

ATTACHMENT B

**COST ENGINEERING AND
RISK ANALYSIS**



**US Army Corps of
Engineers®**

Rio Anton Ruiz, Humacao, Puerto Rico

CAP Section 1135 – Restoration Project

Project Cost Abbreviated Risk Analysis Report

Prepared by:

**U.S. Army Corps of Engineers
Jacksonville District**

MARCH 2017

Table of Contents

EXECUTIVE SUMMARY	ES-1
MAIN REPORT	1
1.0 PURPOSE	1
2.0 BACKGROUND.....	1
3.0 REPORT SCOPE.....	2
3.1 Project Scope	2
4.0 ABBREVIATED RISK ANALYSIS METHODOLOGY/PROCESS	5
4.1 Identify and Assess Risk Factors	6
5.0 KEY ASSUMPTIONS AND LIMITATIONS.....	6
6.0 RESULTS	7
6.1 Risk Register	7
6.2 Cost Contingency.....	7

LIST OF TABLES

Table 1: Alternative Cost Comparison 2
Table 2: Project Cost Contingency Summary..... 7

LIST OF FIGURES

Figure 1: Aerial photo of the project site..... 3

LIST OF APPENDICES

APPENDIX A: RISK REGISTER 8
APPENDIX B: DRAFT TOTAL PROJECT COST SUMMARY (TPCS)..... 17

EXECUTIVE SUMMARY

This Project Cost and Abbreviated Risk Analysis (ARA) Report has been completed by the US Army Corps of Engineers (USACE), Jacksonville District. The ARA was developed with tools provided by the Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works. The ARA was reviewed internally by Jacksonville District Cost Engineering before being presented for Agency Technical Review (ATR). This report presents a recommendation for the total project cost contingency for cost certification of the Rio Anton Ruiz project. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016, an abbreviated risk analysis study was conducted for the development of the contingency to be applied to the total project cost. The purpose of this risk analysis was to establish a project contingency by identifying and measuring the cost impact of project uncertainties with respect to the estimated total project cost.

Specific to Rio Anton Ruiz, the most likely total project cost (at project first cost) is at approximately \$3,731k. Based on the results of the analysis, the Jacksonville District recommends a contingency value of approximately \$580K or 27% for construction costs; \$46K or 19% for Planning, Engineering, and Design costs; and \$42K or 18% for Construction Management costs. An ARA was developed to model the remaining work concerning scope growth, potential for mods and claims, and other concerns as seen in the risk register.

The Jacksonville District Cost Engineering Section performed the risk analysis for this project and it has been internally reviewed, as required, via the ATR process.

MAIN REPORT

1.0 PURPOSE

This report presents a recommendation for the total project cost contingencies for the cost certification of Rio Anton Ruiz Restoration Project.

2.0 BACKGROUND

This estimate is primarily based upon the August 2016 Final Feasibility Report, for assistance in a permanent salt water intrusion measures (SWIM) to the lagoon system and Rio Anton Ruiz.

Location - The Rio Anton Ruiz is located in the Municipality of Humacao on the southeast coast of Puerto Rico. The project area includes a brackish lagoon system and a Pterocarpus Forest in the Humacao Natural Reserve. Six lagoons encompassing approximately 615 acres, compose the system: Mandri 1, 2, and 3; Santa Teresa 1 and 2; and Palmas. The coastal communities of Punta Santiago, Verde Mar, and Villa Palmira are the main populated areas within the watershed.

2001 – Rio Anton Flood Control Project (Section 205) is constructed. Since the completion of the diversion channel, the lagoon system and its surrounding environment have been adversely affected by saltwater intrusion.

2007 - USACE installed temporary impermeable plugs (SWIM) across the diversion channel near the lagoon and across the Rio Anton Ruiz that demonstrated the effectiveness of the control measures.

This Section 1135 project involves two new design and construct permanent measures to reduce the salinity levels within the diversion channel (and thus lagoon system and Pterocarpus Forest).

During the feasibility study the project delivery team (PDT) evaluated another four alternatives to attempt solve some of the problems from different avenues of approach. After a delivered evaluation discussed on the Engineer Appendix the alternative were screen out leaving alternative 1 as the tentative selected plan. Refer to the Engineer Appendix for more information about the other screened out alternatives.

A. Previous alternative overview:

1. Alternative 1 - Two sheet-pile, concrete cap weirs at same location as originally placed temporary SWIM plugs. Top of weirs, 0.25 ft above Mean Low Water (MLW) elevation with a 15 ft wide by 3 ft deep "notch" within the center of diversion channel and Rio Anton Ruiz respectively. Top elevation of notch section will be 2.75 ft below MLW to allow navigation of diversion channel and river at low water elevations.
2. Alternative 1a – One sheet-pile, concrete capped weir at the same location of the temporary SWIM plug at the Rio Anton Ruiz. Top of weir, 0.25 ft above MLW elevation with a 15 foot wide by 3 foot deep "notch" within the center Rio Anton Ruiz respectively. Top elevation of notch section will be 2.75 ft below MLW to allow navigation of river at low water elevations. This alternative is derived from Alternative 1.

3. Alternative 1b - One sheet-pile, concrete capped weir at the same location of the SWIM plug at the diversion channel near the lagoon. Top of weir, 0.25 ft above MLW elevation with a 15 ft wide by 3 ft deep "notch" within the center of diversion channel respectively. Top elevation of notch section will be 2.75 ft below MLW to allow navigation of diversion channel at low water elevations. This alternative is derived from Alternative 1.

4. Alternative 2 – One sheet-pile, concrete cap weir near mouth of river/diversion channel outlet (upstream of PR HWY 3 Bridge). Top of weir, 0.25 ft above MLW elevation with a 15 ft wide by 3 ft deep "notch" within the center of the channel outlet. Top elevation of notch section will be 2.75 ft below MLW to allow navigation of diversion channel and river at low water elevations. Alternative 2 was not carried forward for analysis due to impacts to the 2001 Anton Ruiz Flood Control project

Table 1: Alternative Cost Comparison

Alternative	(Construction Cost Only) 18 AUG 2016	Refined Construction Cost Only including Contingency
Alternative 1	\$2,100,000	\$2,728,000
*Alternative 1a	\$1,571,000	
*Alternative 1b	\$1,264,000	
Alternative 2	\$1,350,000	
Notes:		
1) *Cost for Alt 1a and Alt 1b were subtracted from Alternative 1		
2) None of the construction cost include the "Adaptive Management" neither "Cultural Resources".		

3.0 REPORT SCOPE

The scope of this report is to facilitate a technical overview of the tentative selected plan. Part of the report includes the risk analysis report used to calculate and present the cost contingency at the 80% confidence level using the risk analysis processes, as mandated by U.S Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The study and presentation does not include consideration for life cycle costs.

This report is based on the alternative 1. It consists of two concrete-capped sheet pile weirs, located at the current temporary SWIM locations. One location is within the Rio Anton Ruiz and the other location is within the diversion channel, approximately ½ mile from the mouth of the diversion channel.

3.1 Project Scope

The selected alternative 1 consists of the construction of two concrete-capped sheet pile weirs and the removal of the existing temporary weirs. The weir identification is as follow:

- Weir #1: Rio Anton Ruiz at Confluence with diversion Channel (approximately 180 ft wide)
- Weir #2: Madri Lagoon/ Boca Prieta diversion Channel (approximately 140 ft wide)



Figure 1: Aerial photo of the project site

A. Preparatory Work Weir #1:

1. Construction of a temporary access road as needed
2. Staging area preparation
3. Installation of sediment control features
4. Turbidity barrier installation
5. Temporary cofferdam installation and dewatering system in place

B. Foundation Work Weir #1:

1. 180 lft of sheet pile for the permanent weir at Rio Anton Ruiz at confluence with diversion Channel. The weir has a notch with the follow dimension (3 ft deep x 15 ft wide)
2. Concrete cap of 2 ft x 1 ft

C. Earthwork for Weir #1:

1. Removal of existing sandbags
2. Geotextile installation
3. Stone protection

D. Preparatory Work Weir #2:

1. Remove temporary cofferdam from the Weir #1 location
2. Construction of a temporary access road as needed

3. Staging area preparation
4. Installation of sediment control features
5. Turbidity barrier installation
6. Temporary cofferdam installation and dewatering system in place

E. Foundation Work Weir #2:

1. 140 lft of sheet pile for the permanent weir at Madri Lagoon/ Boca Prieta diversion Channel. The weir has a notch with the follow dimension (3 ft deep x 15 ft wide)
2. Concrete cap of 2 ft x 1 ft

F. Earthwork for Weir #2:

1. Removal of existing sandbags
2. Geotextile installation
3. Stone protection

G. General work:

1. Channel markers and navigation aids for both weirs

H. Project Assumption used for the cost estimate:

1. Construction will be executed during daylight hours and only five days a week.
2. The site layout for the permanent notched weir structures will be placed at the same locations as the temporary SWIMs.
3. Contractor will maintain the water quality monitoring during the construction and will maintain the turbidity barrier.
4. The project will have an adaptive management plan. The assumption is the adaptive management could be extended up to five years.
5. Access to the site will be via existing public roadways, and then via the existing project right-of-way.
6. There are areas along either side of the levee (approximately 20 ft on either side) that can be used as staging or stockpiling areas for the limited amount of equipment and materials that will be used for this project.
7. There are no known or observed utilities or facilities within the project right-of-way.
8. The existing project right-of-way/easement will be used and can accommodate the project features. No additional lands or easements are anticipated.
9. There will be water pumps available during the construction to allow dewatering and water flow as needed.
10. Navigational aids and/or channel markers should be provided within the channel to direct boat traffic through the notches in the sheet pile weirs.
11. The construction method is using a crane with a pile hammer to drive the temporary and permanent sheet pile during the construction. The assumption is that the contractor will construct the weir one at the time to allow reused the temporary sheet pile for the cofferdam.
12. Any deviations from these assumptions will impact costs. The magnitude of those impacts will vary.

I. Major Project Features includes:

1. Removal and disposal of the current SWIMS (Sandbags)
2. Installation of the temporary cofferdam
3. Construction of the two permanent weirs
4. Rip rap installation
5. Channel markers and navigation aids

J. Construction Sequence:

The construction sequence for the project is anticipated to be installation of erosion and sediment control features including silt fence along the work perimeters and floating turbidity barriers within the Rio Anton Ruiz and diversion channels, upstream and downstream of the structure locations. The structures will be sheet pile driven from the bank of the diversion channel. The sheet pile weirs will have a concrete cap. Depending on the tidal conditions, there may be the need to draw down the water level directly adjacent to the sheet pile in order to construct the concrete cap. Sheet pile or other means to create a small dewatering cell and use of pumping directly back into the channel should be sufficient if the concrete cap is placed in sections.

The construction is anticipated to be conducted in sequence starting by Weir #1 and eventually move to Weir #2. Temporary cofferdam will be installed and re-used to allow the construction of the permanent weirs. The estimated construction duration for this projects about 293 calendar days.

4.0 ABBREVIATED RISK ANALYSIS METHODOLOGY/PROCESS

The risk analysis process for this estimate is intended to determine the probability of various cost outcomes and to quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. 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.

Contingency for the cost estimate has been developed using materials provided by the USACE Cost Center of Expertise located in Walla Walla District. The cost estimator assigned risk factors based upon the project Work Breakdown Structure. The contingency was developed using a condensed format since the total project cost is below the threshold for completing a Cost and Schedule Risk Analysis. The contingency was primarily affected by the weight of most likely and possible risks with regards to utilities, ramps, and levee work. Their impacts ranged from marginal to significant.

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

4.1 Identify and Assess Risk Factors

Identifying risk factors is considered a qualitative process that results in establishing a risk register that serves as the basis for the resulting contingency percentage. 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 risk brainstorming session was conducted November 09, 2016, to discuss all possible risks and impacts. The Project Delivery Team (PDT) attendees are listed on the PDT Involvement tab of the ARA spreadsheet.

Contingency is analyzed using formulas within the spreadsheet, as opposed to the more complex analysis of the Crystal Ball software's *Monte Carlo* simulations used in a formal cost and schedule risk analysis. Contingencies are calculated according to the likelihood and impact of each factor identified in the risk register.

The Abbreviate Risk Analysis was developed with input of the PDT and with the sponsor. The highest risk level identified during the development of the Risk Register was level 4. This risk was associated with the potential problems during the construction in the water channel due to adverse weather conditions. The concern is expected to be reduced with the implementation of a temporary cofferdam and the acquisition of water pumps for the construction duration. Another major concern is the potential change on the selected construction material but it will be handled during design and implementation. The rest of the concern risk levels are level 2 and under.

A. Some of the concerns registered in the Risk Register are:

1. Possible construction schedule delays due to season restrictions and possible environmental constraints. This concerns have been addressed in the Risk Register.
2. Possible delays on the weir construction due to adverse weather conditions. This concern has been addressed in the Risk Register.
3. Potential encounter cultural resource

This tool helped the development of the contingency for the project and provides essential information that could be used for establishment of control measures. The Risk Register will continue be updated during the project live cycle.

5.0 KEY ASSUMPTIONS AND LIMITATIONS

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

A. Key assumptions:

1. The site layout for the permanent notched weir structures will be placed at the same locations as the temporary SWIMs
2. Construction will be executed during day light hours and only five days a week.

3. Contractor will maintain the water quality monitoring during the construction and will maintain the turbidity barrier.
4. Access to the site will be via existing public roadways, and then via the existing project right-of way.
5. There are no known or observed utilities or facilities within the project right-of-way.
6. The existing project right-of-way/easement will be used and can accommodate the project features. No additional lands or easements are anticipated.

6.0 RESULTS

6.1 Risk Register

An abbreviated risk register, provided in Appendix A, is a tool commonly used in project planning and risk analysis. 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.

Specific to this abbreviated risk register, it should be noted that there are events reported in the register, but not included in the calculations. That is, the risk register shows the risk events, but they do not contribute to the contingency calculations. In a formal risk analysis, such a practice is commonly used on risks/opportunity events with a Low Risk Level (typical for cost and schedule events with some combination of, for example, Very Unlikely/Unlikely Likelihoods and Negligible/Marginal Impacts). These are documented, but excluded from the calculations in order to better prevent skewed results. Under Risk Level, these show with a Zero (0).

As mentioned in the Executive Summary, tools/materials from the MCX were used throughout the process of acknowledging this risk, trying to account for it, running into the calculation issue, and coming up with the resolution.

6.2 Cost Contingency

The contingency was calculated based off the likelihood and impact of the risk concerns. Some of the major areas of concern were seen under the Construction Elements and External Project Risks categories. For example, the risks for utilities could have a significant impact on the cost, as there has been a history of issues pertaining to utilities for this project area.

Table 1 provides the raw contingencies percentages calculated based upon the factors assigned in the risk register.

Table 2: Project Cost Contingency Summary

Totals	% Contingency
Real Estate	15 %
Construction	27 %
Planning, Engineering & Design	19%
Construction Management	18%
Combined Contingency	24%

APPENDIX A: RISK REGISTER

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				Maximum Project Growth		75%
PS-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> Project access 	The project access could have some difficulties and it could required improve or build a temporary road. The final plan will be completed during the design phase.	Marginal	Possible	1
PS-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> Potential for scope growth, added features and quantities? Water care and diversion fully understood, planned? 	The construction method used for the cost estimate required the installation of two temporary cofferdam (Sheet Pile). The final elevation and deep of the sheet pile will required further evaluation. It is very likely that the quantities will change and the impact will be the increase of cost due to the acquisition of more materials. Normally on previous PR project the cofferdam design are subject to significant changes.	Marginal	Possible	1
PS-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> Design confidence? Investigation sufficient to support design assumptions? 	Based on the initial investigation and design requirements the current scope of work is unlikely have any change because it is very conservative.	Marginal	Possible	1
PS-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> Design confidence? Does design meet the expected life cycle? Investigation sufficient to support design assumptions? 	The current selected material to build the weirs have been selected based on the current site condition including the environmental conditions. It meet the life cycle. But it is possible to have a scope Growth in order to extent the life cycle. It is also possible that the design criteria due to seismic can change and that will possible change the size of the structural element and the cost of piles. Also Historically in PR the minimum size of the piles is PZ-22.	Marginal	Possible	1
PS-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> Design confidence? Investigation sufficient to support design assumptions? 	The design is based on a temporary solution that have been in place for may years and it demonstrated that it work.	Marginal	Possible	1
PS-6	Cultural Resources	<ul style="list-style-type: none"> No concern 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
PS-7	Monitoring Plan	<ul style="list-style-type: none"> No concern 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> Potential for scope growth, added features and quantities? 	Impacts here are dependent upon magnitude of design changes needed, input from outside parties, and what is uncovered during basic investigations needed to complete plans and specifications.	Marginal	Possible	1
PS-14	Construction Management	<ul style="list-style-type: none"> Potential for scope growth, added features and quantities? 	If scope is increased, this item will be impacted.	Marginal	Possible	1

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Acquisition Strategy				Maximum Project Growth		30%
AS-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> • 8a or small business likely? 	<p>During design and Implementation the acquisition strategy will be developed.</p> <p>Note: Updated (23MAR2017) The acquisition strategy risk has a negligible cost impact to the project because the cost estimate already take in consideration a high Job Office Overhead (JOOH) %. The high JOOH is because the construction cost is low compare with the typical Non-CAP project but the Administrative requirement are the same. The Likelihood is likely because the construction cost is assessable to small business.</p>	Negligible	Likely	1
AS-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> • 8a or small business likely? 	<p>There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Construction Elements", "Specially Construction or Fabrication", "Technical Design & Quantities", "Cost Estimate Assumptions", and "External Project Risk"</p> <p>Note: Updated (23MAR2017) The acquisition strategy risk has a negligible cost impact to the project because the cost estimate already take in consideration a high Job Office Overhead (JOOH) %. The high JOOH is because the construction cost is low compare with the typical Non-CAP project but the Administrative requirement are the same. The Likelihood is likely because the construction cost is assessable to small business.</p>	Negligible	Likely	1
AS-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> • Requirement for subcontracting? • 8a or small business likely? 	<p>Depending on the size of the project, the prime contractor may or may not subcontract this work. Estimate assumed that the prime contractor will perform the job. Subcontracting this work may increase costs, as that would be, at the very least, an additional layer of mark-ups.</p> <p>Note: Updated (23MAR2017) The acquisition strategy risk has a negligible cost impact to the project because the cost estimate already take in consideration a high Job Office Overhead (JOOH) %. The high JOOH is because the construction cost is low compare with the typical Non-CAP project but the Administrative requirement are the same. The Likelihood is likely because the construction cost is assessable to small business.</p>	Negligible	Likely	1

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
AS-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> • 8a or small business likely? 	<p>There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Construction Elements", "Specially Construction or Fabrication", "Technical Design & Quantities", "Cost Estimate Assumptions", and "External Project Risk"</p> <p>Note: Updated (23MAR2017) The acquisition strategy risk has a negligible cost impact to the project because the cost estimate already take in consideration a high Job Office Overhead (JOOH) %. The high JOOH is because the construction cost is low compare with the typical Non-CAP project but the Administrative requirement are the same. The Likelihood is likely because the construction cost is assessable to small business.</p>	Negligible	Likely	1
AS-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> • Requirement for subcontracting? • 8a or small business likely? 	<p>Depending on the size of the project, the prime contractor may or may not subcontract this work. Estimate assumed that the prime contractor will perform the job. Subcontracting this work may increase costs, as that would be, at the very least, an additional layer of mark-ups.</p>	Negligible	Likely	1
AS-6	Cultural Resources	<ul style="list-style-type: none"> • 8a or small business likely? 	<p>There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"</p>	Negligible	Unlikely	0
AS-7	Monitoring Plan	<ul style="list-style-type: none"> • 8a or small business likely? 	<p>There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"</p>	Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> • 8a or small business likely? 	<p>At this time, the team is projecting use Small Business (8a) method.</p> <p>Note: Updated (23MAR2017) The acquisition strategy risk has a negligible cost impact to the project because the cost estimate already take in consideration a high Job Office Overhead (JOOH) %. The high JOOH is because the construction cost is low compare with the typical Non-CAP project but the Administrative requirement are the same. The Likelihood is likely because the construction cost is assessable to small business.</p>	Negligible	Likely	1

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
AS-14	Construction Management	<ul style="list-style-type: none"> 8a or small business likely? 	<p>At this time, the team is projecting use Small Business (8a) method.</p> <p>Note: Updated (23MAR2017) The acquisition strategy risk has a negligible cost impact to the project because the cost estimate already take in consideration a high Job Office Overhead (JOOH) %. The high JOOH is because the construction cost is low compare with the typical Non-CAP project but the Administrative requirement are the same. The Likelihood is likely because the construction cost is assessable to small business.</p>	Negligible	Likely	1
Construction Elements				Maximum Project Growth		25%
CON-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> Site access / restrictions. 	The assumption is that there are access to the two project site but there is a concern about what improvement the contractor will have to do in order to allow the traffic of heavy equipment. The impact could be marginal. It is likely to due to the existing site conditions.	Marginal	Possible	1
CE-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> Water care and diversion plan? Potential for construction modification and claims? 	PR rivers are subject to flash flooding and there is very difficult to estimate how many event can occurs per year. Normally in PR we let the contractor to come with his own water care and diversion plan and may be the contractor are not willing to take some risk and this cost can be higher than expected.	Moderate	Likely	3
CE-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> High risk or complex construction elements, site access, in-water? 	A temporary cofferdam (Sheet pile) will be emplaced up stream and down stream to facilitate the construction.	Marginal	Likely	2
CE-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> High risk or complex construction elements, site access, in-water? 	A temporary cofferdam (Sheet pile) will be emplaced up stream and down stream to facilitate the construction.	Marginal	Possible	1
CE-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> High risk or complex construction elements, in-water work? 	Construction of the cap bean can be affected and the design of the cofferdam in a constraint area due to limitation on the RE can increase the cost and duration of the cofferdam installation and removal, therefore will impact the cost of the cap beam.	Moderate	Likely	3
CE-6	Cultural Resources	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
CE-7	Monitoring Plan	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> Potential for construction modification and claims? 	There could be some construction modification and claims during the construction of the project but the design simple. The impact should be marginal	Marginal	Likely	2

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
CE-14	Construction Management	<ul style="list-style-type: none"> Accelerated schedule or harsh weather schedule? 	The contractor may have to work overtime in order to compensate for lost time.	Moderate	Likely	3
Specialty Construction or Fabrication				Maximum Project Growth		65%
SC-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> No concerns 	The project access could have some difficulties and it could required improve or build a temporary road. The final plan will be completed during the design phase.	Negligible	Unlikely	0
SC-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> Project delay due to material is exported to PR. 	The material is common used in PR.	Marginal	Possible	1
SC-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Acquisition Strategy", "Construction Elements", "Technical Design & Quantities", and "Cost Estimate Assumptions".	Negligible	Unlikely	0
SC-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> Project delay due to material is exported to PR. 	The material is common used in PR.	Marginal	Possible	1
SC-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> Concrete cap construction in relation with the water level. 	The material is common used in PR.	Negligible	Likely	1
SC-6	Cultural Resources	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
SC-7	Monitoring Plan	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Construction Elements", and "Technical Design & Quantities"	Negligible	Unlikely	0
SC-14	Construction Management	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Acquisition Strategy", and "Construction Management"	Negligible	Unlikely	0
Technical Design & Quantities				Maximum Project Growth		30%

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
T-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> No concerns 	The project access could have some difficulties and it could required improve or build a temporary road. The final plan will be completed during the design phase.	Negligible	Unlikely	0
T-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> Changes on the propose construction method? 	The construction method will impact the propose temporary cofferdam design and the material quantities.	Marginal	Likely	2
T-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> Change on the final protected area? 	Further design and material evaluation could change the selected material.	Negligible	Likely	1
T-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> Changes on the sheet pile design? 	Further design and material evaluation could change the selected material.	Negligible	Likely	1
T-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> Change on the cap design? 	Further design and material evaluation could change the selected material.	Marginal	Possible	1
T-6	Cultural Resources	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
T-7	Monitoring Plan	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "External Project Risk"	Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> Change on design or requirements? 	It could occur a change on design that require more labor hours to complete the final product.	Marginal	Possible	1
T-14	Construction Management	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Acquisition Strategy", and "Construction Management"	Negligible	Unlikely	0
Cost Estimate Assumptions				Maximum Project Growth		35%
EST-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> Estimate captures scope for all features. 	The initial cost estimate assumed the mobilization and demobilization of heavy equipment along the temporary access and staging area. There is a possibility that the current assumption do not cover all the necessary features.	Marginal	Possible	1
EST-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> Water care and diversion plan? Assumptions regarding crew, productivity, overtime. 	Productivities in PR are normally slower than expected due to climate condition and adverse weather conditions.	Marginal	Possible	1
EST-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> Estimate captures scope for all features. 	There is a possibility that the current assumption do not cover all the necessary features. Right now the estimate is taking in consideration protection in both side of each weirs.	Marginal	Possible	1

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
EST-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> Potential for construction modification and claims? 	There are enough information for the assumption but this do not eliminate the risk. If the design criterial change the type of sheet pile could change increasing the cost in a significant manner.	Moderate	Possible	2
EST-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> Construction method assumed? 	There is a possibility that the current assumption do not cover the exact construction method that the contractor will use.	Marginal	Possible	1
EST-6	Cultural Resources	<ul style="list-style-type: none"> Potential to encounter cultural resources concern in the project site? 	The impact will be marginal because the cost estimate is taking cultural resources in consideration.	Marginal	Possible	1
EST-7	Monitoring Plan	<ul style="list-style-type: none"> No concerns 	The monitoring plan have been well define during the feasibility report and the cost estimate account for it.	Marginal	Possible	1
EST-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Construction Elements", and "Technical Design & Quantities"	Negligible	Unlikely	0
EST-14	Construction Management	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Acquisition Strategy", and "Construction Management"	Negligible	Possible	0
External Project Risks				Maximum Project Growth		40%
EX-1	Mob. Demob & Prep Work at Weir 1 and Weir 2	<ul style="list-style-type: none"> No concerns 	The project access could have some difficulties and it could required improve or build a temporary road. The final plan will be completed during the design phase.	Negligible	Unlikely	0
EX-2	Care and Diversion of Water (Cofferdam)	<ul style="list-style-type: none"> Potential for severe adverse weather? 	The project may be subject to weather delays in the form of flooding events, seismic action, and/or storm events. The area is in the water. There are also risks involving potential delays in deliveries due to strikes, material shortages, or shipping issues.	Moderate	Likely	3
EX-3	Earthwork for Structure (Rip Rap)	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Acquisition Strategy", "Construction Elements", "Technical Design & Quantities", and "Cost Estimate Assumptions".	Negligible	Unlikely	0

Rio Anton Ruiz Improvements Alt 1

Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 9-Nov-16

		Risk Level				
Very Likely	2	3	4	5	5	
Likely	1	2	3	4	5	
Possible	0	1	2	3	4	
Unlikely	0	0	1	2	3	
	Negligible	Marginal	Moderate	Significant	Critical	

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
EX-4	Foundation Work (Sheet Piles for Weirs)	<ul style="list-style-type: none"> Potential for severe adverse weather? 	The project may be subject to weather delays in the form of flooding events, seismic action, and/or storm events. The area is in the water. There are also risks involving potential delays in deliveries due to strikes, material shortages, or shipping issues.	Moderate	Likely	3
EX-5	Overflow Structures (Concrete Cap)	<ul style="list-style-type: none"> Potential for severe adverse weather? 	The project may be subject to weather delays in the form of flooding events, seismic action, and/or storm events. The area is the water. There are also risks involving potential delays in deliveries due to strikes, material shortages, or shipping issues. PR rivers are subject to flash flooding and there is very difficult to estimate how many event can occurs per year. Normally in PR we paid for claim due to the weather impact, in this project the probability to high.	Moderate	Likely	3
EX-6	Cultural Resources	<ul style="list-style-type: none"> Potential to encounter cultural resources concern in the project site? 	The impact will be marginal because the cost estimate is taking cultural resources in consideration.	Marginal	Possible	1
EX-7	Monitoring Plan	<ul style="list-style-type: none"> No concerns. 	The estimate already taking in consideration the monitoring plan for 5 years.	Marginal	Possible	1
EX-13	Planning, Engineering, & Design	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Construction Elements", and "Technical Design & Quantities"	Marginal	Possible	1
EX-14	Construction Management	<ul style="list-style-type: none"> No concerns 	There are not concern related to this feature of work for this risk element partition. The risk associated with this feature of work have been considerate in the risk element of "Project Management & Scope Growth", "Acquisition Strategy", and "Construction Management"	Negligible	Possible	0

APPENDIX B: DRAFT TOTAL PROJECT COST SUMMARY (TPCS)

**WALLA WALLA COST ENGINEERING
MANDATORY CENTER OF EXPERTISE**

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 452782

**SAJ – Rio Anton Ruiz - Section 1135
Project Modifications to Improve the Environment**

The Rio Anton Ruiz – Section 1135 Project as presented by Jacksonville District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of March 24, 2017, the Cost MCX certifies the estimated total project cost:

FY 2018 Project First Cost: \$3,731,000
Total Project Cost: \$3,869,000
Estimated Federal Cost: \$3,152,000

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



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

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

PROJECT: **Rio Anton Ruiz - CAP 1135**
PROJECT NO: **452782**
LOCATION: **Puerto Rico**

DISTRICT: **JACKSONVILLE DISTRICT** PREPARED: **3/23/2017**

POC: **CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM**

This Estimate reflects the scope and schedule in report; CAP Feasibility STUDY

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)					TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST (\$K)	CNTG (\$K)	CNTG (%)	TOTAL (\$K)	ESC (%)	COST (\$K)	CNTG (\$K)	REMAINING COST (\$K)	2018	TOTAL FIRST COST (\$K)	ESC (%)	COST (\$K)	CNTG (\$K)	FULL (\$K)
										Program Year (Budget EC): Effective Price Level Date: 1-Oct-17 Spent Thru: 10/1/2016 (\$K)					
06	ADAPTIVE MANAGEMENT	\$117	\$13	11%	\$130	1.8%	\$119	\$13	\$132		\$132	10.3%	\$131	\$15	\$146
15	FLOODWAY CONTROL	\$2,109	\$570	27%	\$2,679	1.8%	\$2,148	\$580	\$2,728		\$2,728	3.5%	\$2,222	\$600	\$2,823
18	CULTURAL RESOURCES	\$200	\$22	11%	\$222		\$204	\$23	\$226		\$226	0.9%	\$206	\$23	\$228
CONSTRUCTION ESTIMATE TOTALS:		\$2,426	\$605		\$3,031	1.8%	\$2,471	\$616	\$3,087		\$3,087	3.6%	\$2,559	\$638	\$3,197
01	LANDS AND DAMAGES	\$72	\$11	15%	\$83	1.8%	\$73	\$11	\$84		\$84	0.9%	\$74	\$11	\$85
30	PLANNING, ENGINEERING & DESIGN (9.6%)	\$232	\$44	19%	\$276	3.6%	\$240	\$46	\$286		\$286	2.8%	\$247	\$47	\$294
31	CONSTRUCTION MANAGEMENT (9.2%)	\$223	\$41	18%	\$264	3.6%	\$231	\$42	\$273		\$273	6.9%	\$247	\$45	\$292
PROJECT COST TOTALS:		\$2,953	\$701	24%	\$3,654		\$3,016	\$715	\$3,731		\$3,731	3.7%	\$3,128	\$741	\$3,869

- ____ CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM
- ____ PROJECT MANAGER, JAMES SUGGS
- ____ CHIEF, REAL ESTATE, AUDREY ORMERO
- ____ CHIEF, PLANNING, ERIC SUMMA
- ____ CHIEF, ENGINEERING, LAUREEN BOROCHANER
- ____ CHIEF, OPERATIONS, CANDIDA BRONSON
- ____ CHIEF, CONSTRUCTION, STEPHEN DUBA
- ____ CHIEF, CONTRACTING, TIMOTHY BLACK
- ____ CHIEF, PM-PB, KAREN SMITH
- ____ CHIEF, DPM, TIM MURPHY

ESTIMATED TOTAL PROJECT COST: \$3,869
 ESTIMATED FEDERAL COST: **75%** \$2,902
 ESTIMATED NON-FEDERAL COST: **25%** \$967

22 - FEASIBILITY STUDY (CAP studies): \$250
 ESTIMATED FEDERAL COST: **\$250**
 ESTIMATED NON-FEDERAL COST:

ESTIMATED FEDERAL COST OF PROJECT \$3,152