Appendix G

Cost Engineering

Tafuna Flood Risk Management Study
American Samoa

December 2021

1. Introduction

The purpose of this appendix is to summarize the assumptions and basis of the cost estimate for the different proposed plans and features of the project. This includes the costs of the construction as well as the risk-based contingency.

2. Alternatives

Four major Alternatives were considered for this study.

1.1.1 Alternative A: No-Action

The No-Action Alternative is synonymous with no Federal action. This alternative is analyzed as the Future Without Project (FWOP) condition for comparison with the action alternatives.

1.1.2 Alternative B: Channel Conveyance

This alternative includes approximately 6,340 feet of channel conveyance on the Taumata Stream and 13,120 feet of channel conveyance on the Leaveave Stream. This alternative includes vegetation removal and conveyance improvements such as excavation of material to create a uniform channel with a varying bottom width of 5 to 20 feet and 2:1 side slope. Alternative B has the potential to reduce flood risk in all study reaches except Reach 1.

1.1.3 Alternative B1: Flood Barrier and Channel Conveyance

This alternative includes the conveyance improvements described in Alternative B above. In addition, it includes construction of flood barriers on the Leaveave and Taumata . There is approximately 2,400 linear feet of barrier with an average height of 7 feet (from ground elevation) on the Taumata Stream and approximately 3,400 linear feet of barrier with an average height of 5 feet (from ground elevation) on the Leaveave Stream. The potential flood barrier on the Leaveave Stream is expected to provide flood risk protection for structures primarily in Reach 8 while the flood barrier on the Taumata Stream will provide flood risk protection primarily for structures in Reach 5N.

1.1.4 Alternative C: Flood Barrier and Nonstructural

This alternative includes the 2,400 foot Taumata Stream flood barrier that was included in Alternative B1 and nonstructural measures. As in Alternative B1, this flood barrier will provide flood risk protection primarily for Reach 5-N while the nonstructural component of this alternative will provide nonstructural measures structures in all other reaches, which amounts to dry floodproofing 38 nonresidential buildings and elevating 242 residential structures.

1.1.5 Alternative D: Nonstructural

Alternative D includes only nonstructural measures. Preliminary benefit-cost analysis, see below, show that nonstructural measures affecting 312 structures can provide flood risk management benefits comparable to a structural improvement plan. At this stage of the study, dry floodproofing 40 nonresidential structures and elevating 272 residential structures is assumed to be the most effective nonstructural solution given the frequency and depth of flooding. The number and type of nonstructural improvements for this alternative will be refined as the analysis continues. The aggregation methodology and participation rate sensitivity analysis for Alternative D is described below in Section 5.2.

3. Cost Summary

The following table includes cost summary of the various alternatives.

Account	Measure	QTY	UOM	Total Direct Cost	Contingency	Total Project Cost
Alternative A	**No action**			N/A	N/A	N/A
Alternative B	**Channel Conveyance**			$ 19,450,827	$ 9,675,464	$ 29,126,291
01	Lands and Damages (Real Estate)	1	LS	$ 1,023,500	$ 461,800	$ 1,485,300
02	Relocations	1	LS	$ 500,000	$ 250,000	$ 750,000
06	Environmental Mitigation	1	LS	$ -	$ -	$ -
18	Cultural Mitigation	1	LS	$ 500,000	$ 250,000	$ 750,000
	Construction				$ -	
	Riprap Channel	47256	CY	$ 14,644,813	$ 7,322,406	$ 21,967,219
16	Construction Subtotal			$ 14,644,813	$ -	$ -
30	Engineering and Design	13	PCT	$ 1,903,826	$ 951,913	$ 2,855,738
31	Supervision and Admin	6	PCT	$ 878,689	$ 439,344	$ 1,318,033
Alternative B1	**Flood Barrier & Channel Conveyance**			$ 29,381,842	$ 19,705,516	$ 49,087,358
01	Lands and Damages (Real Estate)	1	LS	$ 1,200,200	$ 542,000	$ 1,742,200
02	Relocations	1	LS	$ 500,000	$ 340,000	$ 840,000
06	Environmental Mitigation	1	LS			$ -
18	Cultural Mitigation	1	LS	$ 500,000	$ 340,000	$ 840,000
	Construction					
	Floodwall	1	LS	$ 9,754,315	$ 6,632,934	$ 16,387,248
	Riprap Channel	47256	CY	$ 14,644,813	$ 9,958,473	$ 24,603,285
16	Construction Subtotal			$ 24,399,127	$ 16,591,406	$ 40,990,534
30	Engineering and Design	1	LS	$ 1,903,826	$ 1,294,601	$ 3,198,427
31	Supervision and Admin	1	LS	$ 878,689	$ 597,508	$ 1,476,197
Alternative C	**Flood Barrier & Non-structural Cons.**			$ 97,209,388	$ 41,176,365	$ 138,385,752
01	Lands and Damages (Real Estate)	1	LS	$ 1,665,575	$ 92,525	$ 1,758,100
02	Relocations	1	LS	$ 25,000	$ 10,750	$ 35,750
06	Environmental Mitigation	1	LS		$ -	$ -
18	Cultural Mitigation	1	LS	$ 300,000	$ 129,000	$ 429,000
	Construction				$ -	
	Dryproof	1	LS	$ 89,756,728	$ 38,595,393	$ 128,352,121
	Floodwall	1	LS	$ 4,589,987	$ 1,973,695	$ 6,563,682
16	Construction Subtotal			$ 94,346,715	$ 40,569,088	$ 134,915,803
30	Engineering and Design	13	PCT	$ 596,698	$ 256,580	$ 853,279
31	Supervision and Admin	6	PCT	$ 275,399	$ 118,422	$ 393,821
Alternative D	**Construction (Non-Structural)**			$ 102,628,634	$ 40,443,088	$ 143,071,722
01	Lands and Damages (Real Estate)	1	LS	$ 1,720,190	$ 79,710	$ 1,799,900
06	Environmental Mitigation	1	LS			
18	Cultural Mitigation	1	LS			
	Construction					
	Dryproof	1	LS	$ 99,793,045	$ 39,917,218	$ 139,710,263
16	Construction Subtotal			$ 99,793,045	$ 39,917,218	$ 139,710,263
30	Engineering and Design	1	LS	$ 840,000	$ 336,000	$ 1,176,000
31	Supervision and Admin	1	LS	$ 275,399	$ 110,160	$ 385,559

4. Basis of Estimate

1.2 Basis of Design

Due to the level of design for this design (approximately 5-10% level) the estimate falls into a Class 4 category, based on ER 1110-2-1302. There is still substantial lack of technical information and scope clarity resulting in major estimate assumptions in technical information and quantities, heavy reliance on cost engineering judgment, cost book, parametric, historical, and little specific crew-based costs. While certain construction elements can be

estimated in detail, there is still a great deal of uncertainty relative to major construction components. For the corollary cost data, recent projects in American Samoa with similar scope were used when possible to give the most reasonable similar costs. Typical Contingency Range for this class of estimate could be 30% to 100%.

Costs in this Appendix cover construction of project items with a markup to cover Planning, Engineering, and Design (PED) as well as Construction Management (CM). These items are covered by percentages uniformly applied to the construction costs. Based on historical averages on large multi-year civil works projects, assume 13% to cover 2.75 years of PED + 1 year of EDC as well as reviews (QC, ATR, SAR, etc.) and 6% for CM was used based on 1 year of S&A and approximately 3 FTEs to support. These costs are conservative estimates, and a detailed breakdown of the costs for these items will need to be more fully developed during the next phase of design.

Costs for the Real Estate are covered in the Real Estate Appendix.

All items in this cost estimate are presented in 2021 dollars.

Alternative A: No Action
The No-Action Alternative is synonymous with no Federal (Corps) Action. This alternative is analyzed as the future without-project (FWOP) condition for comparison with the action alternatives.

Alternative B: Channel Conveyance Alternative
This alternative includes approximately 6,340 feet of channel conveyance on the Taumata Stream and 13,120 feet of channel conveyance on the Leaveave Stream. Construction of side slope protection of rip rap would be placed after the widening of the existing channel. This alternative includes vegetation removal and conveyance improvements such as excavation of material to create a uniform channel with a varying bottom width of 5 to 20 feet and 2:1 side slope. Alternative B has the potential to reduce flood risk in all study reaches except Reach 1.

Alternative B1: Floodwall, Levee, and Channel Conveyance Alternative
This alternative includes the 6,340 feet of channel conveyance improvements described in Alternative B above. In addition, it includes construction of flood barriers on the Leaveave and Taumata. There is approximately 2,400 linear feet of barrier with an average height of 7 feet (from ground elevation) on the Taumata Stream and approximately 3,400 linear feet of barrier with an average height of 5 feet (from ground elevation) on the Leaveave Stream. The potential flood barrier on the Leaveave Stream is expected to provide flood risk protection for structures primarily in Reach 8 while the flood barrier on the Taumata Stream will provide flood risk protection primarily for structures in Reach 5N.

Alternative C: Terraced Floodplain and Channel Conveyance Alternative
This alternative includes the combination of a 2,400 foot Taumata Stream flood barrier that was included in Alternative B1 and nonstructural measures. As in Alternative B1, this flood barrier will provide flood risk protection primarily for Reach 5-N while the nonstructural component of this alternative will provide nonstructural measures structures in all other reaches, which amounts to dry floodproofing 38 nonresidential buildings and elevating 242 residential structures.

Alternative D: Non-Structural
Alternative D includes only nonstructural measures. Preliminary benefit-cost analysis, see below, show that nonstructural measures affecting 312 structures can provide flood risk management benefits comparable to a structural improvement plan. At this stage of the study, dry floodproofing 40 nonresidential structures and elevating 272 residential structures is assumed to be the most effective nonstructural solution given the frequency and depth of flooding. The number and type of nonstructural improvements for this alternative will be refined as the analysis continues. The aggregation methodology and participation rate sensitivity analysis for Alternative D is described below in Section 5.2.

1.3 Basis of Quantities

Quantities were provided by the technical team.

1.4 Construction Estimate

Work was predominantly estimated utilizing MII Estimating Software with specified input factors. The alternative analysis included unit costs of all project features and contrasted the options in order to scale relative differences. The next phase is having further design definition that is used to refine the project features.

Major Construction Features for the alternatives were estimated as follows.

1.4.1 Mobilization & Demobilization

Mobilization and Demobilization is assumed to be 10% of the direct costs. Labor and equipment is assumed to be available within a 50 mile radius within American Samoa, but specialized labor, material and equipment would come from as far as New Zealand.

1.4.2 Floodwall

Steel sheet piling (20psf) was assumed to be used (using 30 ft. lengths) capped and tack welded to the sheet piling for stability. No interlock sealant or additional reinforcing steel bars on the sheet piling face are included. More robust concrete T Walls were assumed for the construction of the floodwall.

1.4.3 Channel Improvements, Conveyance (Rip Rap)

- Clearing and Grubbing – Dense brush and trees are assumed to be cleared, chipped, and hauled to a disposal site.
- Excavation – All work is assumed to use a medium size hydraulic excavator, material will be hauled using 8 CY trucks to multiple disposal areas on site and spread using a large dozer. Based on the disposal area size, the depth of the placed material will vary but will be approximately 4 feet.
- Rip Rap Channel – 2' of Limestone RipRap was assumed to be placed on 6" of bedding and geotextile fabric after the excavation.
- Plantings - seed and/or plant live plugs of conspecific native grasses. Plantings would be of low to moderate density based on the long growing season in this sub-tropic zone and the ability for these plants to spread rapidly.

2.0

2.1.1 General Conditions, Overhead, and Profit

MII 2016 English Cost Book was used for general cost data.

Equipment rates are based on the Department of the Army EP 1110-1-8 "Construction Equipment Ownership and Expense Schedule", 2016 Region 12.

Fuel costs were taken from online sources dated 2021.

Prime contractor markups include 12% Job Office Overhead, 15% Home Office Overhead, 12% profit, and 3% bond.

Subcontractor markups include 10% Job Office Overhead, 14% Home Office and 12% profit.

Sales tax of 6.35% is included.

Planning, Engineering and Design (13%) and Construction Management (6%) are added in the estimate summary.

Labor rates were based on the 2021 Davis Bacon Wage Rates for American Samoa and include $15.00/hr for per diem.

Overtime rate of 10% has been applied.

2.1.2 Miscellaneous Markups, Assumptions, & General Notes

- No escalation has been applied.

- Costs for the 30 & 31 accounts (PED and CM respectively are assumed at 13% and 6% respectively of the contract total.
- A 10% Overtime rate was applied in MII and assumes 1 shift, 10 HR work days 5 days per week with 1.5 pay for Saturdays and anytime over a typical 40 hour work.
- Real Estate, cultural resources and mitigation costs included.

2.1.3 Construction Schedule

The construction schedule for this project is based on actual construction beginning FY23 and durations estimated based on the project features contained in the MII estimate.

- Alternative B: Channel conveyance improvements through riprap is assumed to be a 12 month construction project with approximately 8,000 manhours.
- Alternative B1: Floodwall and Channel Conveyance Alternative is assumed to be a 12 month construction project with approximately 21,000 manhours.
- Alternative C: Floodwall and nonstructural construction is assumed to be a 48 month construction project with approximately 26,000 manhours.
- Alternative D: Nonstructural construction is assumed to be a 36 month construction project with approximately 20,000 manhours.

5. Acquisition Plan

The current acquisition strategy is assumed fully open and competitive though an actual contracting plan has yet to be established.

6. Risk Assessment

An abbreviated risk analysis (ARA) was performed to develop a weighted contingency for the construction cost estimate. The overall Project weighted contingency ranged from 40% to 68% (Excluding Real Estate). The contingency accounts for contractor competition and availability cost uncertainties. The concerns outlined in the ARA could have an overall impact on the project. Project costs have the potential to increase due to economic conditions and the level of apparent competition during the solicitation process. Due to the level of technical information available, current plan set provided by the PDT, and Moderate Risk level overall the estimate is considered Class 4 (per ER 1110-2-1302).

7. References

U.S. Army Corps of Engineers, 1993, *Engineering and Design Cost Engineering Policy and General Requirements, Engineering Regulation 1110-1-1300,* Department of the Army, Washington D.C., 26 March 1993.

U.S. Army Corps of Engineers, 1999, *Engineering and Design for Civil Works Projects, Engineering Regulation 1110-2-1150,* Department of the Army, Washington D.C., 31 August 1999.

U.S. Army Corps of Engineers, 2016, *Civil Works Cost Engineering, Engineering Regulation 1110-2-1302,* Department of the Army, Washington D.C., 30 June 2016.

U.S. Army Corps of Engineers, 2019, *Civil Works Construction Cost Index System (CWCCIS), Engineering Manual 1110-2-1304,* Department of the Army, Washington D.C., 31 March 2020.

Unified Facilities Criteria, 2011, *Handbook: Construction Cost Estimating,* Unified Facilities Criteria (UFC) 3-740-05, Department of Defense, 1 June 2011.

8. Attachments

a. MCACES Estimates

b. Abbreviated Risk Analysis