



**US Army Corps
of Engineers ®**

Tulsa District

APPENDIX G: Cost Tulsa and West-Tulsa Levees Feasibility Study

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1 COST SUPPORT

The cost estimates (CE) developed for the alternatives is considered to be a rough order of magnitude, Class 5/4, level of estimate. The CE includes construction and non-construction costs. CE's developed for this project utilized July 2019 pricing data. The costs are based on a combination of Micro-Computer Aided Cost Estimating System Second Generation (MII) cost data and unit costs from similar projects. Quantities were prepared by the SWT Team. The total cost includes a 35% contingency. This percentage falls within American Association of Cost Engineers (AACE) range for a class 4 estimate, +20% to +50%.

Non-construction costs typically include Engineering & Design (E&D) and Supervision & Assurance (S&A). CE costs for Table 1.1 and Table 1.2 were prepared using the USACE Walla Walla (NWW) Cost Center of Expertise (CCX) Total Project Cost Summary Sheet Figure 1.1. This sheet is used USACE wide to develop CE's; the percentages of construction cost within the sheet are based on historical data from Civil Works projects as researched by the NWW CCX. The SWT team determined that the percentages used for Planning & Environmental Compliance and Project Operations will not be applied.

E&D costs include preparation of the plans and specifications, reviews, BCOES, solicitation and award, project management, and engineering during construction for the construction contract.

S&A costs are for the supervision and administration of the contract that will be required to perform the various aspects of construction for this project. S&A includes Project Management, Construction Quality Assurance, and Contract Administration costs.

ENGINEERING & DESIGN PHASE -> 30 ACCOUNT	NWW % of Construction	TWT % Used
Program Management:	2.5%	2.50%
Planning & Environmental Compliance:	1.0%	1.00%
Engineering & Design:	15.0%	15.00%
Reviews, ATRs, IEPRs, VE:	1.0%	1.00%
Life Cycle Updates (cost, schedule, risks):	1.0%	1.00%
Contracting & Reprographics:	1.0%	1.00%
Engineering During Construction:	3.0%	3.00%
Planning During Construction	2.0%	2.00%
Adaptive Mgmt & Monitoring:	1.0%	1.00%
Project Operations	1.0%	1.00%

Figure 1.1 NWW CCX - Total Project Cost Summary Sheet

The Tentatively Selected Plan (TSP) is Alternative 1E, Filtered berm with toe drains within Levees A and B. This plan meets the study objectives of reducing flood risk and flood damages, reducing flood risk to public health, safety and life, and minimizes residual flood risks to the extent justified. The structural features of Alternative 1E include:

- 13 miles of a filtered berm with toe drain
- Approximately 3,000 feet of cut off wall in Levee A at the Superfund site
- Two-stage filter system on landside embankment
- Two detention ponds at Levee B tieback
- Riprap armoring on landside at overtopping in Levee B
- Grouting Penetrations
- Replace Penetrations
- Reconstruction of the pump stations 1 through 7

The features of work identified for Alternative 3B include:

- Cutoff Wall (Soil Bentonite) full length on Levees A, B, and B Tieback.
- Approximately 3,000 feet of cut off wall in Levee A at the Superfund site
- Two detention ponds at Levee B tieback
- Riprap armoring on landside at overtopping in Levee B
- Grouting Penetrations
- Replace Penetrations
- Reconstruction of the pump stations 1 through 7

Previous projects on the levee have encountered contaminated soils. This will require additional costs for handling, hauling and disposal of these contaminated soils to approved landfill sites. It is the Sponsor's responsibility to provide a clean and safe worksite. Therefore, this cost is considered to be 100% local share cost.

Alternative 1E, if approved, would be subject to cost sharing for FRM projects at a 65 percent Federal and 35 percent non-Federal ratio. Table 1.1 and Table 1.2 show the preliminary cost allocations for the TSP and Alternative 3B. These costs may change with additional analysis.

Table 1.1 Summary of TSP Cost Allocation

Item	Total Cost	Federal Share	Local Share
Alternative 1e		65%	35%
Total Correction & Reconstruction	\$ 100,360,667	\$ 65,234,434	\$ 35,126,234
Planning, Engineering & Design	\$ 28,602,790	\$ 18,591,814	\$ 10,010,977
Construction Management	\$ 12,545,083	\$ 8,154,304	\$ 4,390,779
Item	Total Cost	Federal Share	Local Share
Charles Page Floodway Structure		65%	35%
Total Correction & Reconstruction	\$ 1,190,105	\$ 773,568.02	\$ 416,537
Planning, Engineering & Design	\$ 339,180	\$ 220,466.89	\$ 118,713
Construction Management	\$ 148,763	\$ 96,696.00	\$ 52,067
Item	Total Cost	Federal Share	Local Share
Contaminate Soil Disposal¹		0%	100%
Total Soil Disposal	\$ 11,703,150		\$ 11,703,150
Planning, Engineering & Design	\$ 3,335,398		\$ 3,335,398
Construction Management	\$ 1,462,894		\$ 1,462,894
Total Correction & Reconstruction	\$ 159,688,030	\$ 93,071,282	\$ 66,616,747

¹ 100% Local Share

Table 1.2 Summary of Alt 3B Cost Allocation

Item	Total Cost	Federal Share	Local Share
Alternative 3b		65%	35%
Total Correction Cutoff Wall ¹	\$ 204,562,500	\$ -	\$ 204,562,500
Total Correction & Reconstruction	\$ 59,204,356	\$ 38,482,831.56	\$ 20,721,524.69
Planning, Engineering & Design	\$ 75,173,554	\$ 48,862,810	\$ 26,310,744
Construction Management	\$ 32,970,857	\$ 21,431,057	\$ 11,539,800
Item	Total Cost	Federal Share	Local Share
Charles Page Floodway Structure		65%	35%
Total Correction & Reconstruction	\$ 1,190,105	\$ 773,568	\$ 416,537
Planning, Engineering & Design	\$ 339,180	\$ 220,467	\$ 118,713
Construction Management	\$ 148,763	\$ 96,696	\$ 52,067
Item	Total Cost	Federal Share	Local Share
Contaminate Soil Disposal¹		0%	100%
Total Soil Disposal	\$ 11,703,150	\$ -	\$ 11,703,150
Planning, Engineering & Design	\$ 3,335,398	\$ -	\$ 3,335,398
Construction Management	\$ 1,462,894	\$ -	\$ 1,462,894
Total Correction & Reconstruction	\$ 390,090,756	\$ 109,867,430	\$ 280,223,327

¹ 100% Local Share

2 Features of Work

Below is a description of each feature of work. Table 2.1 thru Table 2.5 show the ROM unit prices and quantities.

2.1 Cutoff Wall (Soil Bentonite)

A square foot unit price (wall length x wall depth) is developed from similar cutoff wall construction at Addicks & Barker and information from Dr. Bruce's Barrier Methods Comparisons. The quantity assumes a cutoff wall depth of 40 feet. Additional costs have been included due to the cutoff wall being installed in a superfund site. However, the quantity of contaminated soil disposal is highly unpredictable as well as the precautions required to work in this contaminated area.

2.2 Cutoff Wall Platform

It is assumed that construction of a platform will be required with the construction of the cutoff wall. The current levee width is approximately 8 feet. It is common that a 40 foot wide work surface (platform) be constructed to allow space for equipment and material movement when constructing a cutoff wall. The platform is assumed to be constructed with compacted common

backfill material. The cubic yard unit price for the platform uses the average unit price for compacted fill.

2.3 Two-Stage Filter (Landside Embankment)

The two-stage filter consists of 2 feet of sand filter and 2 feet of gravel placed on the landside embankment. A 4 foot thick impervious layer will be placed over the filter materials.

2.4 Inverted Filter Berm (Landside)

The inverted filter berm consists of 2 feet of sand filter material, 2 feet of coarse filter material, and compacted borrow material. It is assumed the berm will have a width of 45 feet. A toe drain system is to be installed the full length on levees A and B.

2.5 Riprap

24 inch riprap on 12 inch bedding will be installed on the landside embankment of 3,000 linear feet of Levee B.

2.6 Detention Pond

Approximately 6.5 acre detention pond will be constructed on the north side of HWY 412 and 1.5 acre detention pond on the south side of HWY 412 near Levee B Tieback.

2.7 Grout Penetrations

It is assumed that the grouting at each penetration will be for 150 linear feet of 36 inch diameter pipe.

2.8 Replace Penetrations

It is assumed that the RCP is 48" diameter and 150 linear feet per penetration. The cost includes excavation, removal of existing pipe, installing new Reinforced Concrete Pipe (RCP), headwalls, flap gate, and compacted backfill.

2.9 Pump Stations

A total of seven pump stations on Levees A and B. Replacing pumps, motors, and electrical at each of the pump stations.

2.10 Contaminated Soil

It is assumed that 20% of the total excavation will be contaminated with petroleum or other chemical products. The unit cost used includes additional cost for handling, testing, documentation, hauling and disposal at approved hazardous landfills.

Table 2.1 Levee A ROM - Estimated Quantities for Construction

ITEM	QUANTITY	UOM	UNIT PRICE	TOTAL COST
Levee A				
Inverted Filter Berm				\$12,339,736
Excavation	119,575	CY	\$8.15	\$974,536
Fine Filter Material	43,050	CY	\$144.00	\$6,199,200
Coarse Filter Material	43,050	CY	\$120.00	\$5,166,000
Cutoff Wall (superfund site)				\$8,197,875
Cutoff Wall	59,500	SF	\$120.00	\$7,140,000
Work Platform	30,225	CY	\$35.00	\$1,057,875
Abandon Conduits				\$7,697,625
Abandon Conduits	65	EA	\$118,425.00	\$7,697,625
Replace Conduits				\$3,054,400
Replace Conduits	32	EA	\$95,450.00	\$3,054,400
Toe Drain System				\$1,313,025
12" Dia. Pipe	21,525	LF	\$61.00	\$1,313,025
Landside Berm				\$773,333
Compacted Fill	15,945	CY	\$48.50	\$773,333
			Levee A Subtotal	\$33,375,994
			Contingency (35%)	\$11,681,598
			Levee A Construction Total	\$45,057,592

Table 2.2 Levee B ROM - Estimated Quantities for Construction

ITEM	QUANTITY	UOM	UNIT PRICE	TOTAL COST
Levee B				
Inverted Filter Berm				\$14,462,587
Excavation	97,130	CY	\$8.15	\$791,610
Fine Filter Material	51,085	CY	\$144.00	\$7,356,240
Coarse Filter Material	51,085	CY	\$120.00	\$6,130,200
Compacted Fill	12,950	CY	\$14.25	\$184,538
Detention Ponds				\$1,589,482
North Pond	83,895	CY	\$15.30	\$1,283,594
South Pond	19,360	CY	\$15.80	\$305,888
Abandon Conduits				\$14,390,790
Abandon Conduits	114	EA	\$126,235.00	\$14,390,790
Replace Conduits				\$3,203,520
Replace Conduits	32	EA	\$100,110.00	\$3,203,520
Toe Drain System				\$1,618,315
12" Dia. Pipe	20,485	LF	\$79.00	\$1,618,315
Landside Berm				\$1,586,430
Compacted Fill	10,000	CY	\$47.00	\$470,000
Riprap	7,780	CY	\$117.00	\$910,260
Bedding	3,890	CY	\$53.00	\$206,170
			Levee B Subtotal	\$36,851,124
			Contingency (35%)	\$12,897,893
			Levee B Construction Total	\$49,749,017

Table 2.3 Pump Stations ROM - Estimated Quantities for Construction

ITEM	QUANTITY	UOM	UNIT PRICE	TOTAL COST
Pump Stations Replacement				
Levee A				\$3,094,200
<i>Pump Stations</i>	3	EA	\$1,031,400	\$3,094,200
Levee B				\$2,062,800
<i>Pump Stations</i>	2	EA	\$1,031,400	\$2,062,800
Levee C				\$2,062,800
<i>Pump Stations</i>	2	EA	\$1,031,400	\$2,062,800
Levee B Subtotal				\$7,219,800
Contingency (35%)				\$2,526,930
Levee B Construction Total				\$9,746,730

Table 2.4 Floodway Structure ROM - Estimated Quantities for Construction

ITEM	QUANTITY	UOM	UNIT PRICE	TOTAL COST
Charles Page Floodway Structure				
Excavation	860	CY	\$15.40	\$13,244
Fine Filter	430	CY	\$187.00	\$80,410
Compacted Fill	430	CY	\$45.00	\$19,350
Riprap	215	CY	\$117.00	\$25,155
<i>Anchors</i>	90	EA	\$8,260	\$743,400
Floodway Structure Subtotal				\$881,559
Contingency (35%)				\$308,546
Levee B Construction Total				\$1,190,105

Table 2.5 Contaminated Soil Disposal ROM - Estimated Quantities for Construction

ITEM	QUANTITY	UOM	UNIT PRICE	TOTAL COST
Contaminated Soil				
Levee A				\$4,783,000
<i>Haul/Disposal</i>	23,915	CY	\$200.00	\$4,783,000
Levee B				\$3,886,000
<i>Haul/Disposal</i>	19,430	CY	\$200.00	\$3,886,000
Contaminated Soil Disposal Subtotal				\$8,669,000
Contingency (35%)				\$3,034,150
Contaminated Soil Disposal Total				\$11,703,150