APPENDIX I
DETAILED COST ESTIMATE AND COST ANALYSIS

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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:

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March 10, 2014

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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 Lower Colorado River Basin, Phase 1, Onion Creek Interim 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 $235 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 $80 Million, or 34%. This contingency includes $68 Million (29%) for risks related to cost and $11 Million (5%) 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 (34% 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	**$235,000,000**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$278,800,000	18.7%
50%	$301,200,000	28.2%
80%	**$314,000,000**	**33.6%**
95%	$326,500,000	39.0%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

Cost Risks: From the CSRA, the key or greater Cost Risk items, contributing to 53 percent of the statistical cost variance, 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, attributing to 30 percent, 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.

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 (3 federal (only 1 is being constructed under this project), 4 non-federal). 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	**$235,000,000**	
Confidence Level	**Construction Value ($$)**	**Contingency (%)**
5%	$278,800,000	18.7%
50%	$301,200,000	28.2%
80%	**$314,000,000**	**33.6%**
90%	$320,700,000	36.5%

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 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

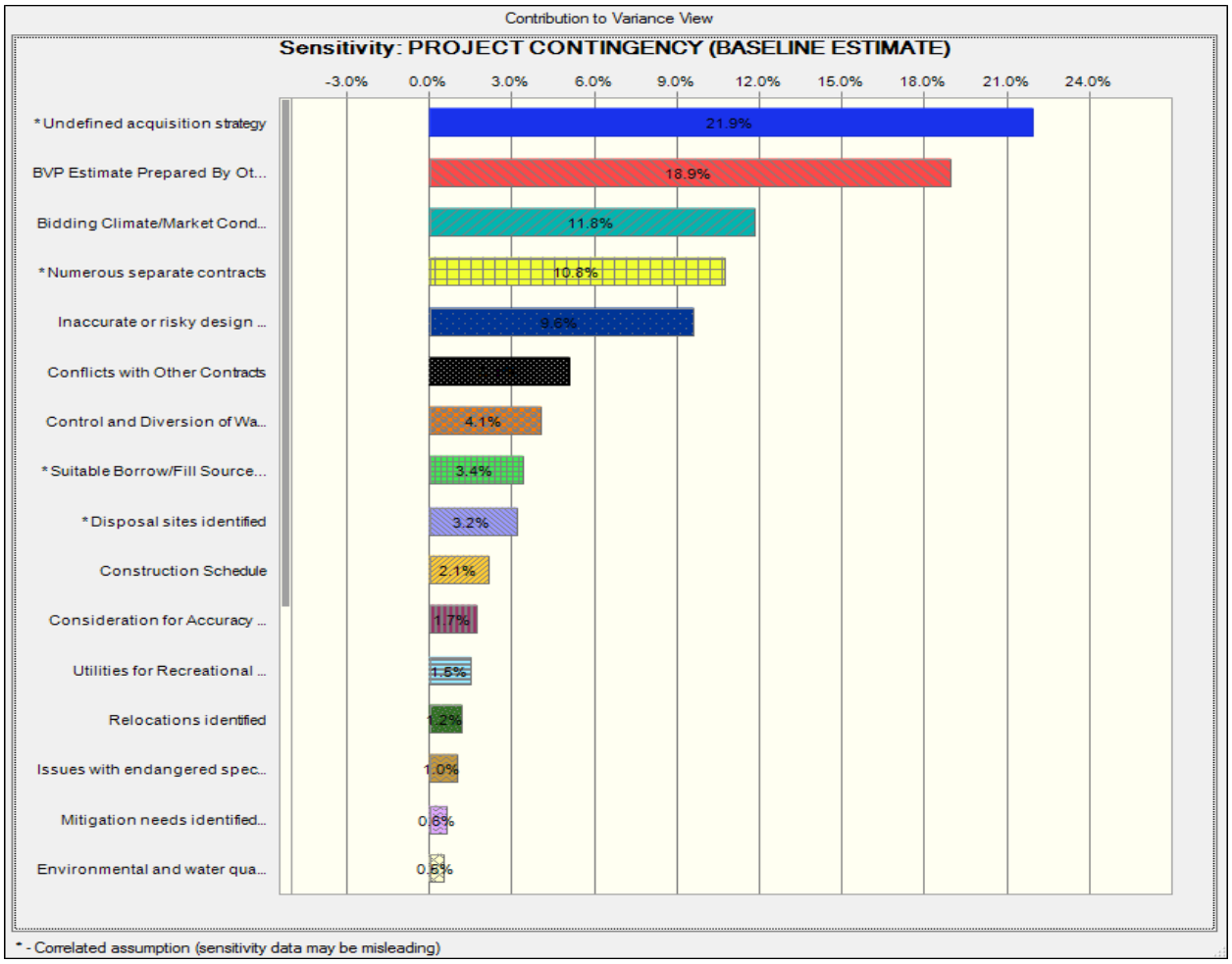
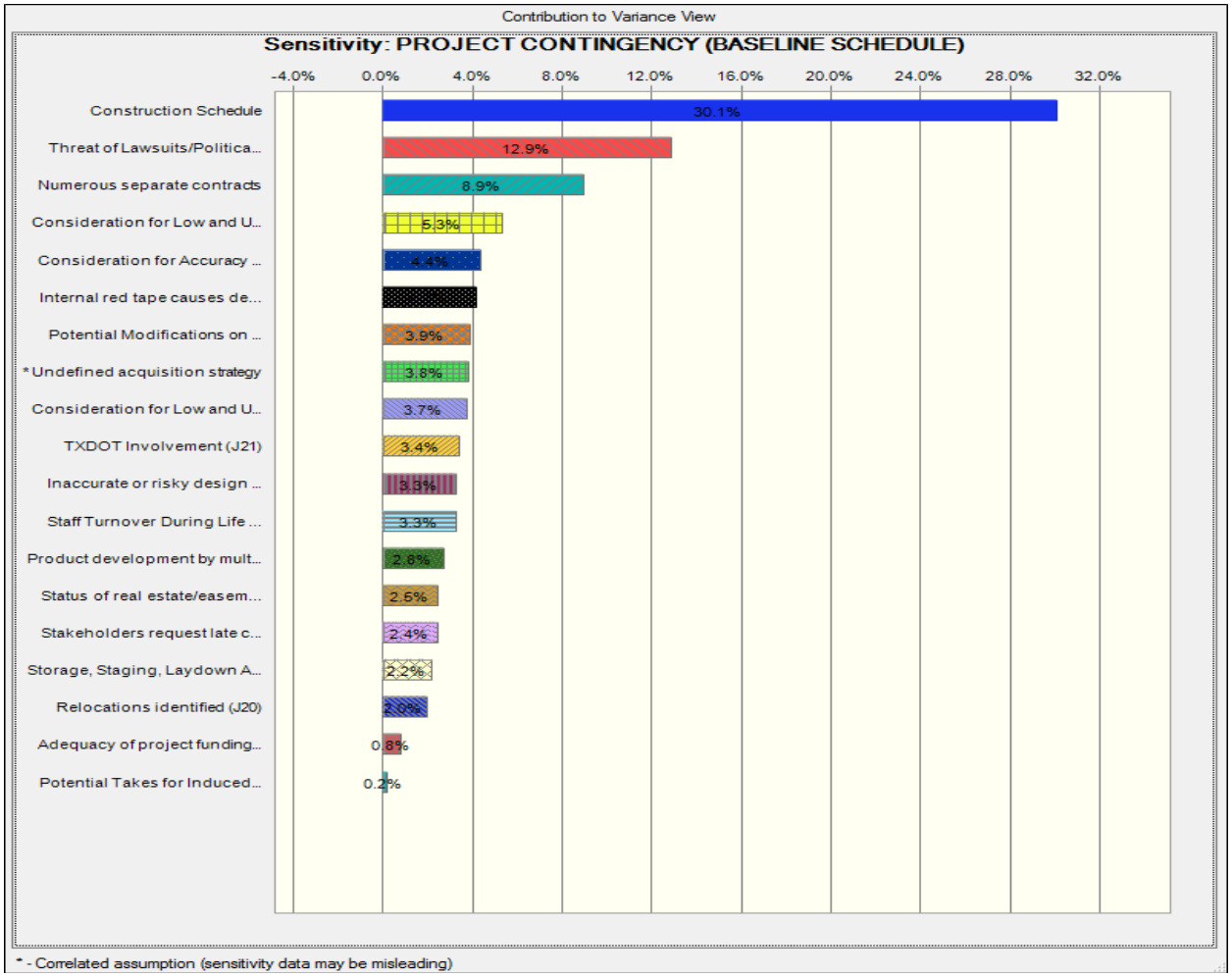

Contribution to Variance View
Sensitivity: PROJECT CONTINGENCY (BASELINE ESTIMATE)
-3.0%
0.0%
3.0%
6.0%
9.0%
12.0%
15.0%
18.0%
21.0%
24.0%
*Undefined acquisition strategy
21.9%
BVP Estimate Prepared By Ot...
18.9%
Bidding Climate/Market Cond...
11.8%
*Numerous separate contracts
10.8%
Inaccurate or risky design ...
9.6%
Conflicts with Other Contracts
Control and Diversion of Wa...
4.1%
*Suitable Borrow/Fill Source...
3.4%
*Disposal sites identified
3.2%
Construction Schedule
2.1%
Consideration for Accuracy ...
1.7%
Utilities for Recreational ...
1.5%
Relocations identified
1.2%
Issues with endangered spec...
1.0%
Mitigation needs identified...
0.6%
Environmental and water qua...
0.6%
* - Correlated assumption (sensitivity data may be misleading)

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	132	40
80% Confidence Level		
Project Duration	132	48
100% Confidence Level		
Project Duration	132	72

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	$234,956,553		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$257,875,524**	**$22,918,971**	**9.75%**
5%	**$278,784,904**	**$43,828,351**	**18.65%**
10%	**$283,258,146**	**$48,301,593**	**20.56%**
15%	**$286,391,199**	**$51,434,646**	**21.89%**
20%	**$288,913,569**	**$53,957,016**	**22.96%**
25%	**$291,218,298**	**$56,261,745**	**23.95%**
30%	**$293,475,800**	**$58,519,247**	**24.91%**
35%	**$295,411,242**	**$60,454,689**	**25.73%**
40%	**$297,320,285**	**$62,363,732**	**26.54%**
45%	**$299,172,969**	**$64,216,416**	**27.33%**
50%	**$301,170,112**	**$66,213,559**	**28.18%**
55%	**$302,970,321**	**$68,013,769**	**28.95%**
60%	**$304,799,242**	**$69,842,689**	**29.73%**
65%	**$306,792,335**	**$71,835,782**	**30.57%**
70%	**$308,958,727**	**$74,002,174**	**31.50%**
75%	**$311,371,090**	**$76,414,537**	**32.52%**
80%	**$313,955,557**	**$78,999,004**	**33.62%**
85%	**$317,049,682**	**$82,093,129**	**34.94%**
90%	**$320,729,667**	**$85,773,114**	**36.51%**
95%	**$326,480,914**	**$91,524,361**	**38.95%**
100%	**$356,736,145**	**$121,779,592**	**51.83%**

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Most Likely Schedule Duration	132.1 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	**142.2 Months**	**10.1 Months**	**7.67%**
5%	**157.8 Months**	**25.7 Months**	**19.49%**
10%	**160.7 Months**	**28.6 Months**	**21.64%**
15%	**162.7 Months**	**30.6 Months**	**23.15%**
20%	**164.3 Months**	**32.2 Months**	**24.36%**
25%	**165.7 Months**	**33.6 Months**	**25.44%**
30%	**167.0 Months**	**34.9 Months**	**26.42%**
35%	**168.2 Months**	**36.1 Months**	**27.32%**
40%	**169.3 Months**	**37.3 Months**	**28.20%**
45%	**170.5 Months**	**38.4 Months**	**29.06%**

50%	**171.6 Months**	**39.5 Months**	**29.92%**
55%	**172.8 Months**	**40.7 Months**	**30.79%**
60%	**173.9 Months**	**41.8 Months**	**31.67%**
65%	**175.1 Months**	**43.0 Months**	**32.58%**
70%	**176.5 Months**	**44.4 Months**	**33.61%**
75%	**177.9 Months**	**45.8 Months**	**34.70%**
80%	**179.5 Months**	**47.5 Months**	**35.93%**
85%	**181.3 Months**	**49.2 Months**	**37.26%**
90%	**183.6 Months**	**51.5 Months**	**39.00%**
95%	**187.0 Months**	**54.9 Months**	**41.57%**
100%	**204.1 Months**	**72.0 Months**	**54.50%**

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	Very Likely	Marginal	MODERATE
CA-2	Numerous separate contracts	Possibilty of more than the 7 assumed contracts.	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 is split into 7 contracts.	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
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

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	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
	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

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.)								
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
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	Significant	HIGH	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

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-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 7 contracts and some will be sequential whil 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	Marginal	MODERATE
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	Significant	HIGH	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
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.	Very Unlikely	Critical	LOW	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

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.)									
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

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

March 10, 2014

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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 Lower Colorado River Basin, Phase 1, Onion Creek Interim 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 $153 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 $50 Million, or 33%. This contingency includes $43 Million (28%) for risks related to cost and $6 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 (33% 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	**$156,300,000**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$177,900,000	15.6%
50%	$193,000,000	26.3%
80%	**$202,600,000**	**32.9%**
95%	$212,300,000	38.9%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

Cost Risks: From the CSRA, the key or greater Cost Risk items, attributing to 88 percent, of include:

-
- EST-1 (Construction Schedule) - 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.

- 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.
- 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.
- CA-1 (Undefined acquisition strategy) – 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.

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 52 percent, is:

- 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.
- TL-3 (HTRW) - captures the possibility of delay if TCEQ does not accept less stringent standards and 11 instead of 2 sites need to be investigated.

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 (3 federal (only 1 will be constructed under this project), 4 non-federal). 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. 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 28.31% of the

total contingency and 4.24% 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 $50 Million at the P80 confidence level (33% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 26% and 55% of the baseline cost estimate, respectively.

Table 1. Construction Cost Contingency Summary

Base Case Construction Cost Estimate	**$152,800,000**	
Confidence Level	**Construction Value ($$)**	**Contingency (%)**
5%	$173,400,000	13.5%
50%	$187,700,000	22.8%
80%	**$196,100,000**	**28.3%**
90%	$200,700,000	31.3%

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

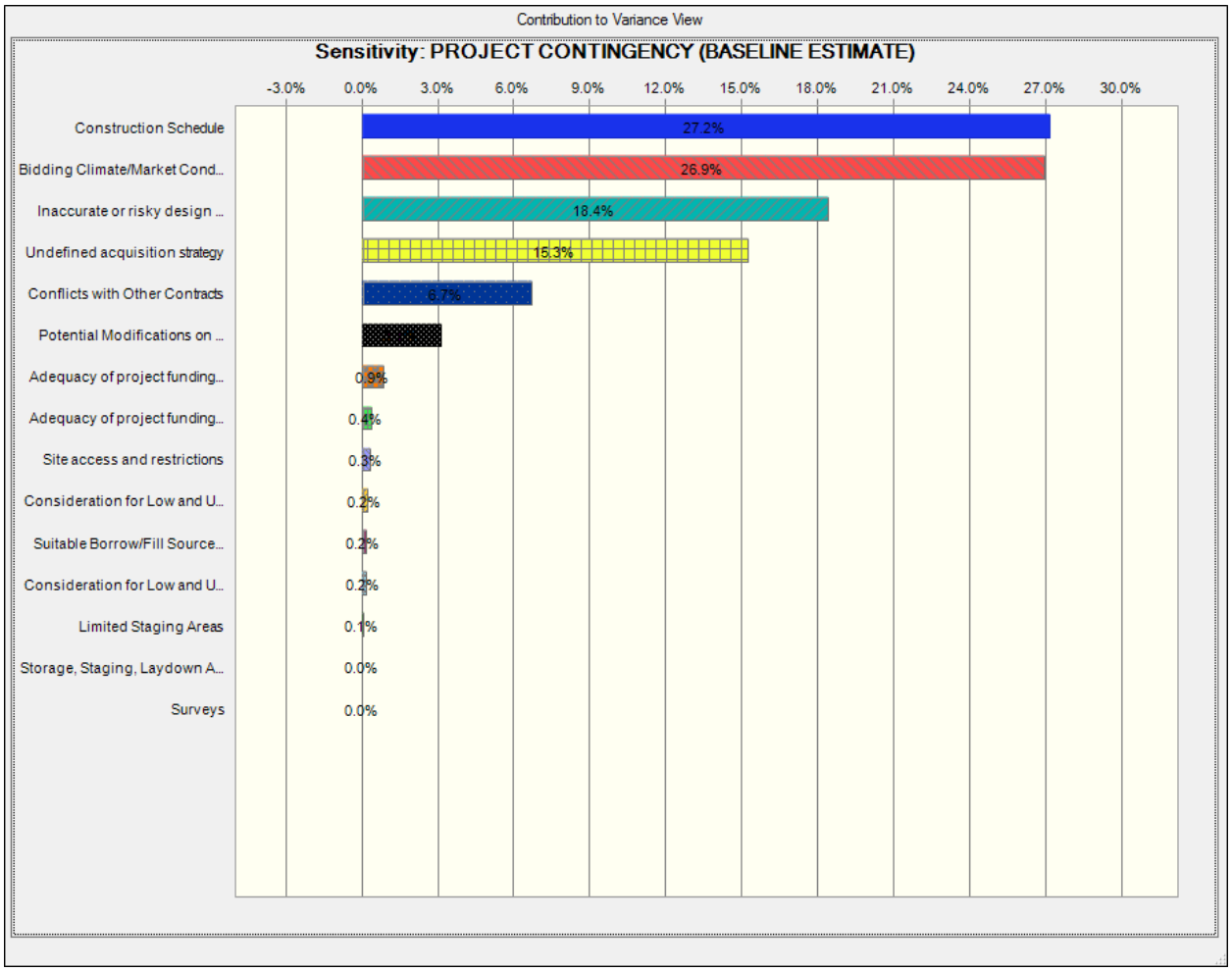
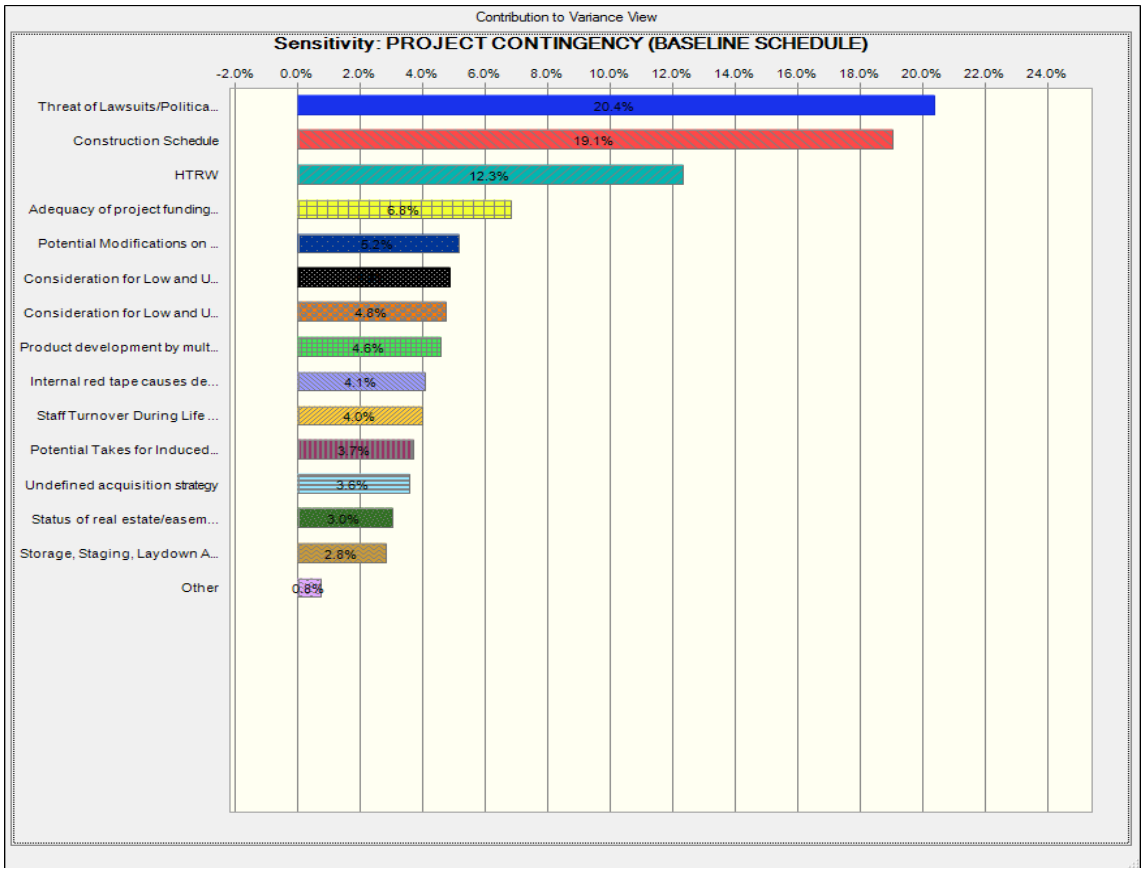

Contribution to Variance View
Sensitivity: PROJECT CONTINGENCY (BASELINE ESTIMATE)
-3.0%
0.0%
3.0%
6.0%
9.0%
12.0%
15.0%
18.0%
21.0%
24.0%
27.0%
30.0%
Construction Schedule
27.2%
Bidding Climate/Market Cond...
26.9%
Inaccurate or risky design ...
18.4%
Undefined acquisition strategy
15.3%
Conflicts with Other Contracts
6.7%
Potential Modifications on ...
Adequacy of project funding...
0.9%
Adequacy of project funding...
0.4%
Site access and restrictions
0.3%
Consideration for Low and U...
0.2%
Suitable Borrow/Fill Source...
0.2%
Consideration for Low and U...
0.2%
Limited Staging Areas
0.1%
Storage, Staging, Laydown A...
0.0%
Surveys
0.0%

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	108	33
80% Confidence Level		
Project Duration	108	40
100% Confidence Level		
Project Duration	108	73

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-1 (Construction Schedule) - 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.
- 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.
- 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.
- CA-1 (Undefined acquisition strategy) – 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.

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-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.
- TL-3 (HTRW) - captures the possibility of delay if TCEQ does not accept less stringent standards and 11 instead of 2 sites need to be investigated.

Table 3. Construction Cost Comparison Summary (Uncertainty Analysis)

Most Likely Cost Estimate	$152,818,533		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$162,183,862**	**$9,365,329.14**	**6.13%**
5%	**$173,402,438**	**$20,583,904.97**	**13.47%**
10%	**$176,343,034**	**$23,524,501.48**	**15.39%**
15%	**$178,229,219**	**$25,410,686.60**	**16.63%**
20%	**$179,848,234**	**$27,029,701.13**	**17.69%**
25%	**$181,371,950**	**$28,553,417.36**	**18.68%**
30%	**$182,715,038**	**$29,896,505.18**	**19.56%**
35%	**$184,008,335**	**$31,189,802.02**	**20.41%**
40%	**$185,211,719**	**$32,393,186.67**	**21.20%**
45%	**$186,395,900**	**$33,577,367.52**	**21.97%**
50%	**$187,676,540**	**$34,858,007.64**	**22.81%**
55%	**$189,009,004**	**$36,190,470.91**	**23.68%**
60%	**$190,151,356**	**$37,332,823.64**	**24.43%**
65%	**$191,525,316**	**$38,706,782.94**	**25.33%**
70%	**$192,909,930**	**$40,091,397.77**	**26.23%**
75%	**$194,439,618**	**$41,621,085.21**	**27.24%**
80%	**$196,088,499**	**$43,269,965.90**	**28.31%**
85%	**$198,128,989**	**$45,310,456.69**	**29.65%**
90%	**$200,624,581**	**$47,806,048.15**	**31.28%**
95%	**$204,634,913**	**$51,816,379.80**	**33.91%**
100%	**$225,573,697**	**$72,755,163.79**	**47.61%**

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Most Likely Schedule Duration	108.1 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	**117.4 Months**	**9.4 Months**	**8.66%**
5%	**127.9 Months**	**19.8 Months**	**18.33%**
10%	**130.3 Months**	**22.2 Months**	**20.59%**
15%	**132.2 Months**	**24.2 Months**	**22.36%**
20%	**133.8 Months**	**25.7 Months**	**23.81%**
25%	**135.1 Months**	**27.0 Months**	**25.00%**
30%	**136.3 Months**	**28.2 Months**	**26.14%**
35%	**137.4 Months**	**29.4 Months**	**27.16%**
40%	**138.5 Months**	**30.4 Months**	**28.18%**
45%	**139.6 Months**	**31.5 Months**	**29.17%**
50%	**140.6 Months**	**32.6 Months**	**30.13%**
55%	**141.7 Months**	**33.6 Months**	**31.12%**
60%	**142.7 Months**	**34.7 Months**	**32.11%**
65%	**143.8 Months**	**35.8 Months**	**33.10%**
70%	**145.0 Months**	**37.0 Months**	**34.23%**
75%	**146.5 Months**	**38.4 Months**	**35.57%**
80%	**147.9 Months**	**39.8 Months**	**36.84%**
85%	**149.5 Months**	**41.4 Months**	**38.35%**
90%	**151.7 Months**	**43.6 Months**	**40.39%**
95%	**155.0 Months**	**46.9 Months**	**43.42%**
100%	**180.7 Months**	**72.6 Months**	**67.22%**

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 7 contracts 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 cost and marginal impact on scheduling.	Likely	Significant	HIGH	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	Significant	HIGH
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).	No greater than 20% swing in VEQ is anticipated.	Likely	Marginal	MODERATE	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.	Very Unlikely	Critical	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	Marginal	MODERATE	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.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
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.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
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.	Very Unlikely	Critical	LOW	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
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

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	4,563 Days

Currency in US dollars

Description	Quantity	UOM	Escalation	Contingency	ProjectCost
PROJECT INDIRECT SUMMARY - Federal Scope			**0**	**0**	**448,428,734**
1 Total Project Cost	**1.00**	**LS**	**0**	**0**	**398,093,717**
1.1 Contract 1 - 277K Levee Raise and AT&SF Bridge Removal/Partial 4:1 Side Slopes	**1.00**	**LS**	**0**	**0**	**7,651,865**
1.3 Contract 3 - River Relocation Top	**1.00**	**LS**	**0**	**0**	**53,447,993**
1.4 Contract 4 - River Relocation Middle	**1.00**	**LS**	**0**	**0**	**88,045,996**
1.5 Contract 5 - Hampton Pump Station	**1.00**	**LS**	**0**	**0**	**68,194,318**
1.6 Contract 6 - River Relocation Bottom	**1.00**	**LS**	**0**	**0**	**91,890,787**
1.8 City Contract	**1.00**	**LS**	**0**	**0**	**88,862,758**
2 Sunk Costs	**1.00**	**LS**	**0**	**0**	**50,335,017**
2.1 01 Lands and Damages	**1.00**	**LS**	**0**	**0**	**2,465,833**
2.2 13 Pumping Plant	**1.00**	**LS**	**0**	**0**	**37,869,184**
2.3 09 - Channels	**1.00**	**LS**	**0**	**0**	**10,000,000**

Currency in US dollars

Description	Quantity	UOM	Escalation	Contingency	ProjectCost
PROJECT INDIRECT SUMMARY - Federal Scope			**0**	**0**	**448,428,734**
Total Project Cost	**1.00**	**LS**	**0**	**0**	**398,093,717**
Contract 1 - 277K Levee Raise and AT&SF Bridge Removal/Partial 4:1 Side Slopes	**1.00**	**LS**	**0**	**0**	**7,651,865**
FRM - Flood Risk Management	**1.00**	**LS**	**0**	**0**	**7,651,865**
06 06 Fish and Wildlife FacilitiesTotal Mitigation Cost	**1.00**	**LS**	**0**	**0**	**36,525**
08 Roads, Railroads, and Bridges	**1.00**	**LS**	**0**	**0**	**1,169,395**
11 11 Levees and Floodwalls	**1.00**	**LS**	**0**	**0**	**5,103,390**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**711,655**
31 31 Construction Management	**1.00**	**LS**	**0**	**0**	**630,900**
Contract 3 - River Relocation Top	**1.00**	**LS**	**0**	**0**	**53,447,993**
ER - Ecosystem Restoration	**1.00**	**LS**	**0**	**0**	**53,447,993**
02 02 Relocations	**1.00**	**LS**	**0**	**0**	**3,886,112**
08 08 Roads, Railroads, and Bridges	**1.00**	**LS**	**0**	**0**	**271,401**
09 - Channels	**1.00**	**LS**	**0**	**0**	**39,926,197**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**4,955,938**
31 31 Construction Management	**1.00**	**LS**	**0**	**0**	**4,408,345**
Contract 4 - River Relocation Middle	**1.00**	**LS**	**0**	**0**	**88,045,996**
ER - Ecosystem Restoration	**1.00**	**LS**	**0**	**0**	**88,045,996**
02 02 Relocations	**1.00**	**LS**	**0**	**0**	**13,453,948**
08 08 Roads, Railroads, and Bridges	**1.00**	**LS**	**0**	**0**	**10,460,742**
09 - Channels	**1.00**	**LS**	**0**	**0**	**48,703,909**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**8,165,735**
31 31 Construction Management	**1.00**	**LS**	**0**	**0**	**7,261,663**
Contract 5 - Hampton Pump Station	**1.00**	**LS**	**0**	**0**	**68,194,318**
					68,194,317.58
FRM - Flood Risk Management	**1.00**	**EA**	**0**	**0**	**68,194,318**
01 Land and Damages	**1.00**	**LS**	**0**	**0**	**11,841,158**
13 13 Pumping Plant	**1.00**	**LS**	**0**	**0**	**46,479,263**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**5,225,998**
31 31 Construction Management	**1.00**	**LS**	**0**	**0**	**4,647,899**
Contract 6 - River Relocation Bottom	**1.00**	**LS**	**0**	**0**	**91,890,787**
ER - Ecosystem Restoration	**1.00**	**LS**	**0**	**0**	**91,890,787**
02 02 Relocations	**1.00**	**LS**	**0**	**0**	**14,620,527**
06 Fish and Wildlife	**1.00**	**LS**	**0**	**0**	**4,250,000**
08 08 Roads, Railroads, and Bridges	**1.00**	**LS**	**0**	**0**	**18,441,657**
09 - Channels	**1.00**	**LS**	**0**	**0**	**38,474,888**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**8,525,008**
31 31 Construction Management	**1.00**	**LS**	**0**	**0**	**7,578,707**
City Contract	**1.00**	**LS**	**0**	**0**	**88,862,758**
Costs City will incur before this project begins	**1.00**	**LS**	**0**	**0**	**88,862,758**
Able Pump Station	**1.00**	**LS**	**0**	**0**	**73,292,608**
30 30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**8,240,921**
31 31 Construction Management	**1.00**	**LS**	**0**	**0**	**7,329,230**
Sunk Costs	**1.00**	**LS**	**0**	**0**	**50,335,017**
01 Lands and Damages	**1.00**	**LS**	**0**	**0**	**2,465,833**
13 13 Pumping Plant	**1.00**	**LS**	**0**	**0**	**37,869,184**
East Levee Pump Stations	**1.00**	**LS**	**0**	**0**	**37,869,184**
Baker Pump Station	**1.00**	**LS**	**0**	**0**	**37,869,184**

Currency in US dollars

Description	Quantity	UOM	Escalation	Contingency	ProjectCost
09 - Channels	**1.00**	**LS**	**0**	**0**	**10,000,000**
Slurry Cut off Walls by River Reloaction	**1.00**	**LS**	**0**	**0**	**10,000,000**
					10,000,000.00
Money spent by sponsor for cutoff wall in place	**1.00**	**EA**	**0**	**0**	**10,000,000**

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

PROJECT: Dallas Floodway Feasibility Study
PROJECT NO: P2 329279
LOCATION: Dallas, TX

DISTRICT: SWF Fort Worth PREPARED: 2/5/2014
POC: CHIEF, COST ENGINEERING, Milton Schmidt

This Estimate reflects the scope and schedule in report; Feasability Report

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
						Program Year (Budget EC): 2014								
						Effective Price Level Date: 1 OCT 13								
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	$10,745	34%	$42,706	0.0%	$31,961	$10,745	$42,706	$0		$38,509	$27,419	$65,928
06	FISH & WILDLIFE FACILITIES	$4,287	$1,441	34%	$5,727	0.0%	$4,287	$1,441	$5,727	$0		$5,490	$1,845	$7,335
08	ROADS, RAILROADS & BRIDGES	$30,343	$10,189	34%	$40,533	0.0%	$30,343	$10,189	$40,533	$0		$38,211	$12,834	$51,044
09	CHANNELS & CANALS	$127,105	$42,733	34%	$169,838	0.0%	$127,105	$42,733	$169,838	$0		$153,175	$51,497	$204,672
11	LEVEES & FLOODWALLS	$5,103	$1,663	33%	$6,767	0.0%	$5,103	$1,663	$6,767	$0		$5,448	$1,776	$7,224
13	PUMPING PLANT	$119,772	$39,034	33%	$158,806	0.0%	$119,772	$39,034	$158,806	$0		$126,922	$41,364	$168,286
	Lands and Damages (Sponsor Costs)	$2,466	$0	0%	$2,466	0.0%	$2,466	$0	$2,466	$0		$2,466	$0	$2,466
	Pumping Plant (Sponsor Costs)	$37,869	$0	0%	$37,869	0.0%	$37,869	$0	$37,869			$37,869	$0	$37,869
	Channel Slurry Wall (Sponsor Costs)	$10,000	$0	0%	$10,000	0.0%	$10,000	$0	$10,000			$10,000	$0	$10,000
	CONSTRUCTION ESTIMATE TOTALS:	$368,906	$105,805		$474,710	0.0%	$368,906	$105,805	$474,710	$0		$418,089	$136,735	$554,824
01	LANDS AND DAMAGES	$11,841	$2,365	20%	$14,206	0.0%	$11,841	$2,365	$14,206	$0		$12,521	$2,500	$15,021
30	PLANNING, ENGINEERING & DESIGN	$35,826	$11,899	33%	$47,725	0.0%	$35,826	$11,899	$47,725	$0		$43,340	$14,416	$57,755
31	CONSTRUCTION MANAGEMENT	$31,856	$10,580	33%	$42,436	0.0%	$31,856	$10,580	$42,436	$0		$45,173	$15,039	$60,212
	PROJECT COST TOTALS:	$448,429	$130,648	29%	$579,077		$448,429	$130,648	**$579,077**	$0		$519,123	$168,690	$687,813

Mandatory by Regulation	CHIEF, COST ENGINEERING, Milton Schmidt	ESTIMATED FEDERAL COST:	**64%**	**$440,200**
Mandatory by Regulation	PROJECT MANAGER, Jon Loxley	ESTIMATED NON-FEDERAL COST:	**36%**	**$247,613**
Mandatory by Regulation	CHIEF, REAL ESTATE, Rocky Lee	**ESTIMATED TOTAL PROJECT COST:**		**$687,813**
	CHIEF, PLANNING,xxx			
	CHIEF, ENGINEERING, xxx			
	CHIEF, OPERATIONS, xxx			
	CHIEF, CONSTRUCTION, Mike Zalesak			
	CHIEF, CONTRACTING,xxx			
	CHIEF, PM-PB, xxxx			

_____

_____ CHIEF, DPM, xxx

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

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

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

DISTRICT: SWF Fort Worth PREPARED: 2/5/2014
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-2013				Program Year (Budget EC): 2014 Effective Price Level Date: 1 OCT 13								
				RISK BASED										
WBS	Civil Works	COST	CNTG	CNTG	TOTAL	ESC	COST	CNTG	TOTAL	Mid-Point	INFLATED	COST	CNTG	FULL
NUMBER	Feature & Sub-Feature Description	($K)	($K)	(%)	($K)	(%)	($K)	($K)	($K)	Date	(%)	($K)	($K)	($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	$37	$12	33%	$48	0.0%	$37	$12	$48	2017Q3	6.8%	$39	$13	$52
08	ROADS, RAILROADS & BRIDGES	$1,169	$381	33%	$1,551	0.0%	$1,169	$381	$1,551	2017Q3	6.8%	$1,248	$407	$1,655
11	LEVEES & FLOODWALLS	$5,103	$1,663	33%	$6,767	0.0%	$5,103	$1,663	$6,767	2017Q3	6.8%	$5,448	$1,776	$7,224
ALL	Lands & Damages (Sunk costs)	$2,466	$0	0%	$2,466	0.0%	$2,466	$0	$2,466	2013Q1	0.0%	$2,466	$0	$2,466
13	Pumping Plant (sunk costs)	$37,869	$0	0%	$37,869	0.0%	$37,869	$0	$37,869	2013Q1	0.0%	$37,869	$0	$37,869
09	Channels (sunk cost)	$10,000	$0	0%	$10,000	0.0%	$10,000	$0	$10,000	2013Q1	0.0%	$10,000	$0	$10,000
	CONSTRUCTION ESTIMATE TOTALS:	$6,309	$2,056	33%	**$8,366**		$6,309	$2,056	$8,366			$9,201	$2,195	$11,396
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$126	$41	33%	$167	0.0%	$126	$41	$167	2016Q2	9.1%	$137	$45	$182
0.5%	Planning & Environmental Compliance	$32	$10	33%	$42	0.0%	$32	$10	$42	2016Q2	9.1%	$35	$11	$46
5.2%	Engineering & Design	$331	$108	33%	$439	0.0%	$331	$108	$439	2016Q2	9.1%	$361	$118	$479
0.5%	Reviews, ATRs, IEPRs, VE	$32	$10	33%	$42	0.0%	$32	$10	$42	2016Q2	9.1%	$35	$11	$46
0.5%	Life Cycle Updates (cost, schedule, risks)	$32	$10	33%	$42	0.0%	$32	$10	$42	2016Q2	9.1%	$35	$11	$46
0.5%	Contracting & Reprographics	$32	$10	33%	$42	0.0%	$32	$10	$42	2016Q2	9.1%	$35	$11	$46
1.0%	Engineering During Construction	$63	$21	33%	$84	0.0%	$63	$21	$84	2017Q3	15.0%	$72	$24	$96
0.5%	Planning During Construction	$32	$10	33%	$42	0.0%	$32	$10	$42	2017Q3	15.0%	$37	$12	$49
0.5%	Project Operations	$32	$10	33%	$42	0.0%	$32	$10	$42	2016Q2	9.1%	$35	$11	$46
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$442	$144	33%	$586	0.0%	$442	$144	$586	2017Q3	15.0%	$508	$166	$674
2.0%	Project Operation:	$126	$41	33%	$167	0.0%	$126	$41	$167	2017Q3	15.0%	$145	$47	$192
1.0%	Project Management	$63	$21	33%	$84	0.0%	$63	$21	$84	2017Q3	15.0%	$72	$24	$96
	CONTRACT COST TOTALS:	$7,652	$2,494		**$10,146**		$7,652	$2,494	$10,146			$10,710	$2,687	**$13,396**

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

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

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

DISTRICT: SWF Fort Worth PREPARED: 2/5/2014
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-2013				Program Year (Budget EC): 2014 Effective Price Level Date: 1 OCT 13								
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	$1,307	34%	$5,193	0.0%	$3,886	$1,307	$5,193	2018Q3	8.8%	$4,227	$1,421	$5,649
08	ROADS, RAILROADS & BRIDGES	$271	$91	34%	$363	0.0%	$271	$91	$363	2018Q4	9.3%	$297	$100	$396
09	CHANNELS & CANALS	$39,926	$13,423	34%	$53,349	0.0%	$39,926	$13,423	$53,349	2020Q4	13.5%	$45,313	$15,234	$60,547
09	Sunk Costs	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$44,084	$14,821	34%	**$58,905**		$44,084	$14,821	$58,905			$49,837	$16,755	$66,592
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$882	$297	34%	$1,179	0.0%	$882	$297	$1,179	2017Q1	12.6%	$993	$334	$1,327
0.5%	Planning & Environmental Compliance	$220	$74	34%	$294	0.0%	$220	$74	$294	2017Q1	12.6%	$248	$83	$331
5.2%	Engineering & Design	$2,313	$778	34%	$3,091	0.0%	$2,313	$778	$3,091	2017Q1	12.6%	$2,605	$876	$3,481
0.5%	Reviews, ATRs, IEPRs, VE	$220	$74	34%	$294	0.0%	$220	$74	$294	2017Q1	12.6%	$248	$83	$331
0.5%	Life Cycle Updates (cost, schedule, risks)	$220	$74	34%	$294	0.0%	$220	$74	$294	2017Q1	12.6%	$248	$83	$331
0.5%	Contracting & Reprographics	$220	$74	34%	$294	0.0%	$220	$74	$294	2017Q1	12.6%	$248	$83	$331
1.0%	Engineering During Construction	$441	$148	34%	$589	0.0%	$441	$148	$589	2020Q4	31.9%	$582	$196	$777
0.5%	Planning During Construction	$220	$74	34%	$294	0.0%	$220	$74	$294	2020Q4	31.9%	$290	$98	$388
0.5%	Project Operations	$220	$74	34%	$294	0.0%	$220	$74	$294	2017Q1	12.6%	$248	$83	$331
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$3,086	$1,038	34%	$4,124	0.0%	$3,086	$1,038	$4,124	2020Q4	31.9%	$4,070	$1,368	$5,439
2.0%	Project Operation:	$882	$297	34%	$1,179	0.0%	$882	$297	$1,179	2020Q4	31.9%	$1,163	$391	$1,554
1.0%	Project Management	$441	$148	34%	$589	0.0%	$441	$148	$589	2020Q4	31.9%	$582	$196	$777
	CONTRACT COST TOTALS:	$53,449	$17,969		**$71,418**		$53,449	$17,969	$71,418			$61,361	$20,630	**$81,991**

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

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

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

DISTRICT: SWF Fort Worth PREPARED: 2/5/2014
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-2013				Program Year (Budget EC): 2014 Effective Price Level Date: 1 OCT 13								
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	$4,523	34%	$17,977	0.0%	$13,454	$4,523	$17,977	2022Q2	16.7%	$15,705	$5,280	$20,985
08	ROADS, RAILROADS & BRIDGES	$10,461	$3,517	34%	$13,978	0.0%	$10,461	$3,517	$13,978	2024Q2	21.2%	$12,679	$4,263	$16,942
09	CHANNELS & CANALS	$48,704	$16,374	34%	$65,078	0.0%	$48,704	$16,374	$65,078	2024Q1	20.6%	$58,753	$19,753	$78,506
	CONSTRUCTION ESTIMATE TOTALS:	$72,619	$24,414	34%	**$97,033**		$72,619	$24,414	$97,033			$87,137	$29,296	$116,433
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$1,452	$488	34%	$1,940	0.0%	$1,452	$488	$1,940	2019Q1	22.5%	$1,779	$598	$2,377
0.5%	Planning & Environmental Compliance	$363	$122	34%	$485	0.0%	$363	$122	$485	2019Q1	22.5%	$445	$150	$594
5.2%	Engineering & Design	$3,810	$1,281	34%	$5,091	0.0%	$3,810	$1,281	$5,091	2019Q1	22.5%	$4,668	$1,569	$6,238
0.5%	Reviews, ATRs, IEPRs, VE	$363	$122	34%	$485	0.0%	$363	$122	$485	2019Q1	22.5%	$445	$150	$594
0.5%	Life Cycle Updates (cost, schedule, risks)	$363	$122	34%	$485	0.0%	$363	$122	$485	2019Q1	22.5%	$445	$150	$594
0.5%	Contracting & Reprographics	$363	$122	34%	$485	0.0%	$363	$122	$485	2019Q1	22.5%	$445	$150	$594
1.0%	Engineering During Construction	$726	$244	34%	$970	0.0%	$726	$244	$970	2024Q2	53.5%	$1,115	$375	$1,489
0.5%	Planning During Construction	$363	$122	34%	$485	0.0%	$363	$122	$485	2024Q2	53.5%	$557	$187	$745
0.5%	Project Operations	$363	$122	34%	$485	0.0%	$363	$122	$485	2019Q1	22.5%	$445	$150	$594
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$5,083	$1,709	34%	$6,792	0.0%	$5,083	$1,709	$6,792	2024Q2	53.5%	$7,804	$2,624	$10,428
2.0%	Project Operation:	$1,452	$488	34%	$1,940	0.0%	$1,452	$488	$1,940	2024Q2	53.5%	$2,229	$750	$2,979
1.0%	Project Management	$726	$244	34%	$970	0.0%	$726	$244	$970	2024Q2	53.5%	$1,115	$375	$1,489
	CONTRACT COST TOTALS:	$88,046	$29,601		**$117,647**		$88,046	$29,601	$117,647			$108,629	$36,521	**$145,150**

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

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

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

DISTRICT: SWF Fort Worth PREPARED: 2/5/2014
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-2013				Program Year (Budget EC): 2014 Effective Price Level Date: 1 OCT 13				FULLY FUNDED PROJECT ESTIMATE				
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 5 Hampton Pump Station													
13	PUMPING PLANT	$46,479	$15,148	33%	$61,627	0.0%	$46,479 $0	$15,148	$61,627	2021Q1	14.0%	$52,991	$17,270	$70,261
	CONSTRUCTION ESTIMATE TOTALS:	$46,479	$15,148	33%	**$61,627**		$46,479	$15,148	$61,627			$52,991	$17,270	$70,261
01	LANDS AND DAMAGES	$11,841	$2,365	20%	$14,206	0.0%	$11,841	$2,365	$14,206	2017Q1	5.7%	$12,521	$2,500	$15,021
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$930	$303	33%	$1,233	0.0%	$930	$303	$1,233	2016Q4	11.5%	$1,037	$338	$1,374
0.5%	Planning & Environmental Compliance	$232	$76	33%	$308	0.0%	$232	$76	$308	2016Q4	11.5%	$259	$84	$343
5.2%	Engineering & Design	$2,439	$795	33%	$3,234	0.0%	$2,439	$795	$3,234	2016Q4	11.5%	$2,718	$886	$3,604
0.5%	Reviews, ATRs, IEPRs, VE	$232	$76	33%	$308	0.0%	$232	$76	$308	2016Q4	11.5%	$259	$84	$343
0.5%	Life Cycle Updates (cost, schedule, risks)	$232	$76	33%	$308	0.0%	$232	$76	$308	2016Q4	11.5%	$259	$84	$343
0.5%	Contracting & Reprographics	$232	$76	33%	$308	0.0%	$232	$76	$308	2016Q4	11.5%	$259	$84	$343
1.0%	Engineering During Construction	$465	$152	33%	$617	0.0%	$465	$152	$617	2021Q1	33.3%	$620	$202	$822
0.5%	Planning During Construction	$232	$76	33%	$308	0.0%	$232	$76	$308	2021Q1	33.3%	$309	$101	$410
0.5%	Project Operations	$232	$76	33%	$308	0.0%	$232	$76	$308	2016Q4	11.5%	$259	$84	$343
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$3,254	$1,060	33%	$4,314	0.0%	$3,254	$1,060	$4,314	2021Q1	33.3%	$4,337	$1,413	$5,751
2.0%	Project Operation:	$930	$303	33%	$1,233	0.0%	$930	$303	$1,233	2021Q1	33.3%	$1,240	$404	$1,644
1.0%	Project Management	$465	$152	33%	$617	0.0%	$465	$152	$617	2021Q1	33.3%	$620	$202	$822
	CONTRACT COST TOTALS:	$68,195	$20,731		**$88,926**		$68,195	$20,731	$88,926			$77,686	$23,738	**$101,423**

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

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PROJECT: Dallas Floodway Feasibility Study
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DISTRICT: SWF Fort Worth PREPARED: 2/5/2014
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				Program Year (Budget EC): 2014								
		Effective Price Level: 1-Oct-2013				Effective Price Level Date: 1 OCT 13				FULLY FUNDED PROJECT ESTIMATE				
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 6 River Relocation Bottom													
02	RELOCATIONS	$14,621	$4,915	34%	$19,536	0.0%	$14,621	$4,915	$19,536	2026Q4	27.1%	$18,577	$6,245	$24,822
08	ROADS, RAILROADS & BRIDGES	$18,442	$6,200	34%	$24,642	0.0%	$18,442	$6,200	$24,642	2028Q1	30.1%	$23,986	$8,064	$32,050
09	CHANNELS & CANALS	$38,475	$12,935	34%	$51,410	0.0%	$38,475	$12,935	$51,410	2027Q1	27.6%	$49,109	$16,511	$65,620
06	FISH & WILDLIFE FACILITIES	$4,250	$1,429	34%	$5,679	0.0%	$4,250	$1,429	$5,679	2027Q2	28.3%	$5,451	$1,833	$7,283
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$75,787	$25,480	34%	**$101,267**		$75,787	$25,480	$101,267			$97,123	$32,653	$129,776
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$1,516	$510	34%	$2,026	0.0%	$1,516	$510	$2,026	2021Q4	37.6%	$2,087	$702	$2,788
0.5%	Planning & Environmental Compliance	$379	$127	34%	$506	0.0%	$379	$127	$506	2021Q4	37.6%	$522	$175	$697
5.2%	Engineering & Design	$3,977	$1,337	34%	$5,314	0.0%	$3,977	$1,337	$5,314	2021Q4	37.6%	$5,474	$1,840	$7,314
0.5%	Reviews, ATRs, IEPRs, VE	$379	$127	34%	$506	0.0%	$379	$127	$506	2021Q4	37.6%	$522	$175	$697
0.5%	Life Cycle Updates (cost, schedule, risks)	$379	$127	34%	$506	0.0%	$379	$127	$506	2021Q4	37.6%	$522	$175	$697
0.5%	Contracting & Reprographics	$379	$127	34%	$506	0.0%	$379	$127	$506	2021Q4	37.6%	$522	$175	$697
1.0%	Engineering During Construction	$758	$255	34%	$1,013	0.0%	$758	$255	$1,013	2028Q1	82.7%	$1,385	$466	$1,850
0.5%	Planning During Construction	$379	$127	34%	$506	0.0%	$379	$127	$506	2028Q1	82.7%	$692	$233	$925
0.5%	Project Operations	$379	$127	34%	$506	0.0%	$379	$127	$506	2021Q4	37.6%	$522	$175	$697
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$5,305	$1,784	34%	$7,089	0.0%	$5,305	$1,784	$7,089	2028Q1	82.7%	$9,692	$3,259	$12,951
2.0%	Project Operation:	$1,516	$510	34%	$2,026	0.0%	$1,516	$510	$2,026	2028Q1	82.7%	$2,770	$931	$3,701
1.0%	Project Management	$757	$255	34%	$1,012	0.0%	$757	$255	$1,012	2028Q1	82.7%	$1,383	$465	$1,848
	CONTRACT COST TOTALS:	$91,890	$30,893		**$122,784**		$91,890	$30,893	$122,784			$123,214	$41,425	**$164,638**

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

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PROJECT: Dallas Floodway Feasibility Study
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DISTRICT: SWF Fort Worth
POC: CHIEF, COST ENGINEERING, Milton Schmidt
PREPARED: 2/5/2014

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-2013				Program Year (Budget EC): 2014 Effective Price Level Date: 1 OCT 13				FULLY FUNDED PROJECT ESTIMATE				
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*
	City Contract for Able Pump Station													
13	PUMPING PLANT	$73,293	$23,886	33%	$97,179	0.0%	$73,293 $0	$23,886	$97,179	2014Q3	0.9%	$73,931	$24,094	$98,025
	CONSTRUCTION ESTIMATE TOTALS:	$73,293	$23,886	33%	**$97,179**		$73,293	$23,886	$97,179			$73,931	$24,094	$98,025
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$1,466	$478	33%	$1,944	0.0%	$1,466	$478	$1,944	2014Q2	0.5%	$1,473	$480	$1,953
0.5%	Planning & Environmental Compliance	$366	$119	33%	$485	0.0%	$366	$119	$485	2014Q2	0.5%	$368	$120	$488
5.2%	Engineering & Design	$3,846	$1,253	33%	$5,099	0.0%	$3,846	$1,253	$5,099	2014Q2	0.5%	$3,865	$1,260	$5,125
0.5%	Reviews, ATRs, IEPRs, VE	$366	$119	33%	$485	0.0%	$366	$119	$485	2014Q2	0.5%	$368	$120	$488
0.5%	Life Cycle Updates (cost, schedule, risks)	$366	$119	33%	$485	0.0%	$366	$119	$485	2014Q2	0.5%	$368	$120	$488
0.5%	Contracting & Reprographics	$366	$119	33%	$485	0.0%	$366	$119	$485	2014Q2	0.5%	$368	$120	$488
1.0%	Engineering During Construction	$733	$239	33%	$972	0.0%	$733	$239	$972	2014Q2	0.5%	$737	$240	$977
0.5%	Planning During Construction	$366	$119	33%	$485	0.0%	$366	$119	$485	2014Q2	0.5%	$368	$120	$488
0.5%	Project Operations	$366	$119	33%	$485	0.0%	$366	$119	$485	2014Q2	0.5%	$368	$120	$488
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$5,130	$1,672	33%	$6,802	0.0%	$5,130	$1,672	$6,802	2014Q3	1.5%	$5,209	$1,698	$6,907
2.0%	Project Operation:	$1,466	$478	33%	$1,944	0.0%	$1,466	$478	$1,944	2014Q2	1.5%	$1,489	$485	$1,974
1.0%	Project Management	$732	$239	33%	$971	0.0%	$732	$239	$971	2014Q2	1.5%	$743	$242	$986
	CONTRACT COST TOTALS:	$88,862	$28,960		**$117,822**		$88,862	$28,960	$117,822			$89,654	$29,218	**$118,872**