Pawcatuck River
Coastal Storm Risk Management
Feasibility Study

Feasibility Report
November 2017

Appendix E

Cost Engineering

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COST ENGINEERING

1.0 COST NARRATIVE

Corps of Engineers cost estimates for planning purposes are prepared in accordance with the following guidance:

- Engineer Technical Letter (ETL) 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 September 2008
- Engineer Regulation (ER) 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302, Civil Works Cost Engineering, 15 September 2008
- ER 1110-2-1150, Engineering and Design For Civil Works Projects, 31 August 1999
- ER 1105-2-100, Planning Guidance Notebook, 22 April 2000, as amended
- Engineer Manual (EM) 1110-2-1304 (Tables revised 30 March 2007), Civil Works Construction Cost Index System, 31 March 2013
- CECW-CP Memorandum For Distribution, Subject: Initiatives To Improve The Accuracy Of Total Project Costs In Civil Works Feasibility Studies Requiring Congressional Authorization, 19 Sep 2007
- CECW-CE Memorandum For Distribution, Subject: Application of Cost Risk Analysis Methods To Develop Contingencies For Civil Works Total Project Costs, 3 Jul 2007
- Cost and Schedule Risk Analysis Guidance, 17 May 2009

The goals of the cost engineering for the Pawcatuck River Coastal Storm Risk Management Feasibility Study are to present a Total Project Cost (construction and non-construction costs) for the Locally Preferred (LP) Plan and National Economic Development (NED) Plan at the current price level to be used for project justification/authorization and to project costs forward in time for budgeting purposes. In addition, the costing efforts are intended to produce a final product, or cost estimate, that is reliable and accurate and that supports the definition of the Government's and the non-Federal sponsor's obligations. It should be noted that the LP Plan is the recommended plan.

2.0 PROJECT DESCRIPTION

The feasibility study formulates, evaluates, and compares reasonable solutions to reduce the risk of coastal storm damages to property and infrastructure and minimize risk to public safety in the study area. The study area is located entirely in southern Washington County, Rhode Island and consists of five primary damage areas including:

- Area 1 (herein referred to as Westerly) is the Misquamicut area in Westerly (Little Maschaug Pond to Winnapaug Pond Breachway),
- Area 2 (herein referred to as Charlestown) is the barrier beach and to some extent property located behind it in Charlestown/South Kingstown,
- Area 3 (herein referred to as South Kingstown) is located at Matunuck in South Kingstown (Roy Carpenter's Beach to Matunuck Point),

- Areas 4 and 5 (herein referred to as Narragansett) are located in Narragansett (Sand Hill Cove) and is the low lying area surrounding Point Judith Pond, respectively.

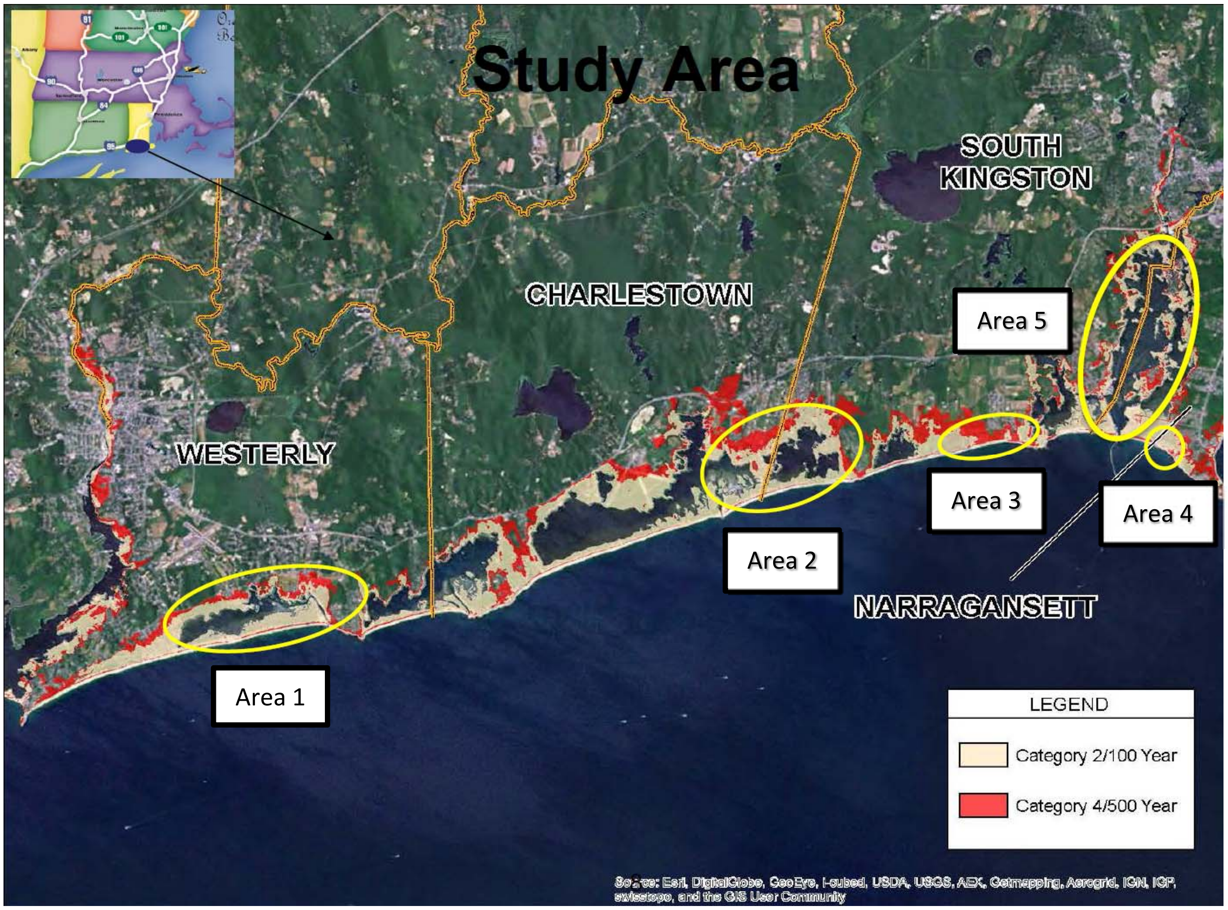


Figure E1: Study Area Location Map

A number of alternatives were considered by the PDT in order to accomplish the goals of reducing the risk of coastal storm damages and minimize risk to public safety. These alternatives consist of beach fill with dune, flood wall, and tide gate and several combinations of these alternatives. The alternatives that contain the beach fill with dune were considered using an upland sand source and an off-shore dredged sand source. An additional non-structural alternative was considered. Preliminary screening of the alternatives determined that structural alternatives in Westerly merited further study, only. Non-structural alternatives merited further study in all the areas.

3.0 ALTERNATIVES (3.1 – 3.4 Westerly only)

3.1 ALTERNATIVE 2 – 4,000 LF BEACH FILL WITH DUNE AND 6,000 LF OF FLOOD WALL

This alternative consists of the shoreline being re-nourished with beach fill by installing a 4,000 linear foot beach berm and dune running parallel with the shoreline from the vicinity of the east shore of Little Maschaug Pond to the west end of the Misquamicut State Beach, to include 6,000 linear feet of flood wall. The flood wall is broken up into a westerly flood wall and an easterly flood wall. The west flood wall will run north approximately 2,100 linear feet from a flood gate at Atlantic Avenue past the east shore of Little Maschaug Pond to tie into high ground at approximately elevation +10.5’ NAVD88 near the edge of the Misquamicut Club golf course. The east flood wall will run north approximately 3,900 linear feet from a flood gate at Atlantic Avenue past the west shore of Winnapaug Pond to tie into high ground at approximately elevation +10.5’ NAVD88 on farmland near Shore Road.

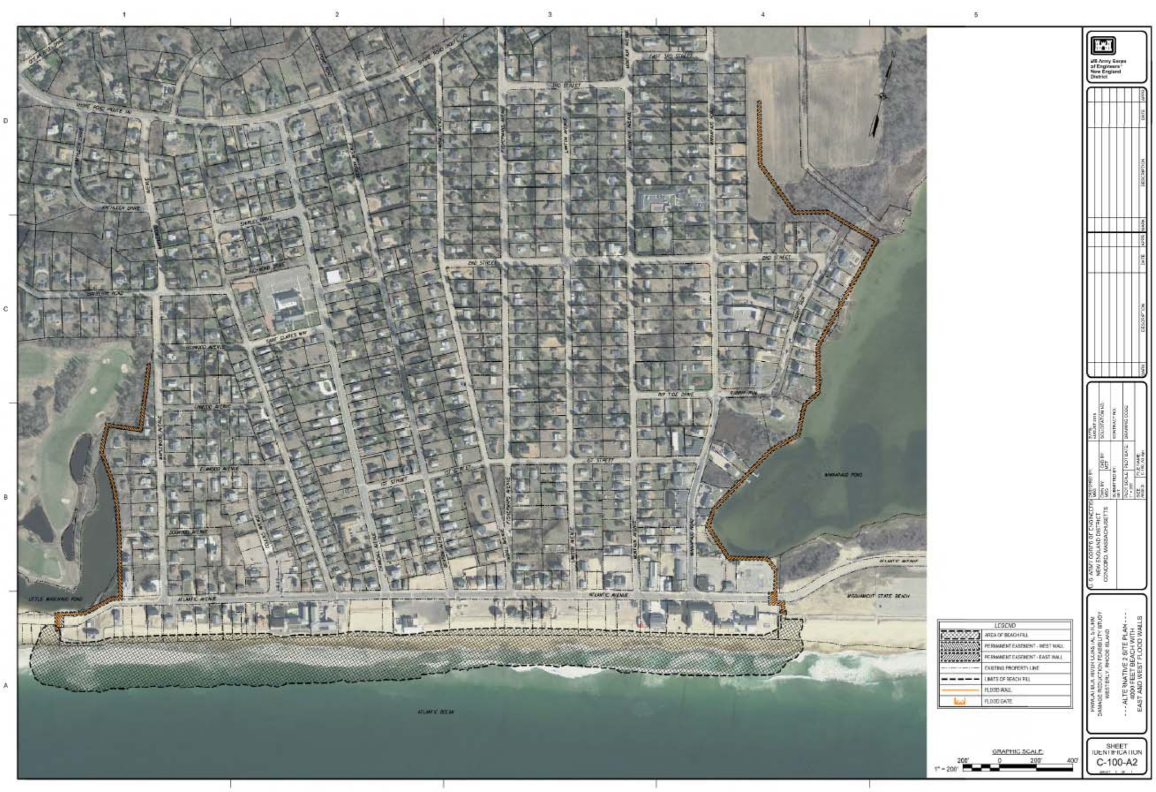


Figure E2: Alternative 2 Design Drawing

3.2 ALTERNATIVE 3 – 4,000 LF OF BEACH FILL WITH DUNE

This alternative consists of the shoreline being re-nourished with beach fill by installing a 4,000 linear foot beach berm and dune running parallel with the shoreline from the vicinity of the east shore of Little Maschaug Pond to the west end of the Misquamicut State Beach.

Figure E3: Alternative 3 Design Drawing

3.3 ALTERNATIVE 4 – 9,000 LF OF BEACH FILL WITH DUNE

This alternative consists of the shoreline being re-nourished with beach fill by installing a 9,000 linear foot beach berm running parallel with the shoreline from the vicinity of the east shore of Little Maschaug Pond to 2,100 linear feet east of the easterly end of the Misquamicut State Beach.

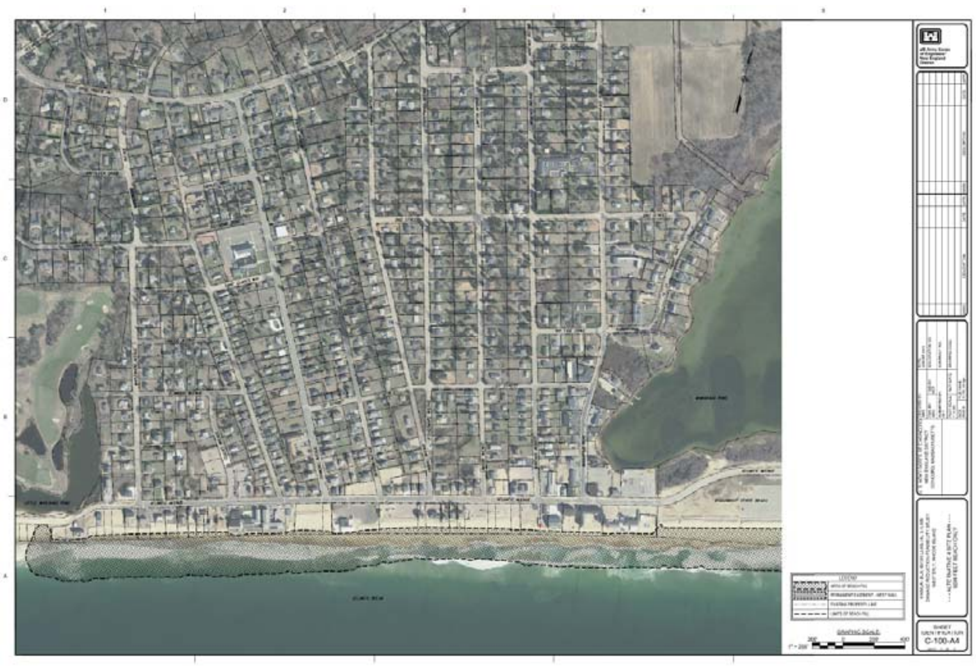


Figure E4: Alternative 4 Design Drawing 1 of 2

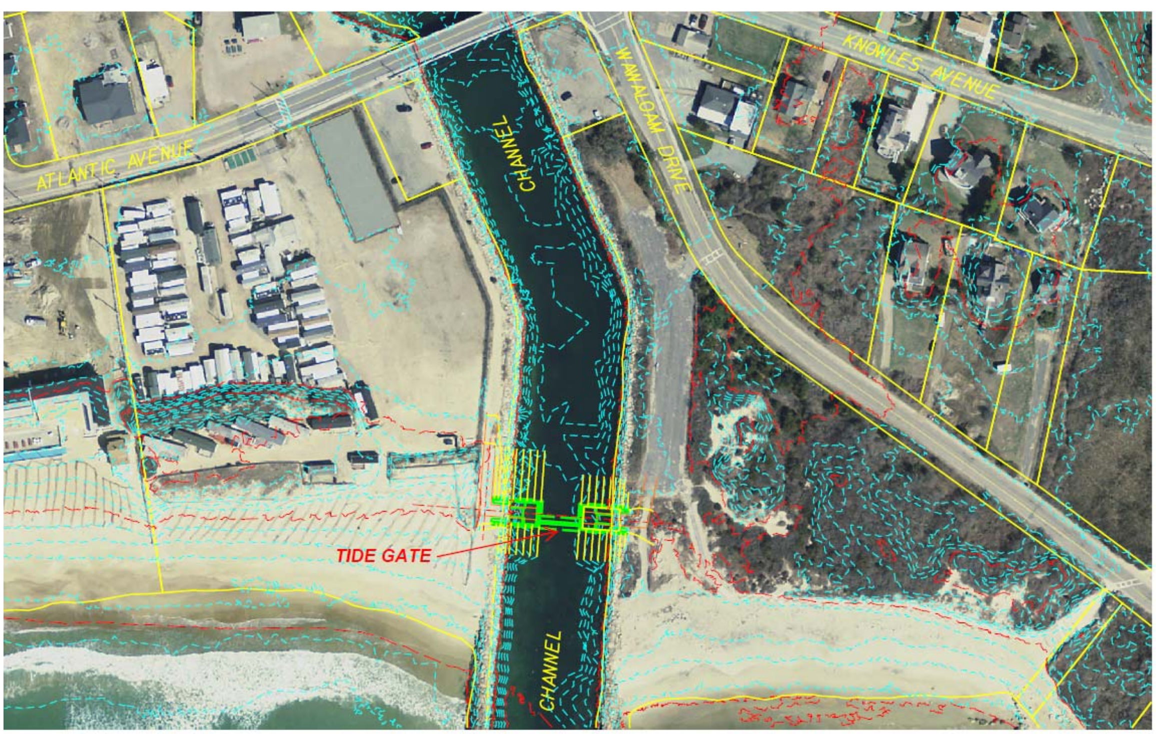
Figure E5: Alternative 4 Design Drawing 2 of 2

3.4 ALTERNATIVE 5 – 9,000 LF OF BEACH FILL WITH DUNE, 2,100 LF OF FLOOD WALL, AND TIDE GATE AT THE WEEKAPAUG BREACHWAY

This alternative consists of the shoreline being re-nourished with beach fill by installing a 9,000 linear foot beach berm running parallel with the shoreline from the vicinity of the east shore of Little Maschaug Pond to 2,100 linear feet east of the easterly end of the Misquamicut State Beach with a west flood wall and tide gate. The west flood wall will run north approximately 2,100 linear feet from a flood gate at Atlantic Avenue past the east shore of Little Maschaug Pond to tie into high ground near the edge of the Misquamicut Club golf course at approximately elevation +10.5' NAVD88. The tide gate will be located at the Weekapaug Breachway.

Figure E6: Alternative 5 Design Drawing 1 of 3

Figure E7: Alternative 5 Design Drawing 2 of 3



PLAN VIEW - TIDE GATE

Figure E8: Alternative 5 Design Drawing 3 of 3

3.5 ALTERNATIVE 6 – NON-STRUCTURAL ALTERNATIVE (ELEVATION)

This alternative consists of non-structural storm damage reduction features in elevating the structures for the most affected properties throughout the study area. It was determined by the PDT that research into each individual structure to be elevated was not appropriate at this time considering there are ~3,600 structures in the coastal flood plain. Instead, each structure was grouped into one of twelve typical structure-types: A Zone and V Zone Simple Ranch with Crawl Space, A Zone and V Zone Complicated Raised Ranch, A Zone and V Zone Complicated 2-Story with Slab, A Zone and V Zone Complicated 2-Story with Basement, A Zone and V Zone Complicated 1-Story Ranch with Basement, A Zone and V Zone Simple 2-Story with Crawl Space. The A Zone and V Zone designations were dependent on where the structure was located according to the FEMA flood plain maps. The type of structure and whether it was deemed "complicated" or "simple" was determined from tax assessor information including photos, interior layouts, and building attributes.

The elevation process involves the following. Holes will be made within the existing foundation walls to accommodate lifting beams. Lifting beams (generally made of structural steel) are used to transfer the weight of the house onto pneumatic jacks. Additional lifting beams, or secondary beams will be required to support masonry chimneys and fireplaces. Utilities and stairways will be separated from the structure. Each house will be elevated by jacking the lifting beams simultaneously. As the jacks become fully extended, the lifting beams will be temporarily supported on timber cribbing. The jacks will be retracted, reset, and the lifting will continue. The house will initially be raised higher than the final elevation, and will be supported on timber cribbing. Temporary utility connections and stairways will be put in place while an extended or new foundation is constructed. The structure will then be lowered onto the foundation, anchored in place, permanent utility connections made and new stairways constructed.

4.0 ALTERNATIVES ROM CONSTRUCTION COST ESTIMATES

Rough Order of Magnitude (ROM) construction cost estimates for all five Alternatives were developed using quantities provided by the PDT, specifically the CENAE Civil Engineering Section and Vicksburg ERDC. These quantities were then applied to parametric unit costs that were based upon historical data and previously developed construction cost estimates for similar work or used along with RSMeans, MII Cost Libraries, and vendor quotations to create new parametric construction cost estimates. An Abbreviated Risk Analysis (ARA) was performed for each alternative to identify and assess potential risks associated with this project. Table E1 summarizes these ROM costs along with the contingency for each alternative developed in the ARA.

Table E1: Alternative ROM Cost Estimate Summary

	Sand Placement via Dredge				Sand Placement via Truck			
	Subtotal	Contigency %	Contingency $	Total	Subtotal	Contigency %	Contingency $	Total
Alternative 2 - 4,000 lf Beach Fill with Dune & 6,500 lf Flood Wall	$19,671,205	32.93%	$6,477,077	$26,148,282	$22,172,784	30.30%	$6,719,204	$28,891,988
Alternative 3 - 4,000 lf Beach Fill with Dune	$7,775,707	39.49%	$3,070,775	$10,846,482	$9,482,609	33.84%	$3,208,624	$12,691,233
Alternative 4 - 9,200 lf Beach Fill with Dune	$14,794,865	41.46%	$6,133,545	$20,928,410	$21,151,409	34.13%	$7,219,996	$28,371,405
Alternative 5 - 9,200 lf Beach Fill with Dune, 1,900 lf Flood Wall, and Tide Gate @	$30,612,834	39.99%	$12,243,089	$42,855,923	$40,083,813	34.77%	$13,935,150	$54,018,963
	Subtotal	Contigency %	Contingency $	Total				
Alternative 6 - Non-Structural Alternative (Elevation)	$35,550,491	25.85%	$9,189,802	$44,740,293				

5.0 RECOMMENDED PLAN

Alternative 6 was identified as the Tentatively Selected Plan. Three hundred and forty-one individual structures were initially found to be economically justified throughout the coastal 100-yr flood plain. The TSP was based on the ‘low’ or ‘historic’ rate of sea level rise without a risk-based decision regarding sea level change. The Corps’ Climate Preparedness & Resilience Community of Practice suggested that the final plan selection must consider how the uncertainty across all future sea level scenarios (i.e. intermediate and high) affects risk levels and plan performance through either a robust design or adaptive capacity. To address this uncertainty, project performance was assessed by estimating the period of time the project would perform at or above a desired level. Based on this additional analysis, it was decided that the intermediate rate of sea level rise offered the best balance between equally unlikely scenarios (i.e. the historic rate of sea level rise continuing indefinitely and the high rate including accelerated rates of change caused by warming temperatures and accelerated ice melt) that risk underperformance and over performance. The intermediate scenario was further optimized (BFE + 1' + intermediate SLR) to yield the National Economic Development (NED) plan that consisted of 357 structure elevations, 21 flood proofed structures, and 7 property buy-outs. The NED plan was shared with the non-Federal sponsor and individual towns who in turn culled and removed all properties from the inventory where the owner of the land was not the same as the owner of the structure. They also chose not to include the 7 buy-outs. This plan, the Locally Preferred (LP) Plan, consists of 247 elevations and 21 flood proofed structures. The structures included in the LP are grouped by town and shown in the following figures. Again, it should be noted that the LP Plan is the recommended plan.

Figure E9: Alternative 6, Westerly Structure Locations

Figure E10: Alternative 6, Charlestown Structure Locations

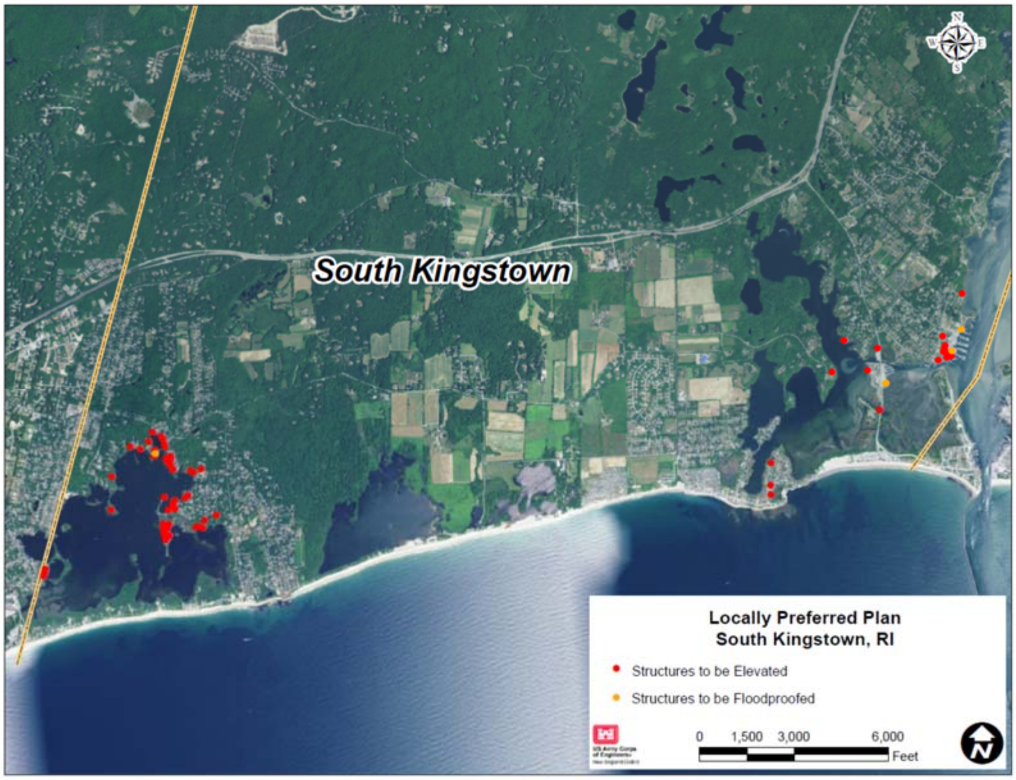


Figure E11: Alternative 6, South Kingston Structure Locations

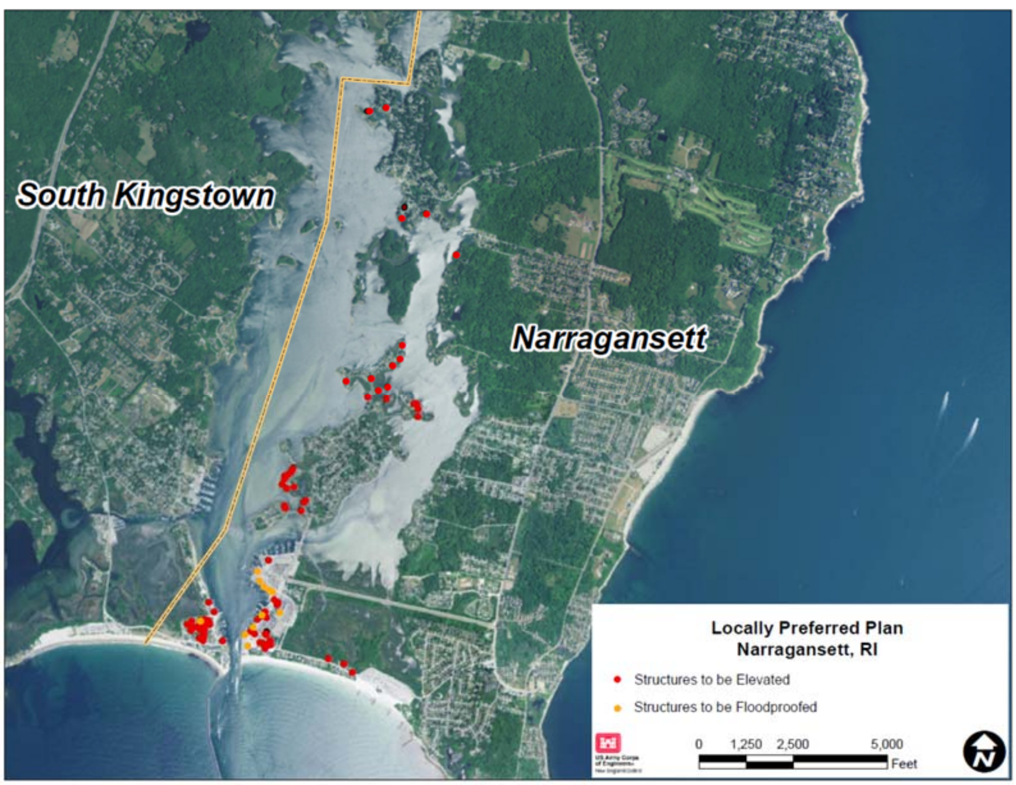


Figure E12: Alternative 6, Narragansett Structure Locations

6.0 BASIS OF ESTIMATE

The construction cost estimate was developed using Micro-Computer Aided Cost Estimating System (MCACES), Second Generation (MII) using the appropriate Work Breakdown Structure (WBS), and is based on individual cost estimates for raising each of the twelve typical structure-types. These individual cost estimates were developed utilizing cost resources such as RSMeans, MII Cost Libraries, and vendor quotations and are supported by the preferred labor, equipment, materials, and crew/production breakdown. These twelve typical structure-type cost estimates were then applied to the number of each typical structure to calculate the total construction cost. The number of each structure-type to be elevated, totaling 247 and 357 for the LP Plan and NED Plan, respectively, and the twelve typical structure-types that the each falls into, were both provided by the New England District Economical and Cultural Resources Section. Table E2 summarizes the quantity of each structure-types and their breakdown by locations:

Table E2: Structure-Type Quantity and Location Breakdown

	South Kingston		Charlestown		Westerly		Narragansett	
Structure-Type	LP	NED	LP	NED	LP	NED	LP	NED
A Zone Simple Ranch	2	93	24	24	15	18	33	35
A Zone Simple 2-Story	0	0	2	2	5	8	16	16
A Zone Complicated 1-Story Ranch w/ Basement	5	9	5	5	3	3	8	9
A Zone Complicated 2-Story w/ Basement	4	4	4	4	1	1	5	5
A Zone Complicated Raised Ranch	0	2	5	5	0	0	8	8
A Zone Complicated 2-Story w/ Slab	2	2	1	1	10	10	6	6
V Zone Simple Ranch	17	19	1	1	8	8	2	2
V Zone Simple 2-Story	7	7	1	1	1	1	0	0
V Zone Complicated 1-Story Ranch w/ Basement	11	13	0	0	1	1	1	1
V Zone Complicated 2-Story w/ Basement	12	12	1	1	1	1	1	1
V Zone Complicated Raised Ranch	2	2	1	1	0	0	0	0
V Zone Complicated 2-Story w/ Slab	10	10	0	0	4	4	1	1
Floodproofings	4	4	0	0	6	6	11	11
Property Buy-Outs	0	2	0	5	0	0	0	0
Total	76	179	45	50	55	61	92	95

Quantities related to the individual cost estimates for each of the twelve typical structure-types and the twenty-one floodproofings were developed with minimal input from the PDT as no design work has been completed for the non-structural alternative. Throughout the individual estimates the cost engineer assumed conservative quantities for excavation, concrete, piles, interior modifications, etc. wherever applicable. The Real Estate Division has provided cost estimates for the 7 buy-outs in the NED Plan.

Once the individual cost estimates were completed, the cost engineer obtained lump sum and unit price quotes from four local contractors for the complete elevation and of similar structures and floodproofings for residential and commercial structures. These quotes were of the same order of magnitude and provided a justification for applying these estimates to the total number of structures to be elevated and floodproofed.

7.0 SCHEDULE

The project schedule for both the LP and NED Plans were prepared using Microsoft Excel. The construction schedule was prepared based on 5 separate contracts performing the structure elevations and floodproofings concurrently. It was assumed that each contractor could work at least eight months a year and complete approximately two structures per month. It should be noted that the real estate activities are expected to continue 6 months after plans and specs are complete in order to finalize all easements and buy-outs with residents. Durations and sequencing for non-construction project activities such as PED and S&A were provided by the New England District Project Delivery Team and was based on a similar project completed in 2004. The project schedule is provided as Attachment 1 to this Cost Engineering Appendix.

8.0 CONTINGENCY

The goal in contingency development is to identify the uncertainties associated with an item of work or task, forecast the cost/risk relationship, and assign a value to this task that would limit the cost risk to an acceptable degree of confidence. Consideration must be given to the details available at each stage of planning, design, or construction for which a cost estimate is being prepared.

A Cost and Schedule Risk Analysis (CSRA) was conducted according to the procedures outlined in the manual entitled “Cost and Schedule Risk Analysis Guidance”, dated 17 May 2009. Members of the New England District Project Delivery Team (PDT) participated in a cost risk analysis brainstorming session to identify risks associated with the project. The Risk Analysis utilized the “MODERATE RISK” category as the project involves typical construction with possible life safety issues. Assumptions were made to the likelihood and impact of each risk item, as well as the probability of occurrence and magnitude of the impact if it were to occur. Adjustments were made to the analysis upon review by the PDT and the final contingencies were established. The CSRA Report is provided as Attachment 2 to this Cost Engineering Appendix.

9.0 PLANNING, ENGINEERING, AND DESIGN (PED)

The costs were developed for all activities associated with the planning, engineering and design effort. The cost for this account includes the preparation of Design Documentation Reports and plans and specifications for each construction contract and engineering support during construction through project completion. It includes all the in-house labor based upon work-hour requirements, material and facility costs, travel and overhead. The percentage breakout in the Total Project Cost Summary (TPCS), was developed based on input from respective offices in accordance with the CWBS as well as historical prices.

10.0 CONSTRUCTION MANAGEMENT (S&A)

The costs were developed for all construction management activities from pre-award requirements through final contract closeout. These costs include the in-house labor based upon work-hour requirements, materials, facility costs, support contracts, travel and overhead. Costs were developed based on the input from the construction division in accordance with the CWBS and include but are not limited to anticipated items such as the salaries of the resident engineer and staff, survey men, inspectors, draftsmen, clerical, and custodial personnel; operation, maintenance and fixed charges for transportation and for other field equipment; field supplies; construction management, general construction supervision; project office administration, distributive cost of area office and general overhead charged to the project. The work items and activities would include, but not be limited to: the salaries of all supervisory, engineering (including resident geologist and geological staff), office and safety field personnel; all on site expenses.

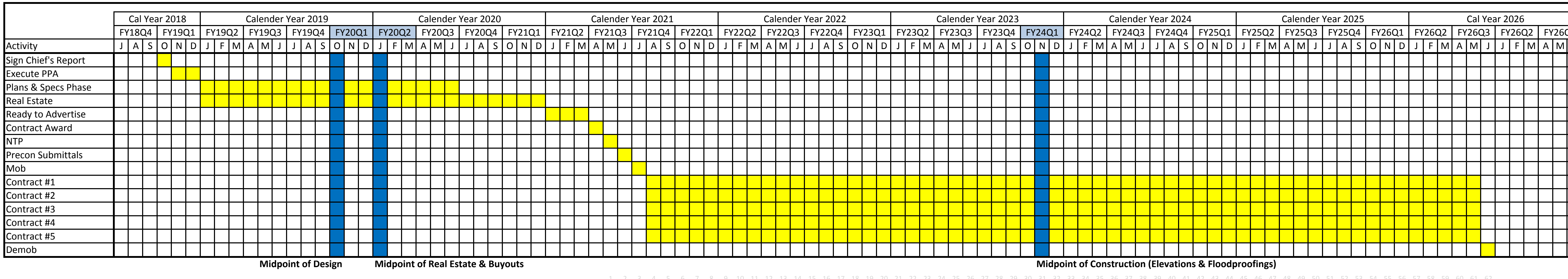
11.0 TOTAL PROJECT COST SUMMARY

The Total Project Cost Summary (TPCS) addresses the inflation through project completion; accomplished by escalation to the mid-point of construction. The TPCS includes Federal and non-Federal costs for all construction features of the project, PED and S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the CWWBS. The TPCS was prepared using the MCACES/MII cost estimate, contingencies developed by the CSRA, the project design and construction schedule, and estimates of PED and S&A prepared by others. The TPCS for both the LP and NED Plan is provided as Attachment 3 to this Cost Engineering Appendix.

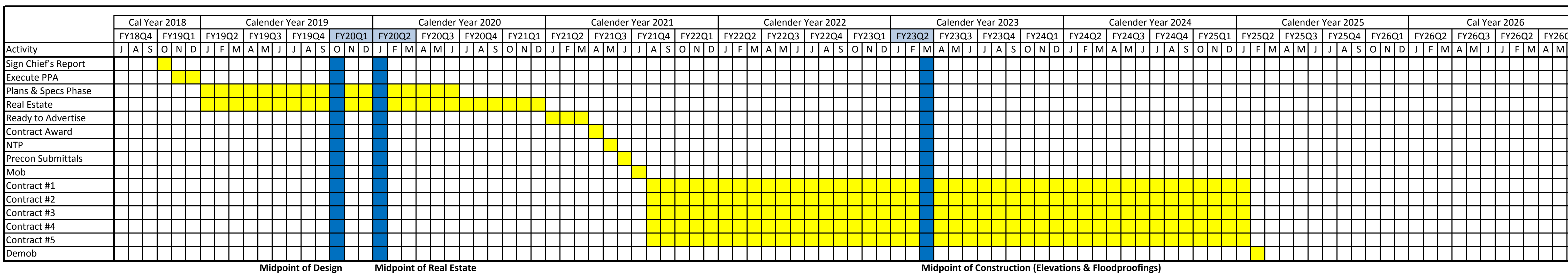
Attachment 1

CONSTRUCTION SCHEDULE

Pawcatuck River Coastal Storm Risk Management Feasibility Study - Recommended Plan



Pawcatuck River Coastal Storm Risk Management Feasibility Study - Locally Preferred Plan



Attachment 2

US Army Corps
of Engineers®

Coastal Storm Risk Management Project

Pawcatuck River, Rhode Island

Cost and Schedule Risk Analysis Report for the Feasibility Report

Prepared for:
U.S. Army Corps of Engineers,
New England District

Prepared by:
U.S. Army Corps of Engineers,
New England District

Date: 20 November 2017

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EXECUTIVE SUMMARY

Project Purpose

The recommended plan, the Locally Preferred (LP) Plan, for the Pawcatuck River Coastal Storm Risk Management project will inform Congress' decision to authorize and fund. If authorized and funded, the project will consist of non-structural storm damage reduction features in elevating 247 structures and floodproofing 21 structures throughout the project study area. It should be noted that the National Economic Development (NED) plan, the plan that maximizes net benefits, consists of elevating 357 structures, floodproofing 21 structures, and 7 buy-outs through the project study area.

Project Scope

The study area consists of the towns of Westerly, South Kingston, Narragansett, and Charlestown (Figure 1), which is subject to storm damage and shoreline erosion. More specifically, the study area includes the following: Westerly, Area 1, is the Misquamicut area in Westerly (Little Maschaug Pond to Winnapaug Pond Breakway); Charlestown, Area 2, is the barrier beach and to some extent property located behind it in the Charlestown/South Kingston area; South Kingstown, Area 3, is located in Matunuck in South Kingstown (Roy Carpenter's Beach to Matunuck Point); and Narragansett, Area 4 and Area 5, located in Narragansett (Sand Hill Cove) and the low laying area surrounding Point Judith Pond, respectively.

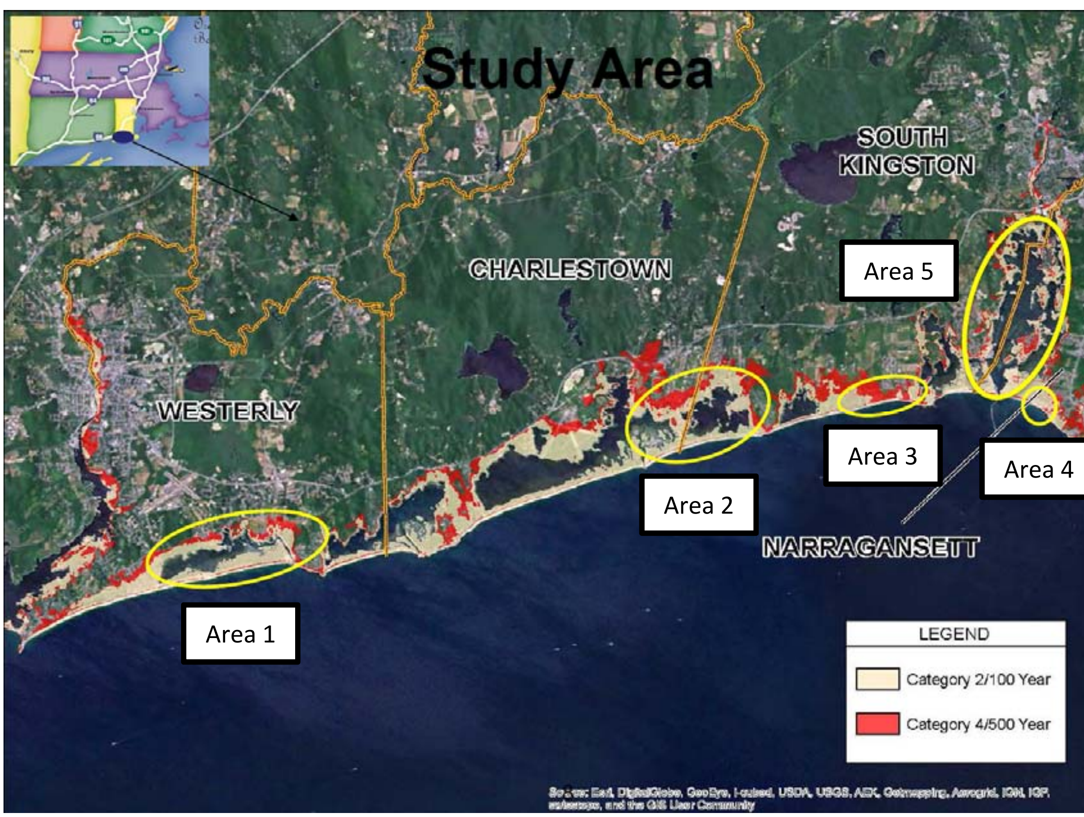


Figure 1 - Project Reach

Risk Analysis Results

A Cost and Schedule Risk Analysis (CSRA) was performed in October 2017, and Revised in November 2017, on this project to identify the 80% confidence level contingencies for the remaining construction activities. The contingencies considered both cost and schedule risk. The risk analysis analyzed the construction costs only; the subsequent contingency will be applied to the Planning, Engineering & Design (PED) and Supervision & Administration (S&A). The following results were observed:

Table 1 - Risk Analysis Results

	Contingency Amount	Contingency %
Locally Preferred Plan		
Project Construction	$9,677,279	30%
Project Schedule	37 Months	48%
NED Plan		
Project Construction	$12,115,426	28%
Project Schedule	38 Months	40%

Key Risk Items, Cost

The following were high risk items affecting cost. The complete risk register can be viewed in Appendix A. The risks associated with the LP Plan and the NED Plan are the same as the work is nearly identical.

- PM1 - Feasibility Scope Definition:

Discussion: The scope is as all-encompassing as possible as we are assuming all structures/properties will be participating in the storm damage reduction project. There is a good possibility the scope will be reduced as property owners will continue to contract their own structure raisings themselves or property owners will opt out of the project due to real estate easement concerns or other issues. It is also possible the storm damage curve utilized by NAE Economics group could change and increase the number of structures if they are impacted by the alternative wave action information in the other damage curve.

Risk Reduction Measures: This risk can be mitigated through buy-in from the PDT as well as the vertical team on all aspects of the project, including the damage curve to be used, as it moves forward in the planning process and into the design and construction phases.

- CA1 - Undefined Acquisition Strategy:

Discussion: Although the project is expected to utilize 5 separate contracts, the value of each contract will likely prohibit small business or 8a. It is unclear whether the contract will be IFB, LPTA or Best Value, however the PDT feels it will not be IFB due to the complexity and scale of the project. Utilizing LPTA or Best Value could have a critical effect on the contract cost of the project(s).

Risk Reduction Measures: Further development of the acquisition strategy through PDT discussion as well as the formal acquisition strategy process the subsequent acquisition strategy memo and possible acquisition strategy plan, will help to flush out this issue.

- EX2 - Market and bidding climate:

Discussion: Unofficial research has been done into current market conditions, however it is unknown what these conditions will be as contract solicitation is closer. It is possible a lack of competition will drive up contract costs.

Risk Reduction Measures: Formal market research and sources sought along with acquisition planning determination will help flush out this issue.

Key Risk Items, Schedule

The following items were high risk items affecting the project schedule. The complete risk register can be viewed in Appendix A.

- EX3 - Project funding:

Discussion – The current plan is to fund this project with Hurricane Sandy funds which would allow us to bypass additional congressional authorization and not require a Chief's report, but would allow us to submit a Director's report. This would allow to start the PED phase much sooner and subsequently start construction much sooner. In order to accomplish this, NAD and HQ has mandated that we stick to a tight schedule for the remainder of the planning process. It is possible, however unlikely, that NAE will fail to meet schedule deadlines resulting in NAD and HQ changing their approach and require us to prepare a Chief's report to seek additional congressional authorization which significantly alter the schedule.

Risk Reduction Measures: The PM and PDT need to keep up to date and on schedule to meet the requirements of NAD and HQ.

- CA1 - Undefined acquisition strategy:

Discussion: Although the project is expected to utilize 5 separate contracts, the value of each contract will likely prohibit small business or 8a. It is unclear whether the contract will be IFB, LPTA or Best Value, however the PDT feels it will not be IFB due to the complexity and scale of the project. Utilizing LPTA or Best Value could have a critical effect on the contract schedule of the project(s).

Risk Reduction Measures: Further development of the acquisition strategy through PDT discussion as well as the formal acquisition strategy process the subsequent acquisition strategy memo and possible acquisition strategy plan, will help to flush out this issue.

- CA2 - Numerous separate contracts:

Discussion – The PDT is currently assuming 5 separate contracts to deal with the number of strutures to be raised. This is based on conversations with contractors at the time of feasibility. Numerous factors could affect the quantity of contracts necessary to complete this work. It is possible there could be as few as 3 or less or as many as 7 or more contracts.

Risk Reduction Measures: This risk can be completely mitigated by through the acquisition strategy, sources sought, and market research to help identify and substantiate the assumptions made by the PDT and the cost engineer.

Total Project Cost Summary

The following table portrays the full costs of the remaining project features based on the anticipated contracts. The costs are intended to address the congressional requests of estimates to complete the project. Costs are in thousands of dollars.

The 30% and 28% contingency, for the Locally Preferred Plan and National Economic Development Plan, respectively, are based on an 80% confidence level, as per USACE Civil Works guidance.

Table 2 - Cost Summary

LOCALLY PREFERRED (LP) PLAN

ACCT	DESCRIPTION		COST ($)	CONTG ($)	TOTALS($)
01	Lands & Damages	10%	2,790	279	3,069
19	Buildings, Grounds & Utilities	30%	32,258	9,677	41,935
	Non-construction Costs				
30	Planning, Engineering & Design**	30%	2,940	882	3,822
31	Supervision & Administration**	30%	3,548	1,064	4,612
	Summary 30 & 31 Account		**6,488**	**1,946**	**8,434**
	Estimated Project First Cost		**41,538**	**11,903**	**53,441**

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

ACCT	DESCRIPTION		COST ($)	CONTG ($)	TOTALS($)
01	Lands & Damages	10%	7,435	743	8,178
19	Buildings, Grounds & Utilities	28%	43,269	12,115	55,385
	Non-construction Costs				
30	Planning, Engineering & Design**	28%	4,246	1,189	5,435
31	Supervision & Administration**	28%	5,147	1,441	6,588
	Summary 30 & 31 Account		**9,393**	**2,630**	**12,023**
	Estimated Project First Cost		**60,097**	**15,488**	**75,586**

PURPOSE/BACKGROUND

The recommended plan, the Locally Preferred (LP) Plan, for the Pawcatuck River Coastal Storm Risk Management project will inform Congress' decision to authorize and fund. If authorized and funded, the project will consist of non-structural storm damage reduction features in elevating 247 structures and floodproofing 21 structures throughout the project study area. It should be noted that the National Economic Development (NED) plan, the plan that maximizes net benefits, consists of elevating 357 structures, floodproofing 21 structures, and 7 buy-outs through the project study area.

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.

Project Scope

Major Project Features studied from the civil works work breakdown structure (CWWBS) for this project include:

19 - Buildings, Grounds, and Utilities (Excavation)

19 - Buildings, Grounds, and Utilities (Raising)

19 - Buildings, Grounds, and Utilities (Foundation Work)

19 - Buildings, Grounds, and Utilities (Utilities)

19 - Buildings, Grounds, and Utilities (Carpentry)

19 - Buildings, Grounds, and Utilities (Site Restoration)

19 - Buildings, Grounds, and Utilities (Floodproofings)

It should be noted that there are real estate costs and an associated contingency, including buy-outs in the NED plan, involved with this project; both of which were developed by NAE Real Estate Division. The construction contingency developed through the CSRA process will be applied to the Planning, Engineering & Design estimates as well as the Supervision & Administration.

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 MCX). 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 MCX.
- 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.

METHODOLOGY/PROCESS

A CSRA meeting was held in the CENAE office on 14 December 2015. Participants include the following members:

Table 3 - PDT Risk Identification Team

Name	Office	Representing
Hatfield, Christopher NAE	CENAE-PDP	Project Manager/Planner
Teller, Jeffrey NAE	CENAE-REA	Real Estate
Kammerer-Cody, Denise NAE	CENAE-PDE	Economics
Gay, Dara NAE	CENAE-EDW	Geotech
Mroz, Marilyn NAE	CENAE-EDW	Hydrology & Hydraulics
Godfrey, Mark NAE	CENAE-EDD	Civil
Nguyen, Thuyen NAE	CENAE-EDD	Structural
Frisino, Angela NAE	CENAE-EDD	Mechanical
Cline, Jeaninie NAE	CENAE-EDD	Electrical
Gaeta, Jeffrey NAE	CENAE-EDD	Cost Engineering
Frazzetta, Ted NAE	CENAE-CDS	Construction
Johnson, Judy NAE	CENAE-PDE	Environmental
Atwood, Kathleen NAE	CENAE-PDE	Economics & Cultural Resources
Winkleman, John NAE	CENAE-EDW	Coastal

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 MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk 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.

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 in CENAE on 14 December 2015 for the purposes of identifying and assessing risk factors. The initial formal 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. Discussions focused primarily on risk factor assessment and quantification.

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 is an example of the PDT quantifying risk factor impacts by using an iterative, consensus-building approach 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.

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 4:

Table 4 - Work Breakdown Structure by Feature

19	BUILDING, GROUNDS, AND UTILITIES (Excavation)
19	BUILDING, GROUNDS, AND UTILITIES (Raising)
19	BUILDING, GROUNDS, AND UTILITIES (Foundation Work)
19	BUILDING, GROUNDS, AND UTILITIES (Utilities)
19	BUILDING, GROUNDS, AND UTILITIES (Carpentry)
19	BUILDING, GROUNDS, AND UTILITIES (Site Restoration)
19	BUILDING, GROUNDS, AND UTILITIES (Floodproofings)

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.

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.

KEY CONSIDERATIONS AND ASSUMPTIONS

Key assumptions include the following:

- It is assumed all property owners will participate in the project; however NAE believes, based on past experience with similar projects, a percentage of owners will not participate which will allow for larger contingencies for those owners that do participate.
- The project schedule is presented in the main report.
- The design is in the feasibility stages; the cost engineer estimated quantities based on discussions with contractors and professional judgement.
- There are no applicable Life Cycle costs for this project.

RISK ANALYSIS RESULTS

Risk Register

Risk is unforeseen or unknown factors that can affect a project's cost or schedule. Time and money have a direct relationship due to the time value of money. 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. The risk register describes risks in terms of cost and schedule. A summary risk register that includes typical risk events studied (high and moderate levels) is presented 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 is 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 and communicating 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.

A correlation is a dependency that exists between two risks and may be direct or indirect. An indirect correlation is one in which large values of one risk are associated with small values of the other. Indirect correlations have correlation coefficients between 0 and -1. A direct correlation is one in which large values of one risk are associated with large values of the other. Direct correlations have correlation coefficients between 0 and 1. Correlations were not identified in this analysis.

The risk register identifies thirty one different risks that are either moderate or high risks. An abridged version of the risk register is presented below.

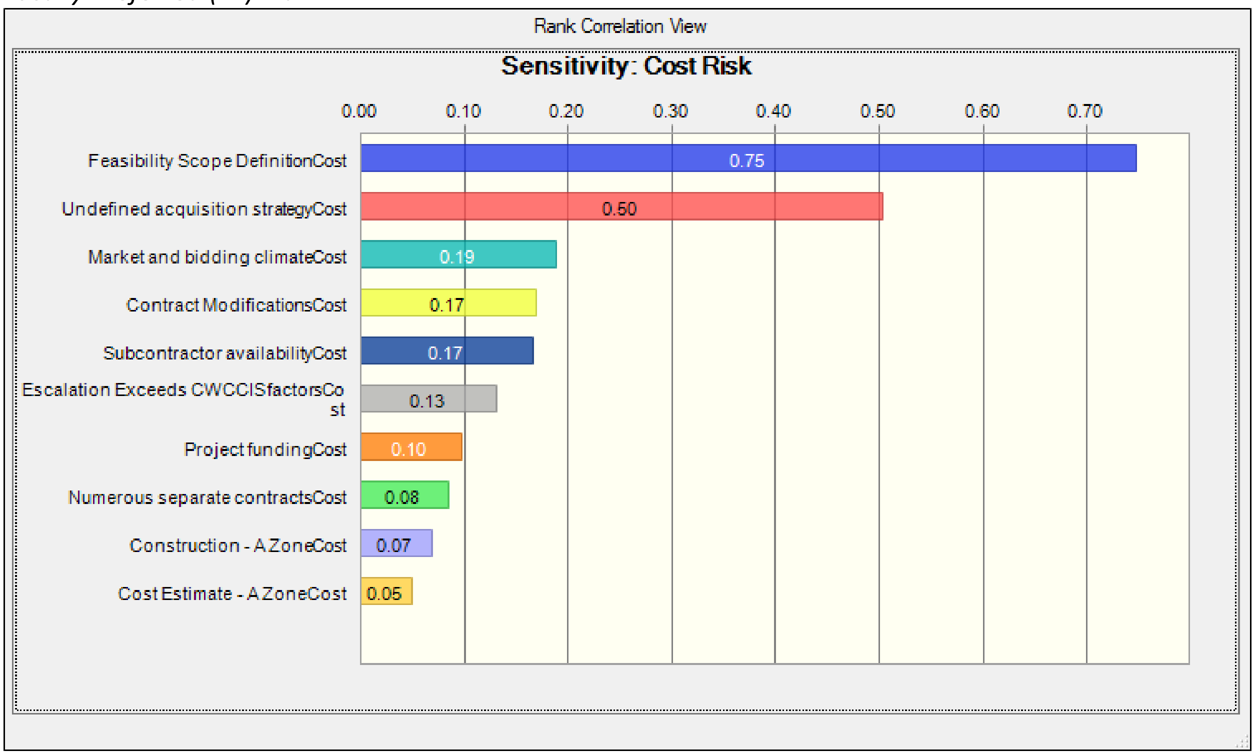
Table 5 - Risk Register (High Risk Level)

						Project Cost			Project Schedule		
RT	Ref #	CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Impact ©	Likelihood ©	Risk Level ©	Impact (S)	Likelihood (S)	Risk Level (S)
CA	38	CA1	Undefined acquisition strategy	Acquisition strategy is currently unknown.	Although the project is expected to utilize 5 separate contracts, the value of each contract will likely prohibit small business or 8a. It is unclear whether the contract will be IFB, LPTA, or Best Value. The cost of the contract will vary based on the acquisition strategy. It is likely we will utilize something other than IFB and this could have a critical effect on the contract cost based on the total contract. The actual construction duration will be unaffected. A Best Value procurement has the ability to delay the schedule before award.	Critical	Likely	High	Critical	Possible	High
CA	40	CA2	Numerous separate contracts	The number of structures to be raised and the estimated construction schedule likely prohibits one contract.	PDT is currently assuming 5 separate contracts to deal with the number of structures to be raised. This is based on conversations with contractors at the time of feasibility. Numerous factors could affect the quantity of contracts necessary to complete this work. It is possible there could be as few as 3 or less or as many as 7 or more contracts.	Marginal	Likely	Meduim	Critical	Possible	High
CO	86	CO2	Reliable Construction Schedule	The existing construction schedule is very vague and very broad-stroked. There is no detail on sequencing or phasing.	The overall production rate of the schedule was determined from speaking with local contractors who are currently doing this work. The overall months-per-year assumed to work was done by the PDT and is considered conservative. It is possible the overall construction schedule is inadequate, but the basis for it is solid and the impact is likely to be marginal.			#N/A	Critical	Possible	High
CO	95	CO3	Subcontractor availability	Most general contractors in the residential construction field that were contacted admitted to relying heavily on subcontractors especially for the lifting and utility work for the structure raisings.	The cost engineer was able to speak with numerous general contractors and structure raising/relocating contractors who have done or are doing this type of work. At the time of estimate development there were ample contractors and subcontractors available to do this work. There is a possibility they will be otherwise occupied at the time of project solicitation which have could have cost and schedule impacts.	Critical	Possible	High	Moderate	Possible	Medium
CO	101	CO5	Contract Modifications	With a project this large dealing with so many separate locations and individuals, there is always a potential for contract modifications.	Contract modifications are likely on a project with so many individual structures. The contractors, no matter how many or few, are likely to encounter issues requiring a modification. We are likely to encounter mods that have the potential for significant impacts to the cost and schedule.	Critical	Likely	High	Significant	Likely	High
PM	9	PM1	Feasibility Scope Definition	Project scope definition is unclear or incomplete; there is a chance the scope will change (either increase or decrease).	The scope is, right now, as all-encompassing as possible as we are assuming all 341 structures are assumed to be participating. There is a good possibility the scope will be reduced by reducing the number of structures due to homeowners either raising their structure on their own or backing out of the program due to the real estate easements or other issues. It is possible the damage curve used by Ecomonics could change and increase the number of structures if they are affected by wave action (Economics is reviewing the damage curve information now but it is unlikely they will make any changes to their current assumptions).	Critical	Very Likely	High	Marginal	Very Likely	Medium
EX	203	EX2	Market and bidding climate	It is unknown what the market conditions and bidding climate will be like at the time of project solicitation.	While unofficial research has been done into current market conditions, it is unknown what they will be at the time of contract solicitation. It is possible a lack of competition will drive up contract costs. Little to no competition could add project costs with the need to resolicited which would also delay the project schedule.	Critical	Possible	High	Marginal	Possible	Low

Cost Risk Analysis - Cost Contingency Results

The project Cost Contingency at the 80% confidence level is 30 % and 28% which translates to $9,677,861 and $12,114,234 of project cost for the LP Plan and NED Plan, respectively. These levels were established by analyzing the different cost risk factors that affect the project. Cost risks that were specific to individual project features were discussed in detail. For example, risk CO8, "Construction - V Zone" references risks associated with the construction of the V-Zone properties which requires a specific type of foundation construction. Most of the risks apply to the entire project such as ES1, "Competition" and EX1, "Acts of God" which would affect all remaining features. Cost contingencies can be either positive or negative. The cost sensitivity chart shows relative cost contingency of individual risks. The sum of all the risks would be 100% of the cost contingency. See the cost sensitivity chart below.

Locally Preferred (LP) Plan



National Economic Development (NED) Plan

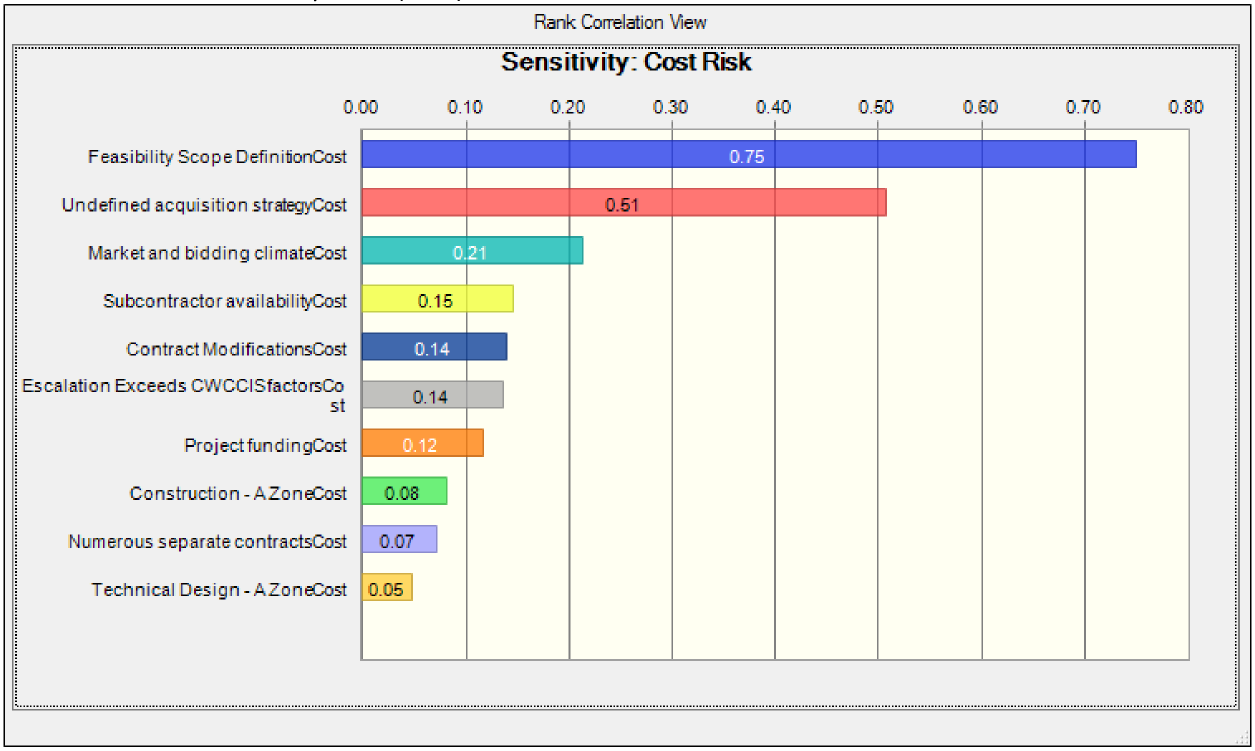


Figure 1 - Cost Risk Sensitivity Analysis

From this chart, we can see that, regardless of the LP or NED Plan, the top three risks that affect cost are;

- PM1 - Feasibility Scope Definition,
- CA1 - Undefined Acquisition Strategy, and
- EX2 – Market and Bidding Climate.

Key Risk Items, Cost

The following were high risk items affecting cost. The complete risk register can be viewed in Appendix A. The risks associated with the LP Plan and the NED Plan are the same as the work is nearly identical.

- PM1 - Feasibility Scope Definition:

Discussion: The scope is as all-encompassing as possible as we are assuming all structures/properties will be participating in the storm damage reduction project. There is a good possibility the scope will be reduced as property owners will continue to contract their own structure raisings themselves or property owners will opt out of the project due to real estate easement concerns or other issues. It is also possible the storm damage curve utilized by NAE Economics group could change and increase the number of structures if they are impacted by the alternative wave action information in the other damage curve.

Risk Reduction Measures: This risk can be mitigated through buy-in from the PDT as well as the vertical team on all aspects of the project, including the damage curve to be used, as it moves forward in the planning process and into the design and construction phases.

- CA1 - Undefined Acquisition Strategy:

Discussion: Although the project is expected to utilize 5 separate contracts, the value of each contract will likely prohibit small business or 8a. It is unclear whether the contract will be IFB, LPTA or Best Value, however the PDT feels it will not be IFB due to the complexity and scale of the project. Utilizing LPTA or Best Value could have a critical effect on the contract cost of the project(s).

Risk Reduction Measures: Further development of the acquisition strategy through PDT discussion as well as the formal acquisition strategy process the subsequent acquisition strategy memo and possible acquisition strategy plan, will help to flush out this issue.

- EX2 - Market and bidding climate:

Discussion: Unofficial research has been done into current market conditions, however it is unknown what these conditions will be as contract solicitation is closer. It is possible a lack of competition will drive up contract costs.

Risk Reduction Measures: Formal market research and sources sought along with acquisition planning determination will help flush out this issue.

The confidence table and curve showing the 80% confidence level is below. Note that these results reflect only those contingencies established from the cost risk analysis.

Table 6 - Cost Contingency Analysis at Various Confidence Levels

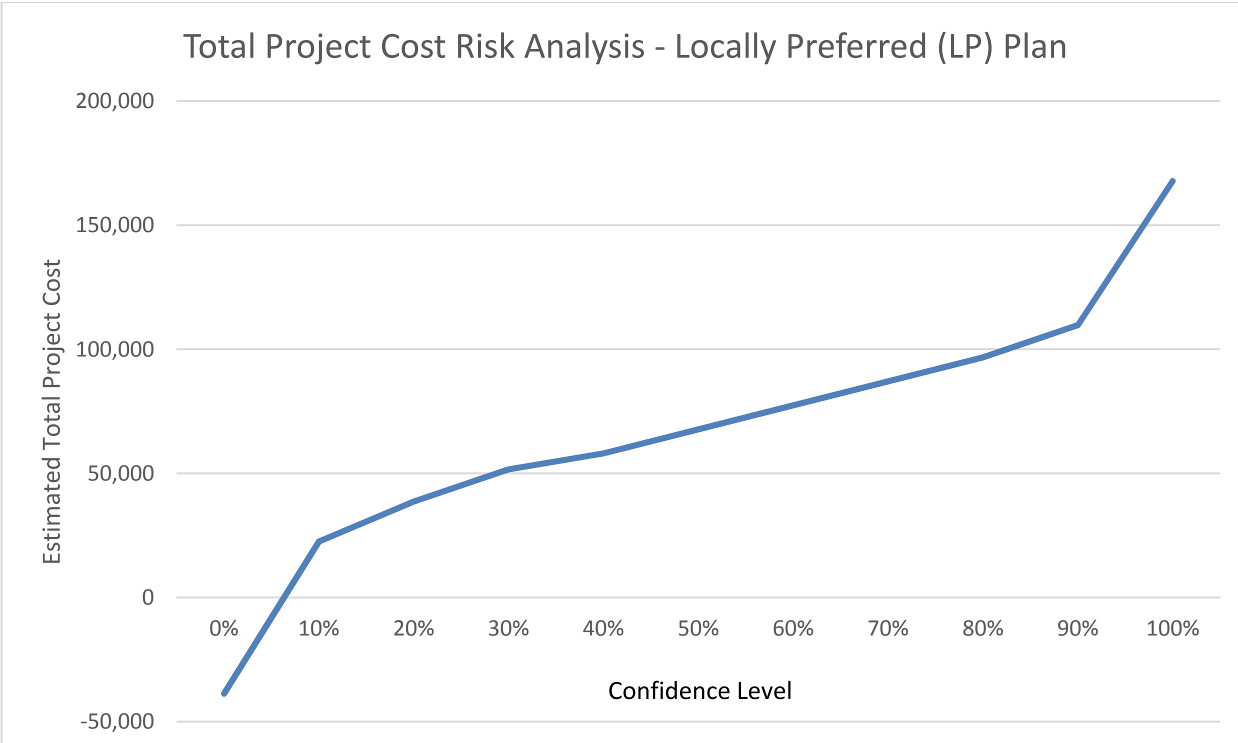
Locally Preferred (LP) Plan

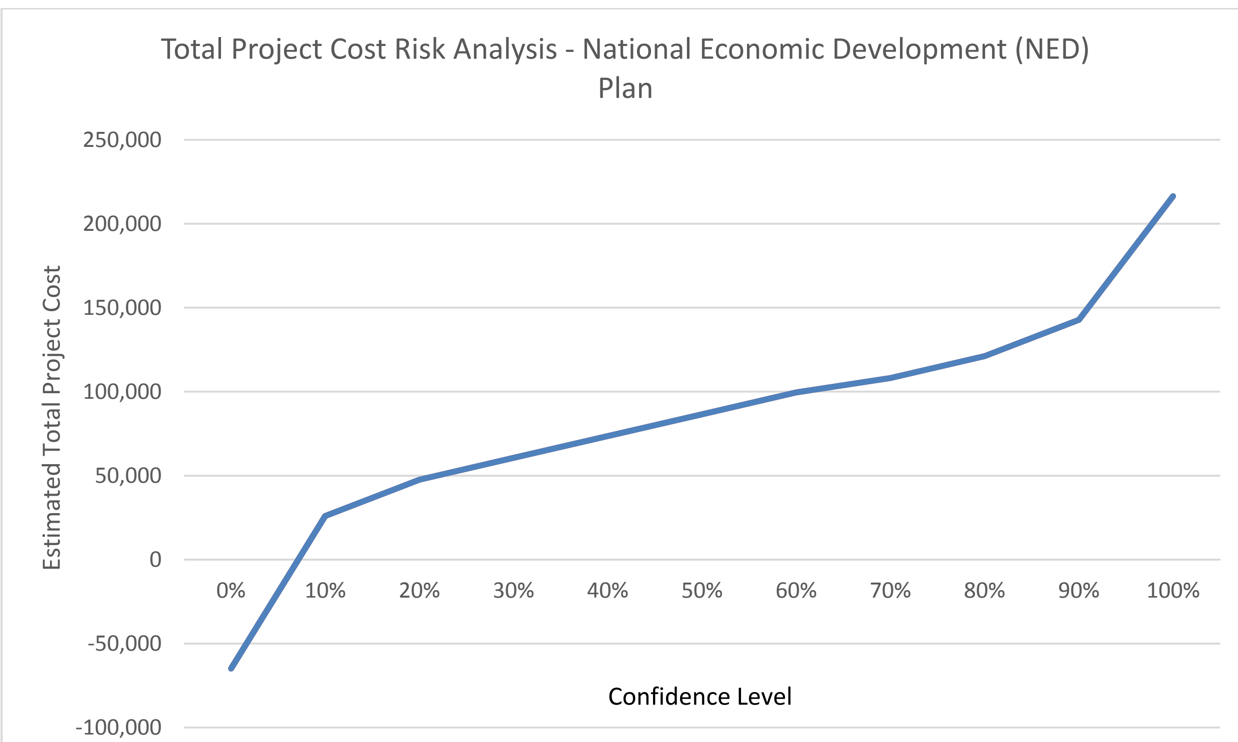
Most Likely Cost Estimate			$32,257,595
Confidence Level	Value	Contingency	Contingency
0%	$28,386,684	-$3,870,911	-12%
10%	$34,515,627	$2,258,032	7%
20%	$36,128,506	$3,870,911	12%
30%	$37,418,810	$5,161,215	16%
40%	$38,063,962	$5,806,367	18%
50%	$39,031,690	$6,774,095	21%
60%	$39,999,418	$7,741,823	24%
70%	$40,967,146	$8,709,551	27%
80%	$41,934,874	$9,677,279	30%
90%	$43,225,177	$10,967,582	34%
100%	$49,031,544	$16,773,949	52%

National Economic Development (NED) Plan

Most Likely Cost Estimate			$43,269,380
Confidence Level	**Value**	**Contingency**	**Contingency**
0%	$36,778,973	-$6,490,407	-15%
10%	$45,865,543	$2,596,163	6%
20%	$48,029,012	$4,759,632	11%
30%	$49,327,093	$6,057,713	14%
40%	$50,625,175	$7,355,795	17%
50%	$51,923,256	$8,653,876	20%
60%	$53,221,337	$9,951,957	23%
70%	$54,086,725	$10,817,345	25%
80%	$55,384,806	$12,115,426	28%
90%	$57,548,275	$14,278,895	33%
100%	$64,904,070	$21,634,690	50%

Table 7 - Total Project Cost Risk Analysis

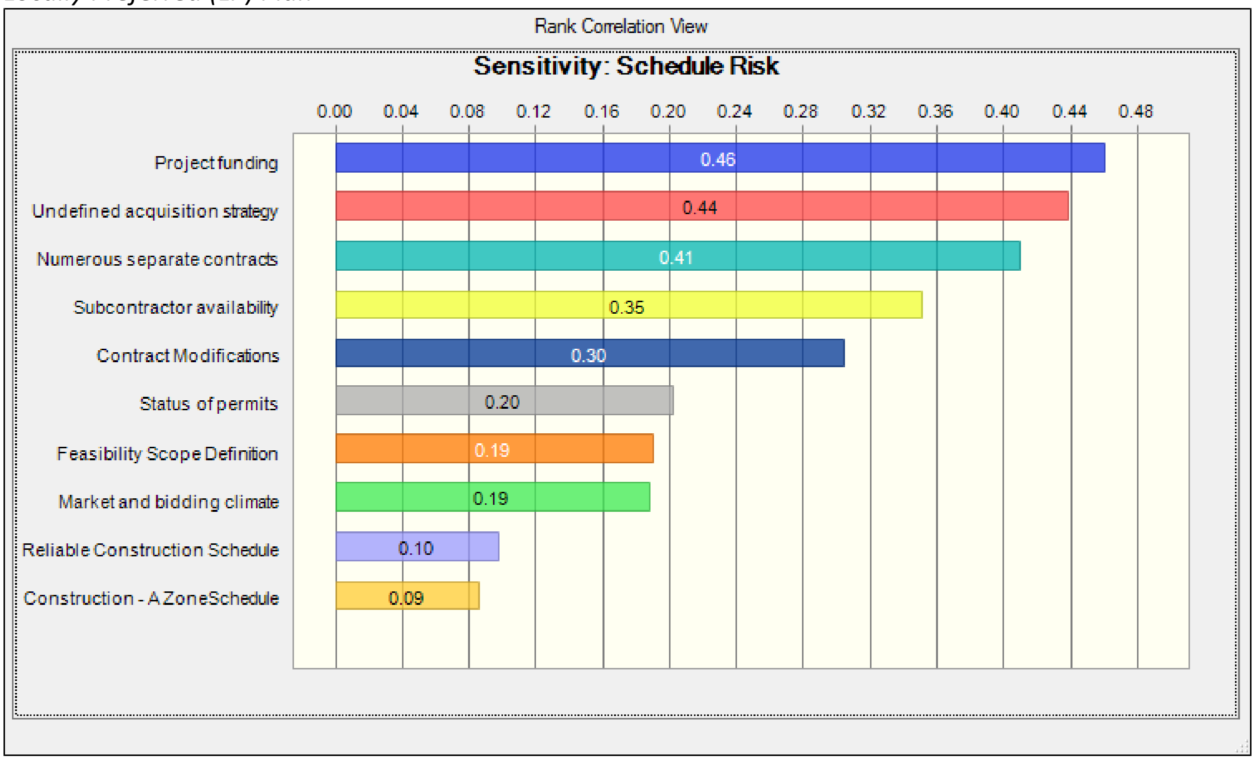




Schedule Risk Analysis - Schedule Contingency Results

The project Schedule Contingency at the 80% confidence level is 48% and 40% which translates to 37 months and 38 months of additional project duration for the LP Plan and NED Plan, respectively. This level was established by analyzing the different schedule risk factors that affect the project. The schedule sensitivity chart shows relative schedule contingency of individual risks. The sum of all the risks would be 100% of the schedule contingency. See the schedule sensitivity chart below.

Locally Preferred (LP) Plan



National Economic Development (NED) Plan

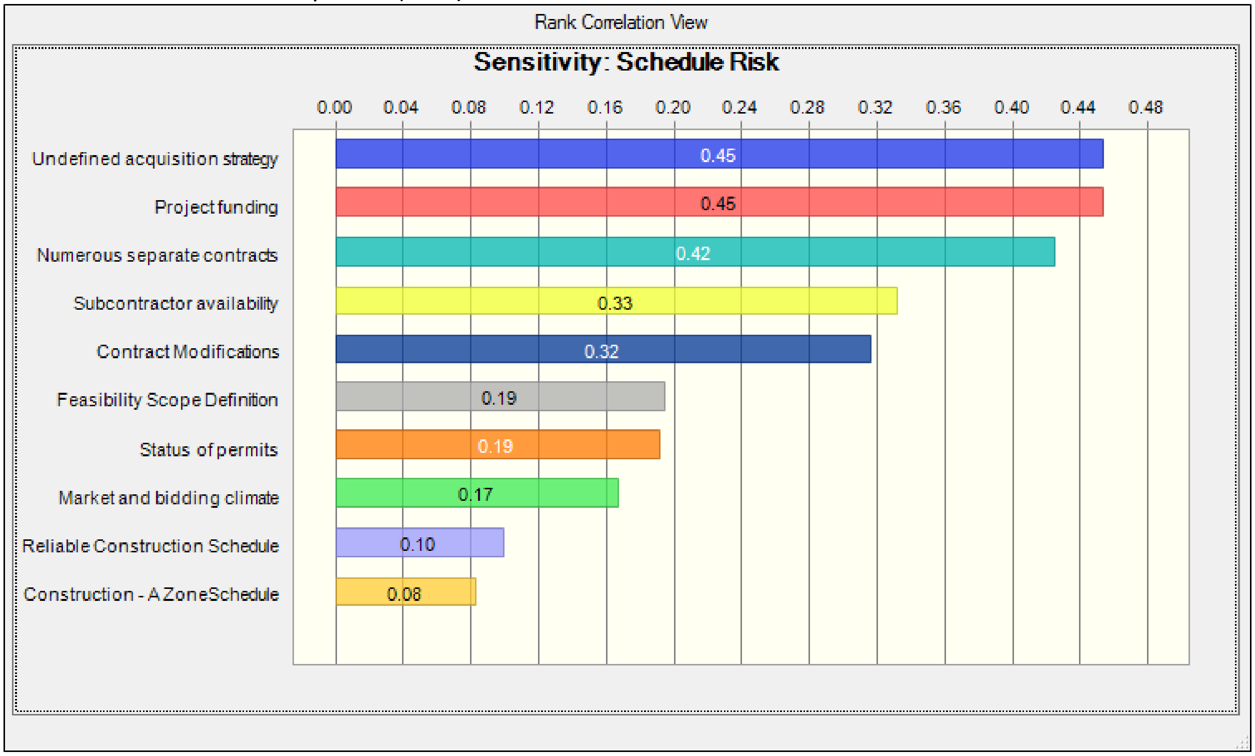


Figure 3 - Schedule Risk Sensitivity Analysis

From this chart, we can see that the top three risks that affect cost are;

- EX3 - Project Funding,
- CA1 - Undefined Acquisition Strategy, and
- CA2 - Numerous Separate Contracts.

Key Risk Items, Schedule

The following items were high risk items affecting the project schedule. The complete risk register can be viewed in Appendix A.

- EX3 - Project funding:

Discussion – The current plan is to fund this project with Hurricane Sandy funds which would allow us to bypass additional congressional authorization and not require a Chief's report, but would allow us to submit a Director's report. This would allow to start the PED phase much sooner and subsequently start construction much sooner. In order to accomplish this, NAD and HQ has mandated that we stick to a tight schedule for the remainder of the planning process. It is possible, however unlikely, that NAE will fail to meet schedule deadlines resulting in NAD and HQ changing their approach and require us to prepare a Chief's report to seek additional congressional authorization which significantly alter the schedule.

Risk Reduction Measures: The PM and PDT need to keep up to date and on schedule to meet the requirements of NAD and HQ.

- CA1 - Undefined acquisition strategy:

Discussion: Although the project is expected to utilize 5 separate contracts, the value of each contract will likely prohibit small business or 8a. It is unclear whether the contract will be IFB, LPTA or Best Value, however the PDT feels it will not be IFB due to the complexity and scale of the project. Utilizing LPTA or Best Value could have a critical effect on the contract schedule of the project(s).

Risk Reduction Measures: Further development of the acquisition strategy through PDT discussion as well as the formal acquisition strategy process the subsequent acquisition strategy memo and possible acquisition strategy plan, will help to flush out this issue.

- CA2 - Numerous separate contracts:

Discussion – The PDT is currently assuming 5 separate contracts to deal with the number of strutures to be raised. This is based on conversations with contractors at the time of feasibility. Numerous factors could affect the quantity of contracts necessary to complete this work. It is possible there could be as few as 3 or less or as many as 7 or more contracts.

Risk Reduction Measures: This risk can be completely mitigated by through the acquisition strategy, sources sought, and market research to help identify and substantiate the assumptions made by the PDT and the cost engineer.

The confidence table showing the 80% confidence level is below. Note that these results reflect only those contingencies established from the schedule risk analysis.

Table 7 - Cost Contingency Analysis at Various Confidence Levels

Locally Preferred (LP) Plan

Most Likely Schedule Duration			77.6 months
Confidence Level	Value	Contingency	Contingency
0%	88 months	10 months	13%
10%	101 months	23 months	30%
20%	104 months	26 months	34%
30%	106 months	28 months	36%
40%	107 months	30 months	38%
50%	109 months	32 months	41%
60%	111 months	33 months	43%
70%	113 months	35 months	45%
80%	115 months	37 months	48%
90%	118 months	40 months	52%
100%	137 months	59 months	76%

National Economic Development (NED) Plan

Most Likely Schedule Duration			93.8 months
Confidence Level	Value	Contingency	Contingency
0%	104 months	10 months	11%
10%	117 months	23 months	25%
20%	120 months	26 months	28%
30%	122 months	28 months	30%
40%	124 months	30 months	32%
50%	126 months	32 months	34%
60%	128 months	34 months	36%
70%	129 months	36 months	38%
80%	131 months	38 months	40%
90%	134 months	40 months	43%
100%	153 months	59 months	63%

APPENDIX A

DETAILED RISK REGISTERS

RT	Ref #	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Impact ©	Likelihood ©	Risk Level ©	Impact (S)	Likelihood (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component
Contract Acquisition (CA)															
CA	38	Undefined acquisition strategy	Acquisition strategy is currently unknown.	Although the project is expected to utilize 5 separate contracts, the value of each contract will likely prohibit small business or 8a. It is unclear whether the contract will be IFB, LPTA, or Best Value. The cost of the contract will vary based on the acquisition strategy. It is likely we will utilize something other than IFB and this could have a critical effect on the contract cost based on the total contract. The actual construction duration will be unaffected. A Best Value procurement has the ability to delay the schedule before award.	Critical	Likely	High	Critical	Possible	High	Triangular	Triangular		Project Management	Contract Cost & Schedule
CA	40	Numerous separate contracts	The number of structures to be raised and the estimated construction schedule likely prohibits one contract.	PDT is currently assuming 5 separate contracts to deal with the number of structures to be raised. This is based on conversations with contractors at the time of feasibility. Numerous factors could affect the quantity of contracts necessary to complete this work. It is possible there could be as few as 3 or less or as many as 7 or more contracts.	Marginal	Likely	Meduim	Critical	Possible	High	Triangular	Triangular		Project Management	Contract Cost & Schedule
CA	42	Acquisition strategy results in higher scope risk (Design Build)	It is possible, due to the number of structures to be investigated, designed, and raised, the acquisition could be design build.	The PDT feels this scheduled-related risk is captured in "Undefined acquisition strategy" above. This risk will not be modeled.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Project Management	Contract Cost & Schedule
Lands and Damages (LD)															
LD	-	Real Estate Cost and Contingency	Our Real Estate Division has developed their own costs and contingency.	The cost and schedule impacts of Real Estate have not been modeled in this Cost and Schedule Risk Assessment.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Real Estate	N/A -Not Modeled
Construction (CO)															
CO	81	Weather Impacts	Performing construction to raise structures in the flood plain has inherent risks. If weather hits the area it very well could effect construction schedule and project costs.	PDT chose to model this risk as a construction modification. Weather impacts outside the allowable weather days permitted per the contract are typically handled as a contract modification.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Construction	Contract Cost & Schedule

RT	Ref #	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Impact ©	Likelihood ©	Risk Level ©	Impact (S)	Likelihood (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component
CO	86	Reliable Construction Schedule	The existing construction schedule is very vague and very broad-stroked. There is no detail on sequencing or phasing.	The overall production rate of the schedule was determined from speaking with local contractors who are currently doing this work. The overall months-per-year assumed to work was done by the PDT and is considered conservative. It is possible the overall construction schedule is inadequate, but the basis for it is solid and the impact is likely to be marginal.			#N/A	Critical	Possible	High	N/A -Not Modeled	Triangular		Construction	Project Schedule
CO	95	Subcontractor availability	Most general contractors in the residential construction field that were contacted admitted to relying heavily on subcontractors especially for the lifting and utility work for the structure raisings.	The cost engineer was able to speak with numerous general contractors and structure raising/relocating contractors who have done or are doing this type of work. At the time of estimate development there were ample contractors and subcontractors available to do this work. There is a possibility they will be otherwise occupied at the time of project solicitation which have could have cost and schedule impacts.	Critical	Possible	High	Moderate	Possible	Medium	Triangular	Triangular		Construction	Contract Cost & Schedule
CO	96	Inefficient contractor	There is a chance the contractor(s) will be inefficient and unable to keep up with the pace assumed in the current schedule.	The PDT feels this scheduled-related risk is captured in "Reliable Construction Schedule" above. This risk will not be modeled.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Construction	Project Schedule
CO	101	Contract Modifications	With a project this large dealing with so many separate locations and individuals, there is always a potential for contract modifications.	Contract modifications are likely on a project with so many individual structures. The contractors, no matter how many or few, are likely to encounter issues requiring a modification. We are likely to encounter mods that have the potential for significant impacts to the cost and schedule.	Critical	Likely	High	Significant	Likely	High	Triangular	Triangular		Construction	Contract Cost & Schedule
CO	103	Adequate staging areas	Due to the lack of existing design there is no accounting for staging area in the cost estimate.	The contractors will require a laydown area which should be accounted for. The cost estimate assumes several items necessary for the contractor laydown area but it is not all-inclusive. It is very likely there will be some cost impact but it is expected to be marginal based on the total value of the contract.	Marginal	Very Likely	Medium			#N/A	Triangular	N/A -Not Modeled		Construction	Contract Cost
CO	-	Construction - A Zone	Regardless of the number of contracts that are utilized, each contractor will have a significant number of structures that require raising.	The PDT feels that while structure raising isn't the most complex construction, the shear number of structures and the difficulty that is present may be an issue for some or all of the contractors. Favorably, the PDT agrees that due to the amount of structures and the relative comparisons between the different "types", the contractor will benefit from economies of scale.	Marginal	Likely	Meduim	Negligible	Possible	Low	Triangular	Triangular		Construction	Contract Cost & Schedule

RT	Ref #	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Impact ©	Likelihood ©	Risk Level ©	Impact (S)	Likelihood (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component
CO	-	Construction - V Zone	Regardless of the number of contracts that are utilized, each contractor will have a significant number of structures that require raising. There is added difficulty with the V Zone structures as they require piles or columns under each.	The PDT feels similar to that of CO7; however understands that piles installation or column construction can be a more difficult feature of work for a residential contractor. The PDT feels the initial ramp up for these features may result in more impacts to the cost and schedule, but, again, would benefit from economies of scale to a certain degree.	Negligible	Very Likely	Low	Negligible	Possible	Low	Triangular	Triangular		Construction	Contract Cost & Schedule
Cost and Schedule (ES)															
ES	117	Competition	It is unknown how many contracts there will be and when they will be solicited. If they are procured at the same time there is a possibility there will be a lack of competition pushing the prices up.	PDT chose to model this risk as "Market conditions and bidding competition".			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Cost Engineering	Contract Cost
ES	-	Cost Estimate - A Zone	The estimates have been developed with little to no technical design work. The quantities utilized in the cost estimate are based on conversations with the PDT as well as contractors performing this work in the real world.	While the quantity of each individual item may be in flux due to the lack of technical design, the cost engineer and PDT feel the overall cost is consistent with this work as it is being constructed in the field. The cost engineer has spoken to several contractors who have provided quotes for each of the six typical A zone structure "types". The base level cost estimate for each of these structure "types" is in line with those quotes. The base level cost estimates are also in line with actual costs we have received from the Town of Westerly for very similar work involving very similar structures in the same geographic area.	Marginal	Unlikely	Low			#N/A	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost
ES	-	Cost Estimate - V Zone	The estimates have been developed with little to no technical design work. The quantities utilized in the cost estimate are based on conversations with the PDT as well as contractors performing this work in the real world.	While the quantity of each individual item may be in flux due to the lack of technical design, the cost engineer and PDT feel the overall cost is consistent with this work as it is being constructed in the field. The cost engineer has spoken to several contractors who have provided quotes for each of the six typical V zone structure "types". The base level cost estimate for each of these structure "types" is in line with those quotes. The base level cost estimates are also in line with actual costs we have received from the Town of Westerly for very similar work involving very similar structures in the same geographic area.	Moderate	Unlikely	Low			#N/A	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost
Project & Program Management (PM)															
PM	9	Feasibility Scope Definition	Project scope definition is unclear or incomplete; there is a chance the scope will change (either increase or decrease).	The scope is, right now, as all-encompassing as possible as we are assuming all 341 structures are assumed to be participating. There is a good possibility the scope will be reduced by reducing the number of structures due to homeowners either raising their structure on their own or backing out of the program due to the real estate easements or other issues. It is possible the damage curve used by Ecomonics could change and increase the number of structures if they are affected by wave action (Economics is reviewing the damage curve information now but it is unlikely they will make any changes to their current assumptions).	Critical	Very Likely	High	Marginal	Very Likely	Medium	Triangular	Triangular		Project Management	Contract Cost & Schedule

RT	Ref #	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Impact ©	Likelihood ©	Risk Level ©	Impact (S)	Likelihood (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component
PM	16	Escalation Exceeds CWCCIS factors	The project construction duration is currently approaching 5 years. Over that span of time there is no guarantee that CWCCIS will remain accurate.	it is possible that escalation could continue to fluctuate over the life of the project.	Significant	Possible	Medium			#N/A	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost
PM	18	PED Funding - E&D Cost Will Vary Significantly from Estimate (30 Account)	Actual PED costs have the potential to vary significant from what has been assumed/calculated to date.	PED costs have been calculated using historical rates for this type of nonstructal work as a percentage of the construction cost. This CSRA is being completed utilizing only the construction cost and the resultant contingency will be applied to the PED cost in the total project cost summary.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Project Management	Project Cost
PM	19	CM Funding - - CM Cost Will Vary Significantly from Estimate (31 Account)	Actual S&A costs have the potential to vary significant from what has been assumed/calculated to date.	S&A costs have been calculated using historical rates for this type of nonstructal work as a percentage of the construction cost. This CSRA is being completed utilizing only the construction cost and the resultant contingency will be applied to the S&A cost in the total project cost summary.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Construction	Project Cost
Regulatory & Environmental (RE)															
RE	160	Status of permits	The contractor(s) will be required to obtain building permits for work on the structures. Failure to do so in a timely fashion may delay the start of construction on any number of structures.	Based on the size of the project it is likely there will be some delays to the schedule due to the permitting issue but the impact is expected to be marginal as the permits require only the town's building inspector(s) and should not require attendance at any ZBA or Planning Board meetings.			#N/A	Marginal	Likely	Meduim	N/A -Not Modeled	Triangular		Contractor	Project Schedule
Technical Design (TD) / Project Scope Growth															
TD	-	Technical Design - A Zone	Currently there is limited technical design for this nonstructural alternative for the A Zone structure raisings.	In this feasibility phase, there is little to no design work that has been done with the nonstructural alternative. The design will require significant investment to research and investigate each structure to determine the requirements for raising. It is possible as the technical design is developed and flushed out there will be some unforeseen impact to cost.	Moderate	Possible	Medium			#N/A	Triangular	N/A -Not Modeled		Engineering Division	Project Cost
TD	-	Technical Design - V Zone	Currently there is limited technical design for this nonstructural alternative for the V Zone structure raisings.	The only change in technical design from A Zone to V Zone is the pile/columns that are required in the V Zone. The lack of design for these piles/columns could result in increased cost when their design comes to fruition. It is possible as the technical design is developed and flushed out there will be additional unforeseen impact to cost.	Marginal	Possible	Low			#N/A	Triangular	N/A -Not Modeled		Engineering Division	Project Cost
External															

RT	Ref #	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Impact ©	Likelihood ©	Risk Level ©	Impact (S)	Likelihood (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component
EX	200	Acts of God	Significant storm events do occur in this area. The impetus for this project is to help mitigate impacts of such acts of God.	PDT chose to model this risk as a construction modification. Acts of God, similar to weather impacts outside the allowable weather days permitted per the contract, are typically handled as a contract modification.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Project Management	Contract Cost & Schedule
EX	203	Market and bidding climate	It is unknown what the market conditions and bidding climate will be like at the time of project solicitation.	While unofficial research has been done into current market conditions, it is unknown what they will be at the time of contract solicitation. It is possible a lack of competition will drive up contract costs. Little to no competition could add project costs with the need to resolicited which would also delay the project schedule.	Critical	Possible	High	Marginal	Possible	Low	Triangular	Triangular		Project Management	Contract Cost & Schedule
EX	213	Project funding	Adequacy of project funding (incremental or full funding)	The current plan is to fund this project with Sandy Funds which would allow us to bypass additional congressional authorization and not require a Chief's report (we will be required to submit a Director's report). In order to accomplish this, NAD and HQ is mandating we stick to a tight schedule for the remainder of the planning process. It is possible, however unlikely, that NAD and HQ will change their mind again and require us to go through the Chief's report and congressional authorization which could significantly alter the schedule. This delay will affect the project cost by adding additional escalation.	Significant	Unlikely	Medium	Significant	Unlikely	Medium	Triangular	Triangular		Programs	Contract Cost & Schedule
EX	-	Sea-level rise	Sea-level rise should be considered a risk, especially considering this is a storm damage reduction project.	PDT is currently utilizing the "medium" sea-level rise curve. The "high" sea-level rise curve would add approximately 140 structures that would require raising. This is approximately 40% of the existing structures. There is a very small likelihood we would be required to use the "high" sea-level rise curve as NAE coastal engineer is confident of current model. UPDATE: Economics has optimized the net benefits utilizing the "Intermediate" sea level rise curve + 1 ft of freeboard. This decision has recieved vertical team concurrance and is longer being modeled.			#N/A			#N/A	N/A -Not Modeled	N/A -Not Modeled		Project Management	Contract Cost & Schedule

Attachment 3

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 403382

NAE – Pawcatuck River Coastal Storm Risk Management Feasibility Study

The Pawcatuck River Coastal Storm Risk Management Feasibility Study, as presented by New England 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 November 21, 2017, the Cost MCX certifies the estimated total project cost:

NED Plan:

Total First Costs:	$75,586,000
Fully Funded Costs:	$85,446,000

LPP Plan:

Total First Costs:	$53,438,000
Fully Funded Costs:	$59,716,000

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: **Pawcatuck River Coastal Storm Risk Management Feasibility Study**
PROJECT NO: P2 403382
LOCATION: Westerly, Charleston, South Kingston, & Narragansett, Rhode Island

DISTRICT: **NAE District** **PREPARED:** **Rev 11/20/17)**
POC: **CHIEF, COST ENGINEERING, Patricia Bolton**

This Estimate reflects the scope and schedule in report; Coastal Storm Risk Management Feasibility Study & Environmental Assessment

**** NATIONAL ECONOMIC DEVELOPMENT PLAN ****

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**						**TOTAL PROJECT COST (FULLY FUNDED)**			
						Program Year (Budget EC): 2018 Effective Price Level Date: 1 OCT 17									
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	**TOTAL ($K)** *J*	Spent Thru: **10/1/2017** ($K)	**TOTAL FIRST COST** ($K) *K*	INFLATED (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
19	BUILDINGS, GROUNDS & UTILITIES Elevati	$41,762	$11,693	28.0%	$53,455	0.0%	$41,762	$11,693	$53,455	$0	$53,455	12.7%	$47,055	$13,175	$60,230
19	BUILDINGS, GROUNDS & UTILITIES Floodp	$1,507	$422	28.0%	$1,929	0.0%	$1,507	$422	$1,929	$0	$1,929	12.7%	$1,698	$476	$2,174
19	BUILDINGS, GROUNDS & UTILITIES Buyout	$3,521	$352	10.0%	$3,873	0.0%	$3,521	$352	$3,873	$0	$3,873	4.6%	$3,683	$368	$4,051
	CONSTRUCTION ESTIMATE TOTALS:	$46,790	$12,467		$59,257	0.0%	$46,790	$12,467	$59,257	$0	$59,257	12.1%	$52,436	$14,019	$66,456
01	LANDS AND DAMAGES	$3,914	$391	10.0%	$4,305	0.0%	$3,914	$391	$4,305	$0	$4,305	4.6%	$4,095	$409	$4,504
30	PLANNING, ENGINEERING & DESIGN	$4,246	$1,189	28.0%	$5,435	0.0%	$4,246	$1,189	$5,435	$0	$5,435	12.4%	$4,772	$1,336	$6,108
31	CONSTRUCTION MANAGEMENT	$5,147	$1,441	28.0%	$6,588	0.0%	$5,147	$1,441	$6,588	$0	$6,588	27.2%	$6,546	$1,833	$8,379
	PROJECT COST TOTALS:	$60,097	$15,489	25.8%	$75,586		$60,097	$15,489	**$75,586**	$0	**$75,586**	13.0%	$67,849	$17,598	$85,446

________________ **CHIEF, COST ENGINEERING, Patricia Bolton**

________________ **PROJECT MANAGER, Christopher Hatfield**

________________ **CHIEF, REAL ESTATE, Anne Kosel**

________________ **CHIEF, PLANNING, John Kennelly**

________________ **CHIEF, ENGINEERING, Frank Fedele**

________________ **CHIEF, OPERATIONS, Eric Pedersen**

________________ **CHIEF, CONSTRUCTION, Sean Dolan**

________________ **CHIEF, CONTRACTING, Sheila Winston-Vincuilla**

________________ **CHIEF, PM-PB, Janet Harrington**

________________ **CHIEF, DPM, Scott Acone**

ESTIMATED FEDERAL COST:	**65%**	**$55,540**
ESTIMATED NON-FEDERAL COST:	**35%**	**$29,906**
ESTIMATED TOTAL PROJECT COST:		**$85,446**

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

**** CONTRACT COST SUMMARY ****

PROJECT: Pawcatuck River Coastal Storm Risk Management Feasibility Study
LOCATION: Westerly, Charleston, South Kingston, & Narragansett, Rhode Island
This Estimate reflects the scope and schedule in report; Coastal Storm Risk Management Feasibility Study & Environmental Assessment

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Patricia Bolton
PREPARED: 18/2017 (Rev 11/20/

**** NATIONAL ECONOMIC DEVELOPMENT PLAN ****

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			/2017 (Rev 11/20/	Program Year (Budget EC):			2018					
		Effective Price Level:			1-Oct-17	Effective Price Level Date:			1 OCT 17					
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***P***	***L***	***M***	***N***	***O***
	PHASE 1 or CONTRACT 1													
19	BUILDINGS, GROUNDS & UTILITIES Elevati	$41,762	$11,693	28.0%	$53,455	0.0%	$41,762	$11,693	$53,455	2024Q1	12.7%	$47,055	$13,175	$60,230
19	BUILDINGS, GROUNDS & UTILITIES Floodp	$1,507	$422	28.0%	$1,929	0.0%	$1,507	$422	$1,929	2024Q1	12.7%	$1,698	$476	$2,174
19	BUILDINGS, GROUNDS & UTILITIES Buyout	$3,521	$352	10.0%	$3,873	0.0%	$3,521	$352	$3,873	2020Q2	4.6%	$3,683	$368	$4,051
	CONSTRUCTION ESTIMATE TOTALS:	$46,790	$12,467	26.6%	**$59,257**		$46,790	$12,467	$59,257			$52,436	$14,019	$66,456
01	LANDS AND DAMAGES	$3,914	$391	10.0%	$4,305	0.0%	$3,914	$391	$4,305	2020Q2	4.6%	$4,095	$409	$4,504
30	PLANNING, ENGINEERING & DESIGN													
0.3%	Project Management	$140	$39	28.0%	$179	0.0%	$140	$39	$179	2020Q1	8.2%	$151	$42	$194
0.5%	Planning & Environmental Compliance	$234	$66	28.0%	$300	0.0%	$234	$66	$300	2020Q1	8.2%	$253	$71	$324
5.0%	Engineering & Design	$2,339	$655	28.0%	$2,994	0.0%	$2,339	$655	$2,994	2020Q1	8.2%	$2,531	$709	$3,239
0.5%	Reviews, ATRs, IEPRs, VE	$234	$66	28.0%	$300	0.0%	$234	$66	$300	2020Q1	8.2%	$253	$71	$324
0.3%	Life Cycle Updates (cost, schedule, risks)	$140	$39	28.0%	$179	0.0%	$140	$39	$179	2020Q1	8.2%	$151	$42	$194
0.4%	Contracting & Reprographics	$187	$52	28.0%	$239	0.0%	$187	$52	$239	2020Q1	8.2%	$202	$57	$259
1.0%	Engineering During Construction	$468	$131	28.0%	$599	0.0%	$468	$131	$599	2024Q1	27.2%	$595	$167	$762
1.0%	Planning During Construction	$468	$131	28.0%	$599	0.0%	$468	$131	$599	2024Q1	27.2%	$595	$167	$762
0.0%	Cultural Resources Coordination & Mitigatio	$36	$10	28.0%	$46	0.0%	$36	$10	$46	2020Q1	8.2%	$39	$11	$50
31	CONSTRUCTION MANAGEMENT													
9.0%	Construction Management	$4,211	$1,179	28.0%	$5,390	0.0%	$4,211	$1,179	$5,390	2024Q1	27.2%	$5,356	$1,500	$6,855
0.0%	Project Operation:	$0	$0	28.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Project Management	$936	$262	28.0%	$1,198	0.0%	$936	$262	$1,198	2024Q1	27.2%	$1,190	$333	$1,524
	CONTRACT COST TOTALS:	$60,097	$15,489		$75,586		$60,097	$15,489	$75,586			$67,849	$17,598	$85,446

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

PROJECT: **Pawcatuck River Coastal Storm Risk Management Feasibility Study**
PROJECT NO: P2 403382
LOCATION: Westerly, Charleston, South Kingston, & Narragansett, Rhode Island

DISTRICT: NAE District **PREPARED: Rev 11/20/17)**
POC: CHIEF, COST ENGINEERING, Patricia Bolton

This Estimate reflects the scope and schedule in report; Coastal Storm Risk Management Feasibility Study & Environmental Assessment

**** LOCALLY PREFERRED PLAN ****

Program Year (Budget EC): 2018
Effective Price Level Date: 1 OCT 17

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	**TOTAL ($K) J**	Spent Thru: **10/1/2017** ($K)	**TOTAL FIRST COST** ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
19	BUILDINGS, GROUNDS & UTILITIES Elevati	$30,750	$9,225	30.0%	$39,975	0.0%	$30,750	$9,225	$39,975	$0	$39,975	11.0%	$34,139	$10,242	$44,381
19	BUILDINGS, GROUNDS & UTILITIES Floodp	$1,507	$452	30.0%	$1,960	0.0%	$1,507	$452	$1,960	$0	$1,960	11.0%	$1,673	$502	$2,176
	CONSTRUCTION ESTIMATE TOTALS:	$32,258	$9,677		$41,935	0.0%	$32,258	$9,677	$41,935	$0	$41,935	11.0%	$35,813	$10,744	$46,556
01	LANDS AND DAMAGES	$2,790	$279	10.0%	$3,069	0.0%	$2,790	$279	$3,069	$0	$3,069	4.6%	$2,919	$292	$3,211
30	PLANNING, ENGINEERING & DESIGN	$2,940	$882	30.0%	$3,822	0.0%	$2,940	$882	$3,822	$0	$3,822	11.5%	$3,278	$984	$4,262
31	CONSTRUCTION MANAGEMENT	$3,548	$1,064	30.0%	$4,612	0.0%	$3,548	$1,064	$4,612	$0	$4,612	23.3%	$4,375	$1,312	$5,687
	PROJECT COST TOTALS:	$41,536	$11,903	28.7%	$53,438		$41,536	$11,903	**$53,438**	$0	**$53,438**	11.7%	$46,384	$13,332	$59,716

______________________ **CHIEF, COST ENGINEERING, Patricia Bolton**

______________________ **PROJECT MANAGER, Christopher Hatfield**

______________________ **CHIEF, REAL ESTATE, Anne Kosel**

______________________ **CHIEF, PLANNING, John Kennelly**

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______________________ **CHIEF, CONSTRUCTION, Sean Dolan**

______________________ **CHIEF, CONTRACTING, Sheila Winston-Vincuilla**

______________________ **CHIEF, PM-PB, Janet Harrington**

______________________ **CHIEF, DPM, Scott Acone**

ESTIMATED FEDERAL COST: **65%** **$38,815**
ESTIMATED NON-FEDERAL COST: **35%** **$20,901**

ESTIMATED TOTAL PROJECT COST: **$59,716**

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

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

PROJECT: Pawcatuck River Coastal Storm Risk Management Feasibility Study
LOCATION: Westerly, Charleston, South Kingston, & Narragansett, Rhode Island
This Estimate reflects the scope and schedule in report; Coastal Storm Risk Management Feasibility Study & Environmental Assessment

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Patricia Bolton
PREPARED: 18/2017 (Rev 11/20/

** LOCALLY PREFERRED PLAN **

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			' (Rev 11/20/17)	Program Year (Budget EC):			2018					
		Effective Price Level:			1-Oct-17	Effective Price Level Date:			1 OCT 17					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
19	BUILDINGS, GROUNDS & UTILITIES Elevati	$30,750	$9,225	30.0%	$39,975	0.0%	$30,750	$9,225	$39,975	2023Q2	11.0%	$34,139	$10,242	$44,381
19	BUILDINGS, GROUNDS & UTILITIES Floodp	$1,507	$452	30.0%	$1,960	0.0%	$1,507	$452	$1,960	2023Q2	11.0%	$1,673	$502	$2,176
	CONSTRUCTION ESTIMATE TOTALS:	$32,258	$9,677	30.0%	**$41,935**		$32,258	$9,677	$41,935			$35,813	$10,744	$46,556
01	LANDS AND DAMAGES	$2,790	$279	10.0%	$3,069	0.0%	$2,790	$279	$3,069	2020Q2	4.6%	$2,919	$292	$3,211
30	PLANNING, ENGINEERING & DESIGN													
0.3%	Project Management	$97	$29	30.0%	$126	0.0%	$97	$29	$126	2020Q1	8.2%	$105	$31	$136
0.5%	Planning & Environmental Compliance	$161	$48	30.0%	$209	0.0%	$161	$48	$209	2020Q1	8.2%	$174	$52	$226
5.0%	Engineering & Design	$1,613	$484	30.0%	$2,097	0.0%	$1,613	$484	$2,097	2020Q1	8.2%	$1,745	$524	$2,269
0.5%	Reviews, ATRs, IEPRs, VE	$161	$48	30.0%	$209	0.0%	$161	$48	$209	2020Q1	8.2%	$174	$52	$226
0.3%	Life Cycle Updates (cost, schedule, risks)	$97	$29	30.0%	$126	0.0%	$97	$29	$126	2020Q1	8.2%	$105	$31	$136
0.4%	Contracting & Reprographics	$129	$39	30.0%	$168	0.0%	$129	$39	$168	2020Q1	8.2%	$140	$42	$181
1.0%	Engineering During Construction	$323	$97	30.0%	$420	0.0%	$323	$97	$420	2023Q2	23.3%	$398	$119	$518
1.0%	Planning During Construction	$323	$97	30.0%	$420	0.0%	$323	$97	$420	2023Q2	23.3%	$398	$119	$518
0.0%	Cultural Resources Coordination & Mitigatio	$36	$11	30.0%	$47	0.0%	$36	$11	$47	2020Q1	8.2%	$39	$12	$51
31	CONSTRUCTION MANAGEMENT													
9.0%	Construction Management	$2,903	$871	30.0%	$3,774	0.0%	$2,903	$871	$3,774	2023Q2	23.3%	$3,579	$1,074	$4,653
0.0%	Project Operation:	$0	$0	30.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Project Management	$645	$194	30.0%	$839	0.0%	$645	$194	$839	2023Q2	23.3%	$795	$239	$1,034
	CONTRACT COST TOTALS:	$41,536	$11,903		$53,438		$41,536	$11,903	$53,438			$46,384	$13,332	$59,716