US Army Corps
of Engineers®

WEST SHORE LAKE PONTCHARTRAIN HURRICANE AND STORM DAMAGE RISK REDUCTION PROJECT

Project Cost and Schedule Risk Analysis Report

Prepared for:
U.S. Army Corps of Engineers
Mississippi Valley Division
New Orleans District

Prepared by:
New Orleans District

Date: **27 JUN 2014**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), New Orleans District, presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Presque Isle Shoreline Erosion Control Project. 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.

The risk analysis is based upon the recommended plan of 18.27-mile levee around Montz, Laplace, Reserve and Garyville, reducing risk to over 7,000 structures. Additionally, four miles of I-10 flooded during Hurricane Isaac is within the proposed system. The plan includes non-structural measures for 1,571 structures in Gramercy, Lutcher and Grand Point. The estimated base cost, excluding contingencies approximates $560M which includes:

- 01 Lands and Damages
- 02 Relocations
- 06 Fish and Wildlife
- 11 Levees and Floodwalls
- 13 Pumping Plant
- 30 Planning, Engineering and Design (PED)
- 31 Construction Management

.
Of the above, the 01 Lands and Damages and the 06 Fish and Wildlife contingencies were provided by others. This risk analysis was devoted to the main construction features: Relocations, Levees and Floodwalls and Pumping Plants, approximating $400M. The other costs excluded from this study are the PED and Construction Management costs. Those two costs, based as a percent of the construction base costs, received the same applied contingency percent.

Cost estimates fluctuate over time. During this period of study, minor cost fluctuations can and have occurred. For this reason, contingency reporting is based in cost and per cent values. Should cost vary to a slight degree with similar scope and risks, contingency per cent values will be reported, cost values rounded. The study resulted in a 29% contingency with an 80% confidence level of successful project completion.

Table 1 Construction Contingency Results

Confidence Level	Base Cost	Contingency $	Contingency (%)
5%	$381,341,070	$50,845,549	13.33%
50%	$381,341,070	$91,328,758	23.95%
80%	$381,341,070	$115,043,125	30.17%
90%	$381,341,070	$126,816,303	33.26%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The PDT worked through the risk register in February 2014, focusing on construction, contract acquisition, design, project management, programmatic and construction management risks. The study outcome identified key cost and schedule risks resulting in an approximate 30% contingency of the costs studied.

Cost Risks: From the CSRA, the key or greater identified Cost Risks include:

- (CON-1) Construction Contract Modifications – Technical complexities and site conditions could result in increased risk of contract modifications. Detailed geotechnical and hydraulic investigations may reduce these risks.

- (TL-4) Borrow Sources Identified/Secured – The uncertainty of a secured borrow source for the last five lifts. Alternative borrow sources may need to be approved in order to reduce this risk.

- CA-1 Contract Acquisition Impacts – Type of contracts and possible impacts to cost and schedule. Early PDT involvement with Contracting and Project Management may lessen the risks and solidify the types of solicitations.

- TL-2 Design Development – Design details for the structural elements whether preliminary or detailed and their impact to costs. Further investigations in the design phases may lessen this risk.

- EST-1 Labor & Equipment Availability/Pricing – Variances in availability of equipment and labor throughout the project and impacts to costs.

- EST-3 Estimate quality when developed by others – Inaccuracies due to a large use of lump sums in the MII could cause changes to cost. Further design and additional QC/QA may reduce this risk.

- PR-1 Funding Availability for PED and Construction – Impacts to costs due to funding variances causing delays and escalation of costs.

- PR-4 Fuel Cost – Fuel price variances impacts to construction costs.

Schedule Risks: Schedule risks indicate a duration uncertainty which can also be translated into cost impacts. The greatest identified schedule risks include:

- CA-2 Numerous Separate Contracts – Numerous separate contracts increases the risks of protests, access to projects choke points, multiple contractor coordination.

- PPM-2 Smart Planning Pilot – Impacts to schedule due to unplanned work or requests for additional modeling/investigations under PED.

- PPM-3 Funding Availability at Pre-solicitation Stage – Impacts to schedule due to lack of funding during PED.

- PR-1 Funding Availability for PED and Construction – Impacts to schedule due to funding variances causing delays and increased costs

- PR-6 Stakeholder Request Late Changes – Additional work or alignment changes would impact costs and increase schedule delays.

Recommendations: Further iterative project and risk study is important throughout the project life-cycle in order to efficiently manage and maintain a reasonable cost and schedule. Certain risks are outside the PDT control, while certain risks can be managed to lessen impact in cost and time. The more critical items that warrant attention are:

- Work to identify and procure quality borrow sources close to the project location. This brings dividends related to haul time and productivity. Closer borrow sources are key in decreasing the cost and risk impacts to this project.

- Identify and resolve the mitigation requirements and concerns in order to gain a better understanding of cost implications.

1. PURPOSE

The study purpose is to provide a recommendation for Federal participation in hurricane storm damage risk reduction for St. Charles, St. John the Baptist and St. James Parishes that would be economically and environmentally justified. The study addresses flooding caused by storm surge but does not address rainfall flooding. There have been significant changes over the last 40 years, especially since Hurricane Katrina. Population has grown over the past few decades. This report presents a collaboratively-developed plan prepared in accordance with the National Environmental Policy Act (NEPA) and Engineering Regulation 1105-2-100, the USACE Planning Guidance Notebook. It consists of a main report and appendices, and identifies the expected benefits, estimated cost and implementation responsibilities for a tentatively selected plan (TSP). The report provides an overview of the study and summarizes detailed information found in technical appendices. The report is an interim response to the study authority. Flooding cause by storm surge damages homes, businesses and infrastructure. Surge travels from the Gulf of Mexico into the basin and floods the three study area parishes and beyond (Figure 1-3).

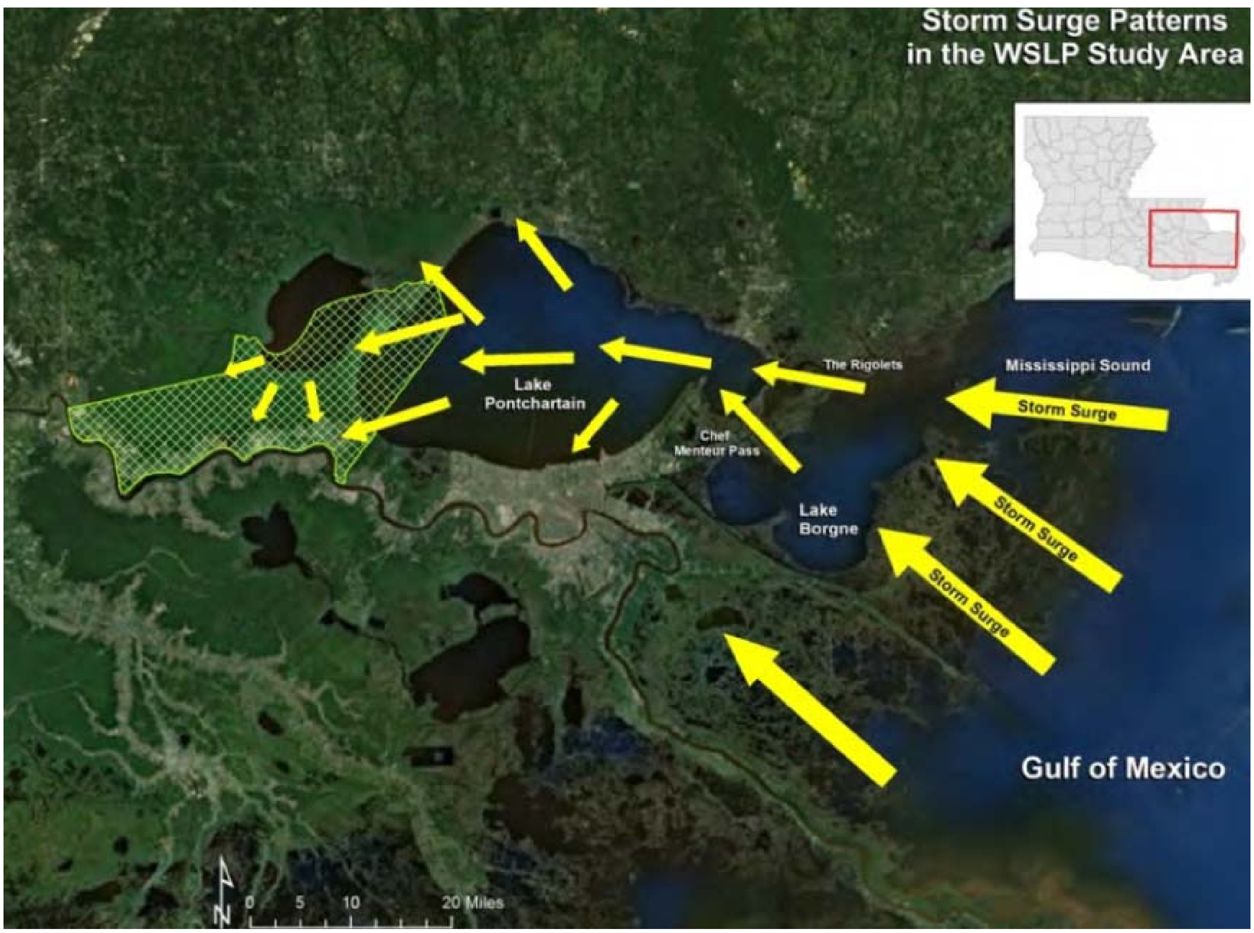

Figure 1 Area Storm Surge Patterns

Since 1855, 70 hurricanes have made landfall within 65 nautical miles of Laplace. Hurricanes Betsy (1965), Camille (1969), Juan (1985), Andrew (1992), Katrina and Rita (2005), Gustav and Ike (2008), and Isaac (2012) caused storm surge flooding. Hurricane Isaac's surge, measured from 6 to 8 feet in the area, threatened lives and damaged more than 7,000 homes, closed roads and disrupted the Nationally-significant energy industry. Businesses and workers serving the Port of South Louisiana are located in the area. The port is the largest volume port in the Western Hemisphere and the ninth largest in the world. It stretches 54 miles on the Mississippi River between New Orleans and Baton Rouge. Hurricane Isaac disrupted port logistics. Its storm surge blocked facility access closing the port. Oil refineries, including the Nation's third largest, were shutdown. Gasoline production stopped. Regional and National fuel prices spiked. The storm caused extensive agricultural losses due to an inability to drain storm surge water from fields.

The study area setting offers bounty of natural resources but it was historically subject to flooding from the river and nearby lakes. Levees were constructed along the Mississippi River starting in the 1700s to combat annual floods. These levees allowed settlement of the area and agricultural production and the harvesting of natural resources. The area remains susceptible to floods from tropical storms and hurricanes. Some natural protection is afforded by large cypress swamp that separates developed areas from nearby tidal lakes. The swamp has degraded over time and the buffer it provides between the lakes and towns is decreasing. As a result, flooding from storm surge (Figure 1-3) remains a risk that is expected to increase over time. The management of Mississippi River flood risk, and the accompanying development of interior drainage systems, allowed urban and suburban expansion in much of the region beyond the natural high-ground near the Mississippi River. Population has increased with suburban development between Baton Rouge and New Orleans. Residents are attracted to the area because of employment opportunities, quality of life, and access to recreation. These factors, increasing population and degrading natural buffers, combine to increase storm surge flooding risks.

2. BACKGROUND

The study area (Figure 1-1) is located in southeast Louisiana between the Mississippi River, and Lakes Maurepas and Pontchartrain.

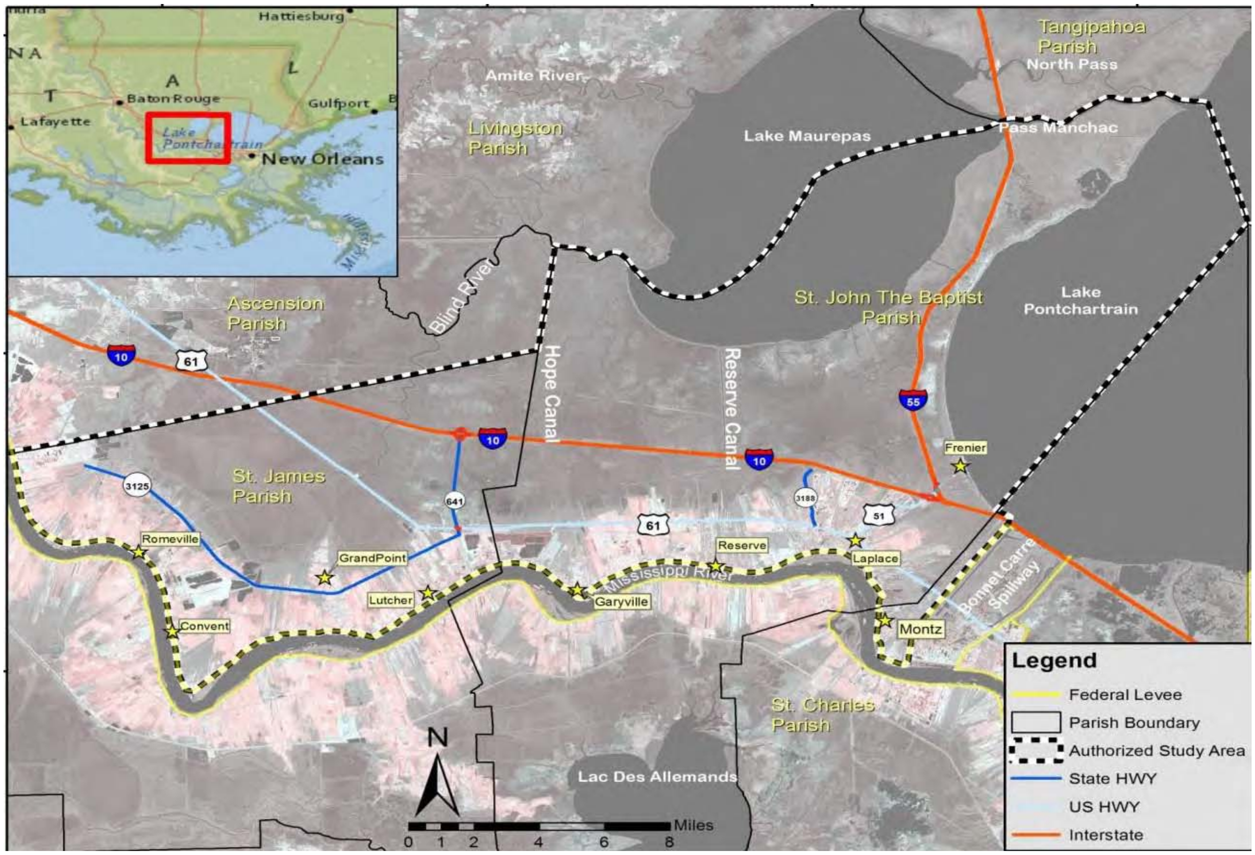

Figure 2 West Shore Lake Pontchartrain Authorized Study Area

The towns of Montz, Laplace, Reserve, Lutcher,
Gramercy, Grand Point, Convent, Garyville and Romeville are area communities. The 184,351 study acre area occupies a portion of one of the oldest delta complexes in the Mississippi River Deltaic Plain. It is located in the lower Mississippi River alluvial plain in the Pontchartrain Basin. The area includes residential and commercial developments south of Interstate 10 (I-10). West of Laplace, a majority of the developed areas are found between U.S. Highway 61 (US-61) and the Mississippi River levee. The area north of I-10 comprises the State of Louisiana's Maurepas Swamp Wildlife Management Area (WMA). The project area includes lands potentially impacted by the proposed action. Hurricane or tropical storm winds push on the ocean's surface, causing a rise of water over and
above the predicted tide. This is called storm surge. Hurricanes and tropical storms are an important part of Louisiana's history and culture. The region experiences tropical waves, depressions, storms and hurricanes. The study area is highly susceptible to storm surge. The destruction caused by a 1915 hurricane was recounted years later:

"… an enormous storm surge advanced with great rapidity upon the western shore of Lake Pontchartrain well ahead of the eye of the hurricane which very nearly struck Frenier head on. As the storm came ashore in the New Orleans area, fifty people drowned as a thirteen foot storm surge swept the Rigolets railroad bridge away. It should also be emphasized that damage and destruction to homes and property were occurring even as the eye of the hurricane was 165 miles from Frenier. Two-hundred seventy-five Louisianians lost their lives

as a result of the "Great West Indian Hurricane of 1915." (Landry 1996)
Recent hurricanes impacting the area include Katrina and Rita in 2005, Gustav and Ike in 2008, and Isaac in 2012. These storms threatened a region that plays a vital national economic role and that serves as a key transportation corridor.
An important swamp buffer separating development from nearby lakes has been impacted over time. The closure of bayous and the construction of levees cut off the annual flooding that historically nourished and maintained the cypress/tupelo habitat in the Maurepas Swamp. The cypress forests of the swamp were logged in the 1890s –1930s. Canals and railroads were built through the swamp to remove cut timber (Figure1-2). The swamp is converting to fragmented marsh and open water (USACE 2010a, USACE 2010b). The area may experience up to 2.32-feet of relative sea level rise (RSLR) over the next 50-years under an “intermediate “scenario. The surge buffer benefits of the swamp will continue to diminish as it degrades and disappears and sea level rises.

3. 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 both cost and schedule risks for all project features. The study and presentation can include or exclude consideration for operation and maintenance or life cycle costs, depending upon the program or decision document intended for funding.

3.1 Project Scope

The U.S. Congress recognized the need for a hurricane and storm damage risk reduction project in the area. Two Congressional resolutions authorize this study. The first was adopted on July 29, 1971 by the U.S. House of Representatives Committee on Public Works.
“RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, with particular reference to providing additional levees for hurricane protection and flood control in St. John the Baptist Parish and that part of St. Charles Parish west of the Bonnet Carré Spillway."

The U.S. Senate Committee on Public Works adopted a resolution on September 20, 1974.
“RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, for hurricane protection and flood control in St. James Parish."

The study was first funded in the 1980s. A 1985 Reconnaissance Report found that there was no justified structural plan suitable for Federal participation. A 1987 reconnaissance report indicated that under Federal criteria a solution could not be found that would be economically justified or environmentally acceptable. Because of increasing population and economic activity, a 1997 reconnaissance report indicated that the study should proceed into feasibility phase. A Feasibility Cost Share Agreement was executed with the Pontchartrain Levee District (PLD) in 1998. The study stopped in 2002. Following Hurricane Katrina, renewed interest by the levee district led to an amended agreement in 2008. Planning for the project was underway when Hurricane Isaac hit in August2012. President Obama traveled to Laplace, Louisiana after the storm to view the damage and visit with residents and local leaders. The President said, **"*We're getting on the case to figure out what happened here and what we can do to make sure it won't happen again.*"** The USACE's post-Isaac damage assessment met the first part of the President's commitment. This study will help deliver the second part.

The report includes the project technical scope, feasibility level estimates developed by the engineering design firm Burk-Kleinpeter, Inc. (BKI), and the New Orleans District Cost Engineering. Construction schedules were developed by the New Orleans District Cost Engineering. New Orleans District Cost Engineering performed the Quality Control Review of BKI's work and did and internal independent review of work prepared by New Orleans District Cost Engineering. Consequently, these documents serve as the basis for the risk analysis. In general terms, the construction scope consists of the following:

- Lands and Damages
- Relocations
- Levees and Floodwalls
- Pumping Plant
- Planning, Engineering and Design
- Construction Management

3.2 USACE Risk Analysis Process

The risk analysis process follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering DX). The risk analysis process reflected within the risk analysis report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. The risk analysis results are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. 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 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 analyses 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, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

- ER 1110-2-1150, Engineering and Design for Civil Works Projects.
- ER 1110-2-1302, Civil Works Cost Engineering.
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works.
- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering DX.
- Memorandum from Major General Don T. Riley (U.S. Army Director of Civil Works), dated July 3, 2007.
- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.

4. METHODOLOGY/PROCESS

The Project Delivery Team is composed of various USACE New Orleans District branches including Project Management, Real Estate, Planning, Contracting, Structures and Levee Design, Hydrologic and Geotechnical and Cost Engineering Offices.

The District PDT conducted a February 2014 risk identification meeting, completing a draft risk register in support of a risk analysis study and modeling. Participants in the risk identification meetings included:

Miguel Ramos	USACE New Orleans	Cost Engineer
Henry Picard	A/E firm Burk Kleinpeter, Inc.	Designer & Cost Engineer
David Boyd	A/E firm Burk Kleinpeter, Inc.	Designer & Cost Engineer
Jeffery Varisco	USACE New Orleans	Project Manager
Travis Creel	USACE New Orleans	Planner
Walter Teckemeyer	USACE New Orleans	Project Engineer
Darrell Normand	USACE New Orleans	Cost Engineer

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 any desired level of cost confidence. A parallel process is also used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) 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 Engineering DX 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 adverse 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 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. Because Crystal Ball is an Excel add-in, the schedules for each option are recreated in an Excel format from their native format. 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 would be provided in section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT are considered a qualitative process that results in establishing a risk register that serves as the document for the further 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.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

A formal PDT meeting was held Feb 24, 2014 at the New Orleans District for the purposes of identifying and assessing risk factors. The meeting included qualified representatives from multiple project team disciplines and functions, for example:

- Project/program managers.
- Planners
- Project Engineers
- Geotechnical Engineers
- Structural Engineers
- Relocations, Real Estate, Economist, Construction (on call)
- Hydraulic Engineers
- Civil, structural, geotechnical, and hydraulic design.
- Cost and schedule engineers.

The initial meeting 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 and phone conversations focused primarily on risk factor assessment and quantification.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are 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 involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The following elements of each risk factor were discussed by the PDT to estimate the 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 risk discussions focused on the various project features as presented within the USACE Civil Works Work Breakdown Structure for cost accounting purposes. It was recognized that the various features carry differing degrees of risk as related to cost, schedule, design complexity, and design progress. The example features under study are presented in table 1:

Table 2 Work Breakdown Structure by Feature

01	LANDS AND DAMAGES
02	RELOCATIONS
11	LEVEES & FLOODWALLS
13	PUMPING PLANT
30	PLANNING, ENGINEERING & DESIGN
31	CONSTRUCTION MANAGEMENT

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 are meant to 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 base 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.

For schedule contingency analysis, the option schedule contingency is calculated as the difference between the P80 option duration forecast and the base schedule duration. These contingencies are then used to calculate the time value of money impact of project delays that are included in the presentation of total cost contingency in section 6. The resulting time value of money, or added risk escalation, is then added into the contingency amount to reflect the USACE standard for presenting the "total project cost" for the fully funded project amount.

Schedule contingency is analyzed only on the basis of each option and not allocated to specific tasks. Based on Cost Engineering DX guidance, only critical path and near critical path tasks are considered to be uncertain for the purposes of contingency analysis.

5. KEY ASSUMPTIONS

Key assumptions are those that are most likely to significantly affect the determinations and/or estimates of risk presented in the risk analysis. The key assumptions are important to help ensure that project leadership and other decision makers understand the steps, logic, limitations, and decisions made in the risk analysis, as well as any resultant limitations on the use of outcomes and results.

The following is an example of key assumptions for the risk analysis that could be identified by the PDT and risk analyst.

- Level of Design: The cost comparisons and risk analyses performed and reflected within this report are based upon design scope and estimates that are considered to be well developed and designed.
- Design Scope: The prescribed scope satisfies the requirements of this acquisition given that it is a re-authorization along the already approved alignment with minor adjustments.
- Operation and Maintenance: Operation and maintenance activities were not included in the cost estimate or schedules
- Contract Acquisition Strategy: Consistent with cost estimate and schedule assumptions, it is assumed that the contract acquisition strategy is predominately firm fixed price.
- Confidence Levels: The Walla Walla Cost Engineering Dx guidance generally focuses on the eighty-percent level of confidence (80%) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (80%) was used. It should be noted that the use of 80% as a decision criteria is a moderate risk aversion approach, generally resulting in higher cost contingencies. However, the 80% level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to completely capture actual project costs.
- Only moderate and high risk levels were applied for the purposes of the CSRA analysis.

The following list identifies the key risk analysis assumptions and limitations within the context of the Morganza to the Gulf of Mexico PAC CSRA. For each item, the context is first provided and then followed by the key assumption or limitation.

- *Unknown Decisions or Decision Makers:* The CSRA was prepared using a framework to generate contingency information that is appropriate for use by State of Louisiana and USACE decision makers for scheduling, budgeting, and project control purposes. The framework may generate results that are appropriate for use by a wide variety of decision makers or stakeholders;

however, the assumed use of CSRA results is limited to scheduling, budgeting, and project control. Other uses by unknown decision makers may not be appropriate.

- *Dynamic Risks:* Risk events are dynamic, not static, and should be evaluated regularly through all phases of design, construction and O&M (if required). The CSRA is based on the identification and assessment of risks as of the date of this document. Reduced utility of current CSRA results should be assumed if the likelihood and impact of risks change over time.
- *Causal Relationships:* With the exception of risk events identified as correlated in the risk register, it is assumed that the impacts of risks are independent and that the realization of one risk does not cause the realization of another. Significant variance of the risk model results from actual project costs and schedules may be experienced if significant causal relationships exist between risks assumed to be independent.
- *Conservation of Market Pricing Risk:* The CSRA assumes that market pricing risks are not created or destroyed but can only be transferred or shared *at a price* as a result of various contract acquisition strategies. As an example, it is assumed that a contractor will add a level of contingency to a fixed price bid, relative to a cost reimbursable bid, that is reflective of the risk transferred contractually from the Government to the contractor. Other aspects of contract acquisition strategies not related to market pricing, such as the management cost of modifications or claims, are not included in this assumption. Any contract acquisition strategy that actually transfers market pricing risk to a contractor *at no cost* to the Government is not reflected in the CSRA.
- *Unknown Unknown* and *Unknowable Risks*: The Kinetin Framework describes decision-making contexts, in part, by characteristic types of uncertainty. Simple, complicated, complex and chaotic contexts within the framework are respectively associated with *known known*, *known unknown*, *unknown unknown* and *unknowable* uncertainties. The CSRA process focuses on *known known* and *known unknown* risks and is not intended to quantify the impacts of *unknown unknown* or *unknowable* risks. Significant variance of the risk model results from actual project costs and schedules may be experienced if *unknown unknowable* risks, as defined in the Cynefin Framework, are realized.

6. RISK ANALYSIS RESULTS

The following sections discuss the risk register, cost risk analysis results, schedule risk analysis results, and the combined cost and schedule risk analysis results.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk studies and Crystal Ball risk models. A summary risk register that includes typical risk events studied (high and moderate levels) should be presented in a table in this section. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. A more detailed risk register would be provided in appendix A. The detailed risk registers of appendix A include low level and unrated risks, as well as additional information regarding the specific 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 risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Risk Analysis - Cost Contingency Results

The cost risk model was run from the project Risk Register for all the project construction work. There were eight risks applicable to the project construction work. As shown in Table 2, there were a total of eight risks used in the modeling for the risk analyses which had a cost impact of moderate or high. The risk was analyzed using the low, most likely, and high estimates for each risk item and the items associated variance distribution. The analysis produced a sensitivity chart of the risk items and confidence levels from 0 to 100% and the associated contingency amount.

The cost sensitivity chart for the Project Cost is shown in Figure 3. The sensitivity chart shows the influence of each risk items on the resulting cost contingency. The risk items are ranked according to their importance to the cost contingency. As shown in the Cost Sensitivity Charts, Possible Construction Modifications and Borrow/Fill Sources Identified items had the most influence on the cost contingency.

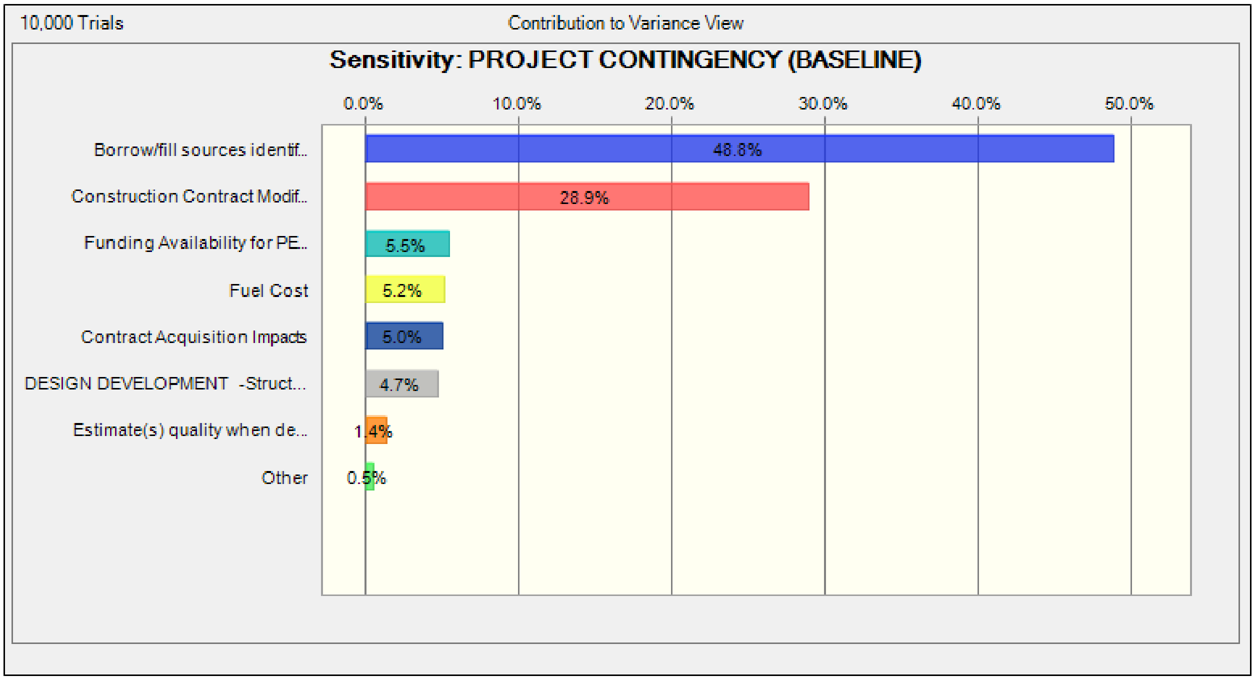

Figure 3 Project Cost Sensitivity Chart

The cost risk analysis also produced a confidence table in five percent increments of project confidence associated with contingency dollars. The confidence levels are shown in Table 3. As seen in the table, all of the associated contingency dollar amounts are positive. The contingency dollar amounts range from over $15 million to over $193 million. The recommended cost contingency amount for the project is $115,965,059.

Table 3 Project Cost Confidence Table

Confidence Level	Value	Contingency
0%	**$411,083,188**	**4.02%**
5%	**$441,601,870**	**11.74%**
10%	**$448,582,338**	**13.51%**
15%	**$453,790,781**	**14.83%**
20%	**$458,090,305**	**15.92%**
25%	**$461,725,542**	**16.84%**
30%	**$465,248,288**	**17.73%**
35%	**$468,462,654**	**18.54%**
40%	**$471,503,691**	**19.31%**
45%	**$474,341,807**	**20.03%**
50%	**$477,518,142**	**20.83%**
55%	**$480,516,261**	**21.59%**
60%	**$483,587,157**	**22.37%**
65%	**$487,146,543**	**23.27%**
70%	**$490,737,500**	**24.18%**
75%	**$494,456,374**	**25.12%**
80%	**$498,653,172**	**26.18%**
85%	**$503,477,035**	**27.40%**
90%	**$509,651,756**	**28.96%**
95%	**$519,422,304**	**31.44%**
100%	**$566,003,261**	**43.22%**

6.3 Schedule Risk Analysis - Schedule Contingency Results

A schedule risk analysis was conducted on five risks of the risk register, shown in Appendix A, which had a schedule impact of moderate or high. The project Risk Register originally considered over 40 risk items but only 5 risks were determined to have an impact on the overall program schedule. The risk was analyzed using the low, most likely, and high estimates for each risk item and the items associated variance distribution. The analysis produced a sensitivity chart of the risk items and confidence levels from 0 to 100% and the associated contingency amount.

The schedule sensitivity chart is shown in Figure 4 below. The sensitivity chart shows the influence of each risk items on the resulting schedule contingency. The risk items are ranked according to their importance to the schedule contingency. As shown in the Schedule Sensitivity Chart, the Numerous Separate Contracts (CA-2) item had the most influence on the schedule contingency. It is important to note again that the schedule is for a Program rather than a Single Project and therefore very few items were considered to be a High risk to the program and did not significantly affect the overall schedule.

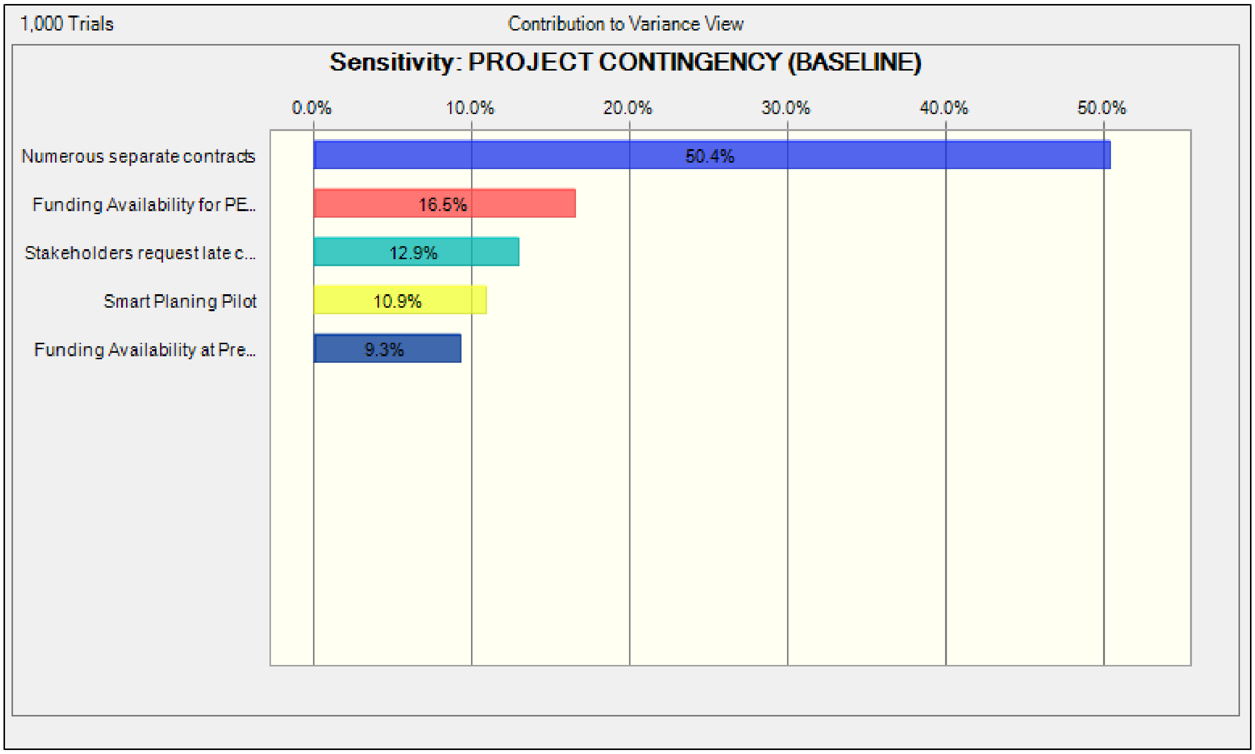

Figure 4 Project Schedule Sensitivity Chart

The schedule risk analysis also produced a confidence table in five percent increments of project confidence associated with contingency months. The confidence table is shown in Table 4 below. As seen in the table, all the associated contingency month amounts are positive. The contingency month amounts range from 4.1 months to over 56 months. The recommended schedule contingency amount is 30.5 months. Note that these results reflect only those contingencies established from the schedule risk analysis.

Confidence Level	Value	Contingency
0%	**4.1 Months**	**0.74%**
5%	**11.5 Months**	**2.07%**
10%	**13.8 Months**	**2.48%**
15%	**15.5 Months**	**2.79%**
20%	**17.2 Months**	**3.09%**
25%	**18.3 Months**	**3.28%**
30%	**19.2 Months**	**3.45%**
35%	**20.4 Months**	**3.66%**
40%	**21.3 Months**	**3.83%**
45%	**22.3 Months**	**4.00%**
50%	**23.5 Months**	**4.22%**
55%	**24.3 Months**	**4.36%**
60%	**25.5 Months**	**4.57%**
65%	**26.7 Months**	**4.79%**
70%	**27.9 Months**	**5.02%**
75%	**29.0 Months**	**5.20%**
80%	**30.5 Months**	**5.48%**
85%	**32.3 Months**	**5.79%**
90%	**34.2 Months**	**6.13%**
95%	**36.7 Months**	**6.59%**
100%	**56.1 Months**	**10.06%**

Table 4 Project Schedule Confidence Table

6.4 Combined Cost and Schedule Contingency Results

To obtain an overall feature contingency, the cost risk analysis confidence table and the schedule risk analysis confidence table are combined. That combined table is shown in Table 8. To obtain the final contingency dollar amount, the schedule contingency is converted into dollars by using the time value of money.

Confidence Level	Contingency	Contingency
0%	**$15,893,329**	**4.1 Months**
5%	**$51,126,450**	**11.5 Months**
10%	**$59,042,361**	**13.8 Months**
15%	**$64,958,788**	**15.5 Months**
20%	**$69,935,351**	**17.2 Months**
25%	**$74,017,034**	**18.3 Months**
30%	**$77,931,608**	**19.2 Months**
35%	**$81,613,631**	**20.4 Months**
40%	**$85,047,490**	**21.3 Months**
45%	**$88,271,729**	**22.3 Months**
50%	**$91,939,953**	**23.5 Months**
55%	**$95,274,616**	**24.3 Months**
60%	**$98,825,250**	**25.5 Months**
65%	**$102,881,524**	**26.7 Months**
70%	**$106,983,530**	**27.9 Months**
75%	**$111,126,364**	**29.0 Months**
80%	**$115,965,059**	**30.5 Months**
85%	**$121,487,874**	**32.3 Months**
90%	**$128,442,416**	**34.2 Months**
95%	**$139,262,068**	**36.7 Months**
100%	**$193,756,345**	**56.1 Months**

Table 5 Combined Confidence Table

7. MAJOR FINDINGS/OBSERVATIONS

The cost and schedule risk analysis resulted in a recommended combined cost contingency of $115,043,125 and a schedule recommended contingency of 30.5 months. The project construction costs for confidence levels 0 to 100% are shown below. Table 6 presents construction costs, which include base cost plus cost and schedule contingencies. Lands and Damages cost and contingency are not included. Figure 5 illustrates the construction cost risk analysis confidence curve. The recommended contingency is 31% based on the 80% confidence level. These contingencies were applied to the detailed estimate for the recommended plan for the West Shore Lake Pontchartrain project. The rounded contingency percentage of 31.0% was transferred to the TPCS for final calculation of Total Contingency and Total Cost. Lands and Damages cost and contingency are not included in the above numbers. Note: The rounding of contingencies causes the totals on the TPCS to be slightly higher than and not add up to exactly the costs above.

Table 6 Project Contingencies

Confidence Level	Project Cost	Contingency ($)	Contingency (%)
0%	**$397,563,680**	**$16,222,611**	**4.25%**
5%	**$432,186,618**	**$50,845,549**	**13.33%**
10%	**$439,852,326**	**$58,511,257**	**15.34%**
15%	**$445,540,981**	**$64,199,911**	**16.84%**
20%	**$450,600,904**	**$69,259,834**	**18.16%**
25%	**$454,852,849**	**$73,511,780**	**19.28%**
30%	**$458,992,901**	**$77,651,832**	**20.36%**
35%	**$462,313,871**	**$80,972,802**	**21.23%**
40%	**$465,774,512**	**$84,433,442**	**22.14%**
45%	**$469,188,782**	**$87,847,712**	**23.04%**
50%	**$472,669,827**	**$91,328,758**	**23.95%**
55%	**$476,002,448**	**$94,661,379**	**24.82%**
60%	**$479,746,788**	**$98,405,719**	**25.81%**
65%	**$483,360,794**	**$102,019,724**	**26.75%**
70%	**$487,188,388**	**$105,847,318**	**27.76%**
75%	**$491,442,168**	**$110,101,099**	**28.87%**
80%	**$496,384,194**	**$115,043,125**	**30.17%**
85%	**$501,851,947**	**$120,510,877**	**31.60%**
90%	**$508,157,373**	**$126,816,303**	**33.26%**
95%	**$518,313,292**	**$136,972,223**	**35.92%**
100%	**$568,598,326**	**$187,257,256**	**49.10%**

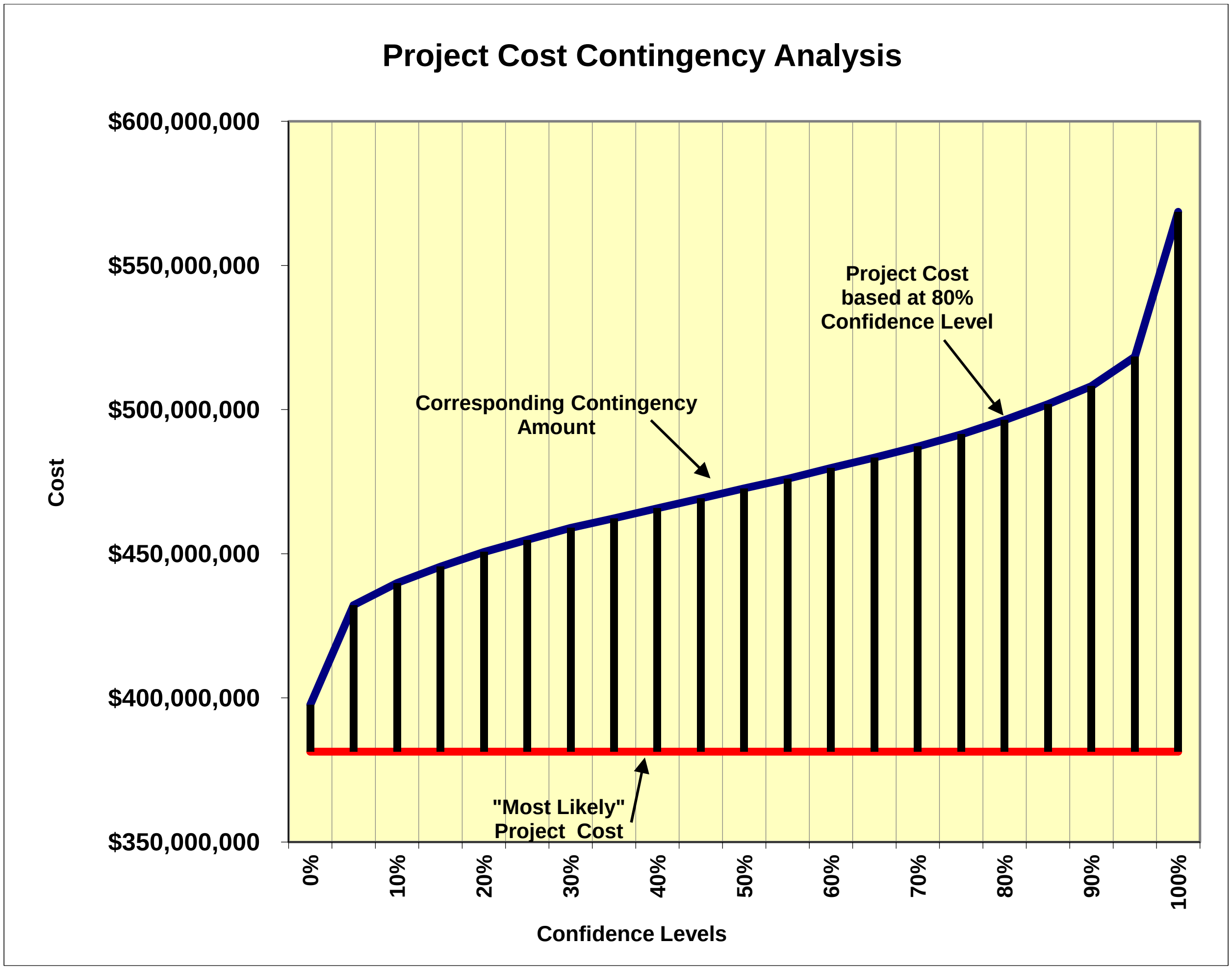

Figure 5 Sample of Project Confidence Curves

The major contributors to the resulting total project cost contingency for the project were:

- (CON-1) Construction Contract Modifications – Technical complexities and site conditions could result in increased risk of contract modifications.
- (TL-4) Borrow Sources Identified/Secured – The uncertainty of a secured borrow source for the last five lifts.
- CA-1 Contract Acquisition Impacts – Type of contracts and possible impacts to cost and schedule.
- TL-2 Design Development – Design details for the structural elements whether preliminary or detailed and their impact to costs.

- EST-1 Labor & Equipment Availability/Pricing – Variances in availability of equipment and labor throughout the project and impacts to costs.

- EST-3 Estimate quality when developed by others – Inaccuracies due to a large use of lump sums in the MII could cause changes to cost.

- PR-1 Funding Availability for PED and Construction – Impacts to costs due to funding variances causing delays and escalation of costs.

- PR-4 Fuel Cost – Fuel price variances impacts to construction costs.

The major contributor to the resulting total project contingency for the Schedule feature was:

- CA-2 Numerous Separate Contracts – Numerous separate contracts increases the risks of protests, access to projects choke points, and multiple contractor coordination.

- PPM-2 Smart Planning Pilot – Impacts to schedule due to unplanned work or requests for additional modeling/investigations under PED.

- PPM-3 Funding Availability at Pre-solicitation Stage – Impacts to schedule due to lack of funding during PED.

- PR-1 Funding Availability for PED and Construction – Impacts to schedule due to funding variances causing delays and increased costs

- PR-6 Stakeholder Request Late Changes – Additional work or alignment changes would impact costs and increase schedule delays.

These items are discussed in more detail in the Mitigation Recommendations section.

Lands and Damages are not included in the CSRA because it was not considered to be an overall program risk by the PDT. Lands and Damages is a very small project cost and any schedule delay in a specific location would not significantly affect the midpoint of the overall program. The Local Sponsor is responsible for LERRDs and in order to serve as the Non-Federal sponsor must have the authority to appropriate (take) property.

The above risk analysis results are intended to provide project leadership with risk and contingency information to support project management in scheduling, budgeting, and project control, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. These conclusions were reached by identifying and assessing risk items for use in the risk analysis. These quantitative impacts of these risk items are then analyzed using a combination of professional judgment, empirical data, and analytical techniques.

8. MITIGATION RECOMMENDATIONS

An important outcome of the cost and schedule risk analysis is the communication of high risk areas which have a high potential to affect the project cost and/or schedule. For the West Shore Lake Pontchartrain project, the high cost risk item is the Construction Modifications and Unidentified Borrow Sources. The high Schedule Risk item is the Numerous Separate Contract for the schedule. Some of these risk items might be mitigated, reducing the risk of an increased project cost.

Construction modifications are very common and often inevitable on a project of this magnitude. No cost for modifications was included in the base cost estimate and the amount of additional cost due to modifications can be mitigated by ensuring QA/QC Guidance is followed and quality products are advertized for construction.

The borrow pit location is the Government property Bonnet Carre' Spillway at this time. Encouraging local sponsors to find suitable borrow at closest possible distance can mitigate the risk of unsecured borrow pit locations the last three lifts (years 2030, 2045, 2060).

Funding availability for PED and construction is a more uncontrollable element that may require the involvement and influence of higher level parish, state and federal elected officials to acquire necessary funding and maintain the funding integrity.

Fuel cost is a more uncontrollable element that may require the investigation of more fuel efficient construction equipment that could help offset the increases in fuel costs and availability.

SMART planning pilot impacts can be adjusted thru early discussions among the PDT, external local officials,

Numerous Separate Contracts might be mitigated by choosing certain contracting methods over other know less efficient methods. Request for Proposal method may reduce the risk of protest and awarding a contract to a contractor that may not perform well.

APPENDIX A

DETAILED RISK REGISTERS

(Present the detailed Risk Register here, covering all risk events, regardless of low, medium, or high risk concerns)

Appendix A Risk Register

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost Likelihood*	Project Cost Impact*	Project Cost 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	Project Personnel Resources	Gov't personnel resources for project management and execution may be insufficient during peak periods of PED and Procurement.	Do not feel will be an issue. Personnel turnover and reassignments have been relatively low. Generally decreased District workload, this would be mainstay project.	Unlikely	Negligible	LOW
PPM-2	Smart Planing Pilot	First project to use new process.	We could run into unplanned work that must be accommodated. External agencies could request additional modeling/investigations under PED.	Likely	Negligible	LOW
PPM-2a	Funding Availability at Pre-solicitation stage	Lack of funding for the early stages of the project.	Lack of funding could impact the schedule and its previously set milestones.	Very Likely	Significant	HIGH

	CONTRACT ACQUISITION RISKS	-	-			
CA-1	Contract Acquisition Impacts	Unknown acquisition strategy	Acquisition startegy not yet defined. Estimate assumes typical sub-contracting. If other acquisition strategies are used on any one/or selected projects, would have minimal impact on overall project cost or schedule. Also combine with related risks from reduced competition and increased protests.	Likely	Marginal	MODERATE
CA-2	Numerous separate contracts	Protest, access to projects, multiple contractors coordinating work effort and highway traffic.	During solicitation, a protest could delay the contruction schedule. Multiple concurrent construction projects require coordination between contractors as well as impact on access roads between borrow sources and project sites.	Unlikely	Marginal	LOW
	TECHNICAL RISKS	-	-			
TL-1	ADEQUATE TECHNICAL STAFF	Gov't personnel resources for project management and execution may be insufficient during peak periods of PED and Procurement.	Do not feel will be an issue. Personnel turnover and reassignments have been relatively low. Generally decreased District workload, this would be mainstay project.	Unlikely	Marginal	LOW
TL-2	DESIGN DEVELOPMENT -Structural	What level of design? Confidence in critical qtys.	Feasibility level designs (close to 35%). Estimates are conservative. More savings may be gained through optimizing aspects of the designs, such as pile layout. Structures are typical to MVN.	Likely	Marginal	MODERATE

TL-3	DESIGN DEVELOPMENT - Geotechnical	What level of design? Confidence in critical qtys.	We have a good amount of data on 2/3 of the levee reaches. In developing the feasibility design, we used the most conservative data on the reaches where no boring/soil information was available. A 25% settlement factor has been included in the quantities. A 5% increase can be expected.	Likely	Negligible	LOW
TL-3	DESIGN DEVELOPMENT - Mechanical and electrical	What level of design? Confidence in critical qtys.	We expect minimal impact on the design. A/E has a wealth of experience on the design of Pumping Stations as well of MVN having major experience on this type of structure.	Unlikely	Marginal	LOW
TL-4	Borrow/fill sources identified / secured	Unidentified borrow sources.	Unknown borrow sources could inpact price of levee embankment of future lifts. This would include the development of new government furnished borrow pits.	Likely	Significant	HIGH
TL-5	Sufficiency/condition of borrow / fill sites	Unknown volume of available suitable material in borrow source.	Uncertainty of how much clearing and grubbing, waste of over burden, amount of processing necessary to achieve a suitable material for use as embankment. Historicaly the Corps has chosen borrow sources with a large portion of the source material as being suitable.	Unlikely	Marginal	LOW
TL-6	EMBANKMENT (Adjacent BORROW)	quality/avail of excavated material from the adjacent canal.	Top assumed unsuitable and wasted. Assumed wet and will process, included in cost and schedule. The cost and effort of achieving a suitable material from the excavated material would be too high in comparison to hauling in the material. The excavated material will be disposed as benefitialuse on the mitigation plan.This item will be removed for the refined risk register.	Likely	Negligible	LOW

	LANDS AND DAMAGES RISKS	-	-			
LD-1	Real Estate Plan	Do we have a RE plan?	Locals are acquiring much of the needed property now for the current interim work along the proposed alignment. Only considering one alignment. We already know many of the landowners. Real estate cost will be very small % of total project cost. Environmental mitigation has been identified. Mitigation included in project plan. LERDs is a Local Sponsor responsibility	Unlikely	Marginal	LOW
LD-2	Relocation Plan	Do we have a plan? Have the owners been contacted and provided input?	Cannot currently access all potential reaches in the proposed alignment. We are using 3 available databases for locating pipelinse utilities etc. There is a small degree of uncertainty because while the owners have been contacted, they have provided little information. At this point most relocation plans are assumptions. Compensability report will be included, most will be compensable. Locals are building in these areas now.	Unlikely	Marginal	LOW
LD-4	BORROW AREA	borrow area NOT indentified for haul-in material yet.	covered in FL-5	Unlikely	Marginal	LOW
	REGULATORY AND ENVIRONMENTAL RISKS	-	-			

RE-1	Impacts to High Value Habitats	Impacts to High Value Habitats (incl Essential fish habitat)	Bottom land hardwoods and forested wetlands have been accounted for under the Habitat Evaluation, mitigation plan and included in the overall project costs. Any additional impacts found would require adding a structure or modify exisiting structure.This risk item will be addressed by Planning Division.	Likely	Marginal	MODERATE
RE-2	HAZARDOUS WASTE SITE ANALYSIS	HTRW Phase I site assesment is already completed.	Avoiding all HTRW issues. Nothing in alignment triggerd Phase II investigation.	Very Unlikely	Significant	LOW
RE-3	NEPA	more NEPA required	NEPA is currently being acquired on the structural plan. Programatic EIS is being acquired for the non-structural plan. Any significant design changes will be addressed under supplemental NEPA documentation. This risk item will be addressed by Planning Division.	Likely	Marginal	MODERATE
RE-4	Cultural	potential that sites will be found.	No cultural issues have been identified.	Very Unlikely	Negligible	LOW
	CONSTRUCTION RISKS	-	-			
CON-1	Construction Contract Modifications	construction contract modifications can impact construction cost and schedule growth.	Technical complexities and site conditions could result in increased risk of contract modifications. Will impact costs, but little overall impact to larger project timeline	Very Likely	Significant	HIGH
CON-2	Alignment Revisions	Alignment revisions can impact Lands and Damages, Real Estate, Relocations, Environmental Mitigation and Utilities.	Already have borings for 2/3 of the aligment. We will be staying within the selected feasibility aligment.	Very Unlikely	Marginal	LOW

CON-3	WEATHER	impacts to project	Long overall project schedule so flexibility included. Typical conditions are already included in the schedule and costs.	Likely	Negligible	LOW
CON-4	ACCELERATED CONTRACT SCHEDULE	will jobs be rushed	currently not a time sensative project	Very Unlikely	Marginal	LOW
CON-5	Unknown Utilities	Unknown utilities may impact costs.	Investigations done with all available databases including the Louisiana Oil Spill Response Database. Locals doing work now in many areas. Impact as compared to total project cost is small.	Likely	Negligible	LOW
CON-6	Work location/condition	Marshy area.	Common South LA work condition, marsh conditions assumed in costs and schedule.	Very Likely	Negligible	LOW
CON-7	Embankment production	Assumed production rate for embankment.	Due to embankment quality, project conditions, or other factor, contractors should be able to achieve historical production on these projects. There will be variations which could impact costs. Impact to overall project schedule will be small.	Likely	Negligible	LOW
CON-8	Conflicts with other contracts		See item CA-2	Unlikely	Marginal	LOW
CON-9	Site access / restrictions (highways, bridges, dams, water, overhead / underground utilities)		See item CA-2	Very Unlikely	Marginal	LOW

CON-10	Material availability and delivery		See item TL-5	Unlikely	Marginal	LOW
	ESTIMATE AND SCHEDULE RISKS	-	-			
EST-1	LABOR & equipment AVAILABILITY/PRICING	labor shortages and increase rates	Possibility that out of state labor would be required due to labor shortage.	Unlikely	Significant	MODERATE
EST-2	MATERIAL AVAILABILITY/PRICING	material shortages and increased cost	projects are using standard mateirals, national economy is in a slump, quotes for all major materials	Unlikely	Marginal	LOW
EST-3	Estimate(s) quality when developed by others	Increased time and schedule inpact.	Possible increased time and schedule inpact due to estimmate being developed by A/E Firm and QA being performed by MVN. Inaccuracies due to large use of Lump Sum items in the MII could cause changes in the cost. BKI has vast experience in the design of pumping stations but due to the early stages of the design, details were not developed in order to capture some costs accurately.	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	Funding Availability for PED and Construction	Project is not authorized/funded. Design and construction delays could occur pending funding, resulting in increased escalation	Project is not authorized/funded. Design and construction delays could occur pending funding, resulting in increased escalation costs.	Very Likely	Significant	HIGH

		costs.				
PR-2	Bid Protest Potential	bid protests causing issues with award	See item CA-2	Likely	Negligible	LOW
PR-3	Bid Competition	low bid competition, increased cost	Good competition, not competing with HSDRRS. Lots of local contractors. - Combine in Contract acquisition risk and with Bid protest risks .	Very Unlikely	Marginal	LOW
PR-4	fuel cost	potential for escalating fuel prices	if fuel prices escalate dramatically with global recovery, could increase costs of constructing project, especially levees with much of it truck hauled	Likely	Marginal	MODERATE
PR-5	Local communities pose objections	Local communities delay project.	Locals might request to be included in the alignment. Causing delays to the schedule but should not increase the cost of the project.	Likely	Negligible	LOW
PR-6	Stakeholders request late changes	Delayed project and increased costs.	Any additional work or alignment change would result on increased costs and schedule delays.	Unlikely	Negligible	LOW