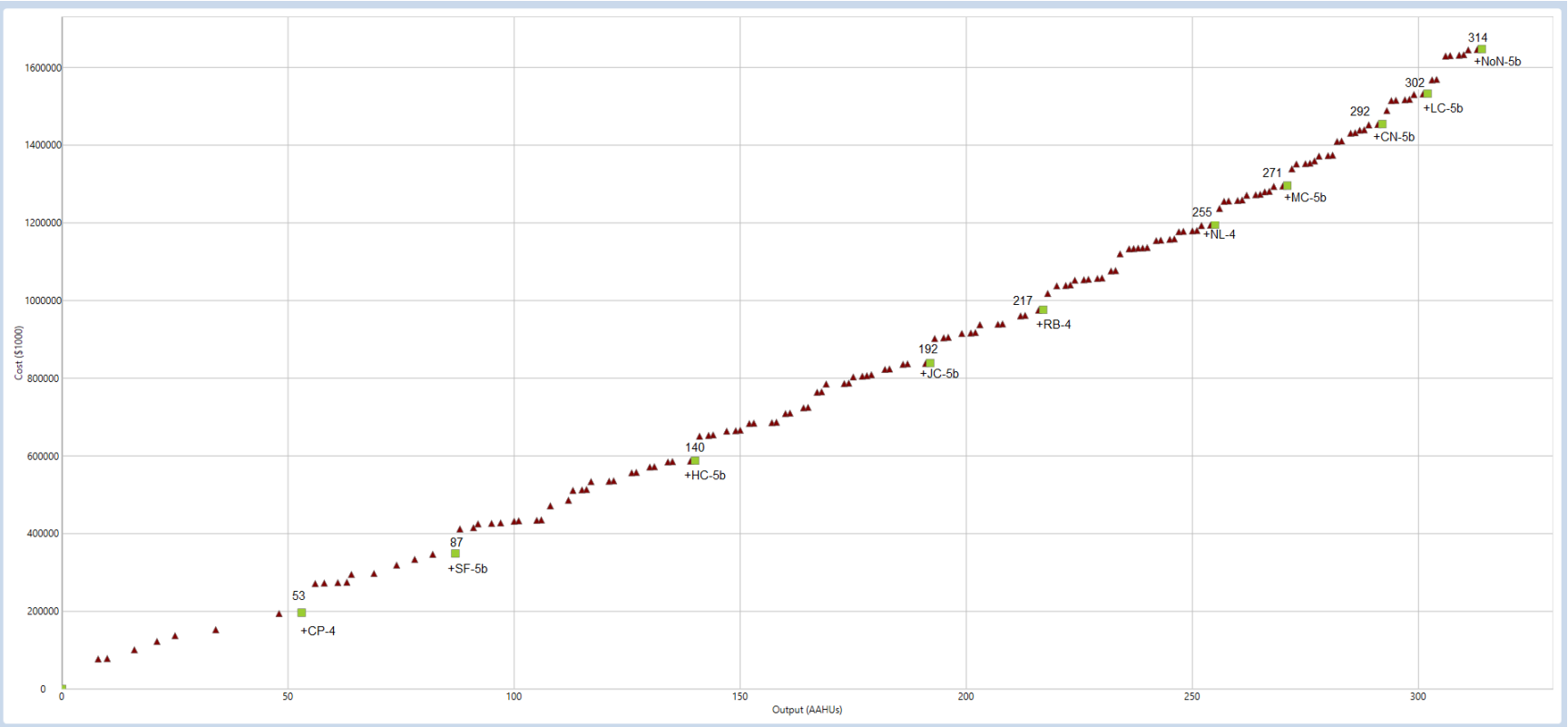


Figure L:8-2 North DeSoto CEICA Cartesian Plot

8.4 INCREMENTAL COST ANALYSIS CONCLUSIONS & RECOMMENDED PLAN

The Best Buy alternatives presented provide the information necessary to make well-informed decisions regarding desired project scale. Progressing through the increasing levels of output for the alternatives in Table L: 8-3 helps determine whether the increase in Net AAHUs is worth the additional cost. Additional information surrounding levels of output can be found in the Environmental appendix (Appendix A). As long as decision makers consider a level of output to be "worth it", subsequent levels of output are considered. When a level of output is determined to be "not worth it", subsequent levels of output will likely be "not worth it", and the final decision regarding desired project scale for environmental restoration planning will have been reached. The PDT recommends selecting the Best Buy alternative for ten of the eleven creeks to form the NER Plan, which carries an average annual cost of $1.6 million.

Table L: 8-3 North DeSoto CE/ICA Summary of Best Buy Plans
(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Stream	Alt #	Grade Control Structures	Riparian Acres	AAHUs	Construction First Cost with Contingency	Interest During Construction	Annualized OMRR&R	Total Average Annual Cost	Average Annual Cost per AAHU
Camp Creek	CP-4	7	47	53	$4,747	$59	$27	$196	$4
Johnson Creek	JC-5b	11	49	52	$6,092	$76	$34	$251	$5
Cane Creek	CN-5b	9	26	21	$3,770	$47	$24	$158	$8
Hurricane Creek	HC-5b	9	64	53	$5,935	$74	$27	$239	$5
Lick Creek	LC-5b	3	14	10	$1,748	$22	$16	$78	$8
Mussacuna Creek	MC-5b	3	23	16	$2,333	$29	$17	$101	$6
Nonconnah Creek	NoN-5b	7	20	12	$2,682	$33	$19	$115	$10
Nolehoe Creek	NL-4	11	18	38	$5,224	$65	$32	$219	$6
Short Fork	SF-5b	9	42	34	$3,598	$45	$24	$153	$4
Red Banks	RB-4	5	24	25	$3,090	$38	$27	$137	$5
NER Plan Total		74	327	314	$39,220	$487	$248	$1,648	$5

Source: IWR Planning Suite 2.0.9

ADDENDUM A: COST ANNUALIZATION TABLES

Table L: A0-1 Cost Annualization for Final 5a

(2022 Price Level; $ Thousands; 2.25% Discount Rate)

ALT 5A. Channel Enlargment 18.56-19.41

Calendar Year	Discounting/ Compounding Year	Structural Construction Costs: Lands and Damages	Mitigation	Relocations	Channels and Canals	Planning Engineering and Design	Construction Management	OMRR&R Costs: Mowing	Cleanout	Total	Compounded Value	Compound Factor
2024	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.105312102
2025	3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.080989831
2026	2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.057202768
2027	1.5	$419,000	$565,000	$ 475,000	$ -	$ 409,000	$ -	$ -	$ -	$ 1,868,000	$ 1,931,398	1.033939138
2028	0.5	$ -	$ -	$ -	$3,551,000	$ -	$ 409,000	$ -	$ -	$ 3,960,000	$ 4,004,302	1.011187421
2029	**-0.5**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 7,200**	**$ -**	**$ 7,200**	**$ 7,120**	**0.988936353**
2030	-1.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,964	0.967174917
2031	-2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,810	0.94589234
2032	-3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,661	0.925078083
2033	-4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,514	0.904721841
2034	-5.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,371	0.884813537
2035	-6.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,230	0.865343312
2036	-7.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 6,093	0.846301528
2037	-8.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,959	0.827678756
2038	-9.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$3,935,000	$ 3,942,200	$ 3,191,076	0.809465776
2039	-10.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,700	0.791653571
2040	-11.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,574	0.774233321
2041	-12.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,452	0.757196402
2042	-13.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,332	0.740534378
2043	-14.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,215	0.724239001
2044	-15.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 5,100	0.708302201
2045	-16.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,988	0.692716089
2046	-17.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,878	0.677472948
2047	-18.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,770	0.66256523
2048	-19.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$3,935,000	$ 3,942,200	$ 2,554,489	0.647985555
2049	-20.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,563	0.633726704
2050	-21.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,462	0.619781618
2051	-22.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,364	0.606143392
2052	-23.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,268	0.592805273
2053	-24.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,174	0.579760658
2054	-25.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 4,082	0.567003089
2055	-26.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,993	0.554526248
2056	-27.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,905	0.542323959
2057	-28.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,819	0.53039018
2058	-29.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$3,935,000	$ 3,942,200	$ 2,044,894	0.518719002
2059	-30.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,653	0.507304648
2060	-31.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,572	0.496141465
2061	-32.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,494	0.485223927
2062	-33.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,417	0.474546627
2063	-34.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,342	0.464104281
2064	-35.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,268	0.453891717
2065	-36.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,196	0.44390388
2066	-37.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,126	0.434135824
2067	-38.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 3,057	0.424582713
2068	-39.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$3,935,000	$ 3,942,200	$ 1,636,958	0.415239817
2069	-40.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,924	0.406102511
2070	-41.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,860	0.39716627
2071	-42.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,797	0.38842667
2072	-43.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,735	0.379879383
2073	-44.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,675	0.371520179
2074	-45.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,616	0.363344919
2075	-46.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,559	0.355349554
2076	-47.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,502	0.347530126
2077	-48.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$ -	$ 7,200	$ 2,447	0.339882764
2078	-49.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,200	$3,935,000	$ 3,942,200	$ 1,310,402	0.332403681

Implementation Costs	$ 5,828,000	Compounded OMRR&R Costs	$ 10,935,418
IDC	$ 107,700		
Total Construction Costs	$ 5,935,700		
Average Annual Total Construction Costs	$198,955	Average Annual OMRR&R Costs	$366,537

Table L: A0-2 Cost Annualization for Final 6a
(2022 Price Level; $ Thousands; 2.25% Discount Rate)

Alternative 6A - Cleanout 18.56 - 19.41 25 Year Plan Plus Lateral D Detention

		Structural Construction Costs							OMRR&R Costs							
Calendar Year	Discounting/ Compounding Year	Lands and Damages	Mitigation	Relocations	Channels and Canals	Floodway Control and Diversion	Planning Engineering and Design	Construction Management	Mowing	Agg Surfacing	Outlet/ Wasteway Replacement	Outlet/ Wasteway Maintenance	Cleanout	Total	Compounded Value	Compound Factor
2024	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.105312102
2025	3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.080989831
2026	2.5	$253,000	$726,000	$ 466,000	$ -	$ -	$ 1,495,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,940,000	$ 3,108,176	1.057202768
2027	1.5	$419,000	$565,000	$ 475,000	$ -	$5,007,500	$ 409,000	$ 747,500	$ -	$ -	$ -	$ -	$ -	$ 7,623,000	$ 7,881,718	1.033939138
2028	0.5	$ -	$ -	$ -	$3,551,000	$5,007,500	$ -	$ 1,156,500	$ -	$ -	$ -	$ -	$ -	$ 9,715,000	$ 9,823,686	1.011187421
2029	**-0.5**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$38,400**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 38,400**	**$ 37,975**	**0.988936353**
2030	-1.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 37,140	0.967174917
2031	-2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 36,322	0.94589234
2032	-3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 35,523	0.925078083
2033	-4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ -	$ -	$ 194,400	$ 175,878	0.904721841
2034	-5.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 33,977	0.884813537
2035	-6.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 33,229	0.865343312
2036	-7.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 32,498	0.846301528
2037	-8.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 31,783	0.827678756
2038	-9.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ 357,500	$ 6,015,000	$ 6,566,900	$ 5,315,681	0.809465776
2039	-10.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 30,399	0.791653571
2040	-11.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 29,731	0.774233321
2041	-12.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 29,076	0.757196402
2042	-13.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 28,437	0.740534378
2043	-14.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ -	$ -	$ 194,400	$ 140,792	0.724239001
2044	-15.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 27,199	0.708302201
2045	-16.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 26,600	0.692716089
2046	-17.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 26,015	0.677472948
2047	-18.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 25,443	0.66256523
2048	-19.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ 357,500	$ 6,015,000	$ 6,566,900	$ 4,255,256	0.647985555
2049	-20.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 24,335	0.633726704
2050	-21.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 23,800	0.619781618
2051	-22.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 23,276	0.606143392
2052	-23.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 22,764	0.592805273
2053	-24.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ -	$ -	$ 194,400	$ 112,705	0.579760658
2054	-25.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 21,773	0.567003089
2055	-26.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 21,294	0.554526248
2056	-27.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 20,825	0.542323959
2057	-28.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 20,367	0.53039018
2058	-29.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ 357,500	$ 6,015,000	$ 6,566,900	$ 3,406,376	0.518719002
2059	-30.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 19,480	0.507304648
2060	-31.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 19,052	0.496141465
2061	-32.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 18,633	0.485223927
2062	-33.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 18,223	0.474546627
2063	-34.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ -	$ -	$ 194,400	$ 90,222	0.464104281
2064	-35.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 17,429	0.453891717
2065	-36.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 17,046	0.44390388
2066	-37.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 16,671	0.434135824
2067	-38.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 16,304	0.424582713
2068	-39.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ 357,500	$ 6,015,000	$ 6,566,900	$ 2,726,838	0.415239817
2069	-40.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 15,594	0.406102511
2070	-41.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 15,251	0.39716627
2071	-42.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 14,916	0.38842667
2072	-43.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 14,587	0.379879383
2073	-44.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ -	$ -	$ -	$ 194,400	$ 72,224	0.371520179
2074	-45.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 13,952	0.363344919
2075	-46.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 13,645	0.355349554
2076	-47.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 13,345	0.347530126
2077	-48.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$ -	$ -	$ -	$ -	$ 38,400	$ 13,051	0.339882764
2078	-49.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$38,400	$156,000	$ 3,575,000	$ 357,500	$ 6,015,000	$10,141,900	$ 3,371,205	0.332403681

Implementation Costs	$ 20,278,000	Compounded OMRR&R Costs	$ 20,604,137
IDC	$ 535,580		
Total Construction Costs	$ 20,813,580		
Average Annual Total Construction Costs	$697,637	Average Annual OMRR&R Costs	$690,617

Table L:A0-3 Cost Annualization for Final 7
(2022 Price Level; $ Thousands; 2.25% Discount Rate)

ALT 7. 3 Detention Sites + Extended Horn Lake Channel Enlargment 18.56 - 19.41 Revision III

		Structural Construction Costs							OMRR&R Costs							
Calendar Year	Discounting/ Compounding Year	Lands and Damages	Mitigation	Relocations	Channels and Canals	Floodway Control and Diversion	Planning Engineering and Design	Construction Management	Mowing	Agg Surfacing	Outlet/ Wasteway Replacement	Outlet/ Wasteway Maintenance	Cleanout	Total	Compounded Value	Compound Factor
2024	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.105312102
2025	3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.080989831
2026	2.5	$827,000	$1,144,000	$1,711,000	$ -	$ -	$ 5,761,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,443,000	$ 9,983,166	1.057202768
2027	1.5	$419,000	$ 565,000	$ 475,000	$ -	$19,609,500	$ 409,000	$ 2,880,500	$ -	$ -	$ -	$ -	$ -	$24,358,000	$ 25,184,690	1.033939138
2028	0.5	$ -	$ -	$ -	$3,551,000	$19,609,500	$ -	$ 3,289,500	$ -	$ -	$ -	$ -	$ -	$26,450,000	$ 26,745,907	1.011187421
2029	**-0.5**	**$ -**	$ -	$ -	$ -	$ -	**$ -**	**$ -**	**$92,025**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 92,025**	**$ 91,007**	**0.988936353**
2030	-1.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 89,004	0.967174917
2031	-2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 87,046	0.94589234
2032	-3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 85,130	0.925078083
2033	-4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ -	$ -	$ 625,025	$ 565,474	0.904721841
2034	-5.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 81,425	0.884813537
2035	-6.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 79,633	0.865343312
2036	-7.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 77,881	0.846301528
2037	-8.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 76,167	0.827678756
2038	-9.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ 1,560,000	$ 9,200,000	$11,385,025	$ 9,215,788	0.809465776
2039	-10.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 72,852	0.791653571
2040	-11.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 71,249	0.774233321
2041	-12.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 69,681	0.757196402
2042	-13.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 68,148	0.740534378
2043	-14.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ -	$ -	$ 625,025	$ 452,667	0.724239001
2044	-15.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 65,182	0.708302201
2045	-16.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 63,747	0.692716089
2046	-17.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 62,344	0.677472948
2047	-18.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 60,973	0.66256523
2048	-19.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ 1,560,000	$ 9,200,000	$11,385,025	$ 7,377,332	0.647985555
2049	-20.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 58,319	0.633726704
2050	-21.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 57,035	0.619781618
2051	-22.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 55,780	0.606143392
2052	-23.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 54,553	0.592805273
2053	-24.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ -	$ -	$ 625,025	$ 362,365	0.579760658
2054	-25.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 52,178	0.567003089
2055	-26.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 51,030	0.554526248
2056	-27.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 49,907	0.542323959
2057	-28.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 48,809	0.53039018
2058	-29.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ 1,560,000	$ 9,200,000	$11,385,025	$ 5,905,629	0.518719002
2059	-30.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 46,685	0.507304648
2060	-31.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 45,657	0.496141465
2061	-32.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 44,653	0.485223927
2062	-33.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 43,670	0.474546627
2063	-34.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ -	$ -	$ 625,025	$ 290,077	0.464104281
2064	-35.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 41,769	0.453891717
2065	-36.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 40,850	0.44390388
2066	-37.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 39,951	0.434135824
2067	-38.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 39,072	0.424582713
2068	-39.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ 1,560,000	$ 9,200,000	$11,385,025	$ 4,727,516	0.415239817
2069	-40.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 37,372	0.406102511
2070	-41.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 36,549	0.39716627
2071	-42.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 35,745	0.38842667
2072	-43.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 34,958	0.379879383
2073	-44.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$ -	$ -	$ -	$ 625,025	$ 232,209	0.371520179
2074	-45.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 33,437	0.363344919
2075	-46.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 32,701	0.355349554
2076	-47.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 31,981	0.347530126
2077	-48.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$ -	$ -	$ -	$ -	$ 92,025	$ 31,278	0.339882764
2078	-49.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$92,025	$533,000	$15,600,000	$ 1,560,000	$ 9,200,000	$26,985,025	$ 8,969,922	0.332403681

Implementation Costs	$60,251,000	Compounded OMRR&R Costs	$40,344,389
IDC	$ 1,662,763		
Total Construction Costs	$61,913,763		
Average Annual Total Construction Costs	$2,075,248	Average Annual OMRR&R Costs	$1,352,278

Table L: A0-4 Cost Annualization for Final 8a

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

ALT8a - I-wall and Levee (optimization)

Calendar Year	Discounting/ Compounding Year	Structural Construction Costs: Lands and Damages	Relocations	Levees and Floodwalls	Planning Engineering and Design	Construction Management	OMRR&R Costs: Mowing	Agg Surfacing	Levee Slide	Floodwall Maintenance	Total	Compounded Value	Compound Factor
2024	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.11752538
2025	3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.09026866
2026	2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.06367674
2027	1.5	$4,884,941	$ 231,000	$ -	$ 652,535	$ -	$ -	$ -	$ -	$ -	$5,768,476	$ 5,986,140	1.03773341
2028	0.5	$ -	$ -	$4,270,000	$ -	$ 652,535	$ -	$ -	$ -	$ -	$4,922,535	$ 4,983,687	1.01242284
2029	**-0.5**	**$ -**	**$ -**	**$ -**	**$ -**	$ -	**$ 5,000**	**$ -**	**$ -**	**$ -**	**$ 5,000**	**$ 4,939**	**0.9877296**
2030	-1.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,818	0.96363863
2031	-2.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,701	0.94013525
2032	-3.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,586	0.91720512
2033	-4.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 26,845	0.89483426
2034	-5.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,365	0.87300904
2035	-6.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,259	0.85171614
2036	-7.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,155	0.83094257
2037	-8.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,053	0.81067568
2038	-9.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 164,508	0.7909031
2039	-10.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,858	0.77161278
2040	-11.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,764	0.75279296
2041	-12.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,672	0.73443215
2042	-13.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,583	0.71651918
2043	-14.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 20,971	0.6990431
2044	-15.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,410	0.68199327
2045	-16.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,327	0.66535928
2046	-17.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,246	0.64913101
2047	-18.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,166	0.63329855
2048	-19.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 128,513	0.61785224
2049	-20.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,014	0.60278267
2050	-21.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,940	0.58808066
2051	-22.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,869	0.57373723
2052	-23.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,799	0.55974363
2053	-24.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 16,383	0.54609135
2054	-25.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,664	0.53277205
2055	-26.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,599	0.51977761
2056	-27.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,536	0.50710011
2057	-28.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,474	0.49473181
2058	-29.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 100,394	0.48266518
2059	-30.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,354	0.47089286
2060	-31.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,297	0.45940767
2061	-32.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,241	0.4482026
2062	-33.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,186	0.43727083
2063	-34.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 12,798	0.42660569
2064	-35.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,081	0.41620067
2065	-36.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,030	0.40604944
2066	-37.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,981	0.39614579
2067	-38.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,932	0.3864837
2068	-39.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 78,428	0.37705727
2069	-40.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,839	0.36786075
2070	-41.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,794	0.35888854
2071	-42.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,751	0.35013516
2072	-43.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,708	0.34159528
2073	-44.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 9,998	0.33326368
2074	-45.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,626	0.3251353
2075	-46.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,586	0.31720517
2076	-47.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,547	0.30946846
2077	-48.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,510	0.30192045
2078	-49.5	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 61,268	0.29455654

Implementation Costs	$ 10,691,010	Compounded OMRR&R Costs	$ 736,365
IDC	$ 278,816		
Total Construction Costs	$ 10,969,826		
Average Annual Total Construction Costs	$386,775	Average Annual OMRR&R Costs	$25,963

Table L: A0-5 Cost Annualization for Final 8b

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

ALT 8b. I-Wall, Levee and 35 commercial structures with floodproofing

Calendar Year	Discounting/ Compounding Year	Nonstructural Costs					Structural Construction Costs					OMRR&R				Total	Compounded Value	Compound Factor
		Lands and Damages	Walking Path	Buildings, Grounds, and Utilities	Planning Engineering and Design	Construction Management	Lands and Damages	Relocations	Levees and Floodwalls	Planning Engineering and Design	Construction Management	Mowing	Agg Surfacing	Levee Slide	Floodwall Maintenance			
2024	4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.11752538
2025	3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.09026866
2026	2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1.06367674
2027	1.5	$ -	$ -	$ -	$ -	$ -	$ 4,884,941	$ 231,000	$ -	$ 652,535	$ -	$ -	$ -	$ -	$ -	$ 5,768,476	$ 5,986,140	1.03773341
2028	0.5	$ 194,059	$ -	$ -	$ 2,016,465	$ -	$ -	$ -	$ 4,270,000	$ -	$ 652,535	$ -	$ -	$ -	$ -	$ 7,133,059	$ 7,221,672	1.01242284
Q4 2028	0.125	$ -	$ -	$ 13,901,000	$ -	$ 2,016,465	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 15,917,465	$ 15,966,672	1.00309134
2029	**-0.5**	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 5,000**	**$ -**	**$ -**	**$ -**	**$ 5,000**	**$ 4,939**	**0.9877296**
2030	-1.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,818	0.96363863
2031	-2.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,701	0.94013525
2032	-3.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,586	0.91720512
2033	-4.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 26,845	0.89483426
2034	-5.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,365	0.87300904
2035	-6.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,259	0.85171614
2036	-7.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,155	0.83094257
2037	-8.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 4,053	0.81067568
2038	-9.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 164,508	0.7909031
2039	-10.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,858	0.77161278
2040	-11.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,764	0.75279296
2041	-12.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,672	0.73443215
2042	-13.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,583	0.71651918
2043	-14.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 20,971	0.6990431
2044	-15.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,410	0.68199327
2045	-16.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,327	0.66535928
2046	-17.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,246	0.64913101
2047	-18.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,166	0.63329855
2048	-19.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 128,513	0.61785224
2049	-20.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 3,014	0.60278267
2050	-21.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,940	0.58808066
2051	-22.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,869	0.57373723
2052	-23.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,799	0.55974363
2053	-24.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 16,383	0.54609135
2054	-25.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,664	0.53277205
2055	-26.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,599	0.51977761
2056	-27.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,536	0.50710011
2057	-28.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,474	0.49473181
2058	-29.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 100,394	0.48266518
2059	-30.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,354	0.47089286
2060	-31.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,297	0.45940767
2061	-32.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,241	0.4482026
2062	-33.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,186	0.43727083
2063	-34.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 12,798	0.42660569
2064	-35.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,081	0.41620067
2065	-36.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 2,030	0.40604944
2066	-37.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,981	0.39614579
2067	-38.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,932	0.3864837
2068	-39.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 78,428	0.37705727
2069	-40.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,839	0.36786075
2070	-41.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,794	0.35888854
2071	-42.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,751	0.35013516
2072	-43.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,708	0.34159528
2073	-44.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ -	$ -	$ 30,000	$ 9,998	0.33326368
2074	-45.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,626	0.3251353
2075	-46.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,586	0.31720517
2076	-47.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,547	0.30946846
2077	-48.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ 5,000	$ 1,510	0.30192045
2078	-49.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 25,000	$ 78,000	$ 100,000	$ 208,000	$ 61,268	0.29455654

Implementation Costs	$ 28,819,000	Compounded OMRR&R Costs	$ 736,365
IDC	$ 355,483		
Total Construction Costs	$ 29,174,483		
Average Annual Total Construction Costs	$1,028,636	Average Annual OMRR&R Costs	$25,963

ADDENDUM B: NER OMRR&R COST ANNUALIZATION

Table L: B0-1 Cost Annualization for Ecosystem OMRR&R for Nolehole Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,283	4,477	113,860	21,971	62,132	30,072	30,072	360,868	281,910	0.7811984
2048	-20	98,283	4,477	113,860	21,971	62,132	30,072	30,072	360,868	220,228	0.6102709
2058	-30	98,283	4,477	113,860	21,971	62,132	30,072	30,072	360,868	172,041	0.4767427
2068	-40	98,283	4,477	113,860	21,971	62,132	30,072	30,072	360,868	134,398	0.3724306
2078	-50	98,283	4,477	113,860	21,971	62,132	30,072	30,072	360,868	104,992	0.2909422

Compounded OMRR&R Costs $913,569 Average Annual OMRR&R Costs $32,211

Table L: B0-2 Cost Annualization for Ecosystem OMRR&R for Johnson Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,283	3,431	119,942	22,449	73,134	31,724	31,724	380,688	297,392	0.7811984
2048	-20	98,283	3,431	119,942	22,449	73,134	31,724	31,724	380,688	232,323	0.6102709
2058	-30	98,283	3,431	119,942	22,449	73,134	31,724	31,724	380,688	181,490	0.4767427
2068	-40	98,283	3,431	119,942	22,449	73,134	31,724	31,724	380,688	141,780	0.3724306
2078	-50	98,283	3,431	119,942	22,449	73,134	31,724	31,724	380,688	110,758	0.2909422

Compounded OMRR&R Costs $963,743 Average Annual OMRR&R Costs $33,980

Table L: B0-3 Cost Annualization for Ecosystem OMRR&R for Horn Lake Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	87,004	3,203	280,938	49,174	119,589	53,991	53,991	647,888	506,129	0.7811984
2048	-20	87,004	3,203	280,938	49,174	119,589	53,991	53,991	647,888	395,387	0.6102709
2058	-30	87,004	3,203	280,938	49,174	119,589	53,991	53,991	647,888	308,876	0.4767427
2068	-40	87,004	3,203	280,938	49,174	119,589	53,991	53,991	647,888	241,293	0.3724306
2078	-50	87,004	3,203	280,938	49,174	119,589	53,991	53,991	647,888	188,498	0.2909422

Compounded OMRR&R Costs $1,640,184 Average Annual OMRR&R Costs $57,830

Table L: B0-4 Cost Annualization for Ecosystem OMRR&R for Hurricane Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	2,969	53,478	10,692	86,077	25,122	25,122	301,460	235,500	0.7811984
2048	-20	98,000	2,969	53,478	10,692	86,077	25,122	25,122	301,460	183,972	0.6102709
2058	-30	98,000	2,969	53,478	10,692	86,077	25,122	25,122	301,460	143,719	0.4767427
2068	-40	98,000	2,969	53,478	10,692	86,077	25,122	25,122	301,460	112,273	0.3724306
2078	-50	98,000	2,969	53,478	10,692	86,077	25,122	25,122	301,460	87,707	0.2909422

Compounded OMRR&R Costs $763,171 Average Annual OMRR&R Costs $26,908

Table L: B0-5 Cost Annualization for Ecosystem OMRR&R for Camp Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	3,278	56,130	11,219	83,681	25,231	25,231	302,769	236,523	0.7811984
2048	-20	98,000	3,278	56,130	11,219	83,681	25,231	25,231	302,769	184,771	0.6102709
2058	-30	98,000	3,278	56,130	11,219	83,681	25,231	25,231	302,769	144,343	0.4767427
2068	-40	98,000	3,278	56,130	11,219	83,681	25,231	25,231	302,769	112,760	0.3724306
2078	-50	98,000	3,278	56,130	11,219	83,681	25,231	25,231	302,769	88,088	0.2909422

Compounded OMRR&R Costs $766,485 Average Annual OMRR&R Costs $27,025

Table L: B0-6 Cost Annualization for Ecosystem OMRR&R for Nonconnah Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	982	37,089	6,779	35,369	17,822	17,822	213,862	167,069	0.7811984
2048	-20	98,000	982	37,089	6,779	35,369	17,822	17,822	213,862	130,514	0.6102709
2058	-30	98,000	982	37,089	6,779	35,369	17,822	17,822	213,862	101,957	0.4767427
2068	-40	98,000	982	37,089	6,779	35,369	17,822	17,822	213,862	79,649	0.3724306
2078	-50	98,000	982	37,089	6,779	35,369	17,822	17,822	213,862	62,222	0.2909422

Compounded OMRR&R Costs $541,410 Average Annual OMRR&R Costs $19,089

Table L: B0-7 Cost Annualization for Ecosystem OMRR&R for Cane Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	1,291	47,127	8,654	68,360	22,343	22,343	268,119	209,454	0.7811984
2048	-20	98,000	1,291	47,127	8,654	68,360	22,343	22,343	268,119	163,625	0.6102709
2058	-30	98,000	1,291	47,127	8,654	68,360	22,343	22,343	268,119	127,824	0.4767427
2068	-40	98,000	1,291	47,127	8,654	68,360	22,343	22,343	268,119	99,856	0.3724306
2078	-50	98,000	1,291	47,127	8,654	68,360	22,343	22,343	268,119	78,007	0.2909422

Compounded OMRR&R Costs $678,765 Average Annual OMRR&R Costs $23,932

Table L: B0-8 Cost Annualization for Ecosystem OMRR&R for Mussacana Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	964	36,116	5,839	21,994	16,291	16,291	195,495	152,721	0.7811984
2048	-20	98,000	964	36,116	5,839	21,994	16,291	16,291	195,495	119,305	0.6102709
2058	-30	98,000	964	36,116	5,839	21,994	16,291	16,291	195,495	93,201	0.4767427
2068	-40	98,000	964	36,116	5,839	21,994	16,291	16,291	195,495	72,808	0.3724306
2078	-50	98,000	964	36,116	5,839	21,994	16,291	16,291	195,495	56,878	0.2909422

Compounded OMRR&R Costs $494,913 Average Annual OMRR&R Costs $17,450

Table L: B0-9 Cost Annualization for Ecosystem OMRR&R for Lick Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	1,133	37,315	6,878	5,731	14,906	14,906	178,868	139,731	0.7811984
2048	-20	98,000	1,133	37,315	6,878	5,731	14,906	14,906	178,868	109,158	0.6102709
2058	-30	98,000	1,133	37,315	6,878	5,731	14,906	14,906	178,868	85,274	0.4767427
2068	-40	98,000	1,133	37,315	6,878	5,731	14,906	14,906	178,868	66,616	0.3724306
2078	-50	98,000	1,133	37,315	6,878	5,731	14,906	14,906	178,868	52,040	0.2909422

Compounded OMRR&R Costs $452,819 Average Annual OMRR&R Costs $15,966

Table L: B0-10 Cost Annualization for Ecosystem OMRR&R for Short Fork Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	1,530	64,691	11,539	49,259	22,502	22,502	270,022	210,941	0.7811984
2048	-20	98,000	1,530	64,691	11,539	49,259	22,502	22,502	270,022	164,787	0.6102709
2058	-30	98,000	1,530	64,691	11,539	49,259	22,502	22,502	270,022	128,731	0.4767427
2068	-40	98,000	1,530	64,691	11,539	49,259	22,502	22,502	270,022	100,565	0.3724306
2078	-50	98,000	1,530	64,691	11,539	49,259	22,502	22,502	270,022	78,561	0.2909422

Compounded OMRR&R Costs $683,584 Average Annual OMRR&R Costs $24,102

Table L: B0-11 Cost Annualization for Ecosystem OMRR&R for Red Bank Creek

(2023 Price Level; $ Thousands; 2.5% Discount Rate)

Calendar Year	Discounting/ Compounding Year	Mob/Demob	Riprap R600	Riprap R200	Bedding Stone	Clearning and Grubbing	E&D	S&A	Total	Compounded Value	Compound Factor
2028	0.5	-	-	-	-	-	-	-	-	-	1.0124228
2029	**-1**	-	-	-	-	-	-	-	-	-	0.9756098
2038	-10	98,000	2,170	51,280	9,762	89,439	25,065	25,065	300,781	234,970	0.7811984
2048	-20	98,000	2,170	51,280	9,762	89,439	25,065	25,065	300,781	183,558	0.6102709
2058	-30	98,000	2,170	51,280	9,762	89,439	25,065	25,065	300,781	143,395	0.4767427
2068	-40	98,000	2,170	51,280	9,762	89,439	25,065	25,065	300,781	112,020	0.3724306
2078	-50	98,000	2,170	51,280	9,762	89,439	25,065	25,065	300,781	87,510	0.2909422

Compounded OMRR&R Costs $761,454 Average Annual OMRR&R Costs $26,847