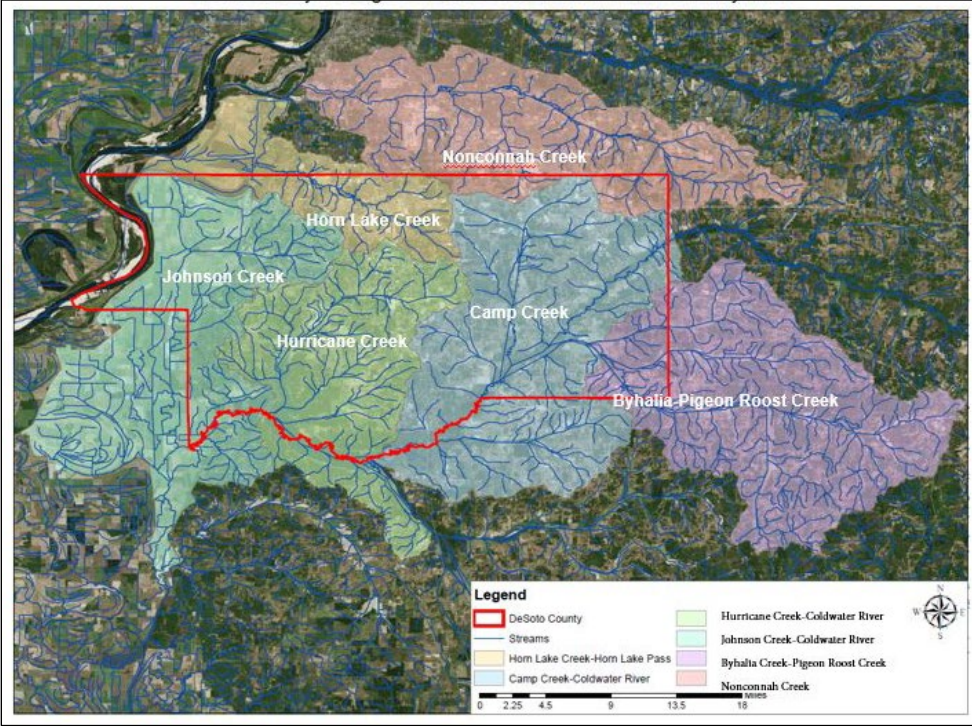


# Memphis Metropolitan Stormwater – North DeSoto County Feasibility Study, DeSoto County, Mississippi



## Appendix J-Cost

MAY 2022

## **J.1 Cost Analysis – Flood Control**

### **J.1.1 Measures**

The PDT developed measures for the Horn lake-Desoto project. A measure is a feature or activity that can be implemented at a specific geographic site that is intended to cause a desirable change and results, preferably, in a positive output. Costs and benefits were applied to each measure to produce a cost – benefit ratio, to inform the decision-making process. Costs included Real Estate, Relocations, Construction, Engineering and Design (E&D), and Supervision and Administration (S&A). The benefits were interpreted as the cost benefit to the community based on the level of protection received from the implemented measures or plan alternatives. These cost benefits for example, could be interpreted as an un-allowed loss of business and reduced insurance premiums. Once the measures had been screened on constructability or benefit, they could be combined to produce the alternative solutions for the project. See below for a table of the measures analyzed (Table J-1. Total Project Cost Summary – Measures 1-22).

### **J.1.2 Cost Benefit Ratio**

In general, each measure is weighted on a cost-benefit methodology. As outlined in this report, the benefits are reflective of the advantages of protecting the community from flood damage. This term is given benefits. The other side to the cost-benefit ratio is the costs associated with each plan or alternative. These costs are Total Project Costs (TPC) including Real Estate, Relocations, Construction, PED (Planning, Engineering, and Design), and S&A (Supervision and Administration). Comparison and ranking ultimately provides an array of alternatives that, for their cost, provide the best return in benefit to the community or study area.

### **J.1.3 Cost Methodology**

For this study, the design engineers take each measure and prepare a preliminary design for that measure which includes the necessary quantities from which a construction cost can be formulated. The quantities derived for each of the 22 measures are shown in Table J-2, Table J-3, Table J-4, and Table J-5 below. Generally, in a measure analysis phase, the cost estimator simply uses a parametric or unit cost type estimate for deriving costs. The costs for each measure were loaded into an excel spreadsheet which highlighted the costs separated by a code of accounts. This excel spreadsheet is referred to as the TPCS or Total Project Cost Spreadsheet.

The economist then took the measures and ran the cost benefits so that the optimum measures could be selected. Once these measures were selected, the PDT could combine the measures in a way to produce alternative plan solutions for the project.

These alternatives (See Table J-6 through J-18) would again be costed and analyzed with an eye towards producing the best alternative plan for the project with the most benefit to the community or study areas. This plan is called the Tentatively Selected Plan (TSP) (See Table J-18. Alternative 8).

For this study, MII software was used to formulate a detailed cost estimate format. The cost estimator used the current or latest versions of the cost book (2016 MII English Cost Book), equipment manual (2020 Equipment R03\_Rev3.mle), and labor library (2021 National Labor Library - Seattle 2021.mll) to estimate the project. Within the software the cost estimator built each bid schedule of quantities and proceeded to formulate costs. There are 4 subgroups to the direct cost formulation for each bid item. They include labor, equipment, materials, and subcontracting. Labor rates were derived from Davis Bacon wage rates provided at <http://www.wdol.gov/dba.aspx>. Equipment was selected based on experience, preference, and crew makeup. Within the MII software there is an RS Means Database from which equipment can be selected. Every couple of years these databases for labor and equipment are reevaluated and indexed to the current year. Material prices were provided by local suppliers within the Desoto County or Greater Memphis area. The equipment manual is divided based on region. The region that the study area is included in is Region III. In order to populate costs within the project; labor, equipment and material are combined into crews. These crews then have production rates applied to them based on the estimator's knowledge and experience. Once the materials and crews are tied to the quantities, they produce a cost for which gives you a direct cost for the group of quantities. For this job, the acquisition approach assumed there would be subcontracting of various elements of the project such as concrete and turfing. The Prime Contractor would construct the remaining items.

The remaining costs for each alternative are considered indirect costs. Indirect costs are the costs that are not specifically associated with one item of work but multiple items of work. These items include job office overhead, home office overhead, bond, and profit. These items are distributed as a % over the construction items. Job office overhead is generally found to range between 5-10% in the U.S. but it can be more based on the project itself. Home office generally ranges between 7-15% but can also be more based on accounting practices or a company's way of doing business. Bond generally ranges from 1-2% and profit can range from 3% and up based on competition. For our purposes, we chose a 10% profit which was applied to each alternative. The job office overhead costs were based on a project schedule modeled using Primavera Software.

Once the construction costs were formulated, they were entered into the Total Project Cost Summary spreadsheet (TPCS). The TPCS for each alternative includes all the costs that would be incurred on the project which for this project include: Lands and Damages or Real Estate Costs, Utility Relocations, Construction Costs, Planning,

Engineering and Design, and Supervision and Administration. Feasibility costs are not included in the Planning portion of the TPCS. These items are broken out by chart of accounts as follows:

- 01 – Lands and Damages
- 02 – Relocations
- 06 – Fish and Wildlife Facilities
- 09 – Channel & Canals
- 11 – Levees and Floodwalls
- 15 – Flood Control & Diversion Structures
- 16 – Bank Stabilization
- 18 – Cultural Resources
- 30 – Planning, E&D
- 31 – Supervision and Administration

#### **J.1.4 Risk Analysis**

For alternative selection on this study, the Corps of Engineers does require a Contingency Cost Based Risk Analysis. For the evaluation of the alternatives the Cost Engineer can use the abbreviated version of the Cost Risk Analysis spreadsheet to capture risk or calculate contingency for the alternatives.

Once the TPCS is chosen, the Corps of Engineers can use the abbreviated cost risk analysis for studies less than \$40,000,000 or the non-abbreviated risk analysis for studies of value greater than \$40,000,000. Because the TPCS for this study will be greater than \$40,000,000, the non-abbreviated risk analysis will be used to capture risk or contingency for the final selected plan. On March 27, 2020, the PDT held a meeting to discuss the risks associated with each of the 6 different alternatives for this project, Table J-6 through J-16 below. On March 2, 2022, the PDT held a meeting to discuss the risks associated with Alternative 7C, I-wall and Levee for this project. Table J-19 below.

The risk analysis spreadsheet defines the risk of each bid item by the likelihood of project scope growth, acquisition strategy, construction elements, and quantities for current scope, specialty fabrication of equipment, cost estimate assumptions, and external project risks. During the course of the meeting, the Cost Engineer reviewed with the PDT the risk for each of these elements as they pertain to each bid item. The PDT decided the likelihood that each of these elements could impact that bid item or vary from what was assumed in the design process. The PDT went through each item and decided whether the likelihood that each element would vary was Very Likely, Likely, Possible, or Unlikely. Likewise, the PDT determined the impact of this likelihood as either negligible, marginal, significant, critical, or crisis. Using this matrix, the

spreadsheet is designed to formulate a risk for each bid item which culminates into an overall risk or contingency for that alternative.

The final costs for each respective alternative are summarized in Table J-6 through J-16 below. These tables also show the risk contingencies developed for the features of work in the PDT's March meeting.

### J.1.5 O&M Costs

In addition to current working costs, (O&M) or Operations and Maintenance costs are needed to determine the economic costs to the life cycle of a project. These costs or future costs are used in determining the cost – benefit ratio to the project. Those costs are calculated for the life of the project and indexed forward to the life year cycle of each alternative measure. These costs can be seen in current year dollars in Table J-20 below.

**Table J-1 Total Project Cost Summary – Measure 1-22**

<b>Measures</b>	<b>Total Project Cost (TPCS)</b>
I– 100 Acre Detention Basin	\$78,198,500
II – 100 Acre Detention Basin + 2005 10 YR Plan	\$99,057,968
III – 100 Acre Detention Basin + 2005 25 YR Plan	\$100,973,128
IV – 2005 10YR Plan	\$20,267,468
V – 2005 25YR Plan	\$21,193,628
VI –Basin Wide Bermless Design	\$76,106,500
VII – Not Used	N/A
VIII – Cowpen Creek Detention	\$12,643,108
IX – Rock Creek Detention	\$15,032,387
X – Horn Lake Detention at Elmore	\$39,374,500
XI – Lateral D Detention	\$11,057,500
XII – Revised Cowpen	Eliminated by Design
XIII – Horn Lake detention at Goodman	Eliminated by Design
XIV – Bullfrog Corner Detention	\$21,627,368
XV – Rocky Creek Levee I	\$4,707,612
XVI – Rocky Creek Levee II	\$8,993,560
XVII – HLC Levee Airways/Elmore	\$4,097,627
XVIII – HLC Levee II @ Goodman	\$14,735,060
XIX – Clearing & Channel Cleanout 19.41 -19.82	\$30,020,628
XX – Clearing & Cleanout 18.86 – 19.91	\$11,112,468
XXI – Drainage Ditch Levee	\$1,174,418
XXII – Cleanout 18.56 – 19.41	\$7,998,258

**Table J-2. Table of Quantities for Measures 1-6**

Items of Work	Units	I	II	III	IV	V	VI
Mob/Demob	LS	1	4	4	3	3	1
Environmental Protection	Job	1	1	1			1
Clearing and Grubbing	AC	152.1	177.1	177.1	25	25	152.1
SWPPP	EA	1	1	1			1
Concrete Vehicle Washdown Rack	EA	1	1	1			1
Silt Fence	LF	12,000	12,000	12,000			12,000
Construction Exit	EA	2	2	2			2
Outlet Structure	EA	1	1	1			8
Wasteway/Emergency Overflow	EA	1	2	2			1
Excavation	BCY		192,432	228,006	121,332	228,006	2,129,241
Embankment	BCY	13,520	18,910	18,910	5,390	5,390	74,388.9
Establishment of Turf	Acres	152.10	183.1	184.10	31	32	100
Agg. Surfacing	TON	5040	5040	5040			4433.33
Geotextile	SF	20,000	20,000	20,000			20,000
Filter Material	TON	600	9,340	9,390	8,740	8,790	1,955.56
R400 Riprap	TON	2235	2235	2235			7,822.22
Sewage Lagoon Outlet Structure	EA		1	1			
Tree Planting	EA		53	53	53	53	
Clearing	ST		102	102	102	102	
Haul off Excavation	CY	2,612,986	2,733,351	2,768,568	120,365	155,582	
Pervious backfill	TON		9836	9836	9836	9836	
Backfill	CY		65,451	65,808	64,451	65,808	
Gravel	Ton		4,957	6,268	4,957	6,268	
Maintenance and Diversion of Stormwater	EA		2	2	2	2	
Sheet Piling	SF		18,000	18,000	18,000	18,000	
Concrete	CY		11,954	12,586	11,954	12,586	
R650	Ton		33,025	33,275	33,085	33,275	
Turf Mat GeoSolutions	SY		21,800	21,800	21,800	21,800	
Traffic Control	EA		1	1	1	1	
Security Fence	LF	12,000	12,000	12,000			13,300

**Table J-3. Table of Quantities for Measures 7-12**

Items of Work	Units	VII	VIII	IX	X	XI	XII
Mob/Demob	LS		1	1	1	1	
Environmental Protection	Job		1	1	1	1	
Clearing and Grubbing	AC		22.2	10	142	22	
SWPPP	EA		1	1	1	1	
Concrete Vehicle Washdown Rack	EA		1	1	1	1	
Silt Fence	LF		5,500	6,500	12,000	4000	
Construction Exit	EA		4	2	2	2	
Outlet Structure	EA		4	6	8	2	
Wasteway/Emergency Overflow	EA		1	2	1	1	
Excavation	BCY		286,869	131,795.6	1,290,000	335,066.7	
Embankment	BCY		20,981	11,444.44	74,389	11,444.44	
Establishment of Turf	Acres		22.2	10	142	22	
Agg. Surfacing	TON		1,833	1,266.67	4,433	1,800	
Geotextile	SF		52,371	36,200	200,400	51,428	
Filter Material	TON		1172	1,467	1,956	488	
R400 Riprap	TON		4688	5,867	7,822	1,956	
Sewage Lagoon Outlet Structure	EA						
Tree Planting	EA						
Clearing	ST						
Haul off Excavation	CY				1,290,000	335,066.7	
Pervious backfill	TON						
Backfill	CY						
Gravel	Ton						
Maintenance and Diversion of Stormwater	EA						
Sheet Piling	SF						
Concrete	CY						
R650	Ton						
Turf Mat GeoSolutions	SY						
Traffic Control	EA						
Security Fence	LF		5,500	3,800	13,300	5,400	
Grout	CY				267	67	

**Table J-4. Table of Quantities for Measures 13-18**

Items of Work	Units	XIII	XIV	XV	XVI	XVII	XVIII
Mob/Demob	LS	1	1	1	1	1	1
Environmental Protection	Job	1	1	1	1	1	1
Clearing and Grubbing	AC	10	67.1	2	4.07	5	10
SWPPP	EA	1	1	1	1	1	1
Concrete Vehicle Washdown Rack	EA		1				
Silt Fence	LF	17,248	11,860	3,426	7,100	7,826	17,248
Construction Exit	EA	2	2	2	2	2	2
Outlet Structure	EA		4				
Wasteway/Emergency Overflow	EA		1				
Excavation	BCY	51,744	860,705.20	10,278	26,766.67	23,478	51,744
Embankment	BCY	51,744	19,074.07	10,278	26,766.67	23,478	51,744
Establishment of Turf	Acres	10	63.8	2	4.07	5	10
Agg. Surfacing	TON	3,641	3,600	725	1,500	1,652	3,641
Geotextile	SF	103,488	102,857.15	20,556	42,600	46,956	103,488
Filter Material	TON		978				
R400 Riprap	TON		3911				
Sewage Lagoon Outlet Structure	EA						
Tree Planting	EA						
Clearing	ST						
Haul off Excavation	CY		860,705.20				
Pervious backfill	TON						
Backfill	CY						
Gravel	Ton						
Maintenance and Diversion of Stormwater	EA						
Sheet Piling	SF						
Concrete	CY						
R650	Ton						
Turf Mat GeoSolutions	SY						
Traffic Control	EA						
Security Fence	LF	17,248	11,300	3,526	4,834	7,926	17,348
Grout	CY		133.33				
Pump	EA			3(150 cfs)	3(500 cfs)	3(60 cfs)	3(950cfs)



**Table J-5. Table of Quantities for Measures 19-22**

Items of Work	Units	XIX	XX	XI	XXII	XXIII	
Mob/Demob	LS	1	3	1	1	1	
Environmental Protection	Job	1	1	1		1	
Clearing and Grubbing	AC			3		1	
SWPPP	EA			1		1	
Concrete Vehicle Washdown Rack	EA						
Silt Fence	LF			3,080		4,000	
Construction Exit	EA			2		1	
Outlet Structure	EA						
Wasteway/Emergency Overflow	EA						
Excavation	BCY	99,210	212,510	12,000	147,500	7,500	
Embankment	BCY			12,000		7,500	
Establishment of Turf	Acres	8	22	3	19	4	
Agg. Surfacing	TON					200	
Geotextile	SF					20,000	
Filter Material	TON		7,410		9,500		
R400 Riprap	TON						
Sewage Lagoon Outlet Structure	EA						
Tree Planting	EA						
Clearing	ST	22	56		45		
Haul off Excavation	CY	33,402	146,702		147,500		
Pervious backfill	TON	9,836	9,836				
Backfill	CY	65,808	65,808				
Gravel	Ton						
Maintenance and Diversion of Stormwater	EA						
Sheet Piling	SF						
R650	Ton		27,650		35,300		
Turf Mat GeoSolutions	SY		21,800		29,200		
Traffic Control	EA						
Security Fence	LF			3,220		1,000	
Grout	CY						
Asphalt Removal	SY			4,000		3,000	
Asphalt New	TN					500	

**Table J-6. Alternative 1A – 3 Detention Sites (Cowpen, Lateral D, Rocky Creek)**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$752,000.00	\$75,200.00	10.00%	\$827,200.00
01 Mitigation	\$1,040,000.00	\$104,000.00	10.00%	\$1,144,000.00
02 Relocations	\$1,069,100.00	\$224,000.00	20.95%	\$1,293,100.00
15 Floodway Control and Diversion	\$21,384,000.00	\$ 8,423,000.00	39.39%	\$29,807,000.00
30 Planning Engineering and Design	\$ 3,368,000.00	\$ 300,000.00	8.91%	\$3,668,000.00
31 Construction Management	\$ 3,368,000.00	\$1,345,000.00	39.93%	\$4,713,000.00
<b>Totals</b>	<b>\$30,981,100.00</b>	<b>\$10,471,200.00</b>	<b>33.8%</b>	<b>\$41,452,300.00</b>

**Table J-7. Alternative 1B. Three detention sites (Cow Pen, Lateral D and Rocky) plus 25 year non-structural**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$752,000.00	\$75,200.00	10.00%	\$827,200.00
01 Mitigation	\$ 1,040,000.00	\$104,000.00	10.00%	\$1,144,000.00
01 25 Year Non-Structural	\$21,700,370.06	\$9,437,490.94	43.49%	\$31,137,861.00
02 Relocations	\$1,069,100.00	\$224,000.00	20.95%	\$1,293,100.00
15 Floodway Control and Diversion	\$21,384,000.00	\$8,423,000.00	39.39%	\$29,807,000.00
30 Planning Engineering and Design	\$ 3,368,000.00	\$300,000.00	8.91%	\$3,668,000.00
31 Construction Management	\$3,368,000.00	\$1,345,000.00	39.93%	\$4,713,000.00
<b>Totals</b>	<b>\$52,681,470.06</b>	<b>\$19,908,690.94</b>	<b>37.79%</b>	<b>\$72,590,161.00</b>

**Table J-8. Alternative 2A. Three detention sites (Cow Pen, Lateral D, and Rocky) plus Horn Lake Creek Channel Enlargement 18.86-19.41**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$999,000.00	\$96,878.00	10.00%	\$1,098,878.20
01 Mitigation	\$1,372,000.00	\$137,247.00	10.00%	\$1,509,247.03
02 Relocations	\$1,314,053.00	\$317,000.00	24.12%	\$1,631,000.00
09 Channels and Canals	\$2,708,000.00	\$894,000.00	33.01%	\$3,602,000.00
15 Floodway Control and Diversion	\$21,384,000.00	\$8,423,000.00	39.39%	\$29,807,000.00
30 Planning Engineering and Design	\$3,664,000.00	\$321,000.00	8.76%	\$3,985,000.00
31 Construction Management	\$3,663,000.00	\$ 1,394,000.00	38.06%	\$5,057,000.00
<b>Totals</b>	<b>\$35,104,052.91</b>	<b>\$11,586,125.23</b>	<b>33.01%</b>	<b>\$46,690,125.23</b>

**Table J-9. Alternative 3A – Channel Enlargement (18.86-19.41)**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$246,782.04	\$24,678.00	10.00%	\$271,460.24
01 Mitigation	\$332,470.25	\$33,247.00	10.00%	\$365,717.28
02 Relocations	\$244,952.91	\$93,000.00	37.97%	\$337,952.91
09 Channels and Canals	\$2,708,000.00	\$894,000.00	33.01%	\$3,602,000.00
30 Planning Engineering and Design	\$295,295.29	\$21,000.00	7.11%	\$316,295.29
31 Construction Management	\$295,295.29	\$49,000.00	16.59%	\$344,295.29
<b>Totals</b>	<b>\$4,122,795.78</b>	<b>\$1,114,925.23</b>	<b>27.04%</b>	<b>\$5,237,721.01</b>

**Table J-10. Alternative 3B. Horn Lake Creek Channel Enlargement 18.86-19.41(25 Year Plan) plus 25 year non-structural**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$246,782.04	\$24,678.00	10.00%	\$271,460.24
01 Mitigation	\$332,470.25	\$33,247.00	10.00%	\$365,717.28
01 50 Year Non-Structural	\$24,158,918.39	\$10,506,713.61	43.49%	\$34,665,632.00
02 Relocations	\$244,952.91	\$93,000.00	37.97%	\$337,952.91
09 Channels and Canals	\$2,708,000.00	\$894,000.00	33.01%	\$3,602,000.00
30 Planning Engineering and Design	\$295,295.29	\$21,000.00	7.11%	\$316,295.29
31 Construction Management	\$295,295.29	\$49,000.00	16.59%	\$316,295.29
<b>Totals</b>	<b>\$28,281,714.17</b>	<b>\$11,621,638.84</b>	<b>41.09%</b>	<b>\$39,903,353.01</b>

**Table J-11. Alternative 4A – 25 YR Non-Structural Aggregate**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 25 Year Non-Structural	\$44,563,607.92	\$19,380,713.08	43.49%	\$63,944,321.00
<b>Totals</b>	<b>\$44,563,607.92</b>	<b>\$19,380,713.08</b>	<b>43.49%</b>	<b>\$63,944,321.00</b>

**Table J-12. Alternative 4B – 50 YR Non-Structural Aggregate**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 50 Year Non-Structural	\$62,141,583.39	\$27,025,374.61	43.49%	\$89,166,958.00
<b>Totals</b>	<b>\$62,141,583.39</b>	<b>\$27,025,374.61</b>	<b>43.49%</b>	<b>\$89,166,958.00</b>

**Table J-13. Alternative 5A. Horn Lake Creek Channel Enlargement 18.56-19.41**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$381,000.00	\$38,139.00	10.00%	\$419,139.00
01 Mitigation	\$514,000.00	\$51,382.00	10.00%	\$565,382.00
02 Relocations	\$378,564.00	\$143,000.00	37.70%	\$522,000.00
09 Channels and Canals	\$ 4,199,000.00	\$1,329,000.00	31.65%	\$5,528,000.00
30 Planning Engineering and Design	\$458,000.00	\$32,000.00	6.99%	\$490,000.00
31 Construction Management	\$458,000.00	\$76,000.00	16.59%	\$534,000.00
<b>Totals</b>	<b>\$6,388,563.58</b>	<b>\$1,669,520.81</b>	<b>26.13%</b>	<b>\$8,058,520.81</b>

**Table J-14. Alternative 5B. Horn Lake Creek Channel Enlargement 18.56-19.41(25 Year Plan) plus 25 year non-structural**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$381,000.00	\$38,139.00	10.00%	\$ 399,550.85
01 Mitigation	\$514,000.00	\$51,382.00	10.00%	\$ 538,285.02
01 25 Year Non-Structural	\$32,653,110.32	\$ 14,200,838.00	43.49%	\$ 46,853,948.00
02 Relocations	\$371,353.00	\$143,000.00	38.51%	\$ 522,000.00
09 Channels and Canals	\$ 4,199,000.00	\$1,329,000.00	31.65%	\$ 5,528,000.00
30 Planning Engineering and Design	\$458,000.00	\$32,000.00	6.99%	\$ 490,000.00
31 Construction Management	\$458,000.00	\$76,000.00	16.59%	\$ 534,000.00
<b>Totals</b>	<b>\$39,034,463.32</b>	<b>\$15,870,358.49</b>	<b>40.95%</b>	<b>\$54,912,468.81</b>

**Table J-15. Alternative 6A. Horn Lake Creek Channel Enlargement 18.56-19.41 Plus Lateral D Detention**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$ 611,390.42	\$61,139.00	10.00%	\$ 672,529.46
01 Mitigation	\$1,173,817.65	\$117,382.00	10.00%	\$1,291,199.42
02 Relocations	\$669,863.58	\$204,000.00	30.45%	\$873,863.58
09 Channels and Canals	\$ 4,199,000.00	\$ 1,329,000.00	31.65%	\$5,528,000.00
15 Floodway Control and Diversion	\$ 5,826,000.00	\$ 2,004,000.00	34.40%	\$7,830,000.00
30 Planning Engineering and Design	\$ 1,332,000.00	\$ 110,000.00	8.26%	\$1,442,000.00
31 Construction Management	\$1,332,000.00	\$425,000.00	31.91%	\$1,757,000.00
<b>Totals</b>	<b>\$15,144,071.65</b>	<b>\$4,250,520.51</b>	<b>28.07%</b>	<b>\$19,394,592.46</b>

**Table J-16. Alternative 6B. Horn Lake Creek Channel Enlargement 18.56-19.41 Plus Lateral D Detention Plus 25 year non-structural**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$ 611,390.42	\$61,139.00	10.00%	\$ 672,529.46
01 Mitigation	\$1,173,817.65	\$117,382.00	10.00%	\$1,291,199.42
01 25 Year Non-Structural	\$21,959,369.29	\$9,550,130.00	43.49%	\$ 31,509,499.00
02 Relocations	\$669,863.58	\$204,000.00	30.45%	\$873,863.58
09 Channels and Canals	\$ 4,199,000.00	\$ 1,329,000.00	31.65%	\$5,528,000.00
15 Floodway Control and Diversion	\$ 5,826,000.00	\$ 2,004,000.00	34.40%	\$7,830,000.00
30 Planning Engineering and Design	\$ 1,332,000.00	\$ 110,000.00	8.26%	\$1,442,000.00
31 Construction Management	\$1,332,000.00	\$425,000.00	31.91%	\$1,757,000.00
<b>Totals</b>	<b>\$37,103,440.94</b>	<b>\$13,800,650.51</b>	<b>37.20%</b>	<b>\$50,904,091.46</b>

**Table J-17. Alternative 7A. 3 Detention Sites Plus Horn Lake Creek Channel Enlargement 18.56-19.41(25 Year Plan) Plus 25 year non-structural**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$ 1,133,000.00	\$113,339.00	10.00%	\$1,246,399.04
01 Mitigation	\$1,554,000.00	\$155,382.00	10.00%	\$ 1,709,381.77
01 25 Year Non-Structural	\$21,700,370.06	\$9,437,490.94	43.49%	\$31,137,861.00
02 Relocations	\$1,447,664.00	\$367,000.00	25.35%	\$1,814,663.58
09 Channels and Canals	\$ 4,199,000.00	\$ 1,329,000.00	31.65%	\$5,528,000.00
15 Floodway Control and Diversion	\$21,384,000.00	\$8,423,000.00	39.39%	\$29,807,000.00
30 Planning Engineering and Design	\$3,826,000.00	\$332,000.00	8.68%	\$4,158,000.00
31 Construction Management	\$3,826,000.00	\$1,421,000.00	37.14%	\$5,247,000.00
<b>Totals</b>	<b>\$59,070,033.64</b>	<b>\$21,578,211.75</b>	<b>36.53%</b>	<b>\$80,648,245.39</b>

**Table J-18. Alternative 8. I-Wall, Levee and 29 commercial structures with floodproofing at Bullfrog Corner**

<b>Feature</b>	<b>Cost</b>	<b>Contingency</b>	<b>Contingency</b>	<b>Total</b>
01 Lands and Damages	\$2,129,000	\$426,000	20.01%	\$2,555,000
01 Mitigation	\$2,981,000	\$596,000	19.99%	\$3,577,000
02 Relocations	\$140,000	\$35,000	25.00%	\$175,000
15 29 Commercial Structure w/floodproofing	\$4,749,322	\$2,065,000	43.49%	\$6,814,803
11 Levees and Floodwalls	\$2,177,000	\$749,000	34.41%	\$2,926,000
30 Planning Engineering and Design	\$1,060,000	\$360,000	33.96%	\$1,420,000
31 Construction Management	\$1,060,000	\$360,000	33.96%	\$1,420,000
<b>Totals</b>	<b>\$14,296,322</b>	<b>\$4,591,000</b>	<b>32.11%</b>	<b>\$18,887,803</b>

**Table J-19. Risk Analysis for Alternative 7A. I-Wall and Levee**

<b>CWWBS</b>	<b>Feature of Work</b>	<b>Contract Cost</b>	<b>Contingency %</b>	<b>Contingency \$</b>	<b>Total</b>
01 Lands and Damages	Real Estate	\$5,110,000.00	20%	\$1,022,000.00	\$5,110,000.00
02 Relocations	Utilities	\$140,000.00	25.34%	\$35,469.00	\$175,469.23
11 Levees and Floodwalls	Mob and Demob	\$140,000.00	19.42%	\$27,184.00	\$167,184.48
11 Levees and Floodwalls	Embankment	\$69,000.00	28.36%	\$27,221.00	\$123,221.45
11 Levees and Floodwalls	Concrete	\$940,000.00	49.40%	\$464,404.00	\$1,404,403.51
11 Levees and Floodwalls	Asphalt Removal	\$170,000.00	24.52%	\$41,683.00	\$211,682.53
11 Levees and Floodwalls	Asphalt New	\$100,000.00	24.52%	\$24,519.00	\$124,519.14
11 Levees and Floodwalls	Demolition	\$550,000.00	19.55%	\$107,506.00	\$657,506.31
11 Levees and Floodwalls	Remaining Construction Items	\$181,000.00	30.66%	\$55,504.00	\$236,503.56
30 Planning Engineering and Design	Planning Engineering and Design	\$352,000.00	33.98%	\$119,608.00	\$471,607.50
31 Construction Management	Construction Management	\$348,000.00	33.98%	\$118,248.00	\$466,248.32
<b>Total</b>		<b>\$8,127,000.00</b>			<b>\$10,170,346.00</b>



**Table J – 20. O&M for Measures carried forward**

Interval	(YR)	1	5	10	50	10	50	10	10
Measure	Description	Mowing	Agg. Surfacing	Levee Slide	Pump Replacement	Pump Maintenance	Outlet/Wasteway Replacement	Outlet/Wasteway Maintenance	Cleanout
VIII	Cowpen Detention	\$19,500	\$117,000				\$ 3,900,000	\$390,000	\$975,000
IX	Rocky Creek Detention	\$34,125	\$260,000				\$ 8,125,000	\$ 812,500	\$2,210,000
X	HLC Detention at Elmore	\$221,520	\$487,500				\$10,500,000	\$1,050,000	\$9,000,000
XI	Lateral D Detention	\$31,200	\$156,000				\$3,575,000	\$357,500	\$2,080,000
XIV	Bullfrog Corner Detention	\$65,000	\$390,000				\$5,850,000	\$585,000	\$5,200,000
XV	Rocky Creek Levee I	\$2,106	\$130,000	\$78,000	\$3,640,000	\$ 364,000			
XVI	Rocky Creek Levee II	\$4,290	\$214,500	\$78,000	\$6,890,000	\$ 689,000			
XVII	HLC Levee I B/W Airways and Elmore	\$5,265	\$240,500	\$78,000	\$2,210,000	\$ 221,000			
XVIII	HLC Levee 2 @ Goodman	\$10,530	\$468,000	\$78,000	\$10,660,000	\$ 1,066,000			
XIX	Clearing/Channel Cleanout 19.41-19.82	\$7,800							\$1,950,000
XX	Clearing, Cleanout, Channel Excavation 18.86 - 19.91	\$15,600							\$9,100,000
XXI	Drainage Ditch Levee	\$3,600		\$78,000					
XXII	Cleanout 18.86-19.41	\$7,200							\$3,935,000
XXIII									
Notes									
1. Assumed Cleanout at 20% Capacity every 10 Years to be hauled off 10 miles									
2. Costs are in present day dollars.									
3. Assumed 10% per 10 years on Outlet/Wasteway Maintenance Costs									
4. Costs are per interval.									
5. Added 30% to costs to account for E&D and S&A									

## J.2 Cost Analysis - Environmental Features

### J.2.1 Introduction

An additional aspect to this project was the added environmental features. In general, each alternative is weighted on a cost-benefit methodology. As outlined in this report, the benefits are reflective of the advantages of restoring the ecosystem. This term is given ecobenefits. The other side to the cost-benefit ratio is the costs associated with each plan. Comparison and ranking ultimately provides an array of alternatives that, for their cost, provide the best return in ecological benefit.

Eco-benefits were produced through added grade control structures and tree plantings or riparian buffers. Using these features made the project a more viable project.

### J.2.2 Cost Methodology

The cost methodology was no different than the process outlined above for the Flood Control portion of the study. In all, 11 creeks were evaluated for increased eco-habitat. These included Nolehoe Creek, Johnson Creek, Horn Lake Creek, Hurricane Creek, Camp Creek, Nonconnah Creek, Cane Creek, Mussacuna Creek, Lick Creek, Short Fork Creek, and Red Banks Creek. The total construction costs for each creek is shown in Table J-21.

**J-21. Construction Costs for Grade Control and Riparian Buffer Zone**

<b>Creek</b>	<b>Construction Costs</b>
Nolehoe Creek Alt 4	\$3,251,283
Johnson Creek Alt 5b	\$4,033,823
Horn Lake Creek Alt 4	\$6,982,973
Hurricane Creek Alt 5b	\$4,084,715
Camp Creek Alt 4	\$3,166,536
Nonconnah Creek Alt 5b	\$1,502,193
Cane Creek Alt 5b	\$2,461,923
Mussacuna Creek Alt 5b	\$1,516,149
Lick Creek Alt 5b	\$1,014,851
Short Fork Creek Alt 5b	\$2,773,875
Red Banks Creek Alt 4	\$2,647,779
Total	\$33,436,100

<b>Code of Accounts</b>	<b>Division</b>	<b>Totals</b>	<b>Contingency</b>	<b>Grand Total</b>
01	Real Estate	\$6,638,787	\$1,327,757	\$7,966,544
02	Relocations	\$0	\$0	\$0
06	Fish and Wildlife Facilities	\$405,649	\$49,676	\$455,907
16	Bank Stabilization	\$16,472,000	\$2,758,416	\$19,230,416
18	Cultural Resources	\$170,200	\$45,600	\$213,700
30	E&D	\$2,557,177	\$227,656	\$2,784,766
31	S&A	\$2,557,177	\$227,656	\$2,784,766
<b>Grand Totals</b>		<b>\$28,800,991</b>	<b>\$4,695,878</b>	<b>\$33,436,100</b>

### J.2.3 Risk Analysis

A separate risk analysis was performed for the environmental features on Jan 22, 2021. Key members of the PDT met and discussed the cost risks associated with the environmental features. The risk register is broken out into 6 categories. These categories are outlined below in Table J-22. During the meeting, PDT members debate the associated costs risks with each element of the total cost. An item receives a risk rating which ultimately drives the contingency applied to each feature of the study. The risk analysis for Nolehoe Creek is shown as an example in Table J-22.

#### J-22. Risk Register for Abbreviated Risk Analysis (Nolehoe)

<b>CWWBS</b>	<b>Feature of Work</b>	<b>Contract Cost</b>	<b>Contingency %</b>	<b>Total</b>
01 Lands and Damages	Real Estate	\$1,008,000.00	25%	\$1,260,000.00
06 Wildlife Facilities and Sanctuaries	Riparian Buffer	\$63,000.00	14.34%	\$72,000.00
16 Bank Stabilization	Access Road	\$260,000.00	16.12%	\$302,000.00
16 Bank Stabilization	Clearing and Grubbing	\$71,000.00	19.44%	\$85,000.00
16 Bank Stabilization	Divert Flow	\$50,000.00	14.53%	\$57,000.00
16 Bank Stabilization	Riprap	\$1,119,000.00	18.41%	\$1,325,000.00
16 Bank Stabilization	Check Dams	\$58,000.00	10.72%	\$64,000.00
16 Bank Stabilization	Turfing	\$65,000.00	12.54%	\$73,000.00
16 Bank Stabilization	Riser Pipe	\$10,000.00	16.12%	\$12,000.00
16 Bank Stabilization	Remaining Construction Items	\$138,000.00	10.72%	\$153,319.52
18 Cultural Resources	Cultural Resources	\$74,000	25.00%	\$93,000.00

30 Planning Engineering and Design	Planning Engineering and Design	\$286,000.00	8.90%	\$311,000.00
31 Construction Management	Construction Management	\$286,000.00	8.90%	\$311,000.00
Total		\$3,488,000.00		\$4,118,000.00

#### J.2.4 O&M – Environmental Features

In general, O&M costs are the costs to maintain that project. For this portion of the study, it was assumed that O&M costs associated with the Riparian Buffer would be negligible since the trees would likely have minimal death and would be able to replace themselves over time with minimal O&M costs. Conversely, it is likely that over time the weir or grade control structures would require additional work to keep them in working order. It was assumed for the weir structures that every 10 years over the 100-year life that the access would have to be cleared again and 10% of the rock replaced. An example of the costs for Horn Lake Creek are shown in Table J-23. The cumulative O&M for each creek is shown in Table J-24.

#### J-23. Example (Horn Lake Creek) O&M Costs

Project Feature	Original QTY.	UNIT	% of Original QTY	O&M QTY	Unit Price	Cost Per Occurrence	No. of Occurrence	Cost over Life 2021 Dollars (100 Years)
Mob/Demob	1	LS	100%	1	\$76,653.00	\$76,753.00	10	\$766,530.00
R600	527	TN	10%	52.7	\$56	\$2,963.00	10	\$29,635.00
R200	49,768	TN	10%	4,977	\$52	\$259,289.00	10	\$2,592,892.00
Bedding Stone	9,424	TN	10%	942	\$48	\$45,235.00	10	\$452,347.00
Clearing and Grubbing	25	AC	50% (Assumed 10 YR Growth would be Smaller Tree Growth)	13	\$5,692	\$71,145.00	10	\$711,449.00
Subtotal								\$3,786,323.00
E&D	10%							\$833,918.00
S&A	10%							\$833,918.00
Total								\$5,386,770.00

**J-24. O&M Costs for each Creek**

<b>Creek</b>	<b>Mob/Demob</b>	<b>Weir O&amp;M</b>	<b>E&amp;D</b>	<b>S&amp;A</b>	<b>Total</b>
Nolehoe	\$768,040	\$1,475,375	\$371,879	\$371,879	\$2,615,294
Johnson	\$767,850	\$1,623,312	\$401,447	\$401,447	\$2,792,610
Horn Lake	\$766,530	\$3,786,323	\$833,918	\$833,918	\$5,386,770
Hurricane	\$770,000	\$1,313,419	\$339,684	\$339,684	\$2,423,102
Camp	\$770,000	\$1,040,556	\$285,111	\$285,111	\$2,095,668
Nonconnah	\$770,000	\$561,483	\$189,297	\$189,297	\$1,520,779
Cane	\$770,000	\$847,253	\$246,451	\$246,451	\$1,863,704
Mussacunna	\$770,000	\$468,891	\$170,778	\$170,778	\$1,409,669
Lick	\$770,000	\$336,556	\$144,311	\$144,311	\$1,250,867
Short Fork	\$770,000	\$898,875	\$256,775	\$256,775	\$1,925,650
Red Banks	\$770,000	\$1,010,773	\$279,155	\$279,155	\$2,059,928