APPENDIX J
DETAILED COST ESTIMATE AND COST ANALYSIS

This page intentionally left blank.

Table of Contents

Appendix J

Detailed Cost Estimate and Cost Analysis

Project Goals and Objectives

The goal is to provide an economical flood risk management option to the City of Dallas to aid in protecting the city from flood events. The objective is to choose a plan that provides the highest possible flood protection within an economically feasible design that can be maintained without adding unnecessary cost.

Methodology

To arrive at the current costs for each of the alternative, the MII V 4.1 software was used. This project was has been through a few iterations before reaching the point it is at now. The previous information was based on unsteady runs and used SPF for the determination of the alternatives. This time around a steady run was used to determine the quantities for the various levee raise measures and armoring measures. There was an A&SF Bridge removal that showed promise for the Benefit to Cost ratio and was brought forward and prices updated to use as a possible stand alone alternative. The other measures being considered are armoring (using articulated concrete block (ACB), scour stop, and turf reinforcement mat (TRM)), fill in low spots on levee (4:1 and 3:1 slope considered), and placing a soil-bentonite slurry cut off wall. The measures were broken out based on the Civil Works Work Breakdown Structure (CWWBS). It was assumed that the following would be used for this level to estimate BCY, LCY and ECY. LCY is 1.46 BCY and ECY is .86 BCY. These factors were based on information from the Cost Estimating PROSPECT course material for the type of soil in the area. Those factors may change once more information is known. Currently the Project Development Team (PDT) is working to determine which measures will become alternatives and part of the Flood Risk Management (FRM). To arrive at a Tentatively Selected Plan (TSP) the information from the FRM recommendation, along with information from the City of Dallas for the Interior Drainage Plan (IDP) and the Balanced Vision Plan (BVP) have been combined to get an overall cost for this project. Once the TSP is chosen it will be refined to be more specific. The estimate currently includes construction, relocations, plantings, Real Estate (for the IDP), PED and Construction Management costs, Environmental and Cultural Mitigation costs and contingency.

Assumptions and Constraints

The assumption for this project is that all work will be done within the existing right of way and no other Real Estate will have to be acquired for the FRM portion, some Real Estate will be required for the IDP. There are some bridges within the construction limits but it is assumed that if affected by the design plan a seal can be placed during construction to prevent future damage that would not otherwise have been an issue. It is assumed that all borrow material needed to complete filling in the low spots on the levee is available within a 12 mile round trip of any place on the levee. Also since the area for the borrow material is located within the project limits those areas affected will be mitigated and used as possible wetland areas. The estimate assumes that Scour Stop or TRM could be used in lieu of ACB but upon further discussion it was determined that is not a viable option. The method for construction of the slurry walls are based on the assumption that the soil will be excavated out leaving an open trench, then the soil will be mixed with the bentonite slurry mixture on the ground next the trench and dumped back in.

Risks

To determine the best option for the FRM portion an abbreviated risk analysis was completed to determine contingencies for comparison purposes. Those findings indicated the following to be risk items that could potentially increase cost significantly, 1) lack of a defined project scope, 2) Construction complexity (mostly for slurry cut off walls), 3) quantity information available, 4) cost estimating method, and 5) and the external project risks.

The quantities for the bridge modification were brought forward from a previous installment of this project and there may have been modifications to the site that will have to be determined in the planning phase if it is considered for the recommended plan as a standalone option or in conjunction with another measure. The PDT determined the contingency to be roughly 33.33%.

Armoring with Articulated Concrete Block (ACB) has a contingency of 25% based on an undefined scope and the uncertainty as to whether or not it would be buried and to account for additional material needed.

The 4:1 slope fill in low spots on the levee is about 25% contingency due to the possibility of having to go outside the project limits to acquire suitable borrow material. The 3:1 slope fill in the low spots is roughly 18.75%. The difference is the mostly due to

the availability of soil on site for the 3:1 versus the 4:1 and the uncertainty of the quantities.

The soil-bentonite slurry cut off wall has a contingency of roughly 60.42%. The PDT determined that with the assumed method of construction and the lack of knowledgeable contractors in the area for jet grouting, which would be used under bridges and around existing utilities, it would add costs to the project.

Once the FRM piece was finalized and it was determined that the IDP and BVP were a part of the total project cost, contingencies were determined based on the risks inputted into the Crystal Ball Cost Schedule Risk Analysis and the produced models. Due to the magnitude of the project and the various components the CSRA was split into two pieces, the first encompassing the FRM and IDP portions and the second dealing with the BVP aspects. The initial findings from the CSRA shows the FRM and IDP to have approximately 28% contingency and the BVP has roughly 31% contingency.

Alternatives

Alternatives for the Tentatively Selected Plan wes based on at least one of the following measures: 1) fill in low spots at either a 4:1 or 3:1 slope, 2) armoring (ACB, Scour Stop or TRM), 3) Soil-bentonite slurry cutoff wall, 4) AT&SF Bridge removal. The 3:1 slope and removal of the AT&SF bridge, along with necessary mitigation was determined to be the best alternative for the FRM portion.

Recommended Plan

The recommended plan includes the FRM portion: 3:1 levee raise, 4:1 slope flattening, removal of the AT&SF Bridge, the IDP, relocations, and Real Estate, and Ecosystem Restoration: Relocations and River Relocation.

TSP Dallas Floodway, Dallas, TX

Cost revised Aug 07, 2014 to exclude Able Pump station from the Project costs.

Cost revised June 20, 2014 to add West Levee IDP as indicated by WRDA 2014.

Cost revised Jan 3, 2014 to delete West Dallas Lake from the scope of this project.

Cost revised Nov 15, 2013 to MII V 4.2 and 2012 cost books and 2012 Labor.

Costs for the BVP features and the IDP are based on information received from the City of Dallas, TX.
Costs for the FRM features are based on quantities developed by Civil.

Costs include the $10M already spent by the City on Slurry walls as well as the required Slurry walls that will need to be put in place if the BVP is developed.
PED and CM are based on 12% of the construction cost for new features (excluded the $10M for slurry walls and the East Levee Pump Station that has already been awarded for the Federal Project).

Estimated by	CH Revised by Taggart/Druzba
Designed by	Jeff Comer Revised by Do Dang
Prepared by	CH Revised by Taggart/Druzba
Preparation Date	2/5/2014
Effective Date of Pricing	10/1/2013
Estimated Construction Time	4,080 Days

Labor ID: DC2013 EQ ID: EP11R06 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	ContractCost	Escalation	Contingency	ProjectCost
PROJECT INDIRECT SUMMARY			**445,936,796**	**0**	**0**	**445,936,796**
1 Remaining Project Costs	**1.00**	**LS**	**385,730,765**	**0**	**0**	**385,730,765**
1.1 Contract 1 - 277K Levee Raise and AT&SF Bridge Removal/Partial 4:1 Side Slopes	**1.00**	**LS**	**7,599,730**	**0**	**0**	**7,599,730**
1.3 Contract 3 - River Relocation Top	**1.00**	**LS**	**55,160,575**	**0**	**0**	**55,160,575**
1.4 Contract 4 - River Relocation Middle	**1.00**	**LS**	**90,178,899**	**0**	**0**	**90,178,899**
1.5 Contract 5 - Hampton Pump Station	**1.00**	**LS**	**63,816,598**	**0**	**0**	**63,816,598**
1.6 Contract 6 - River Relocation Bottom	**1.00**	**LS**	**93,664,410**	**0**	**0**	**93,664,410**
			37,418,132.30			*37,418,132.30*
1.7 Contract 7 - Charlie Pump Station	**1.00**	**EA**	**37,418,132**	**0**	**0**	**37,418,132**
1.8 Contract 8 - Delta Pump Station	**1.00**	**LS**	**3,805,030**	**0**	**0**	**3,805,030**
1.9 Contract 9 - Trinity Portland Station	**1.00**	**LS**	**34,087,391**	**0**	**0**	**34,087,391**
2 Sponsor Spent Costs	**1.00**	**LS**	**60,206,031**	**0**	**0**	**60,206,031**
2.1 01 Lands and Damages	**1.00**	**LS**	**2,465,833**	**0**	**0**	**2,465,833**
2.2 13 Pumping Plant	**1.00**	**LS**	**37,869,184**	**0**	**0**	**37,869,184**
2.3 09 - Channels	**1.00**	**LS**	**10,000,000**	**0**	**0**	**10,000,000**
2.4 Design Costs	**1.00**	**LS**	**9,871,014**	**0**	**0**	**9,871,014**

Labor ID: DC2013 EQ ID: EP11R06 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	ContractCost	Escalation	Contingency	ProjectCost
PROJECT INDIRECT SUMMARY			**445,936,796**	**0**	**0**	**445,936,796**
Remaining Project Costs	**1.00**	**LS**	**385,730,765**	**0**	**0**	**385,730,765**
Contract 1 - 277K Levee Raise and AT&SF Bridge Removal/Partial 4:1 Side Slopes	**1.00**	**LS**	**7,599,730**	**0**	**0**	**7,599,730**
FRM - Flood Risk Management	**1.00**	**LS**	**7,599,730**	**0**	**0**	**7,599,730**
08 Roads, Railroads, and Bridges	**1.00**	**LS**	**1,169,396**	**0**	**0**	**1,169,396**
11 11 Levees and Floodwalls	**1.00**	**LS**	**5,103,396**	**0**	**0**	**5,103,396**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**702,966**	**0**	**0**	**702,966**
31 31 Construction Management	**1.00**	**LS**	**623,973**	**0**	**0**	**623,973**
Contract 3 - River Relocation Top	**1.00**	**LS**	**55,160,575**	**0**	**0**	**55,160,575**
ER - Ecosystem Restoration	**1.00**	**LS**	**55,160,575**	**0**	**0**	**55,160,575**
01 Lands and Damages	**1.00**	**LS**	**3,951**	**0**	**0**	**3,951**
02 02 Relocations	**1.00**	**LS**	**3,886,116**	**0**	**0**	**3,886,116**
08 08 Roads, Railroads, and Bridges	**1.00**	**LS**	**271,401**	**0**	**0**	**271,401**
09 - Channels	**1.00**	**LS**	**41,349,102**	**0**	**0**	**41,349,102**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**5,118,033**	**0**	**0**	**5,118,033**
31 31 Construction Management	**1.00**	**LS**	**4,531,972**	**0**	**0**	**4,531,972**
Contract 4 - River Relocation Middle	**1.00**	**LS**	**90,178,899**	**0**	**0**	**90,178,899**
ER - Ecosystem Restoration	**1.00**	**LS**	**90,178,899**	**0**	**0**	**90,178,899**
01 Lands and Damages	**1.00**	**LS**	**3,951**	**0**	**0**	**3,951**
02 02 Relocations	**1.00**	**LS**	**13,453,963**	**0**	**0**	**13,453,963**
08 08 Roads, Railroads, and Bridges	**1.00**	**LS**	**10,460,754**	**0**	**0**	**10,460,754**
09 - Channels	**1.00**	**LS**	**50,485,427**	**0**	**0**	**50,485,427**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**8,363,896**	**0**	**0**	**8,363,896**
31 31 Construction Management	**1.00**	**LS**	**7,410,908**	**0**	**0**	**7,410,908**
Contract 5 - Hampton Pump Station	**1.00**	**LS**	**63,816,598**	**0**	**0**	**63,816,598**
FRM - Flood Risk Management	**1.00**	**LS**	**63,816,598**	**0**	**0**	**63,816,598**
01 Land and Damages	**1.00**	**LS**	**7,331,478**	**0**	**0**	**7,331,478**
13 13 Pumping Plant	**1.00**	**LS**	**46,604,180**	**0**	**0**	**46,604,180**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**5,238,968**	**0**	**0**	**5,238,968**
31 31 Construction Management	**1.00**	**LS**	**4,641,972**	**0**	**0**	**4,641,972**

Labor ID: DC2013 EQ ID: EP11R06 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	ContractCost	Escalation	Contingency	ProjectCost
Contract 6 - River Relocation Bottom	**1.00**	**LS**	**93,664,410**	**0**	**0**	**93,664,410**
ER - Ecosystem Restoration	**1.00**	**LS**	**93,664,410**	**0**	**0**	**93,664,410**
01 Lands and Damages	**1.00**	**LS**	**3,951**	**0**	**0**	**3,951**
02 02 Relocations	**1.00**	**LS**	**14,620,543**	**0**	**0**	**14,620,543**
06 Fish and Wildlife	**1.00**	**LS**	**4,423,631**	**0**	**0**	**4,423,631**
08 08 Roads, Railroads, and Bridges	**1.00**	**LS**	**18,441,678**	**0**	**0**	**18,441,678**
09 - Channels	**1.00**	**LS**	**39,791,653**	**0**	**0**	**39,791,653**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**8,684,976**	**0**	**0**	**8,684,976**
31 31 Construction Management	**1.00**	**LS**	**7,697,978**	**0**	**0**	**7,697,978**
			37,418,132.30			*37,418,132.30*
Contract 7 - Charlie Pump Station	**1.00**	**EA**	**37,418,132**	**0**	**0**	**37,418,132**
FRM - Flood Risk Management	**1.00**	**LS**	**37,418,132**	**0**	**0**	**37,418,132**
01 - Lands and Damages	**1.00**	**LS**	**172,564**	**0**	**0**	**172,564**
13 - Pumping Plants	**1.00**	**LS**	**30,727,522**	**0**	**0**	**30,727,522**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**3,457,025**	**0**	**0**	**3,457,025**
31 31 Construction Management	**1.00**	**LS**	**3,061,022**	**0**	**0**	**3,061,022**
Contract 8 - Delta Pump Station	**1.00**	**LS**	**3,805,030**	**0**	**0**	**3,805,030**
FRM - Flood Risk Management	**1.00**	**LS**	**3,805,030**	**0**	**0**	**3,805,030**
13 - Pumping Station	**1.00**	**LS**	**3,138,030**	**0**	**0**	**3,138,030**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**354,000**	**0**	**0**	**354,000**
31 31 Construction Management	**1.00**	**LS**	**313,000**	**0**	**0**	**313,000**
Contract 9 - Trinity Portland Station	**1.00**	**LS**	**34,087,391**	**0**	**0**	**34,087,391**
FRM - Flood Risk Management	**1.00**	**LS**	**34,087,391**	**0**	**0**	**34,087,391**
01 - Lands and Damages	**1.00**	**LS**	**565,080**	**0**	**0**	**565,080**
14 - Pumping Station	**1.00**	**LS**	**27,659,304**	**0**	**0**	**27,659,304**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**3,108,004**	**0**	**0**	**3,108,004**
31 31 Construction Management	**1.00**	**LS**	**2,755,003**	**0**	**0**	**2,755,003**
Sponsor Spent Costs	**1.00**	**LS**	**60,206,031**	**0**	**0**	**60,206,031**
01 Lands and Damages	**1.00**	**LS**	**2,465,833**	**0**	**0**	**2,465,833**
13 13 Pumping Plant	**1.00**	**LS**	**37,869,184**	**0**	**0**	**37,869,184**
East Levee Pump Stations	**1.00**	**LS**	**37,869,184**	**0**	**0**	**37,869,184**

Labor ID: DC2013 EQ ID: EP11R06 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	ContractCost	Escalation	Contingency	ProjectCost
Baker Pump Station	**1.00**	**LS**	**37,869,184**	**0**	**0**	**37,869,184**
09 - Channels	**1.00**	**LS**	**10,000,000**	**0**	**0**	**10,000,000**
Slurry Cut off Walls by River Reloaction	**1.00**	**LS**	**10,000,000**	**0**	**0**	**10,000,000**
Money spent by sponsor for cutoff wall in place	**1.00**	**LS**	**10,000,000**	**0**	**0**	**10,000,000**
Design Costs	**1.00**	**LS**	**9,871,014**	**0**	**0**	**9,871,014**

Labor ID: DC2013 EQ ID: EP11R06 Currency in US dollars TRACES MII Version 4.2

US Army Corps
of Engineers®
Fort Worth District

RISK MANAGEMENT PLAN FOR
Dallas Floodway

Prepared by:

U.S. Army Corps of Engineers
Fort Worth District

Aug 25, 2014

Table of Contents

List of Tables

List of Figures

List of Appendixes

1. INTRODUCTION

1.1 Purpose

This Risk Management Plan (RMP) presents the process for implementing the comprehensive and proactive management of risk as part of the overall management of the Dallas Floodway. Risk management is a project management tool to handle events that might adversely impact the program, thereby increasing the probability/likelihood of success. This RMP describes a management tool that will:

- Serve as a basis for identifying alternatives to achieve cost, schedule, and performance goals;
- Assist in making decisions on budget and funding priorities;
- Provide risk information for Milestone decisions; and
- Allow monitoring the health of the program as it proceeds.

The RMP describes methods for assessing (identifying and analyzing), prioritizing, and monitoring risk drivers; developing risk-handling approaches, and applying adequate resources to handle risk. It assigns specific responsibilities for these functions, and prescribes the documenting, monitoring, and reporting processes to be followed.

The four main building blocks of the risk management process are identification, assessment, response, and documentation. The Cost and Schedule Risk Analysis (CSRA) process addresses the “identification” and “assessment” portions of the risk management process. The activities of “response” and “documentation” are PM and PDT management efforts to mitigate, monitor, and manage the risks throughout the life cycle of the project.

If necessary, this RMP will be updated at the following milestones: (1) following approval of the FCSA (milestone complete); (2) Congressional authorization for construction (milestone complete); (3) receipt of Preconstruction, Engineering and Design and Construction General funding; or (4) concurrent with the review and update of other program plans.

Objectives: The objectives of the RMP are:

To focus attention on minimizing threats to achievement of the project objectives; and
To provide an approach for:
Identifying and assessing risks;
Determining cost-effective risk reduction actions; and
Monitoring and reporting progress in reducing risk.

The overall goal of this process is to progressively reduce the project's exposure to events that threaten the accomplishment of its objectives by:
Incorporating approaches into the project plans that minimize or avoid identified risks;
Developing proactive, contingent risk response actions; and
Rapidly implementing risk responses based on timely identification of risk occurrence.

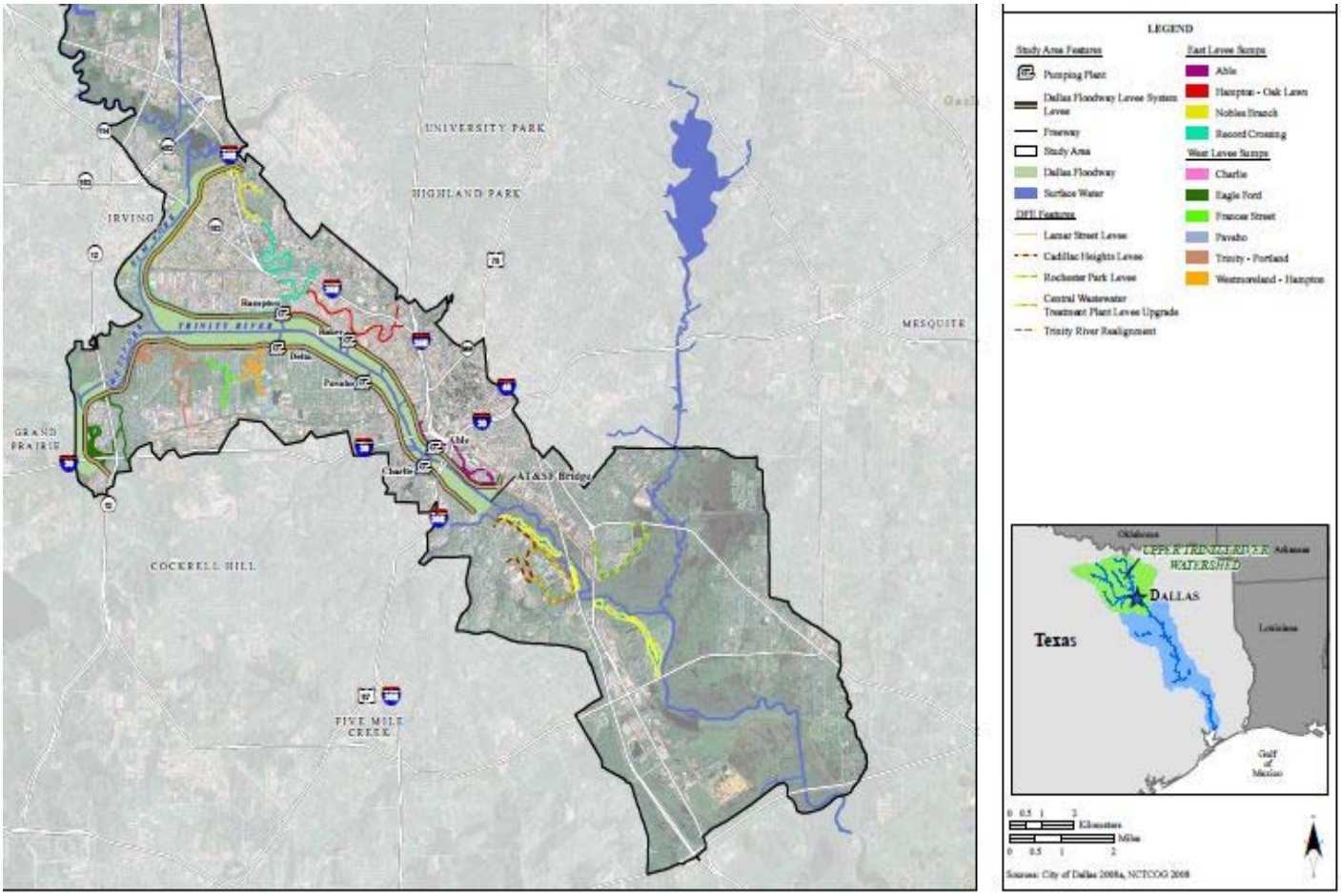
2. PROJECT SUMMARY

2.1 Project Area

The focal point in the study area (project area) is the existing Dallas Floodway Project, comprised of the East and West Levees and the area between the levees commonly referred to as the "Floodway." The Dallas Floodway Project encompasses the East and West Levees, Floodway, and interior drainage system features including drainage structures, pressure sewers, pump stations and sump areas. The East and West Levees extends along the Trinity River upstream from approximately the Atchison, Topeka and Santa Fe (AT&SF) Railroad Bridge at Trinity River Mile 497.37, to the confluence of the West and Elm Forks at River Mile 505.50, thence upstream along the West Fork for approximately 2.2 miles and upstream along the Elm Fork approximately 4 miles. Of the 22.6 miles of levees within this reach, the East Levee is 11.7 miles in length and the West Levee is 10.9 miles in length, which includes a 1.5-mile segment along Mountain Creek. The authorized DFE Project area is directly downstream of the East and West Levee (approximately downstream of the AT&SF Railroad Bridge). The distance between the levees vary between approximately 2,500 feet to 3,000 feet and extends for nearly eight river miles on the main stem of the Trinity River. The levees are approximately 30 feet high with slopes that vary. Through the Floodway, the existing river channel is approximately 30 feet deep and 200 to 250 feet wide at its banks. The existing Dallas Floodway Project features are displayed in Figure 1-1.

The same levees that provide flood damage reduction benefits to the City of Dallas from Trinity River flood events also prevent the local stormwater runoff from draining directly to the river. A system of sump areas, pressure sewers and pump stations has been constructed to accommodate the interior drainage. The stormwater runoff collects in low-lying areas on the land side of the levees (typically a remnant of the historic river channel) until it can be pumped into the river, drain through pressure sewers, or drain through gravity sluices. There are six pumping plants and sumps, seven pressure sewers and gravity sluices associated with the Interior Drainage System (IDS). The location of the pump stations and sumps are shown in Figure 1-1.

Figure 1-1. Dallas Floodway Project Area



Project Scope

The scope of the project is design and construction of the Recommended Plan identified in the feasibility report for the Dallas Floodway Project. The project was authorization in Section 5141 of the Water Resources Development Act of 2007. The Recommended Plan includes:

- NED Plan (277K Levee Raise with AT&SF Railroad Bridge Modification and EAP Improvements);
- Levee Side Slope Flattening (at 100% non-Federal cost);
- East Levee IDP Phase I (Able, Hampton, and Baker Pump Stations, and the Nobles Branch Sump Improvements);
- River Relocation; and
- Corinth Wetlands.

The Recommended Plan assumes the Trinity Parkway is built in the Floodway. The scope of the Recommended Plan features is fully described in the feasibility report. Not all features associated with a BVP and IDP Projects are proposed in the Recommended Plan and will be pursued as a Section 408 project. Design and construction of those features are the responsibility of the City of Dallas. Specific features are reflected in the Recommended Plan summaries provided in the design and cost estimate accompanying the feasibility report (Appendices D and I). A general overview of the Recommended Plan features is provided in Appendix K (Figures K-23 through K-25).

3. RISK-RELATED DEFINITIONS

The U.S. Army Corps of Engineers Cost Engineering Directory of Expertise for Civil Works (Cost Dx) recommends the following definitions for risk, as contained in current project and risk management guidance and literature, as noted.

Risk

An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives (source: *PMBoK® Guide*, p. 373).

Technical Risk

Risks having to do with product, process, or "technique" issues involved with designing and producing the deliverable (source: *Project Risk Management*, p. 78).

Cost Risk

The risk associated with the ability of the program to achieve its life cycle cost objectives (source: *Defense Acquisition Deskbook*).

Schedule Risk

Events or conditions that may have a negative influence on the project's timing (source: *Risk Management Concepts and Guidance*, p. 376).

Life-Safety Risk

Risk relating to the safety and/or security of human interests.

Reliability Risk

Risk relating to the performance and/or reliability of the system, product, or project feature being acquired.

Non-Technical Risk

Any risk that is not technical in nature and does not directly influence cost growth. Such risks would include organizational risks, political exposure, public relations issues, or potential loss of "goodwill" (public trust).

Internal Risk

An item or activity upon which the PDT has control or influence.

External Risk

An item or activity upon which the PDT has no control or influence.

Risk Management

Project Risk Management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project; most of these processes are updated throughout the project (source: *PMBoK® Guide*, 3rd edition, p. 237).

Risk Analysis

Qualitative or quantitative evaluations of the potential impact and probability of project risk events (source: *Risk Management Concepts and Guidance*, p. 373).

Qualitative Risk Analysis

Prioritizing risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact (source: *PMBoK® Guide*, 3rd edition, p. 237).

Quantitative Risk Analysis

Numerically analyzing the effect on overall project objectives of identified risks (source: *PMBoK® Guide*, 3rd edition, p. 237).

Cost and Schedule Risk Analysis (CSRA)

Technique used to improve the development of contingencies by studying the variance of project cost caused by the effects of cost and schedule risk events. This process relies on qualitative and quantitative (e.g. Monte Carlo simulation) risk analysis techniques. CSRA is required on projects costs anticipated to be $40 Million or higher.

Risk Communication

Exchange or sharing of information about risk between the decision-maker, often the project manager, and other stakeholders (source: *Project Risk Management Guidelines*, p. 372).

Risk Response Planning/Mitigation

Developing options and actions to enhance opportunities, and to reduce threats to project objectives (source: *PMBoK® Guide*, 3rd edition, p. 237).

Risk Monitoring and Control

Tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle (source: *PMBoK® Guide*, 3rd edition, p. 237).

Risk Register

The document containing the results of the qualitative risk analysis, quantitative risk analysis and risk response planning. The risk register details all identified risks, including description, category, cause, probability of occurring, impact(s) on objectives, proposed responses, owners, and current status (source: *PMBoK® Guide*, 4th edition, p. 439).

Risk Trigger

An indicator of the imminent occurrence of a given risk event that serves as an immediate precursor to the occurrence of the risk. Often used to initiate specific actions, behaviors, or responses (source: *Risk Management Concepts and Guidance*, p. 376).

Watch List

A list of major risks examined at each project risk review meeting (source: Project Risk Management Guidelines, p. 372).

4. RISK MANAGEMENT STRATEGY

The Dallas Floodway risk management strategy is to handle program risks, both technical and non-technical, before they become problems, causing serious cost, schedule, or performance impacts. This strategy is an integral part of project success, and will be executed primarily through the Government Project Delivery Team (PDT). The PDT will continuously and proactively assess critical areas to identify and analyze specific risks and will develop options to mitigate all risks designated as moderate and high.

The PDT will keep risk information current by maintaining the risk register described in paragraph 6.2. Risk status will be reported at all project milestone reviews.

5. RESPONSIBILITIES AND ASSIGNMENTS

Over the course of the project, the Project Manager (PM) may make specific assignments to individual members of the PDT, within their functional areas, to provide updates or input to the risk register. Table 1 below lists the general assignments and responsibilities:

Table 1-Risk Management Responsibilities

Task	Lead	Support
Risk Management Planning	PM	Cost Dx/PDT
Risk Identification	PM	PDT
Risk Analysis and Quantification	Cost Dx/PM*	PDT
Risk Response/Mitigation Plan	PM	PDT
Risk Monitoring and Control	PM	PDT
Risk Communication	PM	PDT
Risk Documentation/Closeout	PM	PDT

*The Cost Dx prepares the CSRA.

6. RISK MANAGEMENT PROCESS AND PROCEDURES

Led by the PM, the PDT will conduct risk management activities to address those risks that are pertinent to the project. The project manager will employ the assistance of members of the PDT, project sponsors/customers and other subject matter experts as appropriate.

6.1 Overview of Project Risk Management Activities

- Risk Management Planning
- Risk Identification
- Risk Analysis and Quantification
- Risk Response Planning and Mitigation
- Risk Monitoring and Control
- Risk Communication
- Risk Documentation/Closeout

6.2 Risk Management Planning

Risk Management Planning will occur in conjunction with the development of the Project Management Plan (PMP) and will culminate with the approval of the PMP. The RMP will present the strategy for procedures for identifying, analyzing, responding to, and monitoring risk throughout the project life cycle. The RMP will include treatment for both technical and non-technical risks, as well as risks that affect the project cost and schedule performance. Per ER 1110-2-1302 and ETL 1110-2-573, this project requires and will undergo a formal Cost and Schedule Risk Analysis (CSRA).

6.3 Risk Identification

6.3.1 Initial Risk Discussions

Identification of risks will be accomplished through brainstorming sessions held with the PDT and project stakeholders. The PDT brainstorming session is the initial attempt to develop the risk register that serves as the basis for both the risk register development and the CSRA.

6.3.2 PDT Coordination

The PM will coordinate initial risk discussion meetings, also referred to as a PDT brainstorming session. The PM will also coordinate recurring risk discussion meetings with the PDT. These meetings are where the PDT attempts to collectively capture the project risks and place them into the risk register or update accordingly. The brainstorming session will include the major PDT members.

6.3.3 PDT Brainstorming Session

The PDT brainstorming session is the opportunity to bring the PDT together to qualitatively define the risk concerns as well as potential opportunities. As the concerns are discussed, the facilitator or risk analyst begins developing the initial risk register, capturing the PDT's concerns and discussions.

6.3.4 Risk Level

Each identified risk will be assigned a risk rating based on the joint consideration of event probability/likelihood and consequence/impact (see the Probability vs. Impact Risk Matrix below in Figure 6-1). This rating is a reflection of the severity of the risk and provides a starting point for the development of options to handle the risk. Probabilities are described as, "Very Unlikely," "Unlikely," "Likely," or "Very Unlikely." Impacts are described as, "Negligible," "Marginal," "Significant," "Critical," or "Crisis." Risk levels are described as, "Low," "Moderate," or "High."

It is important to consider both the probability/likelihood and consequences/impacts in establishing the rating, as there may be risk events that have a low probability/likelihood, but whose consequences/impacts are so severe that the occurrence of the event would be disastrous to the project.

6.3.5 Completing Initial Risk Register

The risk register will serve as the basis for risk management, including the CSRA process. When referring to the risk register, the PDT should focus on the following:

- Risk/Opportunity – Event;
- PDT Event Concerns – Describe the risk event;
- PDT Discussions – List the implications or any relevant background for this risk;
- Responsibility/POC – List who should have the action on the status of this risk;
- Likelihood – Describe the likelihood of this risk occurring, using "Very Unlikely," "Unlikely," "Likely," or "Very Unlikely."

- Impact – Describe the impact of this risk if it occurs, using “Negligible,” “Marginal,” “Significant,” “Critical,” or “Crisis.”
- Risk Level – Determine the risk level according to the matrix below, using “Low,” “Moderate,” or “High.”

Figure 6-1 Probability vs. Impact Risk
Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

The PDT should capture all concerns for all project features even if the risk level is considered low. The register serves as an archive of discussions and there is potential that low-level risks may become higher following market studies, more information being made available, or over time during the risk management and mitigation processes.

Within the risk register, the PDT concerns and discussions must be adequately and clearly captured, because the logic presented in those discussions must support the “likelihood” and “impact” decisions reflected within the risk register. While this product is the initial risk register, it has already captured the PDT’s greatest concerns. The PDT can begin using this data to prepare for project risk management.

The project is approaching completion of the feasibility study and currently manages two risk registers, one for study, life safety, and decision making risks, and the other cost and schedule risks.

6.3.6 Risk Analysis

Risk analysis includes both qualitative and quantitative techniques to determine the key drivers of risk. Qualitative risk analysis shall occur on all risks, both technical and non-technical. The Project Risk “Watch List” will incorporate all risks identified as “Moderate” or “High” by qualitative analysis. All risks determined to have cost and/or schedule impacts and rated as “Moderate” or “High” will be quantitatively studied through the CSRA process. The PDT will enlist the support of the Cost Engineering Dx for completion of the CSRA process.

6.3.7 Qualitative Risk Analysis

Qualitative risk analysis will be conducted on all project risks, utilizing the collective judgment of the PDT and project stakeholders. Qualitative analysis will occur simultaneously to the completion of the initial risk register. Additionally, the qualitative analysis will be updated as the risks change throughout the project life cycle. Changes to the status of risks shall be captured by the project risk register at each monthly risk review meeting.

6.3.8 Quantitative Risk Analysis

Quantitative analysis will be conducted on all risks qualitatively rated as “Moderate” or “High” that affect cost and/or schedule performance. Quantitative analysis shall be conducted using the Monte Carlo technique with the support of the Cost Engineering Dx. Other risks may also be studied quantitatively, as directed. The results of the quantitative analysis will be presented in a final report and will include identification of the key drivers of risk for cost and schedule. The results of the quantitative analysis will include recommended levels for contingency and management reserve for completion of the project through implementation.

6.3.9 Cost and Schedule Risk Analysis (CSRA)

The CSRA will be performed in accordance with ER 1110-2-1302, ETL 1110-2-573, and Cost and Schedule Risk Analysis Guidance published by the Cost Engineering Dx. The project will utilize the Cost Engineering Dx for performance of the CSRA, using Crystal Ball software. At a minimum, the CSRA will include but not be limited to:

- Review of planning, design and/or construction contract documents;
- Deliverables and work processes;
- Milestones and schedule dates;
- Resource estimates/needs/sources; and
- Performance requirements.

Discussions and brainstorming activities with PDT members, appropriate stakeholders/sponsor representatives and other qualified/knowledgeable individuals to develop a comprehensive list of risks for this project, referred to as the Risk Register.

Investigation of the various sources and symptoms of risks to aid in subsequent determination of risk controllability and selection of appropriate risk response actions. The guidance and processes recommended to perform an acceptable cost and schedule risk analysis (CSRA) that meets Headquarters (HQ), U.S. Army Corps of Engineers (USACE) requirements and successfully passes an agency technical review (ATR) can be found at *http://www.nww.usace.army.mil/Missions/CostEngineering.aspx*.

6.3.10 Risk Prioritization

The PM and the PDT will prioritize the “Moderate” or “High” risks in their disciplines or functional areas. This prioritization will provide the basis for the development of risk handling plans and the allocation of risk management resources. Prioritization will be

accomplished using expert opinion within the PDT, and will be based on the following criteria:

- Risk Rating – “Moderate” or “High;”
- Consequence/Impact – Within each rating, the highest value of consequence/impact;
- Urgency – How much time is available before risk-handling actions must be initiated; and
- Probability/Likelihood – Within each rating, the highest value.

The PDT will review the prioritized list of developed risks, and integrate them into a single list of prioritized project risks, using the same criteria.

6.4 Risk Response Planning and Mitigation

Following initial identification and analysis of risks, the PDT will develop an approach for risk handling for all key drivers of risk, including each “Moderate” or “High” risk. For all such risks, the various handling techniques should be evaluated in terms of feasibility, expected effectiveness, cost and schedule implications, and the effect on the project’s performance. Risk responses will also include an accompanying “fallback” plan if the primary treatment strategy is not effective at mitigating the impact of risk. Reducing requirements as a risk avoidance technique will be used only as a last resort, and then only with the participation and approval of District and Division Management.

In addition to developing approaches for handling each “Moderate” or “High” risk, the following will act as risk triggers requiring an immediate response and mitigation plan:

- Cost growth greater than 2.5% of the estimated project cost;
- Schedule delays greater than 6months;
- Potential for significant damage to private or public property;
- Potential for injury or loss of life;
- Potential to generate media coverage (either positive or negative);
- Potential environmental degradation or release of deleterious substances ; and
- Potential to alter political or stakeholder support.

The results of the evaluation and selection will be included and documented. This documentation will include the following elements:

- What must be done;
- List of all assumptions;
- Level of effort and resources required;
- Resources needed that are outside the expertise of the PDT;
- Estimated cost to implement the plan;

- Proposed schedule showing the proposed start date, the time phasing of significant risk reduction activities, the completion date, and their relationship to significant project activities/milestones;
- Recommended metrics for tracking risk-handling activity;
- Considerations for secondary or residual risks implications; and
- Person responsible for implementing and tracking the selected option.

6.5 Risk Monitoring and Control

Risk monitoring is the systematic tracking and evaluation of the progress and effectiveness of risk-handling actions by the comparison of predicted results of planned actions with the results actually achieved to determine status and the need for any change in risk-handling actions. The PM and the PDT will monitor all identified risks in their disciplines or areas, with particular attention to those risks rated as “Moderate” or “High.”

6.5.1 Monitor Risk Status

As work is performed on the project, the PDT will monitor and assess:

Progress in reducing risk,
Occurrence of risks that call for initiation of contingent risk responses; and
Effectiveness of implemented risk reduction actions and any needs to modify these actions.

Risk status will be updated immediately when risks change and upon the completion of a project milestone. The status of the risks and the effectiveness of the risk-handling actions will be agenda items for all design and program reviews, and will be reported to the PM on the following occasions:

- Monthly,
- When the PDT determines that the status of the risk area has changed significantly (as a minimum when the risk changes from high to moderate to low, or vice versa), and
- When requested by Management.

There are a number of techniques and tools available for monitoring the effectiveness of risk-handling actions. At a minimum, the PM and PDT will use the Risk Register and Watch List for day-to-day management and monitoring of risks.

“Moderate” or “High” risks will be monitored by the PM until the risk is considered LOW and recommended for “Close Out.” Functional area leads will continue to monitor LOW risk events in their areas to ensure that appropriate risk-handling action can be initiated if there are indications that the rating may change.

6.5.2 Maintenance of Project Risk Register

Throughout the life cycle of the project, the PDT will update the Risk Register to reflect the results of monitoring risk status. This list will also reflect the effect of any project re-planning changes and/or change controls. Updates shall be made monthly to the risk register. Any changes to risk status upon event occurrence or completion of a project milestone will also be captured immediately on the risk register.

The Risk Register will be discussed at project team meetings and specific risks of concern should be elevated to the Pre-PRB, PRB and/or project sponsors as appropriate.

6.5.3 Maintenance of Project Watch List

Throughout the life cycle of the project, the PM and the PDT will maintain a project watch list to reflect the results of monitoring risk status. The watch list, at a minimum, will contain the:

- Potential Risk Event;
- Planned Risk Reduction Actions;
- Point of Contact/Assignment;
- Due Date, and
- Status.

6.6 Risk Communication

Risk communication is essential to actively managing risks throughout the project life cycle. Communication begins with the preparation of the Risk Management Plan and continues through project closeout. Subsequently, the preparation of the project risk register facilitates communication of risks at all levels. The Cost Engineering Dx will also prepare a report regarding the formal CSRA process to be incorporated within the Cost Appendix to the Engineering Appendix of the Feasibility Report.

The PDT will review the risk register monthly to provide visibility of risks and progress in mitigating them. If necessary, risk occurrences will be elevated to the Pre-PRB, PRB and/or project sponsors for their attention (note “internal” vs. “external” risks).

The following risk triggers, as contained in paragraph 6.4 above, shall prompt the immediate communication of risks to Management:

- Cost growth greater than 2.5% of the estimated project cost;
- Schedule delays greater than 6 months;
- Potential for significant damage to private or public property;
- Potential for injury or loss of life;
- Potential to generate media coverage (either positive or negative);

- Potential environmental degradation or release of deleterious substances; and
- Potential to alter political or stakeholder support.

6.7 Risk Documentation and Closeout

6.7.1 Risk Documentation

Risks are documented in the Risk Register included in the Cost Schedule Risk Analysis (CSRA) for the Balanced Vision Plan (BVP), Flood Risk Management (FRM) and Interior Drainage Plan (IDP). The PDT also has a Project Risk Register that has been updated through the course of the feasibility study and will be kept current as the project pushes forward.

6.7.2 Risk Closeout

When the project reaches the closeout phase, the PM and the PDT will document the final results of the execution of the Risk Management Plan for inclusion in the final project records and the District and/or Enterprise Lessons Learned database. At a minimum, this information will include risk assessment documents (including the risk register), risk-handling plans (including the project watch list), contract deliverables, if appropriate, and any other risk-related reports.

Appendix A – Cost and Schedule Risk analysis Report (including risk register)

US Army Corps
of Engineers®

Dallas Floodway
Interior Drainage (IDP) and Flood Risk Management (FRM) Plans
Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Ft. Worth District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

August 11, 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), Ft. Worth District, presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Dallas Floodway Interior Drainage Plan and Flood Risk Management Feasibility Report. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis, *Monte-Carlo* based-study was conducted by the Project Development Team (PDT) on remaining costs. The purpose of this risk analysis study is to present the cost and schedule risks considered, those determined and respective project contingencies at a recommended 80% confidence level of successful execution to project completion.

Specific to the Dallas Floodway IDP/FRM project, the base case project cost for the Tentatively Selected Plan is estimated at approximately $178 Million (excluding Lands and Damages). Based on the results of the analysis, the Cost Engineering Mandatory Center of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $39 Million, or 28%. This contingency includes $33.8 Million (24%) for risks related to cost and $5 Million (4%) for the effect of schedule delay on overall project costs.

Walla Walla Cost MCX performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portray the development of contingencies (32% overall). The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Base Cost Estimate	**$138,700,000**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$154,500,000	11.4%
50%	$168,900,000	21.8%
80%	**$177,800,000**	**28.2%**
95%	$186,900,000	34.8%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

Cost Risks: From the CSRA, the key or greater Cost Risk items, include:

- EST-3 Pump Stations estimated by Others – The pump stations are currently at a 35% design and were estimated by others, which could lead to fluctuations in costs and quantities.

- TL-6 (Inaccurate or risky design assumptions on technical issues (FRM VEQ)) - captures the risk that the design is not yet complete and based off of information obtained from others, which could impact ultimate project costs.

- PR-1 (Bidding Climate/Market Conditions) - bidding climate in the area may be at a premium due to the number of contracts that are planned for execution in the area during this time.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The greatest risk is:

- PR-2 (Adequacy of project funding (federal)) – There is a possibility of federal funding not being acquired in a timely manner or in the increments assumed during planning.
- PR-3 (Adequacy of project funding (sponsor)) – There is a possibility the sponsor will not have the necessary funding in a timely manner to keep the project moving forward to follow the expected construction schedule.
- PR-4 (Threat of Lawsuits/Political Opposition) - captures the fact that the implementation of this project could be effected if the Parkway project ends up in litigation, pushing the assumed schedule out for an indeterminate time.
- EST-1 (Construction Schedule) - captures the risk of having a schedule based on a certain number of contracts being awarded and assumed methodology, which could result in significant delay of project implementation beyond what is currently contemplated.

Recommendations: As detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Ft. Worth District, this report presents a recommendation for the total project cost and schedule contingencies for the Dallas Floodway IDP/FRM Inlet Navigation Pilot Study Project.

2.0 BACKGROUND

The Dallas Floodway project is comprised of the Balance Vision Plan (IDP/FRM), Interior Drainage Plan (IDP), and Flood Risk Management (FRM) components. The IDP/FRM contains 7 river relocations (7 bends), creation of three lakes (West Dallas and Downtown Lakes (not included in this project)), and appurtenant recreation facilities (trails, parklands, recreational fields, promenade, etc.(not included in this project)). The IDP/FRM also contains a cutoff wall. The IDP consists of seven pump stations (7 federal (only 4 will be constructed under this project). The FRM consists of levee raises and modifications and removal of the AT&SF Bridge. The modifications made to the levee for the FRM portion were determined based on information developed during the VE study.

As a part of this effort, Ft. Worth District requested that the USACE Cost Engineering Mandatory Center of Expertise for Civil Works (Cost Engineering MCX) provide an agency technical review (ATR) of the cost estimate and schedule for Recommended Project Plan. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the base case Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Ft. Worth District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Walla Walla Cost Engineering MCX performed the Cost and Schedule Risk Analysis, relying on local Ft. Worth District staff to provide information gathering. The Walla Walla Cost Engineering MCX facilitated an on-site risk identification meeting on April 30, 2013 with the Ft. Worth District PDT to produce a risk register that served as the framework for the risk analysis. Participants in risk identification meeting included the following:

Name	Organization
Jon Loxely	SWF-PM
Ninfa Taggart	SWF-EC
Glenn Matlock	NWW-EC-C
David Wilson	EC-HH
Helena Mosser	SWF-EC-HH
Jesse Coleman	SWF-EC-GE
Nizar Almasri	SWF-EC-SE
Lauren Kruse	SWF-PP
Do Dang	EC-DC
Marcia Hackett	PER-EE
Renee Russell	RE-P
Mike Bormann	
Chris Chini	EC-DC

The first cost risk model was completed May 13, 2013. However, scope and estimate updates since then. Also, a PDT sanity check review necessitated a rerun of the original model. The final results were reported to Ft. Worth on July 29, 2013 and updated on January 13, 2014 to account for changes in cost.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

A formal PDT meeting was held with the Ft. Worth District office for the purposes of identifying and assessing risk factors. The meeting included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, environmental compliance, and real estate

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed

by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Dallas Floodway IDP/FRM project.

a. The Ft. Worth District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files electronically. The MII and CWE files transmitted and downloaded on July 23, 2013 was the basis for the updated cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay. Specific to the Dallas Floodway IDP/FRM project, the schedule was analyzed only for impacts due to residual fixed costs.

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for the State of Texas is 0.87, meaning that the average inflation for the project area is assumed to be 13% lower than the national average for inflation. Therefore, it is assumed that the project inflations experienced are similar (or better) to OMB inflation factors for future construction. Thus, the risk analyses accounted for no escalation over and above the national average.

e. Per the data in the estimate, the Overhead percentage for the Prime Contractor is 15%, and 8% for the Subcontractors. Thus, the assumed residual fixed cost rate for this

project is 11.5%. For the P80 schedule, this comprises approximately 28.24% of the total contingency and 3.37% of the base cost estimate. This is due to the accrual of residual fixed costs associated with delay associated with the implementation schedule.

f. The Cost MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk "watch list".

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for

implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $64 Million at the P80 confidence level (28% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 23% and 48% of the baseline cost estimate, respectively.

Table 1. Construction Cost Contingency Summary

Base Case Construction Cost Estimate	**$138,700,000**	
Confidence Level	**Construction Value ($$)**	**Contingency (%)**
5%	$152,100,000	9.7%
50%	$164,800,000	18.9%
80%	**$172,500,000**	**24.4%**
90%	$176,700,000	27.5%

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 40 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Figure 1. Cost Sensitivity Analysis

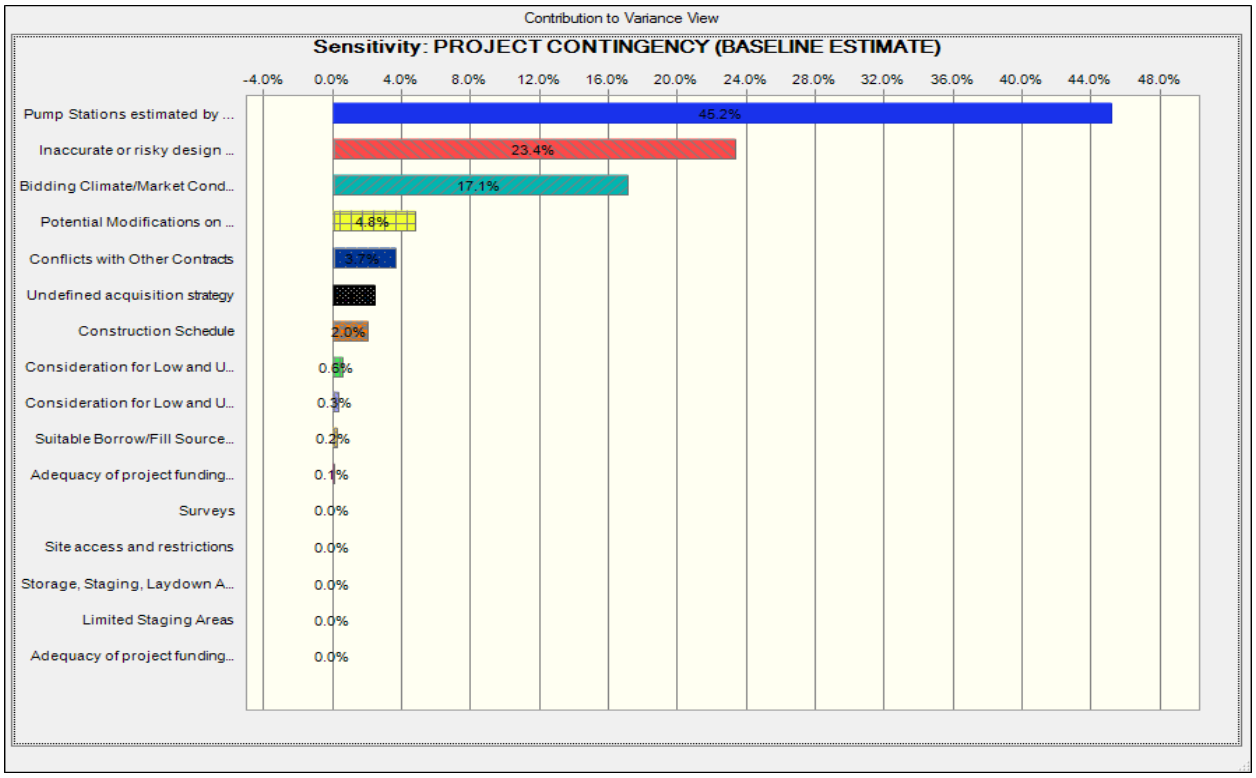
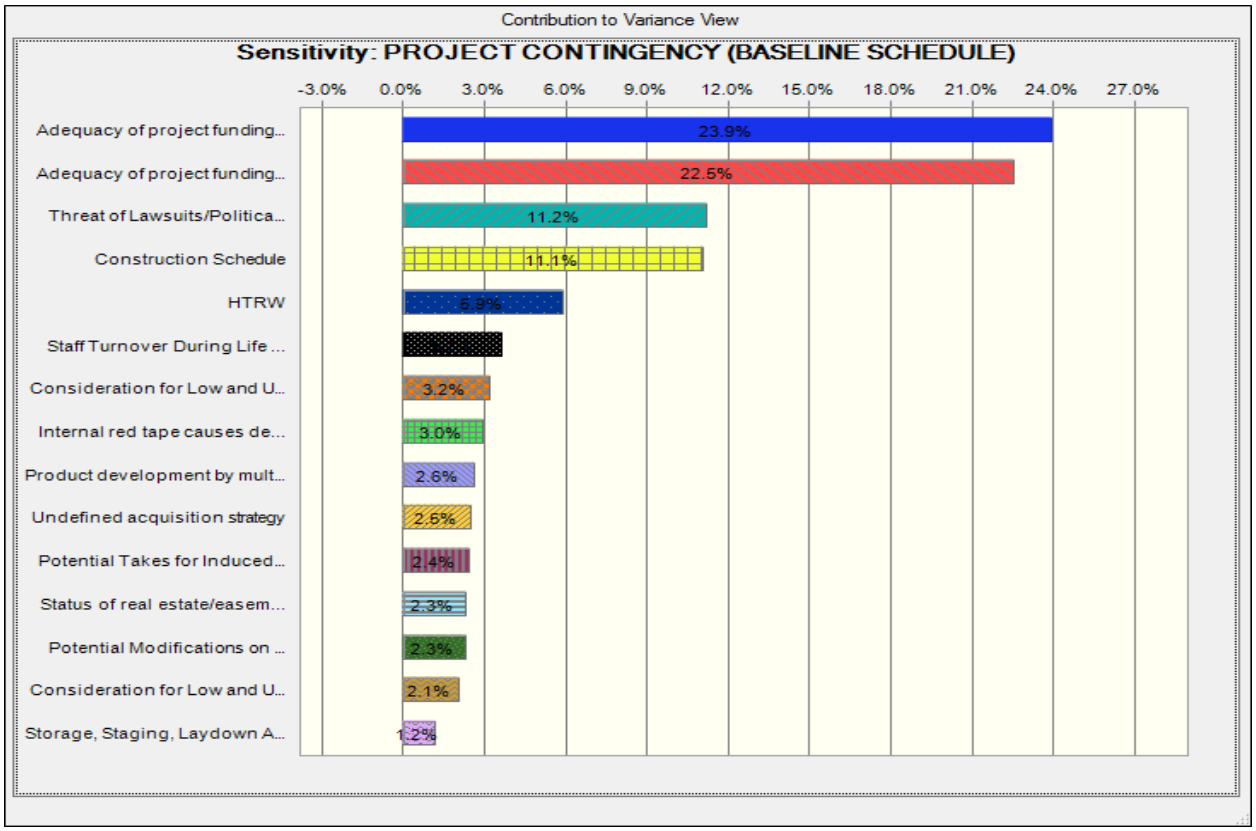


Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	136	35
80% Confidence Level		
Project Duration	136	44
100% Confidence Level		
Project Duration	136	92

Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3. Additional major findings and observations of the risk analysis are listed below.

Cost Risks: From the CSRA, the key or greater Cost Risk items of include:

- EST-3 Pump Stations estimated by Others – The pump stations are currently at a 35% design and were estimated by others, which could lead to fluctuations in costs and quantities.
- TL-6 (Inaccurate or risky design assumptions on technical issues (FRM VEQ)) - captures the risk that the design is not yet complete and based off of information obtained from others, which could impact ultimate project costs.

- PR-1 (Bidding Climate/Market Conditions) - bidding climate in the area may be at a premium due to the number of contracts that are planned for execution in the area during this time.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The greatest risk is:

- PR-2 (Adequacy of project funding (federal)) – There is a possibility of federal funding not being acquired in a timely manner or in the increments assumed during planning.
- PR-3 (Adequacy of project funding (sponsor)) – There is a possibility the sponsor will not have the necessary funding in a timely manner to keep the project moving forward to follow the expected construction schedule.

- PR-4 (Threat of Lawsuits/Political Opposition) - captures the fact that the implementation of this project could be effected if the Parkway project ends up in litigation, pushing the assumed schedule out for an indeterminate time.
- EST-1 (Construction Schedule) - captures the risk of having a schedule based on a certain number of contracts being awarded and assumed methodology, which could result in significant delay of project implementation beyond what is currently contemplated.

Table 3. Construction Cost Comparison Summary (Uncertainty Analysis)

Most Likely Cost Estimate	$138,657,760		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$141,511,488**	**$2,853,727.90**	**2.06%**
5%	**$152,056,900**	**$13,399,140.26**	**9.66%**
10%	**$154,502,557**	**$15,844,796.80**	**11.43%**
15%	**$156,241,355**	**$17,583,595.33**	**12.68%**
20%	**$157,775,581**	**$19,117,821.30**	**13.79%**
25%	**$159,033,356**	**$20,375,596.10**	**14.69%**
30%	**$160,245,537**	**$21,587,776.77**	**15.57%**
35%	**$161,425,880**	**$22,768,119.68**	**16.42%**
40%	**$162,547,414**	**$23,889,653.96**	**17.23%**
45%	**$163,679,710**	**$25,021,949.67**	**18.05%**
50%	**$164,817,871**	**$26,160,110.75**	**18.87%**
55%	**$165,988,330**	**$27,330,569.78**	**19.71%**
60%	**$167,147,353**	**$28,489,592.76**	**20.55%**
65%	**$168,346,235**	**$29,688,474.88**	**21.41%**
70%	**$169,556,068**	**$30,898,307.98**	**22.28%**
75%	**$170,955,886**	**$32,298,125.56**	**23.29%**
80%	**$172,541,028**	**$33,883,267.58**	**24.44%**
85%	**$174,278,446**	**$35,620,686.19**	**25.69%**
90%	**$176,712,539**	**$38,054,779.02**	**27.45%**
95%	**$180,200,274**	**$41,542,513.82**	**29.96%**
100%	**$196,580,134**	**$57,922,374.23**	**41.77%**

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Most Likely Schedule Duration	135.7 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	**146.6 Months**	**10.9 Months**	**8.06%**
5%	**156.1 Months**	**20.4 Months**	**15.03%**
10%	**158.7 Months**	**23.1 Months**	**17.00%**
15%	**160.7 Months**	**25.1 Months**	**18.48%**
20%	**162.5 Months**	**26.8 Months**	**19.76%**
25%	**163.8 Months**	**28.2 Months**	**20.76%**
30%	**165.2 Months**	**29.6 Months**	**21.80%**
35%	**166.5 Months**	**30.8 Months**	**22.69%**
40%	**167.6 Months**	**32.0 Months**	**23.57%**
45%	**168.9 Months**	**33.2 Months**	**24.49%**
50%	**170.1 Months**	**34.5 Months**	**25.41%**
55%	**171.4 Months**	**35.8 Months**	**26.36%**
60%	**172.8 Months**	**37.1 Months**	**27.37%**
65%	**174.4 Months**	**38.7 Months**	**28.56%**
70%	**176.0 Months**	**40.3 Months**	**29.73%**
75%	**177.9 Months**	**42.2 Months**	**31.11%**
80%	**180.0 Months**	**44.3 Months**	**32.68%**
85%	**182.8 Months**	**47.1 Months**	**34.75%**
90%	**186.6 Months**	**50.9 Months**	**37.54%**
95%	**192.3 Months**	**56.7 Months**	**41.76%**
100%	**228.1 Months**	**92.4 Months**	**68.12%**

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

Risk Drivers:

1. Cost Risk: Based on an assumed the way the project will be contracted out leads to the possibility that the assumed midpoints of construction could be incorrect. Project leadership will have to diligently watch for fluctuations in the bidding climate due to the increase in projects being awarded and construction in the Dallas area. Inaccurate or risky design assumptions on technical issues (FRM VEQ) captures the risk that the design is not yet complete and based off of information obtained from others, which could impact ultimate project costs. The assumption is this project will be broken out into 6 contracts with the city having an additional one before the rest of the project is started. If there ends up being more contracts the project costs would be impacted.

2. Schedule Risk: Threat of Lawsuits/Political Opposition captures the fact that the implementation of this project could be effected if the Parkway project ends up in litigation, pushing the assumed schedule out for an indeterminate time. Having a schedule based on a certain number of contracts being awarded and assumed methodology could result in a significant delay of project implementation beyond what is currently contemplated. HTRW captures the possibility of delay if TCEQ does not accept less stringent standards and 11 instead of 2 sites need to be investigated.

3. Risk Management: Accurate representation of estimates and risks throughout the development of the in the project is critical, and the risk analysis study and technical review of said estimate is a critical mitigation strategy. Cost Engineering and ATR MCX recommends continuous, proactive, and timely updates to estimates in conjunction with proactive contract placement and phasing planning and execution. It is recommended for the outputs created during the initial risk analysis effort serve as tools in future risk management processes. The risk register should be updated at each major project milestone and estimate update. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings. As an example, recommended uses of the risk register include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination or mitigation actions required for implementation of risk management plans.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
	PROJECT & PROGRAM MGMT								
PPM-1	Staff Turnover During Life of Project	There has been a great deal of turnover on the project throughout multiple disciplines, PM, etc. This creates inefficiencies and loss of knowledge and information.	This could impact the overall project schedule.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
PPM-2	Product development by multiple sources	The project is being prepared by multiple agencies, firms, and design entities.	This is a coordination issue that predominantly impacts schedule.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
PPM-3	Insufficient time to plan	The pressure to deliver the project can leave the project without insufficient time to plan in a holistic way to ensure quality, eliminate duplication of effort, and communicate information effectively.	This has impact the project, but in terms of schedule only.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
PPM-4	Internal red tape causes delay getting approvals, decisions	Requirements for compliance with RMC, HQUSACE design standards, ATR, and IEPR will impact the schedule implementation.	This will impact the overall schedule.	Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
	CONTRACT ACQUISITION RISKS								
CA-1	Undefined acquisition strategy	There is no comprehensive plan for the procurement for this project. There is a preference in the District for Best Value-Tradeoff procurements. Many of the work features lend themselves to small business.	The current assumption is that there will be 5 contracts for the FRM-IDP and none will be small business. If there are more contracts and any of them go to a small buisness there could be a significant impact on scheduling.	Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
	TECHNICAL RISKS								
TL-1	Suitable Borrow/Fill Sources Identified	The source identification for the BVP are complete. However, the quantity availability as well as suitability are uncertain. The material required for the FRM component of the project is assured.	The ROM estimate is that there may be a requirement of up to 200,000 cy of imported material from a source not yet identified.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW
TL-2	Surveys	Most of the data is based on 1991 LIDAR data. Bathymetry data has been obtained more recently.	The City has performed work on the side slopes of the levees since 1991. Therefore, there is uncertainty as to the disposition of the current conditions. This could impact scope development (positive or negative). In fact, it is more likely to see reduction in scope rather than increase.	Very Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW
TL-3	HTRW	The Corps has completed a Phase I HTRW survey recently. TEC (Contractor) produced a report that identified 11 potential sites for HTRW presence (USTs, deleterious materials, etc.). The final trip report shows no indications of apparent sites of concern.	The Corps has fulfilled its obligations in investigations. The 11 sites of concern were originally identified by using the most stringent (TRRs) standards. Per dermal standards, there are only 2 sites of concern. If TCEQ does not accept the less stringent standards, there are still 11 sites to address. Regardless, investigations would be borne by the sponsor, but cleanup would be outside the authorization. If cleanup is required, then it could significantly delay the project.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
TL-5	Base condition risk assessment	The base condition risk assessment with other than steady state flow, the conditions are reduced to manageable levels. Existing conditions were based on steady state seepage conditions.	Although this may not impact the project as it currently stands, it is predicated on assumptions. It could have implications for effectiveness based on low probability, high impact events (separate from this authorization).	N/A	N/A	N/A	N/A	N/A	N/A

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
TL-6	Inaccurate or risky design assumptions on technical issues (FRM VEQ)	Quantity estimates are approximations rather than detailed design (specific to the FRM and side-slope flattening). The Pump Stations are designed to a 35% level.	No greater than 20% swing in VEQ is anticipated. Because the pump stations are based on 35% design and there is the opportunity for change it could have a moderate affect on costs.	Likely	Significant	HIGH	N/A	N/A	N/A
TL-7	Houston Street Bridge	There is concern with the Houston Street Bridge as is lower than the surrounding levees. If there was a flood event, then it could breach the levees due to introduction of an artificial seepage path.	Some analysis needs to be performed to see if there is anything that will be appurtenant to this project that needs to be added.	Unlikely	Marginal	LOW	N/A	N/A	N/A
TL-8	Design changes to accommodate overlapping footprints for work packages	The number of contracts occurring within the project footprint may require design changes to accommodate probable overlap of project efforts.	This is not seen as a significant impact to cost.	Unlikely	Marginal	LOW	N/A	N/A	N/A
	LANDS AND DAMAGES RISKS								
LD-1	Status of real estate/easement acquisition	The acquisitions are getting done, but they are not all complete yet. There is some confusion and communication issues with obtaining information and updates.	Most of the needs for the actual project features are known. Some are still being finalized. The pricing is fairly stable and real estate has confidence in their estimates. The greatest impact will be in terms of delay.	Unlikely	Marginal	LOW	Likely	Marginal	MODERATE
LD-2	Storage, Staging, Laydown Area Needs Not Defined	Needs have not been identified yet for the staging areas.	There will likely be acquisitions or easement that need to be obtained for staging areas. This will increase costs as well as potentially delay the schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
LD-5	DART Involvement	There is an old crossing (AT&SF) that is not currently service that the Government will be modifying. It is owned by DART.	There is not a huge concern regarding resistance from DART, as the City has already done work in this area without major issues.	Likely	Negligible	LOW	N/A	N/A	N/A
LD-6	Potential Takes for Induced Flooding	The Corps has imposed regulations regarding neutrality in hydraulics. The PDT is counting on a waiver on this regulation, as it is not currently in compliance. The project is reducing the water level and thereby reducing storage.	Induced flooding may require real estate acquisition (takes).	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE
	CONSTRUCTION RISKS								
CON -1	Conflicts with Other Contracts	There is a great deal of construction work occurring within the project area. There are currently approximately 15-20 contracts occurring within the Dallas Floodway footprint. There will also be several contracts occurring under the umbrella of this project.	There is inherent risk of coordination and efficiency with respect to other contracts. However, phasing and specifications should handle much of the issue. Still, there is risk of impact.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON -2	Limited Staging Areas	There is concern that there are no designated areas for staging for the contracts. The federal real estate is currently in the floodway, which is not adequate for contractor staging. The City will have to accommodate staging.	There could be staging areas identified that are not proximate to the actual contract work sites. This may lead to inefficiencies and lower productivities.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW
CON -3	Air Quality Restrictions	There are air quality restrictions in terms of emissions.	Officially, there are limits on the number of machines that can be working. However, this is rarely enforced.	Very Unlikely	Negligible	LOW	Very Likely	Negligible	LOW
CON -4	Noise Pollution Requirements	The City has some regulations that would effectively limit construction to daytime operations.	This could impact the overall schedule and sequencing. There will be a possibility for a variance due to the project location to work at night. These restrictions are known and common.	Very Unlikely	Negligible	LOW	Very Likely	Negligible	LOW
CON -5	Site access and restrictions	There are highways, bridges, dams, water, overhead and underground utilities, as well as levees. This is a highly urbanized area with heavy traffic.	This could impact the overall contractor productivity during construction.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
CON -6	Critical fabrication and delivery (pumps)	There has been long lead times for pumps. This could become and issue for delivery.	This could impact the delivery schedule.	Likely	Negligible	LOW	Likely	Negligible	LOW
CON - MOD	Potential Modifications on Existing Contract	There is inherent risk due to issues with post-award modifications due to design errors, unknowns, and other changes.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	ESTIMATE AND SCHEDULE RISKS								
EST-1	Construction Schedule	A detailed schedule has been developed under the assumption that 7 contracts will be used.	If there are more or less contracts it will impact e the current schedule, either lengthening or shortening the schedule.	Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
EST-2	Configuration of Estimate to Match Acquisition	The current estimate is configured for one large contract with multiple subcontractors. It is likely that the project will be broken into several work packages/contracts (17-20). Therefore, there will be additional costs not captured in the current estimate.	The costs not included in the estimate would include mobilization, varying indirect costs, and efficiency loss. This risk is captured under CA-1 and will not be used for risk calculation.	Very Unlikely	Negligible	N/A	Likely	Marginal	N/A
EST-3	Pump Stations estimated by Others	The pump station estimate was created by others, based on 35% design. There could be disparitities in the estimate that could affect the cost.	The other pump stations that have been constructed in the area were estimated by the same organization as these and they were not underestimated.	Likely	Significant	HIGH	Likely	Marginal	MODERATE
	CONSIDERATION FOR LOW AND UNKNOWN INTERAL RISK								
INT-1	Consideration for Low and Unknown Internal Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	Programmatic Risks	(External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)							
PR-1	Bidding Climate/Market Conditions	There are a number of large civil works/earthwork projects occurring within the Dallas Metro area that will compete with this project.	The ultimate bid prices may be at a premium due to demand issues.	Likely	Significant	HIGH	Unlikely	Marginal	LOW
PR-2	Adequacy of project funding (federal)	There is the possibility that the federal funding may not be obtained timely, or in the contemplated increments, or in the amounts in the program estimates.	If funding is not obtained, it could be a show-stopping risk. However, if funds are not received timely, or they are received in less than optimal increments, it could have significant impact on the cost and schedule. The project has been broken out into multiple contracts to account for duration and the possible incremental funding, to mitigates the cost risk.	Unlikely	Marginal	LOW	Likely	Significant	HIGH
PR-3	Adequacy of project funding (sponsor)	There is the possibility that the sponsor funding may not be obtained timely, or in the contemplated increments, or in the amounts in the program estimates.	If funding is not obtained, it could be a show-stopping risk. However, if funds are not received timely, or they are received in less than optimal increments, it could have significant impact on the cost and schedule. The project has been broken out into multiple contracts to account for duration and the possible incremental funding, to mitigates the cost risk.	Unlikely	Marginal	LOW	Likely	Significant	HIGH
PR-4	Threat of Lawsuits/Political Opposition	There is a high likelihood that the Parkway will end up in litigation. This could delay implementation of this project. If the Parkway project is stopped, it may require additional mitigation and excavation costs to be borne by this project.	This has a very small chance of significantly increasing costs, and a more likely chance of producing delays.	Unlikely	Critical	MODERATE	Likely	Significant	HIGH

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)									
PR-5	Severe flood event	There is a small probability of a severe weather event producing a flood. The worst case scenario is that it could produce a catastrophic blowout of existing river relocation work, necessitating rework.	The chance of occurrence is very low, but would have significant cost impact and moderate schedule impacts.	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW
EXT-1	Consideration for Low and Unknown External Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

US Army Corps
of Engineers®

Dallas Floodway
Balance Vision Plan (BVP)
Tentatively Selected Plan
Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Ft. Worth District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

August 11, 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), Ft. Worth District, presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Dallas Floodway Balanced Vision Plan Feasibility Report. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis, *Monte-Carlo* based-study was conducted by the Project Development Team (PDT) on remaining costs. The purpose of this risk analysis study is to present the cost and schedule risks considered, those determined and respective project contingencies at a recommended 80% confidence level of successful execution to project completion.

Specific to the Dallas Floodway BVP project, the base case project cost for the Tentatively Selected Plan is estimated at approximately $314 Million. Based on the results of the analysis, the Cost Engineering Mandatory Center of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $74 Million, or 31%. This contingency includes $65 Million (27%) for risks related to cost and $9 Million (4%) for the effect of schedule delay on overall project costs.

Walla Walla Cost MCX performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portray the development of contingencies (31% overall). The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Base Cost Estimate	**$239,000,000**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$279,700,000	17.1%
50%	$301,100,000	26.0%
80%	**$313,100,000**	**31.0%**
95%	$325,600,000	36.3%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

Cost Risks: From the CSRA, the key or greater Cost Risk items include:

- CA-1 (Undefined Acquisition Strategy) - can impact cost and schedule if more or less contracts are awarded.
- EST-2 (BVP Estimate Prepared By Others) - captures the risk that the estimate was prepared by a consultant to the City of Dallas, so recalculations in USACE standards may increase the eventual costs.

- PR-1 (Bidding Climate/Market Conditions) - have an effect on any estimate, depending on what type of work and the area at the time determines how much of an effect.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The greatest risk, attributing to 30 percent, is:

- EST-1(Construction Schedule) - captures the risk that the detailed construction schedule could be off based on the method assumed by estimator affecting the overall duration of the project, resulting in significant delay of project implementation beyond what is currently contemplated.

Recommendations: As detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Ft. Worth District, this report presents a recommendation for the total project cost and schedule contingencies for the Dallas Floodway BVP Inlet Navigation Pilot Study Project.

2.0 BACKGROUND

The Dallas Floodway project is comprised of the Balance Vision Plan (BVP), Interior Drainage Plan (IDP), and Flood Risk Management (FRM) components. The BVP contains 7 river relocations (7 bends), creation of three lakes (West Dallas and Downtown Lakes (not constructed under this project)), and appurtenant recreation facilities (trails, parklands, recreational fields, promenade, etc. (not included in this project)). The BVP also contains a cutoff wall. The IDP consists of seven pump stations (7 federal (only 3 are being constructed under this project). The FRM consists of levee raises and modifications and removal of the AT&SF Bridge.

As a part of this effort, Ft. Worth District requested that the USACE Cost Engineering Mandatory Center of Expertise for Civil Works (Cost Engineering MCX) provide an agency technical review (ATR) of the cost estimate and schedule for Recommended Project Plan. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the base case

Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Ft. Worth District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Walla Walla Cost Engineering MCX performed the Cost and Schedule Risk Analysis, relying on local Ft. Worth District staff to provide information gathering. The Walla Walla Cost Engineering MCX facilitated an on-site risk identification meeting on April 30, 2013 with the Ft. Worth District PDT to produce a risk register that served as the framework for the risk analysis. Participants in risk identification meeting included the following:

Name	Organization
Jon Loxely	SWF-PM
Ninfa Taggart	SWF-EC
Glenn Matlock	NWW-EC-C
David Wilson	EC-HH
Helena Mosser	SWF-EC-HH
Jesse Coleman	SWF-EC-GE
Nizar Almasri	SWF-EC-SE
Lauren Kruse	SWF-PP
Do Dang	EC-DC
Marcia Hackett	PER-EE
Renee Russell	RE-P
Mike Bormann	
Chris Chini	EC-DC

The first cost risk model was completed May 13, 2013. However, scope and estimate updates since then, as well as a PDT sanity check review, necessitated a rerun of the original model. The final results were completed and reported to Ft. Worth on July 29, 2013.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least

in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

A formal PDT meeting was held with the Ft. Worth District office for the purposes of identifying and assessing risk factors. The meeting included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, environmental compliance, and real estate

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk

factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT.

Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Dallas Floodway BVP project.

a. The Ft. Worth District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files electronically. The MII and CWE files transmitted and downloaded on July 23, 2013 was the basis for the updated cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay. Specific to the Dallas Floodway BVP project, the schedule was analyzed only for impacts due to residual fixed costs.

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for the State of Texas is 0.87, meaning that the average inflation for the project area is assumed to be 13% lower than the national average for inflation. Therefore, it is assumed that the project inflations experienced are similar (or better) to OMB inflation factors for future construction. Thus, the risk analyses accounted for no escalation over and above the national average.

e. Per the data in the estimate, the Overhead percentage for the Prime Contractor is 15%, and 10% for the Subcontractors. Thus, the assumed residual fixed cost rate for this project is 12.5%. For the P80 schedule, this comprises approximately 29.13% of

the total contingency and 4.5% of the base cost estimate. This is due to the accrual of residual fixed costs associated with delay associated with the implementation schedule.

f. The Cost MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk "watch list".

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $80 Million at the P80 confidence level (34% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 28% and 52% of the baseline cost estimate, respectively.

Table 1. Construction Cost Contingency Summary

Base Case Construction Cost Estimate	**$238,900,000**	
Confidence Level	**Construction Value ($$)**	**Contingency (%)**
5%	$275,100,000	15.1%
50%	$293,800,000	22.9%
80%	**$304,300,000**	**27.3%**
90%	$310,100,000	29.8%

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 46 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Figure 1. Cost Sensitivity Analysis

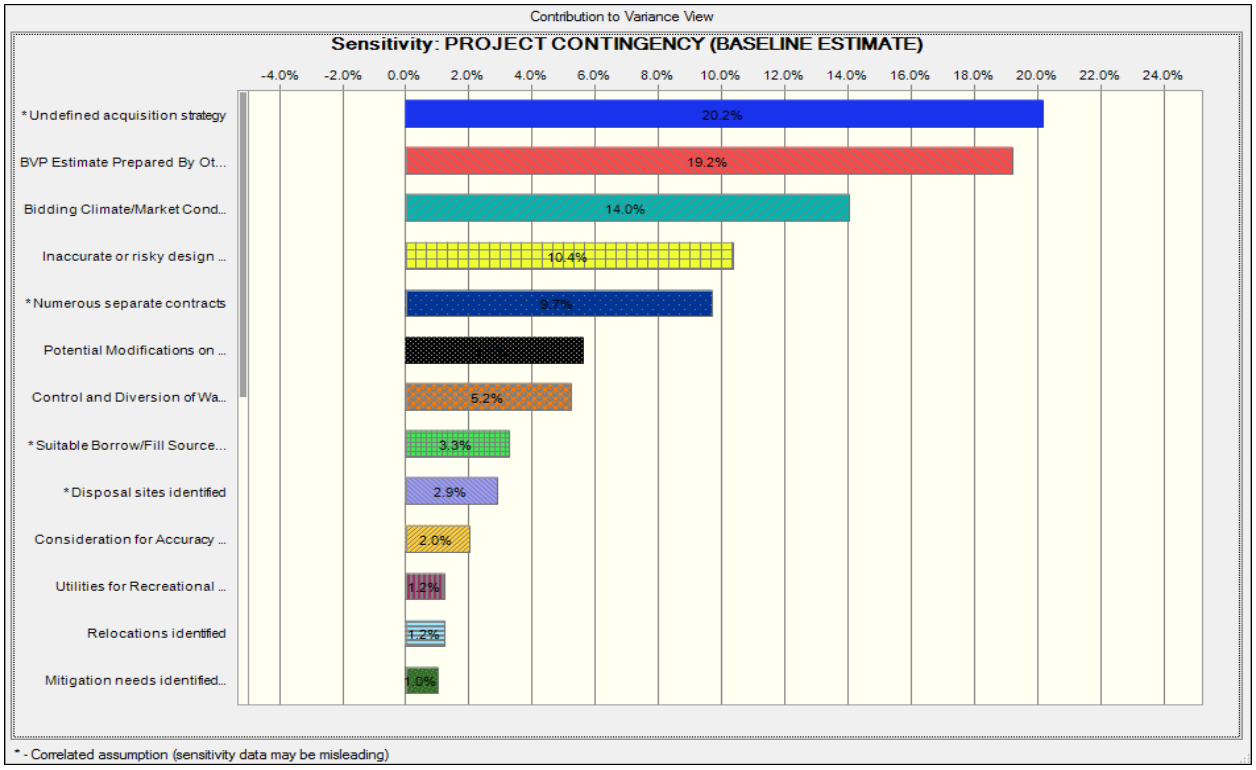
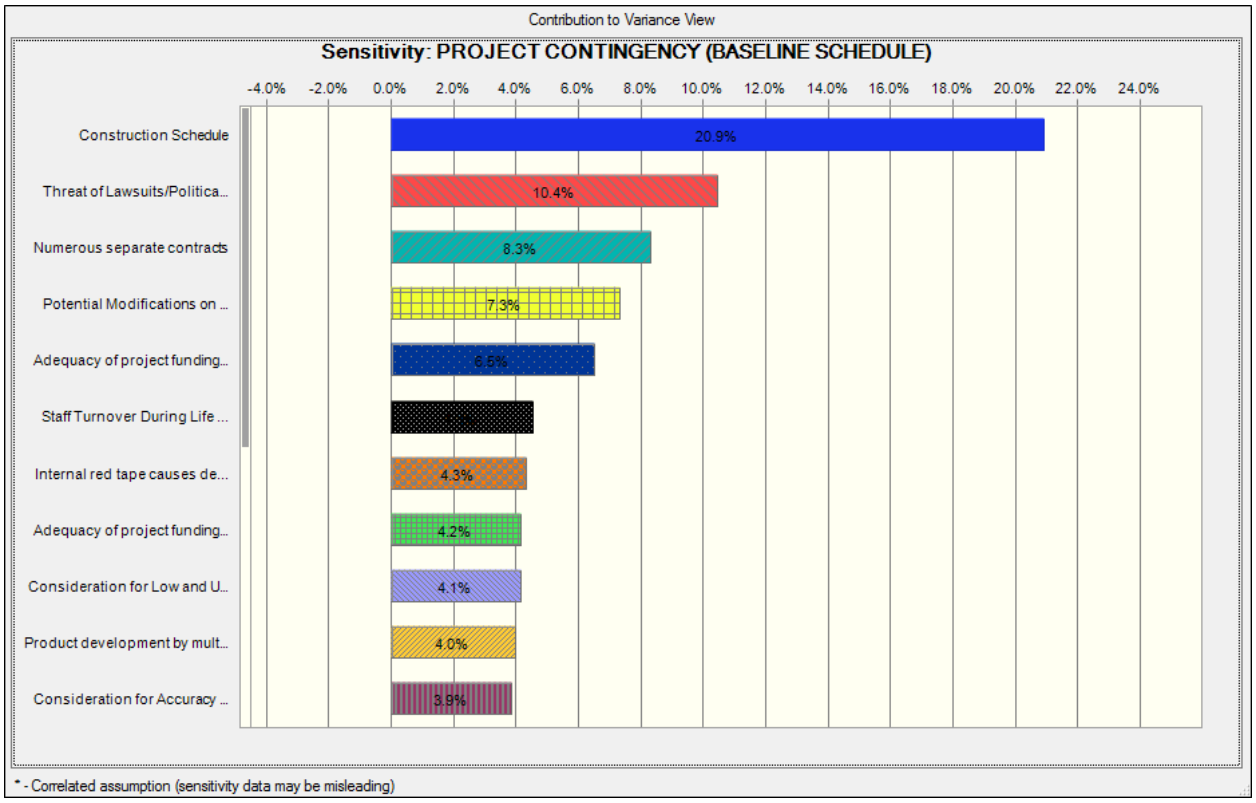


Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	179	43
80% Confidence Level		
Project Duration	179	53
100% Confidence Level		
Project Duration	179	95

Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3. Additional major findings and observations of the risk analysis are listed below.

Cost Risks: From the CSRA, the key or greater Cost Risk items of include:

- CA-1 (Undefined Acquisition Strategy) - can impact cost and schedule if more or less contracts are awarded.
- EST-2 (BVP Estimate Prepared By Others) - captures the risk that the estimate was prepared by a consultant to the City of Dallas, so recalculations in USACE standards may increase the eventual costs.
- PR-1 (Bidding Climate/Market Conditions) - have an effect on any estimate, depending on what type of work and the area at the time determines how much of an effect.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The greatest risk is:

- EST-1(Construction Schedule) - captures the risk that not having a detailed construction schedule could misrepresent the overall duration of the project, resulting in significant delay of project implementation beyond what is currently contemplated.

Table 3. Construction Cost Comparison Summary (Uncertainty Analysis)

Most Likely Cost Estimate	$238,992,031		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$256,240,093**	**$17,248,061.37**	**7.22%**
5%	**$275,108,048**	**$36,116,017.01**	**15.11%**
10%	**$278,777,060**	**$39,785,028.57**	**16.65%**
15%	**$281,461,265**	**$42,469,233.86**	**17.77%**
20%	**$283,682,795**	**$44,690,763.80**	**18.70%**
25%	**$285,722,790**	**$46,730,758.67**	**19.55%**
30%	**$287,484,680**	**$48,492,648.87**	**20.29%**
35%	**$289,182,421**	**$50,190,389.34**	**21.00%**
40%	**$290,788,917**	**$51,796,885.59**	**21.67%**
45%	**$292,316,962**	**$53,324,931.01**	**22.31%**
50%	**$293,831,194**	**$54,839,162.95**	**22.95%**
55%	**$295,380,961**	**$56,388,929.30**	**23.59%**
60%	**$296,858,605**	**$57,866,574.02**	**24.21%**
65%	**$298,469,080**	**$59,477,049.02**	**24.89%**
70%	**$300,281,147**	**$61,289,116.01**	**25.64%**
75%	**$302,158,237**	**$63,166,206.06**	**26.43%**
80%	**$304,273,171**	**$65,281,140.04**	**27.32%**
85%	**$306,949,617**	**$67,957,585.64**	**28.44%**
90%	**$310,087,420**	**$71,095,389.30**	**29.75%**
95%	**$314,804,269**	**$75,812,238.16**	**31.72%**
100%	**$344,387,747**	**$105,395,716.24**	**44.10%**

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Most Likely Schedule Duration	179.1 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	**191.2 Months**	**12.1 Months**	**6.75%**
5%	**206.8 Months**	**27.7 Months**	**15.44%**
10%	**209.8 Months**	**30.7 Months**	**17.12%**
15%	**212.0 Months**	**32.8 Months**	**18.33%**
20%	**213.7 Months**	**34.6 Months**	**19.32%**
25%	**215.2 Months**	**36.1 Months**	**20.16%**
30%	**216.7 Months**	**37.6 Months**	**21.00%**
35%	**218.1 Months**	**39.0 Months**	**21.76%**
40%	**219.6 Months**	**40.4 Months**	**22.58%**
45%	**221.0 Months**	**41.9 Months**	**23.37%**
50%	**222.4 Months**	**43.2 Months**	**24.14%**
55%	**223.7 Months**	**44.6 Months**	**24.91%**
60%	**225.2 Months**	**46.0 Months**	**25.70%**
65%	**226.7 Months**	**47.5 Months**	**26.54%**
70%	**228.4 Months**	**49.3 Months**	**27.52%**
75%	**230.3 Months**	**51.2 Months**	**28.59%**
80%	**232.4 Months**	**53.3 Months**	**29.76%**
85%	**234.9 Months**	**55.8 Months**	**31.14%**
90%	**238.3 Months**	**59.2 Months**	**33.06%**
95%	**243.9 Months**	**64.7 Months**	**36.14%**
100%	**274.0 Months**	**94.9 Months**	**52.96%**

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

Risk Drivers:

1.Cost Risk: Acquisition strategy needs to be determined during PED so that when the estimate is updated it will be as accurate as possible. The PDT should invest in detailed estimates that reflect all known scope, converting the lump sum items and A-E generated estimates to MCACES estimates in accordance with USACE estimating guidance and methodologies. The Project Manager needs to be aware of what type of projects are under construction in the area when each of the contracts are up for solicitation. It is assumed that there is no need to go outside of the area for qualified contractors, but if it was it could affect the bidding climate.

2. Schedule Risk: Project leadership should invest in development of a detailed construction schedule that captures likely durations, crew productivities, constraints and restrictions, and likely market-driven methodologies.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.

- Providing project sponsors, stakeholders and leadership/management with a documented framework from which risk status can be reported in the context of project controls.

- Communicating risk management issues.

- Providing a mechanism for eliciting risk analysis feedback and project control input.

- Identifying risk transfer, elimination or mitigation actions required for implementation of risk management plans.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
	PROJECT & PROGRAM MGMT								
PPM-1	Staff Turnover During Life of Project	There has been a great deal of turnover on the project throughout multiple disciplines, PM, etc. This creates inefficiencies and loss of knowledge and information.	This could impact the overall project schedule.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
PPM-2	Product development by multiple sources	The project is being prepared by multiple agencies, firms, and design entities.	This is a coordination issue that predominantly impacts schedule.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
PPM-3	Insufficient time to plan	The pressure to deliver the project can leave the project without insufficient time to plan in a holistic way to ensure quality, eliminate duplication of effort, and communicate information effectively.	This has impact the project, but in terms of schedule only.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
PPM-4	Internal red tape causes delay getting approvals, decisions	Requirements for compliance with RMC, HQUSACE design standards, ATR, and IEPR will impact the schedule implementation.	This will impact the overall schedule.	Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
	CONTRACT ACQUISITION RISKS								
CA-1	Undefined acquisition strategy	There is no comprehensive plan for the procurement for this project. There is a preference in the District for Best Value-Tradeoff procurements. Many of the work features lend themselves to small business.	The lack of the acquisition plan will likely impact the cost significantly and also impact the schedule.	Very Likely	Significant	HIGH	Likely	Marginal	MODERATE
CA-2	Numerous separate contracts	Possibilty of more than the 7 assumed contracts for the entire project.	Multiple contracts will introduce multiple mobilization and separate contact action costs, as well as produce challenges for phasing and sequencing. At this point the estimate for the BVP is split into 3 contracts, with 5 other contracts for the FRM and IDP.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	TECHNICAL RISKS								
TL-1	Suitable Borrow/Fill Sources Identified	The source identification for the BVP are complete. However, the quantity availability as well as suitability are uncertain. The material required for the FRM component of the project is assured.	The ROM estimate is that there may be a requirement of up to 200,000 cy of imported material from a source not yet identified.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW
TL-2	Disposal sites identified	There is potential that disposal of excavated material may be required off-site. This is particularly true if the Parkway project does not go forward.	If the Parkway project does not go forward, then the PDT will need to locate disposal sites for excavated material, increasing the construction costs.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW
TL-3	Design development, incomplete or preliminary	The design is not yet complete for the project, and much of the project has been designed by others and is at different levels of completeness (A&Es working on behalf of the City).	The state of design will likely impact the costs in terms of scope/methodology details. It may also impact the schedule. (The risks forthis item are captures under TL-5 and will not add additional risks to the model)	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
TL-4	Sinkhole adjacent to East Levee	There is a sinkhole located near the East Levee. There is no remedy in place yet. A remediation plan is being worked under separate action that should be resolved prior to the start of this project. There was a tunnel collapse that developed into a sinkhole. The Parkway currently is located above the sinkhole.	Whereas there are no direct impact on the Dallas Floodway project, it could have second order impacts on the project and is noted herein as such.	N/A	N/A	N/A	N/A	N/A	N/A

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
TL-5	Inaccurate or risky design assumptions on technical issues	Quantity estimates are uncertain (specific to the BVP). There are quantities developed, but there is not confidence in how they were developed or obtained.	Based on the rough calculations done by cost and civil design the AE estimate appears to be conservative in the earthwork and optimistic in the bridge pier mods(based on typical design).	Likely	Significant	HIGH	Likely	Marginal	MODERATE
TL-6	Other Bridges	There are 7 area bridges crossing the Trinity River in the project footprint that are impacted by the proposed water surface elevation. All of them (low cord) are lower than the existing levees. There is the chance during a very high flood event that the decks would be submerged. However, all of the bridges with the exception of Houston Street Bridge would be inundated for 2 hours or less.	Seepage paths created by the bridges during flood events could introduce potential issues for the levees.	Very Unlikely	Significant	LOW	N/A	N/A	N/A
TL-7	Design changes to accommodate overlapping footprints for work packages	The number of contracts occurring within the project footprint may require design changes to accommodate probable overlap of project efforts.	This is not seen as a significant impact to cost.	Unlikely	Marginal	LOW	N/A	N/A	N/A
TL-8	Clay Liner of Lake	The minimum depth of the clay liner is 18" which is was used in the evaluation of quantities for the BVP. This is a minimum and may change based on further analysis to upwards of 30". This will increase the required material that may or may not be available within the floodway.	This will increase project costs marginally and will be a very likely addition in some areas. The PDT does not foresee any issues with scheduling as this will be worked out in further design phases. (This is not included since it only relates to the West Dallas Lakes.)	N/A	N/A	N/A	N/A	N/A	N/A
TL-9	Utilities for Recreational Features	There may be uncaptured quantities for utilities that support the BVP recreational features, lighting, electrical conduit, water and sanitary sewer for bathrooms and water fountains.	Talking to the fire protection expert, there may be additional costs for fire hydrants and emergency vehicle access to marinas and amphitheaters for water lines to support fire hydrants to those facilities. This must be confirmed with the City of Dallas. Meanwhile, it may impact cost.	Very Likely	Marginal	MODERATE	N/A	N/A	N/A
	LANDS AND DAMAGES RISKS								
LD-1	Status of real estate/easement acquisition	The acquisitions are getting done, but they are not all complete yet. There is some confusion and communication issues with obtaining information and updates.	Most of the needs for the actual project features are known. Some are still being finalized. The pricing is fairly stable and real estate has confidence in their estimates. The greatest impact will be in terms of delay.	Unlikely	Marginal	LOW	Likely	Marginal	MODERATE
LD-2	Storage, Staging, Laydown Area Needs Not Defined	Needs have not been identified yet for the staging areas.	There will likely be acquisitions or easement that need to be obtained for staging areas. This will increase costs as well as potentially delay the schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
LD-3	Relocations identified	The PDT does not have all the information for all of the utility relocations.	This could produce delays, and there is some uncertainty as to cost (cost share or not). There are costs in the estimate for the franchise and utilities. However, it does not contain all the details.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
LD-6	TXDOT Involvement	There are highway bridge within the project footprint. There is uncertainty as to who owns the ROWs in these areas (ONCOR or City).	There hasn't been significant issues working with these entities in the past. However, the uncertainty as to ultimate ownership introduces potential for delay.	Very Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
LD-7	Potential Takes for Induced Flooding	The Corps has imposed regulations regarding neutrality in hydraulics. The PDT is counting on a waiver on this regulation, as it is not currently in compliance. The project is reducing the water level and thereby reducing storage.	Induced flooding may require real estate acquisition (takes).	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
	REGULATORY AND ENVIRONMENTAL RISKS								
RE-1	Mitigation needs identified	There may be a requirement for riverine impacts that would require purchase of banking credits.	There is an imminent meeting that will help resolve this matter.	Likely	Marginal	MODERATE	N/A	N/A	N/A
RE-2	Environmental and water quality issues	The project hinges on the determination of environmental acceptability. There will be coordination between federal, state, and city entities.	The acceptability may be contingent on obtaining more information or modifying certain features. More likely, it will be that certain criteria must be met during construction that will impact methods and productivities.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
RE-3	Hazardous wildlife attractants on or near airports	The FAA is resistant to the addition of water features near Love Field, as they will attract additional riparian wildlife.	PDT is confident that the issues can be worked through.	Unlikely	Negligible	LOW	Likely	Negligible	LOW
RE-4	Issues with endangered species	There is a question regarding freshwater mussels.	If mussels are present, they may need to be relocated which will increase costs.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW
RE-5	Status of permits	The PDT is not contemplating any delay or issue in obtaining permits. However, implementing what is required may be a challenge (particularly with water quality). Permits must be obtained prior to construction.	The State Water Quality and the Corps Regulatory requirements are currently the most challenging to implement.	Likely	Negligible	LOW	Likely	Negligible	LOW
	CONSTRUCTION RISKS								
CON-1	Unknown Utilities	There are several utilities in the floodway project. Most of these are known. However, there is inherent risk of encountering known or unknown utilities.	This could impact the contractor productivities. However, this pertains to the risk of encountering utilities during construction. The PDT feels that the overall risk is low.	Unlikely	Marginal	LOW	Unlikely	Negligible	LOW
CON-2	Conflicts with Other Contracts	There is a great deal of construction work occurring within the project area. There are currently approximately 15-20 contracts occurring within the Dallas Floodway footprint. There will also be several contracts occurring under the umbrella of this project.	There is inherent risk of coordination and efficiency with respect to other contracts. However, phasing and specifications should handle much of the issue. Still, there is risk of impact.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON-3	Limited Staging Areas	There is concern that there are no designated areas for staging for the contracts. The federal real estate is currently in the floodway, which is not adequate for contractor staging. The City will have to accommodate staging.	There could be staging areas identified that are not proximate to the actual contract work sites. This may lead to inefficiencies and lower productivities.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW
CON-4	Air Quality Restrictions	There are air quality restrictions in terms of emissions.	Officially, there are limits on the number of machines that can be working. However, this is rarely enforced.	Very Unlikely	Negligible	LOW	Very Likely	Negligible	LOW
CON-5	Noise Pollution Requirements	The City has some regulations that would effectively limit construction to daytime operations.	This could impact the overall schedule and sequencing. There will be a possibility for a variance due to the project location to work at night. These restrictions are known and common.	Very Unlikely	Negligible	LOW	Very Likely	Negligible	LOW
CON-6	Site access and restrictions	There are highways, bridges, dams, water, overhead and underground utilities, as well as levees. This is a highly urbanized area with heavy traffic.	This could impact the overall contractor productivity during construction.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW
CON-7	In-water work	There are bridge modifications and pumping plant work that will occur in the wet. This will also include diversion activities.	There will likely be little to no actual in the wet work beyond the actual diversion activities. However, there is a deep lake (West Dallas) that will probably necessitate in the wet work (this is a large excavation).	Likely	Negligible	LOW	Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
CON-8	Control and Diversion of Water	There will be river diversion work as well as dewatering involved in the project. There will several coffer dams (at least 6) built throughout this project.	Issues with this could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON-10	Contract Management Processes	The sponsors do not have the same latitude for dealing with contract administration as the federal government. This could introduce potential for changes and cost growth.	This could impact the overall costs and schedule.	Likely	Marginal	MODERATE	Unlikely	Marginal	LOW
CON-MOD	Potential Modifications on Existing Contract	There is inherent risk due to issues with post-award modifications due to design errors, unknowns, differing site conditions, and other changes.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	ESTIMATE AND SCHEDULE RISKS								
EST-1	Construction Schedule	There is a detailed project scheduled based on the assumption that there will be 9 contracts for the entire project and some will be sequential while others are concurrent.	If there are more contracts than assumed it could lead to a delay in contract award and cause the project to take longer than anticipated and increase cost.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
EST-2	BVP Estimate Prepared By Others	The BVP estimate was received by the City of Dallas. There was little information to assist in configuring into the overall cost estimate for the project.	There is some uncertainty and lack of confidence in the details and methodologies used in preparing the BVP estimate due to lack of information. This could impact the cost and schedule.	Likely	Significant	HIGH	Likely	Marginal	MODERATE
EST-3	Consideration for Accuracy of Crew Generation and Productivities	The accuracy of the crews and productivities used in the BVP estimate is in question. Many of the costs were provided as lump sums rather than calculated costs.	This could impact the cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
EST-4	Confidence the Cutoff Wall Estimate	The calculations and methods for the slurry cutoff walls was based on advisement from others. Therefore, the PDT lacks confidence in the soundness of the estimate for these walls.	The cost is conservative. Therefore, the costs may be too high in the current estimate.	Likely	Marginal	MODERATE	Unlikely	Negligible	LOW
EST-5	Configuration of Estimate to Match Acquisition	The current estimate is configured for one large contract with multiple subcontractors. It is likely that the project will be broken into several work packages/contracts (17-20). Therefore, there will be additional costs not captured in the current estimate.	The costs not included in the estimate would include mobilization, varying indirect costs, and efficiency loss. This issue is captured under CA-1 and this is just for informational purposes.	Likely	Negligible	LOW	Likely	Negligible	LOW
	CONSIDERATION FOR LOW AND UNKNOWN INTERAL RISK								
INT-1	Consideration for Low and Unknown Internal Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)								
PR-1	Bidding Climate/Market Conditions	There are a number of large civil works/earthwork projects occurring within the Dallas Metro area that will compete with this project.	The ultimate bid prices may be at a premium due to demand issues.	Likely	Significant	HIGH	Unlikely	Marginal	LOW
PR-2	Adequacy of project funding (sponsor)	There is the possibility that the sponsor funding may not be obtained timely, or in the contemplated increments, or in the amounts in the program estimates.	If funding is not obtained, it could be a show-stopping risk. However, if funds are not received timely, or they are received in less than optimal increments, it could have significant impact on the cost and schedule.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
PR-3	Stakeholders request late changes	Stakeholders include the City of Dallas, landowners, TXDOT, state and federal agencies, the tollway, and the general public.	There may be a call for uncontemplated work features after award to accommodate stakeholders issues.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)								
PR-4	Threat of Lawsuits/Political Opposition	There is a high likelihood that the Parkway will end up in litigation. This could delay implementation of this project. If the Parkway project is stopped, it may require additional mitigation and excavation costs to be borne by this project.	This has a very small chance of significantly increasing costs, and a more likely chance of producing delays.	Unlikely	Critical	MODERATE	Likely	Significant	HIGH
PR-5	Severe flood event	There is a small probability of a severe weather event producing a flood. The worst case scenario is that it could produce a catastrophic blowout of existing river relocation work, necessitating rework.	The chance of occurrence is very low, but would have significant cost impact and moderate schedule impacts.	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW
PR-6	Adequacy of project funding (sponsor)	There is the possibility that the sponsor funding may not be obtained timely, or in the contemplated increments, or in the amounts in the program estimates.	If funding is not obtained, it could be a show-stopping risk. However, if funds are not received timely, or they are received in less than optimal increments, it could have significant impact on the cost and schedule. The project has been broken out into multiple contracts to account for duration and the possible incremental funding, this mitigates the cost risk.	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE
EXT-1	Consideration for Low and Unknown External Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 329279

SWF – Dallas Floodway Feasibility

The Dallas Floodway Feasibility study, as presented by Ft. Worth District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of August 21, 2014, the Cost MCX certifies the estimated total project cost of:

FY 2014 Price Level: $571,591,000
Fully Funded Amount: $673,066,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

Digitally signed by CALLAN.KIM.C.1231558221
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CALLAN.KIM.C.1231558221

Kim C. Callan, PE, CCE, PM
Chief, Cost Engineering MCX
Walla Walla District

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

PROJECT: Dallas Floodway Feasibility Study
PROJECT NO: P2 329279
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
						Program Year (Budget EC): 2015								
						Effective Price Level Date: 1 OCT 14								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: 1-Oct-13 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
02	RELOCATIONS	$31,961	$9,920	31%	$41,881	1.8%	$32,547	$10,102	$42,649	$0		$38,509	$11,953	$50,462
06	FISH & WILDLIFE FACILITIES	$4,424	$1,373	31%	$5,797	1.8%	$4,505	$1,398	$5,903	$0		$5,674	$1,761	$7,434
08	ROADS, RAILROADS & BRIDGES	$30,343	$9,385	31%	$39,728	1.8%	$30,900	$9,558	$40,458	$0		$38,211	$11,826	$50,036
09	CHANNELS & CANALS	$131,626	$40,857	31%	$172,483	1.8%	$134,042	$41,608	$175,650	$0		$158,619	$49,237	$207,856
09	Channel Slurry Wall (Sponsor Costs)	$10,000	$0	0%	$10,000	0.0%	$10,000	$0	$10,000			$10,000	$0	$10,000
11	LEVEES & FLOODWALLS	$5,103	$1,440	28%	$6,543	1.8%	$5,197	$1,466	$6,663	$0		$5,448	$1,537	$6,985
13	PUMPING PLANT	$108,129	$30,492	28%	$138,621	1.8%	$110,115	$31,051	$141,166	$0		$125,585	$35,413	$160,998
13	Pumping Plant (Sponsor Costs)	$37,869	$0	0%	$37,869	0.0%	$37,869	$0	$37,869			$37,869	$0	$37,869
	CONSTRUCTION ESTIMATE TOTALS:	$359,455	$93,467		$452,922	1.6%	$365,175	$95,183	$460,358	$0		$419,914	$111,726	$531,640
01	LANDS AND DAMAGES	$8,083	$1,611	20%	$9,694	1.8%	$8,231	$1,641	$9,872	$0		$8,489	$1,692	$10,182
01	Lands and Damages (Sponsor Costs)	$2,466	$0	0%	$2,466	0.0%	$2,466	$0	$2,466	$0		$2,466	$0	$2,466
30	PLANNING, ENGINEERING & DESIGN	$35,028	$10,510	30%	$45,538	3.7%	$36,313	$10,888	$47,201	$0		$44,272	$13,300	$57,572
30	Design (Sponsor Costs)	$3,115	$0	0%	$3,115	0.0%	$3,115	$0	$3,115	$0		$3,115	$0	$3,115
31	CONSTRUCTION MANAGEMENT	$31,036	$9,311	30%	$40,347	3.7%	$32,171	$9,653	$41,824	$0		$47,146	$14,190	$61,336
31	Construction Managment (Sponsor Costs)	$6,756	$0	0%	$6,756	0.0%	$6,756	$0	$6,756	$0		$6,756	$0	$6,756
	PROJECT COST TOTALS:	$445,939	$114,899	26%	$560,838		$454,227	$117,364	**$571,591**	$0		$532,158	$140,908	$673,066

CHIEF, COST ENGINEERING, Milton Schmidt

PROJECT MANAGER, Jon Loxley

CHIEF, REAL ESTATE, Rocky Lee

CHIEF, PLANNING,Eric Verwers

CHIEF, ENGINEERING & CONSTRUCTION, Brian Giacomozzi

CHIEF, DPM, Peggy Grubbs

ESTIMATED FEDERAL COST:	**64%**	**$430,762**
ESTIMATED NON-FEDERAL COST:	**36%**	**$242,304**
ESTIMATED TOTAL PROJECT COST:		**$673,066**

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

****** CONTRACT COST SUMMARY ******

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14								
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	Contract 1 277K cfs Levee Raise													
06	FISH & WILDLIFE FACILITIES	$0	$0	0%	$0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
08	ROADS, RAILROADS & BRIDGES	$1,169	$330	28%	$1,499	1.8%	$1,191	$336	$1,527	2017Q3	4.8%	$1,249	$352	$1,601
11	LEVEES & FLOODWALLS	$5,103	$1,440	28%	$6,543	1.8%	$5,197	$1,466	$6,663	2017Q3	4.8%	$5,448	$1,537	$6,985
	CONSTRUCTION ESTIMATE TOTALS:	$6,272	$1,770	28%	**$8,042**		$6,388	$1,802	$8,190			$6,697	$1,889	$8,586
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$125	$35	28%	$160	3.7%	$130	$36	$166	2016Q2	5.3%	$137	$38	$175
0.5%	Planning & Environmental Compliance	$31	$9	28%	$40	3.7%	$32	$9	$41	2016Q2	5.3%	$34	$9	$43
5.2%	Engineering & Design	$329	$93	28%	$422	3.7%	$341	$96	$437	2016Q2	5.3%	$359	$101	$460
0.5%	Reviews, ATRs, IEPRs, VE	$31	$9	28%	$40	3.7%	$32	$9	$41	2016Q2	5.3%	$34	$9	$43
0.5%	Life Cycle Updates (cost, schedule, risks)	$31	$9	28%	$40	3.7%	$32	$9	$41	2016Q2	5.3%	$34	$9	$43
0.5%	Contracting & Reprographics	$31	$9	28%	$40	3.7%	$32	$9	$41	2016Q2	5.3%	$34	$9	$43
1.0%	Engineering During Construction	$63	$18	28%	$81	3.7%	$65	$19	$84	2017Q3	11.0%	$72	$21	$93
0.5%	Planning During Construction	$31	$9	28%	$40	3.7%	$32	$9	$41	2017Q3	11.0%	$36	$10	$46
0.5%	Project Operations	$31	$9	28%	$40	3.7%	$32	$9	$41	2016Q2	5.3%	$34	$9	$43
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$439	$124	28%	$563	3.7%	$455	$129	$584	2017Q3	11.0%	$505	$143	$648
2.0%	Project Operation:	$125	$35	28%	$160	3.7%	$130	$37	$167	2017Q3	11.0%	$144	$41	$185
1.0%	Project Management	$60	$17	28%	$77	3.7%	$62	$18	$80	2017Q3	11.0%	$69	$20	$89
	CONTRACT COST TOTALS:	$7,599	$2,146		**$9,745**		$7,763	$2,191	$9,954			$8,189	$2,308	**$10,497**

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

****** CONTRACT COST SUMMARY ******

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: / Effective Price Level:			2/5/2014 / 1-Oct-13	Program Year (Budget EC): / Effective Price Level Date:			2015 / 1 OCT 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	Contract 3 River Relocation Top													
02	RELOCATIONS	$3,886	$1,206	31%	$5,092	1.8%	$3,957	$1,228	$5,185	2018Q3	6.8%	$4,227	$1,312	$5,539
08	ROADS, RAILROADS & BRIDGES	$271	$84	31%	$355	1.8%	$276	$86	$362	2018Q4	7.3%	$296	$92	$389
09	CHANNELS & CANALS	$41,349	$12,835	31%	$54,184	1.8%	$42,108	$13,071	$55,179	2020Q4	11.4%	$46,927	$14,567	$61,494
	CONSTRUCTION ESTIMATE TOTALS:	$45,506	$14,125	31%	**$59,631**		$46,341	$14,385	$60,726			$51,450	$15,971	$67,421
01	LANDS AND DAMAGES	$13	$3	20%	$16	1.8%	$14	$3	$17	2015Q1	0.0%	$14	$3	$17
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$910	$282	31%	$1,192	3.7%	$943	$292	$1,235	2017Q1	8.7%	$1,025	$317	$1,342
0.5%	Planning & Environmental Compliance	$228	$71	31%	$299	3.7%	$236	$74	$310	2017Q1	8.7%	$256	$80	$336
5.2%	Engineering & Design	$2,385	$740	31%	$3,125	3.7%	$2,472	$767	$3,239	2017Q1	8.7%	$2,686	$833	$3,519
0.5%	Reviews, ATRs, IEPRs, VE	$228	$71	31%	$299	3.7%	$236	$74	$310	2017Q1	8.7%	$256	$80	$336
0.5%	Life Cycle Updates (cost, schedule, risks)	$228	$71	31%	$299	3.7%	$236	$74	$310	2017Q1	8.7%	$256	$80	$336
0.5%	Contracting & Reprographics	$228	$71	31%	$299	3.7%	$236	$74	$310	2017Q1	8.7%	$256	$80	$336
1.0%	Engineering During Construction	$455	$141	31%	$596	3.7%	$472	$146	$618	2020Q4	27.2%	$601	$186	$787
0.5%	Planning During Construction	$228	$71	31%	$299	3.7%	$236	$74	$310	2020Q4	27.2%	$300	$94	$394
0.5%	Project Operations	$228	$71	31%	$299	3.7%	$236	$74	$310	2017Q1	8.7%	$256	$80	$336
					$6,707									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$3,185	$989	31%	$4,174	3.7%	$3,302	$1,025	$4,327	2020Q4	27.2%	$4,202	$1,304	$5,506
2.0%	Project Operation:	$910	$282	31%	$1,192	3.7%	$943	$292	$1,235	2020Q4	27.2%	$1,200	$372	$1,572
1.0%	Project Management	$437	$136	31%	$573	3.7%	$453	$141	$594	2020Q4	27.2%	$576	$179	$755
	CONTRACT COST TOTALS:	$55,170	$17,124		**$72,294**		$56,356	$17,495	$73,851			$63,334	$19,659	**$82,993**

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

****** CONTRACT COST SUMMARY ******

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	Contract 4 River Relocation Middle													
02	RELOCATIONS	$13,454	$4,176	31%	$17,630	1.8%	$13,701	$4,253	$17,954	2022Q2	14.6%	$15,705	$4,875	$20,580
08	ROADS, RAILROADS & BRIDGES	$10,461	$3,247	31%	$13,708	1.8%	$10,653	$3,307	$13,960	2024Q2	19.0%	$12,680	$3,936	$16,616
09	CHANNELS & CANALS	$50,485	$15,671	31%	$66,156	1.8%	$51,412	$15,959	$67,371	2024Q1	18.5%	$60,902	$18,905	$79,806
	CONSTRUCTION ESTIMATE TOTALS:	$74,400	$23,094	31%	**$97,494**		$75,766	$23,519	$99,285			$89,287	$27,716	$117,003
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$1,488	$462	31%	$1,950	3.7%	$1,542	$479	$2,021	2019Q1	18.2%	$1,823	$566	$2,389
0.5%	Planning & Environmental Compliance	$372	$115	31%	$487	3.7%	$386	$119	$505	2019Q1	18.2%	$456	$141	$597
5.2%	Engineering & Design	$3,900	$1,211	31%	$5,111	3.7%	$4,043	$1,255	$5,298	2019Q1	18.2%	$4,779	$1,483	$6,262
0.5%	Reviews, ATRs, IEPRs, VE	$372	$115	31%	$487	3.7%	$386	$119	$505	2019Q1	18.2%	$456	$141	$597
0.5%	Life Cycle Updates (cost, schedule, risks)	$372	$115	31%	$487	3.7%	$386	$119	$505	2019Q1	18.2%	$456	$141	$597
0.5%	Contracting & Reprographics	$372	$115	31%	$487	3.7%	$386	$119	$505	2019Q1	18.2%	$456	$141	$597
1.0%	Engineering During Construction	$744	$231	31%	$975	3.7%	$771	$239	$1,010	2024Q2	48.1%	$1,142	$354	$1,496
0.5%	Planning During Construction	$372	$115	31%	$487	3.7%	$386	$119	$505	2024Q2	48.1%	$572	$176	$748
0.5%	Project Operations	$372	$115	31%	$487	3.7%	$386	$119	$505	2019Q1	18.2%	$456	$141	$597
					$10,958									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$5,208	$1,617	31%	$6,825	3.7%	$5,399	$1,676	$7,075	2024Q2	48.1%	$7,997	$2,483	$10,480
2.0%	Project Operation:	$1,488	$462	31%	$1,950	3.7%	$1,542	$479	$2,021	2024Q2	48.1%	$2,284	$710	$2,994
1.0%	Project Management	$715	$222	31%	$937	3.7%	$741	$230	$971	2024Q2	48.1%	$1,098	$341	$1,439
	CONTRACT COST TOTALS:	$90,175	$27,989		**$118,164**		$92,120	$28,591	$120,711			$111,262	$34,534	**$145,796**

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

****** CONTRACT COST SUMMARY ******

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	TOTAL ($K) *J*	Mid-Point Date *P*	INFLATED (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
	Contract 5 Hampton Pump Station													
13	PUMPING PLANT	$46,604	$13,142	28%	$59,746	1.8%	$47,460 $0	$13,383	$60,843	2021Q1	12.0%	$53,134	$14,983	$68,117
	CONSTRUCTION ESTIMATE TOTALS:	$46,604	$13,142	28%	**$59,746**		$47,460	$13,383	$60,843			$53,134	$14,983	$68,117
01	LANDS AND DAMAGES	$7,331	$1,462	20%	$8,793	1.8%	$7,466	$1,489	$8,955	2017Q1	3.8%	$7,752	$1,546	$9,299
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$932	$263	28%	$1,195	3.7%	$966	$273	$1,239	2016Q4	7.5%	$1,039	$294	$1,333
0.5%	Planning & Environmental Compliance	$233	$66	28%	$299	3.7%	$242	$68	$310	2016Q4	7.5%	$260	$73	$333
5.2%	Engineering & Design	$2,443	$689	28%	$3,132	3.7%	$2,532	$714	$3,246	2016Q4	7.5%	$2,723	$768	$3,491
0.5%	Reviews, ATRs, IEPRs, VE	$233	$66	28%	$299	3.7%	$242	$68	$310	2016Q4	7.5%	$260	$73	$333
0.5%	Life Cycle Updates (cost, schedule, risks)	$233	$66	28%	$299	3.7%	$242	$68	$310	2016Q4	7.5%	$260	$73	$333
0.5%	Contracting & Reprographics	$233	$66	28%	$299	3.7%	$242	$68	$310	2016Q4	7.5%	$260	$73	$333
1.0%	Engineering During Construction	$466	$131	28%	$597	3.7%	$483	$136	$619	2021Q1	28.6%	$621	$175	$796
0.5%	Planning During Construction	$233	$66	28%	$299	3.7%	$242	$68	$310	2021Q1	28.6%	$311	$87	$398
0.5%	Project Operations	$233	$66	28%	$299	3.7%	$242	$68	$310	2016Q4	7.5%	$260	$73	$333
					$6,718									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$3,262	$920	28%	$4,182	3.7%	$3,381	$954	$4,335	2021Q1	28.6%	$4,347	$1,227	$5,574
2.0%	Project Operation:	$932	$263	28%	$1,195	3.7%	$966	$273	$1,239	2021Q1	28.6%	$1,242	$351	$1,593
1.0%	Project Management	$448	$126	28%	$574	3.7%	$464	$131	$595	2021Q1	28.6%	$597	$168	$765
	CONTRACT COST TOTALS:	$63,817	$17,392		**$81,209**		$65,170	$17,761	$82,931			$73,066	$19,964	**$93,030**

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

**** CONTRACT COST SUMMARY ****

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	Contract 6 River Relocation Bottom													
02	RELOCATIONS	$14,621	$4,538	31%	$19,159	1.8%	$14,889	$4,621	$19,510	2026Q4	24.8%	$18,577	$5,766	$24,343
08	ROADS, RAILROADS & BRIDGES	$18,442	$5,724	31%	$24,166	1.8%	$18,780	$5,829	$24,609	2028Q1	27.7%	$23,986	$7,445	$31,431
09	CHANNELS & CANALS	$39,792	$12,351	31%	$52,143	1.8%	$40,522	$12,578	$53,100	2027Q1	25.3%	$50,790	$15,765	$66,555
06	FISH & WILDLIFE FACILITIES	$4,424	$1,373	31%	$5,796	1.8%	$4,505 $0	$1,398	$5,903	2027Q2	25.9%	$5,674	$1,761	$7,434
	CONSTRUCTION ESTIMATE TOTALS:	$77,278	$23,986	31%	**$101,264**		$78,696	$24,426	$103,122			$99,027	$30,736	$129,763
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$1,546	$479	31%	$2,025	3.7%	$1,603	$497	$2,100	2021Q4	32.8%	$2,128	$660	$2,788
0.5%	Planning & Environmental Compliance	$386	$120	31%	$506	3.7%	$400	$124	$524	2021Q4	32.8%	$531	$165	$696
5.2%	Engineering & Design	$4,050	$1,257	31%	$5,307	3.7%	$4,198	$1,303	$5,501	2021Q4	32.8%	$5,574	$1,730	$7,304
0.5%	Reviews, ATRs, IEPRs, VE	$386	$120	31%	$506	3.7%	$400	$124	$524	2021Q4	32.8%	$531	$165	$696
0.5%	Life Cycle Updates (cost, schedule, risks)	$386	$120	31%	$506	3.7%	$400	$124	$524	2021Q4	32.8%	$531	$165	$696
0.5%	Contracting & Reprographics	$386	$120	31%	$506	3.7%	$400	$124	$524	2021Q4	32.8%	$531	$165	$696
1.0%	Engineering During Construction	$773	$240	31%	$1,013	3.7%	$801	$249	$1,050	2028Q1	76.3%	$1,412	$439	$1,851
0.5%	Planning During Construction	$386	$120	31%	$506	3.7%	$400	$124	$524	2028Q1	76.3%	$705	$219	$924
0.5%	Project Operations	$386	$120	31%	$506	3.7%	$400	$124	$524	2021Q4	32.8%	$531	$165	$696
					$11,381									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$5,409	$1,679	31%	$7,088	3.7%	$5,607	$1,740	$7,347	2028Q1	76.3%	$9,882	$3,067	$12,949
2.0%	Project Operation:	$1,546	$480	31%	$2,026	3.7%	$1,603	$497	$2,100	2028Q1	76.3%	$2,825	$876	$3,701
1.0%	Project Management	$743	$231	31%	$974	3.7%	$770	$239	$1,009	2028Q1	76.3%	$1,357	$421	$1,778
	CONTRACT COST TOTALS:	$93,661	$29,072		**$122,733**		$95,678	$29,695	$125,373			$125,565	$38,973	**$164,538**

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

****** CONTRACT COST SUMMARY ******

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	Contract 7 West IDP -Charlie PumpStation													
13	PUMPING PLANT	$30,728	$8,665	28%	$39,393	1.8%	$31,292 $0	$8,824	$40,116	2022Q1	14.1%	$35,699	$10,067	$45,765
	CONSTRUCTION ESTIMATE TOTALS:	$30,728	$8,665	28%	**$39,393**		$31,292	$8,824	$40,116			$35,699	$10,067	$45,765
01	LANDS AND DAMAGES	$173	$34	20%	$207	1.8%	$176	$35	$211	2013Q1	-3.8%	$170	$34	$203
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$615	$173	28%	$788	3.7%	$637	$179	$816	2018Q2	14.5%	$729	$205	$934
0.5%	Planning & Environmental Compliance	$154	$43	28%	$197	3.7%	$160	$45	$205	2018Q2	14.5%	$183	$52	$235
5.2%	Engineering & Design	$1,611	$454	28%	$2,065	3.7%	$1,670	$471	$2,141	2018Q2	14.5%	$1,912	$539	$2,451
0.5%	Reviews, ATRs, IEPRs, VE	$154	$43	28%	$197	3.7%	$160	$45	$205	2018Q2	14.5%	$183	$52	$235
0.5%	Life Cycle Updates (cost, schedule, risks)	$154	$43	28%	$197	3.7%	$160	$45	$205	2018Q2	14.5%	$183	$52	$235
0.5%	Contracting & Reprographics	$154	$43	28%	$197	3.7%	$160	$45	$205	2018Q2	14.5%	$183	$52	$235
1.0%	Engineering During Construction	$307	$87	28%	$394	3.7%	$318	$90	$408	2022Q1	34.2%	$427	$121	$548
0.5%	Planning During Construction	$154	$43	28%	$197	3.7%	$160	$45	$205	2022Q1	34.2%	$215	$60	$275
0.5%	Project Operations	$154	$43	28%	$197	3.7%	$160	$45	$205	2018Q2	14.5%	$183	$52	$235
					$4,429									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$2,151	$607	28%	$2,758	3.7%	$2,230	$629	$2,859	2022Q1	34.2%	$2,993	$844	$3,837
2.0%	Project Operation:	$615	$173	28%	$788	3.7%	$637	$180	$817	2022Q1	34.2%	$855	$242	$1,097
1.0%	Project Management	$295	$83	28%	$378	3.7%	$306	$86	$392	2022Q1	34.2%	$411	$115	$526
	CONTRACT COST TOTALS:	$37,419	$10,534		**$47,953**		$38,226	$10,764	$48,990			$44,325	$12,486	**$56,811**

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

****** CONTRACT COST SUMMARY ******

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	Contract 8 - West IDP - Delta													
13	PUMPING PLANT	$3,138	$885	28%	$4,023	1.8%	$3,196 $0	$901	$4,097	2015Q3	1.0%	$3,227	$910	$4,136
	CONSTRUCTION ESTIMATE TOTALS:	$3,138	$885	28%	**$4,023**		$3,196	$901	$4,097			$3,227	$910	$4,136
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$63	$18	28%	$81	3.7%	$65	$19	$84	2015Q2	1.0%	$66	$19	$85
0.5%	Planning & Environmental Compliance	$16	$5	28%	$21	3.7%	$17	$5	$22	2015Q2	1.0%	$17	$5	$22
5.2%	Engineering & Design	$164	$46	28%	$210	3.7%	$170	$48	$218	2015Q2	1.0%	$172	$48	$220
0.5%	Reviews, ATRs, IEPRs, VE	$16	$5	28%	$21	3.7%	$17	$5	$22	2015Q2	1.0%	$17	$5	$22
0.5%	Life Cycle Updates (cost, schedule, risks)	$16	$5	28%	$21	3.7%	$17	$5	$22	2015Q2	1.0%	$17	$5	$22
0.5%	Contracting & Reprographics	$16	$5	28%	$21	3.7%	$17	$5	$22	2015Q2	1.0%	$17	$5	$22
1.0%	Engineering During Construction	$31	$9	28%	$40	3.7%	$32	$9	$41	2015Q3	2.1%	$33	$9	$42
0.5%	Planning During Construction	$16	$5	28%	$21	3.7%	$17	$5	$22	2015Q3	2.1%	$17	$5	$22
0.5%	Project Operations	$16	$5	28%	$21	3.7%	$17	$5	$22	2015Q2	1.0%	$17	$5	$22
					$457									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$220	$62	28%	$282	3.7%	$228	$64	$292	2015Q3	2.1%	$233	$65	$298
2.0%	Project Operation:	$63	$18	28%	$81	3.7%	$65	$19	$84	2015Q3	2.1%	$66	$19	$85
1.0%	Project Management	$30	$8	28%	$38	3.7%	$31	$8	$39	2015Q3	2.1%	$32	$8	$40
	CONTRACT COST TOTALS:	$3,805	$1,076		**$4,881**		$3,889	$1,098	$4,987			$3,931	$1,108	**$5,038**

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

**** CONTRACT COST SUMMARY ****

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	Sponsor Spent Costs													
13	Pumping Plant (Sponsor Costs)	$37,869	$0	0%	$ 37,869	0.0%	$37,869	$0	$37,869	2014Q1	0.0%	$37,869	$0	$37,869
09	Channel Slurry Wall (Sponsor Costs)	$10,000	$0	0%	$ 10,000	0.0%	$10,000	$0	$10,000	2014Q1	0.0%	$10,000	$0	$10,000
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$47,869	$0	0%	**47,869**		$47,869	$0	$47,869			$47,869	$0	$47,869
01	LANDS AND DAMAGES	$0	$0	0%	$ -	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
01	Lands and Damages (Sponsor Costs)	$2,466	$0	0%	$ 2,466	0.0%	$2,466	$0	$2,466	0-Jan-00	0.0%	$2,466	$0	$2,466
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
0.5%	Planning & Environmental Compliance		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
5.2%	Engineering & Design		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
0.5%	Reviews, ATRs, IEPRs, VE		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
0.5%	Life Cycle Updates (cost, schedule, risks)		$0	0.0%	$0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
0.5%	Contracting & Reprographics		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
1.0%	Engineering During Construction		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
0.5%	Planning During Construction		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
0.5%	Project Operations		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
30	Design (Sponsor Costs)	$3,115	$0	0%	$ 3,115	0.0%	$3,115	$0	$3,115	0-Jan-00	0.0%	$3,115	$0	$3,115
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
2.0%	Project Operation:		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
1.0%	Project Management		$0	0.0%	0	0.0%	$0	$0	$0	0-Jan-00	0.0%	$0	$0	$0
30-Jan-00	Construction Management (Sponsor Costs)	$6,756	$0	0%	$ 6,756	0.0%	$6,756	$0	$6,756	0-Jan-00	0.0%	$6,756	$0	$6,756
	CONTRACT COST TOTALS:	$60,206	$0		**60,206**		$60,206	$0	$60,206			$60,206	$0	**$60,206**

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

**** CONTRACT COST SUMMARY ****

PROJECT: Dallas Floodway Feasibility Study
LOCATION: Dallas, TX
This Estimate reflects the scope and schedule in report; Feasibility Report

DISTRICT: SWF Fort Worth PREPARED: 8/12/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 2/5/2014 Effective Price Level: 1-Oct-13				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	Contract 9 - West IDP - Trinity Portland													
13	PUMPING PLANT	$27,659	$7,800	28%	$35,459	1.8%	$28,167 $0	$7,943	$36,110	2024Q2	19.0%	$33,526	$9,454	$42,980
	CONSTRUCTION ESTIMATE TOTALS:	$27,659	$7,800	28%	**$35,459**		$28,167	$7,943	$36,110			$33,526	$9,454	$42,980
01	LANDS AND DAMAGES	$565	$112	20%	$677	1.8%	$575	$114	$689	2013Q1	-3.8%	$553	$110	$663
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$553	$156	28%	$709	3.7%	$573	$162	$735	2019Q2	19.4%	$684	$193	$877
0.5%	Planning & Environmental Compliance	$138	$39	28%	$177	3.7%	$143	$40	$183	2019Q2	19.4%	$171	$48	$219
5.2%	Engineering & Design	$1,450	$409	28%	$1,859	3.7%	$1,503	$424	$1,927	2019Q2	19.4%	$1,795	$506	$2,301
0.5%	Reviews, ATRs, IEPRs, VE	$138	$39	28%	$177	3.7%	$143	$40	$183	2019Q2	19.4%	$171	$48	$219
0.5%	Life Cycle Updates (cost, schedule, risks)	$138	$39	28%	$177	3.7%	$143	$40	$183	2019Q2	19.4%	$171	$48	$219
0.5%	Contracting & Reprographics	$138	$39	28%	$177	3.7%	$143	$40	$183	2019Q2	19.4%	$171	$48	$219
1.0%	Engineering During Construction	$277	$78	28%	$355	3.7%	$287	$81	$368	2024Q2	48.1%	$425	$120	$545
0.5%	Planning During Construction	$138	$39	28%	$177	3.7%	$143	$40	$183	2024Q2	48.1%	$212	$59	$271
0.5%	Project Operations	$138	$39	28%	$177	3.7%	$143	$40	$183	2019Q2	19.4%	$171	$48	$219
					$3,985									
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$1,936	$546	28%	$2,482	3.7%	$2,007	$566	$2,573	2024Q2	48.1%	$2,973	$838	$3,811
2.0%	Project Operation:	$553	$156	28%	$709	3.7%	$573	$162	$735	2024Q2	48.1%	$849	$240	$1,089
1.0%	Project Management	$266	$75	28%	$341	3.7%	$276	$78	$354	2024Q2	48.1%	$409	$116	$525
	CONTRACT COST TOTALS:	34,087	9,566		**$43,653**		$34,819	$9,770	$44,589			$42,281	$11,876	**$54,157**