Fairfield and New Haven Counties, CT
Coastal Storm Risk Management
Feasibility Study

Draft Feasibility Report and Environmental Assessment
December 2019

Appendix E

Cost Engineering (DRAFT)

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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 cost engineering for the Fairfield and New Haven Counties, CT Coastal Storm Risk Management Feasibility Study are to present a Total Project Cost (construction and non-construction costs) for the 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.

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. Five primary damage areas (Stratford and Fairfield in Fairfield County and Milford, West Haven, and New Haven in New Haven County) were initially identified by the Regional Councils of Governments in Connecticut for assessment. However, the Town of Fairfield and City of New Haven areas were selected for further evaluation based on their density of development and potential to support a federally constructed project. Alternative coastal storm risk management solutions were developed for the Town of Fairfield, which would be the future local sponsor responsible for cost-sharing of the preconstruction engineering and design phase. These alternatives would require a substantial amount of money (approximately $500-700 million) as well as real estate requirements that the Town was unable to commit to. Therefore, this study will focus solely on the City of New Haven study area.

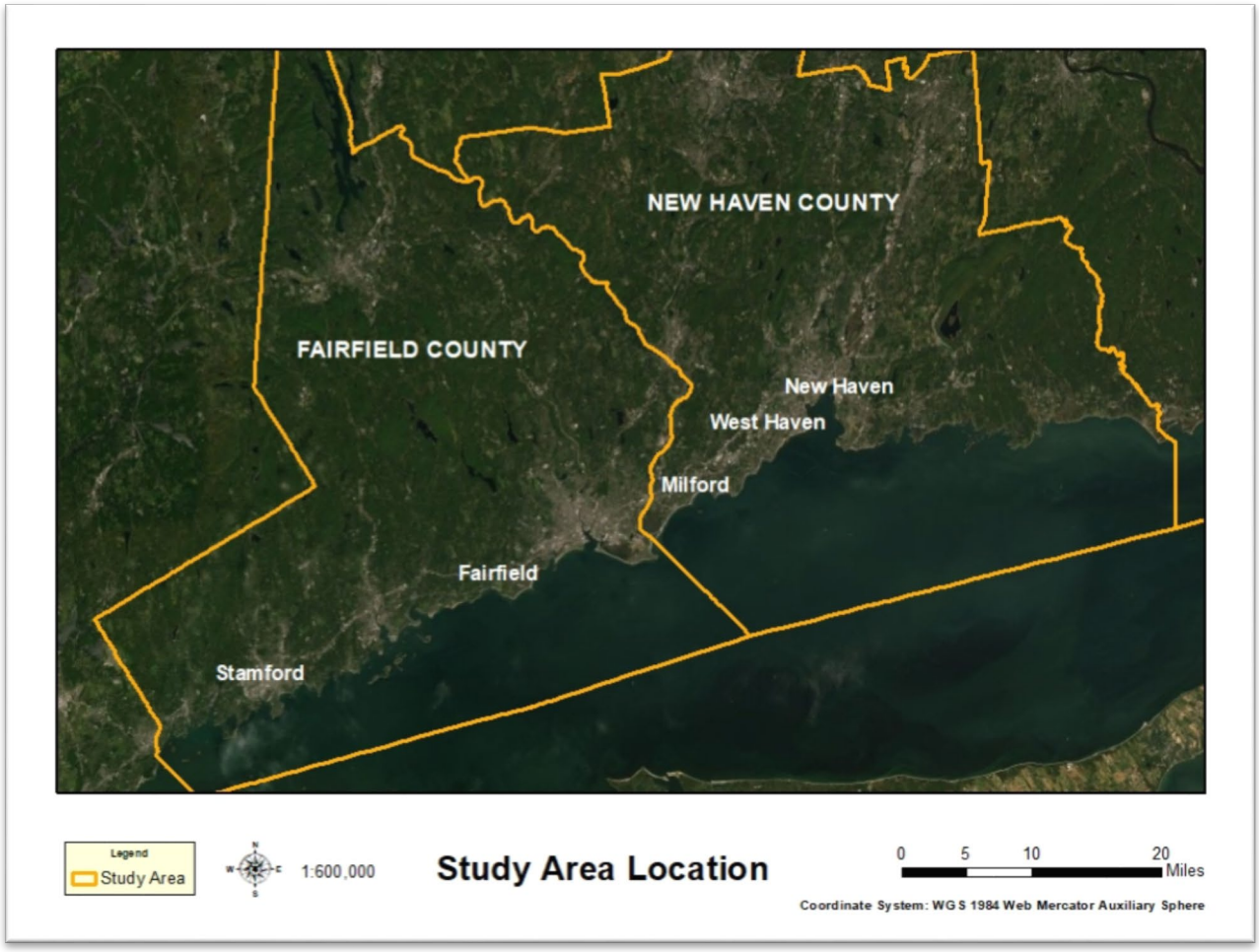


Figure E1: Authorized Study Area

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 sheet pile flood walls, pump stations with interior drainage improvements, closure structures, nonstructural measures such as structure raising and wet/dry flood proofing and several combinations of these alternatives.

3.0 ALTERNATIVES

3.1 ALTERNATIVE 2 - NONSTRUCTURAL

The Nonstructural alternative for the Long Wharf focused study area consists of providing non-structural storm risk management benefits through a combination of elevating or floodproofing eligible structures within the study area. 138 structures were initially found to be eligible for potential floodproofing or elevation of the first floor. The majority of these structures are large commercial properties. There are 12 residential structures within the study area that are potential candidates for elevating the first floor. There are 126 commercial structures within the study area that are potential candidates for either wet or dry floodproofing. Most of the buildings are large commercial buildings that would be extremely difficult, if not impossible to properly floodproof. This option would not reduce the risk of coastal storm damage to the rail and highway infrastructure. (Note that additional analysis of non-structural components will occur following public and agency review of the draft feasibility report and the Agency Decision Milestone.)

Figure E2: Alternative 2 Conceptal Design

3.2 ALTERNATIVE 3A - EXISTING I-95 EMBANKMENT

This alternative uses deployable measures under I-95 to reduce the flood event frequency. Deployable structures would be used to prevent floodwaters from passing through where Long Wharf Drive, Canal Dock Road pass under I-95 and where Brewery Street passes under the Oak Street Connector. For costing purposes a post and panel system was assumed, however a more detailed analysis will be required at design. These systems would need to be stored near the openings and put in place prior to a storm event.

The structure to close Long Wharf Drive would be roughly 60 foot wide and 3-4 foot high. Canal Dock Road would require a roughly 190 foot wide structure 4-5 foot high and Brewery Street would be approximately 65 feet wide and 1-2 foot high.

Foundations for the system will require significant coordination with the existing utilities in the streets as well as coordination with ConnDot to tie the structures effectively into the I-95 walls or embankment. This option would provide protection only up to a flood elevation of approximately elevation 10.5' NAVD88 after which water would start flooding across I-95 near where the Long Wharf drive crosses under I-95.

Pumps will be required to move any stormwater out of the protected area. See Chapter 6 for more detail on the proposed pumping systems.

Figure E3: Alternative 3A Conceptual Design

3.3 ALTERNATIVE 3B - ENHANCED I-95 EMBANKMENT

This alternative combines structural storm damage reduction features described in Alternative 3A including pumps and deployable structures, designed with a top elevation of 15.0 feet (NAVD88). In order to reduce the risk of structural failure of the I-95 embankment, this alternative entails a 6,425 liner foot system that parallels I-95 along the length of the Long Wharf area. The system includes 5,950 linear feet of pile-supported floodwall along the seaward side of I-95 from near the Howard Avenue overpass to 600 feet North of Canal Dock Road. The system also includes a combined 475 linear feet of deployable closure structures (i.e. floodgates). In addition to the closure structures described for alternative 3A, two deployable structures approximately 6-8 feet high, would be needed for protection at the exit 46 on and off ramps. The alignment was assumed to be as close to the grade break at the top of I-95 in order to minimize the height. Maximum wall height in that scenario is in the range of 6 to 8 feet. This Alternative would protect the commercial and railroad areas behind I-95 from storms and waves up to approximately elevation 15 NAVD88. By the end of the fifty year period of analysis (2074), this alternative would potentially be exceeded by the 0.4-percent annual exceedance probability water level, considering the intermediate sea level change scenario. The Long Wharf Maritime Center would not be protected by this alternative and those structures and other residential properties may potentially be eligible for floodproofing which will be further analyzed by the study team following the Agency Decision Milestone.

Figure E4: Alternative 3B Conceptual Design

3.4 ALTERNATIVE 4A - SHORELINE FLOODWALL

This alternative uses an approximate 6,850 foot long pile supported floodwall along Long Wharf Drive (rather than along I-95). Due to the low elevations in the area, the floodwall would be as high as 9 feet above existing grade and would reduce the risk of coastal storm damage to the commercial and transportation facilities extending to the same endpoints as Alternative 3B. At least 4 deployable structures would be required, one at Brewery Street described in option 3A, one crossing Long Wharf Drive roughly 65 feet wide and 7 feet high, one at the Canal Dock Boathouse Access approximately 35 feet long and 9 feet high and one at the Long Wharf Park parking area which would be roughly 50 foot wide and 5 foot high. Additional access doors and/or structures would be needed to make the Long Wharf Park access convenient to pedestrians and other users. This alternative would restrict access and views of Long Wharf Park and would require some tree removal.

This Alternative would protect the commercial and railroad areas behind I-95 from storms and waves up to approximately elevation 15 NAVD88. The Long Wharf Maritime Center would not be protected by this alternative and those structures may potentially be eligible for floodproofing which will be further analyzed following the Agency Decision Milestone.

Pumps will be required to move any stormwater out of the protected area as required in Alternatives 3A and 3B. See Chapter 6 of the Civil Engineering Appendix for more detail on the proposed pumping systems.

Figure E5: Alternative 4A Conceptual Design

3.5 ALTERNATIVE 4B - EXTENDED SHORELINE FLOODWALL

This alternative consists of all the structures in alternative 4A except the Long Wharf Drive closure structure and extends the floodwall around the Long Wharf Maritime Center extending the wall approximately 3,000 feet. Due to the low elevations in the area, the floodwall would be as high as 13 feet above existing grade. Part of this alignment would be along an existing seawall alignment and would pose difficult construction and design issues due to the available space to work around the existing wall.

In addition to the deployable structures in Alternative 4A, structures would be needed at the entrance to the Tank Farm (55 foot long and 9 foot high), crossing East Street (90 feet long and 5 foot high), and crossing Water Street at the intersection with East Street (90 feet wide and 5 foot high).

At least one additional pump would be needed in the Long Wharf Maritime Center to handle stormwater behind the floodwalls.

This Alternative would protect the commercial and railroad areas behind I-95 from storms and waves up to approximately elevation 15' NAVD88. The Long Wharf Maritime Center would be protected.

Figure E6: Alternative 4B Conceptual Design

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. A set of typical cross sections were generated for the flood wall and the post & panel closure structure features of work. A quantity for each aspect of work for these two features was developed on a per-foot basis; these aspects of work include excavation, compaction, concrete, reinforcement, backfill, restoration, etc.. These per-foot quantities were then multiplied by the length of each feature of work to generate final quantities. These final 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. Due to schedule constraints, an Abbreviated Risk Analysis (ARA) was performed in leui of the more robust Cost and Schedule Risk Analysis (CSRA). Lands and Damages costs were also provided by NAE Real Estate Division to capture costs associated with temporary easements to facilitate construction activities and permanent easements to facilitate future operation and maintenance. Table E1 summarizes these ROM costs along with the contingency for the features of work, as determined by the ARA, in each alternative.

Table E1: Alternative ROM Cost Estimate Summary (Project First Costs)

	Account	Feature of Work	Cost ($k)	Cntg (%)	Cntg ($k)	Total ($k)
Alternative 2 - Nonstructural						
	19	Residential Structure Elevations	$3,764	33.6%	$1,265	$5,028
	19	Commercial Structure Floodproofing	$9,489	33.6%	$3,188	$12,678
	19	General Conditions	$17,142	25.9%	$4,442	$21,584
	30	PED	$3,058	37.7%	$1,151	$4,209
	31	Construction Management	$3,058	29.2%	$893	$3,951
		ALTERNATIVE 2 TOTAL	**$36,510**		**$10,939**	**$47,449**
Alternative 3A - Existing Embankment						
	11	Post & Panel Closure Structures	$2,150	48.1%	$1,034	$3,184
	15	Pump Stations	$34,109	49.5%	$16,891	$51,000
	15	General Conditions	$9,620	25.9%	$2,493	$12,113
	30	PED	$2,769	37.7%	$1,043	$3,812
	31	Construction Management	$1,846	29.2%	$539	$2,385
		ALTERNATIVE 3A TOTAL	**$50,516**		**$21,999**	**$72,515**
Alternative 3B - Enhanced Embankment						
	11	T-Wall 1	$13,710	46.2%	$6,330	$20,040
	11	T-Wall 2	$41,065	46.2%	$18,960	$60,024
	11	Post & Panel Closure Structures	$3,751	48.1%	$1,804	$5,555
	15	Pump Stations	$34,109	49.5%	$16,891	$51,000
	11	General Conditions	$10,818	25.9%	$2,803	$13,621
	01	Lands and Damages	$357	11.4%	$41	$397
	30	PED	$6,245	37.7%	$2,351	$8,596
	31	Construction Management	$4,163	29.2%	$1,216	$5,379
		ALTERNATIVE 3B TOTAL	**$114,217**		**$50,395**	**$164,612**
Alternative 4A - Shoreline Floodwall						
	11	T-Wall 1	$13,710	46.2%	$6,330	$20,040
	11	T-Wall 2	$60,733	46.2%	$28,040	$88,773

	11	Post & Panel Closure Structures	$1,353	48.1%	$650	$2,003
	15	Pump Stations	$34,109	49.5%	$16,891	$51,000
	11	General Conditions	$10,818	25.9%	$2,803	$13,621
	01	Lands and Damages	$521	Included	Included	$521
	30	PED	$7,287	37.7%	$2,744	$10,030
	31	Construction Management	$4,858	29.2%	$1,419	$6,277
		ALTERNATIVE 3A TOTAL	**$133,389**		**$58,877**	**$192,265**
	Alternative 4B - Extended Shoreline Floodwall					
	11	T-Wall 1	$13,710	46.2%	$6,330	$20,040
	11	T-Wall 2	$105,895	46.2%	$48,892	$154,786
	11	Post & Panel Closure Structures	$2,604	48.1%	$1,252	$3,857
	15	Pump Stations	$43,293	49.5%	$21,438	$64,731
	11	General Conditions	$15,012	33.6%	$3,890	$18,902
	01	Lands and Damanges	$975	Included	Included	$975
	30	PED	$10,896	37.7%	$4,102	$14,998
	31	Construction Management	$7,264	29.2%	$2,122	$9,386
		ALTERNATIVE 4B TOTAL	**$199,649**		**$88,026**	**$287,675**

5.0 RECOMMENDED PLAN

Alternative 3B was identified as the Tentatively Selected Plan (TSP). The TSP consists of five road closure structures (one at Long Wharf Drive approximately 60 feet wide by 4 feet high; one at Canal Dock Road approximately 130 feet wide by 5 feet high; one at Brewery Street approximately 65 feet wide by 2 feet high; two at Exit 46 approximately 50 feet wide and 6-8 feet high); two pumping stations which would handle approximately 500 cubic feet of water per second (cfs); enhancement of the I-95 embankment with approximately 2,000 linear feet of "T-wall" type floodwall at Exit 46 and approximately 1,000 linear feet of "T-wall" type floodwall near the Howard Street overpass; and possible floodproofing of fourteen structures primarily in the Long Wharf Maritime Center in New Haven, Connecticut. The floodwall would be built to a top elevation of +15 feet NAVD88.

Table E2 summarizes the ROM cost for the TSP along with the contingencies developed in the ARA.

Table E2: TSP ROM Cost Estimate Summary (Project First Costs)

	Account	Feature of Work	Cost ($k)	Cntg (%)	Cntg ($k)	Total ($k)
Tentatively Selected Plan (TSP) - Enhanced Embankment						
	15	T-Wall 1	$13,710	46.2%	$6,330	$20,040
	15	T-Wall 2	$41,065	46.2%	$18,960	$60,024
	15	Post & Panel Closure Structures	$3,751	48.1%	$1,804	$5,555
	15	Pump Stations	$34,109	49.5%	$16,891	$51,000
	15	General Conditions	$10,818	25.9%	$2,803	$13,621
	01	Lands and Damages	$357	11.4%	$41	$397
	30	PED	$6,245	37.7%	$2,351	$8,596
	31	Construction Management	$4,163	29.2%	$1,216	$5,379
		TSP TOTAL	**$114,217**		**$50,395**	**$164,612**

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). Quantities were developed from the typical sections of the sheet pile floodwalls and the closure structures along with the anticipated lengths of each feature. These quantities were used to develop cost estimates for each feature 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. Costs for the pump stations and interior drainage were estimated based on a conceptual cost estimate for a pump station and interior drainage created by Tighe & Bond for a potential future project in the Town of Fairfield. The nonstructural features were estimated using recently certified costs from the Pawcatuck Coastal Storm Risk Management Feasibility Study which contained both structure elevating and floodproofing costs. The Pawcatuck Coastal Storm Risk Management Feasiblity Study included costs for elevating 12 typical structure types found in that area; because limited information is known about the structures in this study, an average cost of the 12 typical structures from Pawcatuck was calculated and utilized in this study. Similarly, the floodproofing costs from Pawcatuck were converted to a per-square-foot cost and then applied to the appropriate structures in this study.

It is assumed the lengths where flood wall is to be constructed will be excavated as necessary to the bottom of the T-wall. Pipe piles and sheeting will be installed via hammer or vibration. The necessary section of wall will be formed, reinforcement installed, and concrete placed and finished. The area adjacent to the wall will be backfilled with rip-rap installed for added toe protection and the site will be restored with loam and seed. A similar methodology will be used for the post & panel closure structures with installation of the steel channel embedded in the concrete slab for future installation, as necessary, of the post and panel system.

It is assumed the wall sections and the post & panel closure structures will be constructed consecutively. The pump stations and any non-structural measures will be installed concurrently along with the wall sections and post & panel structures.

7.0 SCHEDULE

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.

An Abbreviated Risk Assessment (ARA) was developed by the Cost Engineering Section with input soliciated from the PDT.

A Cost and Schedule Risk Analysis (CSRA) will be 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) will participate in a cost risk analysis brainstorming session to identify risks associated with the project. The Risk Analysis will utilize the "MODERATE RISK" category as the project involves typical construction with possible life safety issues. Assumptions will be 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 will be made to the analysis upon review by the PDT and the final contingencies will be 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 ARA/CSRA, the project design and construction schedule, and estimates of PED and S&A prepared by others. The TPCS is provided as Attachment 3 to this Cost Engineering Appendix.

Attachment 1

Fairfield & New Haven Conneticut Coastal Study - General Investigation

Construction Activity - Projected Time Schedule

By: JAG & APJ
10/1/2019

SUMMARY

WBS Line Item Description - Major Feature of Work	Duration (Months)	Duration (Years)
Fairfield & New Haven Counties		
New Haven County		
TSP - Alternative 3B		
NHA3B Structural	35	2.9
NHA3B Non-Structural	2	0.2

	FY25Q2			FY25Q3			FY25Q4			FY26Q1			FY26Q2			FY26Q3			FY26Q4			FY27Q1			FY27Q2			FY27Q3			FY27Q4			FY28Q1		
	2024												2025												2026											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Fairfield & New Haven Counties																																				
New Haven County																																				
TSP - Alternative 3B																																				
NHA3B Structural			1	2	3	4	5	6	7	8	9				10	11	12	13	14	15	16	17	18				19	20	21	22	23	24	25	26	27			
NHA3B Non-Structural			1	2																																

	FY27Q2			FY27Q3			FY27Q4			FY28Q1		
	2027											
	J	F	M	A	M	J	J	A	S	O	N	D
	37	38	39	40	41	42	43	44	45	46	47	48
Fairfield & New Haven Counties												
New Haven County												
TSP - Alternative 3B												
NHA3B Structural			28	29	30	31	32	33	34	35		
NHA3B Non-Structural												

Attachment 2

Abbreviated Risk Analysis

Project (less than $40M): **Fairfield & New Haven Coastal Storm Risk Management** **Alternative: Alternative 3B**

Project Development Stage/Alternative: **Feasibility (Recommended Plan)**

Risk Category: **Moderate Risk: Typical Project Construction Type** **Meeting Date: 8/13/2019**

Total Estimated Construction Contract Cost = $ 100,241,506

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ 345,500		11.43%	$ 39,500	$ 385,000
1	11 02 FLOODWALLS	General Conditions & Mob/Demob	$ 10,482,465		25.91%	$ 2,715,580	$ 13,198,045
2	11 02 FLOODWALLS	Wall 1	$ 13,284,152		46.17%	$ 6,132,788	$ 19,416,940
3	11 02 FLOODWALLS	Wall 2	$ 39,789,837		46.17%	$ 18,369,456	$ 58,159,293
4	11 02 FLOODWALLS	Post & Panel Closure Structure(s)	$ 3,634,572		48.09%	$ 1,747,862	$ 5,382,434
5	13 PUMPING PLANT	Pump Station(s)	$ 33,050,480		49.52%	$ 16,365,456	$ 49,415,936
6	19 BUILDINGS, GROUNDS, AND UTILITIES	Non-Structural	$ -		0.00%	$ -	$ -
7			$ -		0%	$ -	$ -
8			$ -		0%	$ -	$ -
9			$ -		0%	$ -	$ -
10			$ -		0%	$ -	$ -
11			$ -		0%	$ -	$ -
12	All Other	Remaining Construction Items	$ -	*0.0%*	0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 6,014,000		37.65%	$ 2,264,311	$ 8,278,311
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 4,010,000		29.21%	$ 1,171,271	$ 5,181,271
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ 345,500	11.43%	$ 39,500	$	385,000.00
Total Construction Estimate	$ 100,241,506	45.22%	$ 45,331,142	$	145,572,648
Total Planning, Engineering & Design	$ 6,014,000	37.65%	$ 2,264,311	$	8,278,311
Total Construction Management	$ 4,010,000	29.21%	$ 1,171,271	$	5,181,271
Total Excluding Real Estate	**$ 110,265,506**	**44.23%**	**$ 48,766,724**	**$**	**159,032,230**
		Base	**50%**		**80%**
Confidence Level Range Estimate ($000's)		$110,266k	$139,526k		$159,032k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

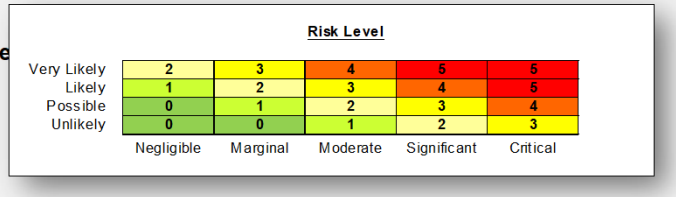
Fairfield & New Haven Coastal Storm Risk Management Alternative 3B
Feasibility (Recommended Plan)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$345,500
11 02 FLOODWALLS	General Conditions & Mob/Demob	0	2	2	0	0	1	2	$10,482
11 02 FLOODWALLS	Wall 1	1	2	4	0	1	3	2	$13,284
11 02 FLOODWALLS	Wall 2	1	2	4	0	1	3	2	$39,790
11 02 FLOODWALLS	Post & Panel Closure Structure(s)	1	2	4	0	2	3	2	$3,635
13 PUMPING PLANT	Pump Station(s)	0	2	4	0	3	3	2	$33,050
19 BUILDINGS, GROUNDS, AND UTILITIES	Non-Structural	0	2	2	0	3	1	2	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
All Other	Remaining Construction Items	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	3	2	0	0	0	3	0	$6,014
31 CONSTRUCTION MANAGEMENT	Construction Management	3	2	0	0	0	0	0	$4,010
									$110,266
Risk		$ 2,682	$ 11,989	$ 17,681	$ -	$ 3,733	$ 8,299	$ 4,384	**$48,767**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ 2,682	$ 11,989	$ 17,681	$ -	$ 3,733	$ 8,299	$ 4,384	**$48,767**
								Total	**$159,032**

Fairfield & New Haven Coastal Storm Risk Management Alte

Feasibility (Recommended Plan)
Abbreviated Risk Analysis
Meeting Date: 13-Aug-19



Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**75%**
PS-1	General Conditions & Mob/Demob	- Is there the possibility of scope growth to include longer wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact.	Marginal	Unlikely	0
PS-2	Wall 1	- Is there the possibility of scope growth to include longer wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact. - While wall length is unlikely to be significantly longer, the wall height could be increased if utility conflicts, ConnDOT, or FHWA require the wall to move downslope. The higher walls have the potential to add cost to the project by requiring additional material to achieve the height requirement and potentially a larger foundation/cross section to support it. This likelihood is possible and the impact could be moderate.	Moderate	Unlikely	1
PS-3	Wall 2	- Is there the possibility of scope growth to include longer wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact. - While wall length is unlikely to be significantly longer, the wall height could be increased if utility conflicts, ConnDOT, or FHWA require the wall to move downslope. The higher walls have the potential to add cost to the project by requiring additional material to achieve the height requirement and potentially a larger foundation/cross section to support it. This likelihood is possible and the impact could be moderate. This pertains to the closure structures as well.	Moderate	Unlikely	1

PS-4	Post & Panel Closure Structure(s)	- Is there the possibility of scope growth to include longer wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact. - While wall length is unlikely to be significantly longer, the wall height could be increased if utility conflicts, ConnDOT, or FHWA require the wall to move downslope. The higher walls have the potential to add cost to the project by requiring additional material to achieve the height requirement and potentially a larger foundation/cross section to support it. This likelihood is possible and the impact could be moderate. This pertains to the closure structures as well.	Moderate	Unlikely	**1**
PS-5	Pump Station(s)	- Is there the possibility of scope growth to include longer wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact. - While we attempted to be conservative. The size of the pump stations was estimated based on our understanding of the watershed after work by the Town of New Haven presently in design. A more complete analysis is required. Also there are 2-3 small storm sewers off the main outlets, that we believe could be bypassed to the pump stations under flood conditions, but this has not been fully evaluated. Note it is assumed the existing outfalls can be used with the pump stations but this has not been confirmed.	Marginal	Unlikely	**0**
PS-6	Non-Structural	- Is there the possibility of scope growth to include longer wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact.	Marginal	Unlikely	**0**
PS-13	Planning, Engineering, & Design	- Is there the possibility of scope growth to include longer or higher wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project? - Has risk of interagency requirements been fully accounted for? - Has risk of impact/coordination with Town/State/abutters been accounted for?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact. - Addressing interagency requirements and coordination with Town/State/abutters during the PED phase has the potential to impact PED costs and delay that phase's schedule and overall project completion. This concern is likely to occur and the impact is anticipated to be moderate.	Moderate	Likely	**3**

PS-14	Construction Management	- Is there the possibility of scope growth to include longer or higher wall, more pump stations, more closure structures, etc.? - Is the project missing any major features of work to make the project a complete usable project? - Has risk of interagency requirements been fully accounted for? - Has risk of impact/coordination with Town/State/abutters been accounted for?	- Different alternatives considered in the alternatives analysis considered longer walls along with different configurations, pump stations, closure structures, etc. Different scopes have been considered and discounted based on review of the alternatives and the BCRs. - It is unlikely the current concept omits any major features of work however the impact of any minor features or subfeatures not currently considered is expected to have a marginal impact. - Addressing interagency requirements and coordination with Town/State/abutters during the PED phase has the potential to impact PED costs and delay that phase's schedule and overall project completion. This concern is likely to occur and the impact is anticipated to be moderate.	Moderate	Likely	3
Acquisition Strategy				**Maximum Project Growth**		**30%**
AS-1	General Conditions & Mob/Demob	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The likelihood is possible due to the size/complexity of the project and impact is moderate as contractors are not incentivized to submit lowest possible prices.	Moderate	Possible	2
AS-2	Wall 1	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
AS-3	Wall 2	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
AS-4	Post & Panel Closure Structure(s)	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
AS-5	Pump Station(s)	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
AS-6	Non-Structural	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
AS-13	Planning, Engineering, & Design	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
AS-14	Construction Management	- Is the project complex enough to warrant a source selection or some contracting method other than IFB? Concern affects all risk elements.	- Estimate currently assumes IFB with no restrictions for SB, SDVs, etc. There is potential for all features of work to increase in cost if source selection contracting method is used. The	Moderate	Possible	2
Construction Elements				**Maximum Project Growth**		**25%**
CON-1	General Conditions & Mob/Demob	- Being adjacent to the ocean, and in an area constructed with fill, there is concern over the water level affecting construction of features with work in the subsurface. - With a project of this size, location, and complexity, there is potential for modifications and claims. - There are a numerous utilities in the area that will need to be dealt with during design and construction.	- There is some dewatering in the estimate right now, however, a high water table will affect construction of all subsurface elements, which effects nearly all features of work. - Modifications and claims are to be expected on a project of this size. - The utility crossings and possible relocations are a serious concern as we have little information right now on location, size, or quantity of the crossings but we do know they are out there. The General Conditions & Mob/Demob feature of work of this project should not be affected by the utility crossing concern and the likelihood of dewatering and mods/claims is more possible than likely. The impact of those concerns is closer to moderate as this is not a significant feature of work of the project.	Moderate	Possible	2

CE-2	Wall 1	- Being adjacent to the ocean and in an area constructed with fill there is concern over the water level affecting construction of features with work in the subsurface. - With a project of this size, location, and complexity, there is potential for modifications and claims. - There are a numerous utilities in the area that will need to be dealt with during design and construction.	- There is some dewatering in the estimate right now, however, a high water table will affect construction of all subsurface elements, which effects nearly all features of work. - Modifications and claims are to be expected on a project of this size. - The utility crossings and possible relocations are a serious concern as we have little information right now on location, size, or quantity of the crossings but we do know they are out there. Any one or any combination of these concerns is likely and could have a significant impact on the cost of the project across nearly all features of work.	Significant	Likely	**4**
CE-3	Wall 2	- Being adjacent to the ocean and in an area constructed with fill there is concern over the water level affecting construction of features with work in the subsurface. - With a project of this size, location, and complexity, there is potential for modifications and claims. - There are a numerous utilities in the area that will need to be dealt with during design and construction.	- There is some dewatering in the estimate right now, however, a high water table will affect construction of all subsurface elements, which effects nearly all features of work. - Modifications and claims are to be expected on a project of this size. - The utility crossings and possible relocations are a serious concern as we have little information right now on location, size, or quantity of the crossings but we do know they are out there. Any one or any combination of these concerns is likely and could have a significant impact on the cost of the project across nearly all features of work.	Significant	Likely	**4**
CE-4	Post & Panel Closure Structure(s)	- Being adjacent to the ocean and in an area constructed with fill there is concern over the water level affecting construction of features with work in the subsurface. - With a project of this size, location, and complexity, there is potential for modifications and claims. - There are a numerous utilities in the area that will need to be dealt with during design and construction.	- There is some dewatering in the estimate right now, however, a high water table will affect construction of all subsurface elements, which effects nearly all features of work. - Modifications and claims are to be expected on a project of this size. - The utility crossings and possible relocations are a serious concern as we have little information right now on location, size, or quantity of the crossings but we do know they are out there. Any one or any combination of these concerns is likely and could have a significant impact on the cost of the project across nearly all features of work.	Significant	Likely	**4**
CE-5	Pump Station(s)	- Being adjacent to the ocean and in an area constructed with fill there is concern over the water level affecting construction of features with work in the subsurface. - With a project of this size, location, and complexity, there is potential for modifications and claims. - There are a numerous utilities in the area that will need to be dealt with during design and construction.	- There is some dewatering in the estimate right now, however, a high water table will affect construction of all subsurface elements, which effects nearly all features of work. - Modifications and claims are to be expected on a project of this size. - The utility crossings and possible relocations are a serious concern as we have little information right now on location, size, or quantity of the crossings but we do know they are out there. Any one or any combination of these concerns is likely and could have a significant impact on the cost of the project across nearly all features of work.	Significant	Likely	**4**

CE-6	Non-Structural	- Being adjacent to the ocean and in an area constructed with fill there is concern over the water level affecting construction of features with work in the subsurface. - With a project of this size, location, and complexity, there is potential for modifications and claims. - There are a numerous utilities in the area that will need to be dealt with during design and construction.	- There is some dewatering in the estimate right now, however, a high water table will affect construction of all subsurface elements, which effects nearly all features of work. - Modifications and claims are to be expected on a project of this size. - The utility crossings and possible relocations are a serious concern as we have little information right now on location, size, or quantity of the crossings but we do know they are out there. The non-structural feature of work of this project should not be affected by the utility crossing concern and the likelihood of dewatering and mods/claims is more possible than likely. The impact of those concerns is closer to moderate as this is not a significant feature of work of the project.	Moderate	Possible	2
CE-13	Planning, Engineering, & Design			Negligible	Unlikely	0
CE-14	Construction Management			Negligible	Unlikely	0
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	General Conditions & Mob/Demob	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-2	Wall 1	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-3	Wall 2	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-4	Post & Panel Closure Structure(s)	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-5	Pump Station(s)	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-6	Non-Structural	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
SC-14	Construction Management	- At this time, the PDT does not believe there will be any specialty construction or fabrication necessary for this project.		Negligible	Unlikely	0
Technical Design & Quantities				**Maximum Project Growth**		**30%**
T-1	General Conditions & Mob/Demob			Negligible	Unlikely	0
T-2	Wall 1	- Design and subsequent quantity development of the walls is based on two typical wall heights.	- Favorably, the design of the walls has been assumed to be T-walls with significant foundation details (such as steel pipe piles and sheet piling). There are four typical walls designs and this alternative has selected the first two smaller walls. It is possible future investigations will show one of the larger walls will be necessary. The impact is expected to be marginal, though, as the higher wall requires slightly more concrete and slightly closer steel pipe pile placement.	Marginal	Possible	1

T-3	Wall 2	- Design and subsequent quantity development of the walls is based on two typical wall heights.	- Favorably, the design of the walls has been assumed to be T-walls with significant foundation details (such as steel pipe piles and sheet piling). There are four typical walls designs and this alternative has selected the first two smaller walls. It is possible future investigations will show one of the larger walls will be necessary. The impact is expected to be marginal, though, as the higher wall requires slightly more concrete and slightly closer steel pipe pile placement.	Marginal	Possible	1
T-4	Post & Panel Closure Structure(s)	- Design and subsequent quantity development of the post & panel closure structures are based on three typical flood gate heights.	- Favorably, the design of the post and panel closer structures has been assumed with significant foundation details (such as steel pipe piles and sheet piling). There has been little to no engineering, however, at the interface of the closure structure and whatever is on each end of them. There will be some engineering necessary for these interfaces which will have a possible impact on the cost to this feature of work. It should be noted that final closure type will be determined during the design phase but post & panel closure structure was selected currently as it is the most constructable and potentially highest cost of any feasible option; i.e. is a conservative choice for this stage of the project. The impact could be moderate depending on what is found to be necessary.	Moderate	Possible	2
T-5	Pump Station(s)	- Little to no engineering has been on the pump stations to this point. A CFS has been assigned but not fully vetted or calculated. The locations are very conceptual and no information is known about the subsurface conditions or requirements for construction.	- If new pump outfalls are required to be installed across I-95, that would likely be an operation with high risk of hitting utilities, structures, rock fill, or disrupting I-95. Final location of pump station(s) may have unanticipated risks or impacts to existing facilities. With no design and very broad assumptions made on the pump stations, it is possible there will be some impact on the cost to this feature of work. The impact could be significant depending on what is utimately designed.	Significant	Possible	3
T-6	Non-Structural	- No design or quantity information has been generated to this point. No information is known about the existing structures first floor elevations so the height of raisings is unknown.	- With no design and very broad assumptions made on the non-structural features of work, it is possible there will be some impact on the cost of this feature. The impact could be significant depending on the existing conditions of the structures to be raised or floodproofed.	Significant	Possible	3
T-13	Planning, Engineering, & Design			Negligible	Unlikely	0
T-14	Construction Management			Negligible	Unlikely	0
Cost Estimate Assumptions				**Maximum Project Growth**		**35%**
EST-1	General Conditions & Mob/Demob	- The general conditions are based on a rough schedule pulled together given durations estimated for each major feature of work. It was assumed some features could be constructed in parallel but a majority were assumed to be constructed in series. Given the lack of detail in the current design, there is concern the construction schedule and subsequent general conditions may be low. - The mob/demob may be low given this subfeature of work was the last item estimated before the alternatives analysis due date.	- If the current schedule is too aggressive the general conditions could be underestimated. There is little concurrent work planned in the schedule right now so it's possible the schedule is too short. The impact is expected to be marginal, though, given the current schedule assumptions.	Marginal	Possible	1
EST-2	Wall 1	- The cost estimate is very reliant on cost book items. Very few quotes were obtained for the alternatives analysis. - Subfeatures of work selected based on typical wall sections. Not enough concentration on ancillary subfeatures that may affect construction (such as the need for construction mats, dealing with subsurface utilities, significant dewatering efforts, etc.) - Little thought was given to site access, which could result in constructability issues (such as delays or productivity loss).	- Favorably, the cost estimate does include a factor on all steel material based on the current steel tariff conversations. - The utility concern and accounting for risk has been captured in the Construction Elements risk category. - There is still risk in other concerns in this risk category that are expected to carry some impact. The likelihood of these is likely and the impact is expected to be moderate.	Moderate	Likely	3

EST-3	Wall 2	- The cost estimate is very reliant on cost book items. Very few quotes were obtained for the alternatives analysis. - Subfeatures of work selected based on typical wall sections. Not enough concentration on ancillary subfeatures that may affect construction (such as the need for construction mats, dealing with subsurface utilities, significant dewatering efforts, etc.) - Little thought was given to site access, which could result in constructability issues (such as delays or productivity loss).	- Favorably, the cost estimate does include a factor on all steel material based on the current steel tariff conversations. - The utility concern and accounting for risk has been captured in the Construction Elements risk category. - There is still risk in other concerns in this risk category that are expected to carry some impact. The likelihood of these is likely and the impact is expected to be moderate.	Moderate	Likely	3
EST-4	Post & Panel Closure Structure(s)	- The cost estimate is very reliant on cost book items. Very few quotes were obtained for the alternatives analysis. - Subfeatures of work selected based on typical wall sections. Not enough concentration on ancillary subfeatures that may affect construction (such as the need for construction mats, dealing with subsurface utilities, significant dewatering efforts, etc.) - Little thought was given to site access, which could result in constructability issues (such as delays or productivity loss).	- Favorably, the cost estimate does include a factor on all steel material based on the current steel tariff conversations. - The utility concern and accounting for risk has been captured in the Construction Elements risk category. - There is still risk in other concerns in this risk category that are expected to carry some impact. The likelihood of these is likely and the impact is expected to be moderate.	Moderate	Likely	3
EST-5	Pump Station(s)	- The pump station cost was estimated using a conceptal cost estimate generated by Tighe & Bond for a proposed pump station in Fairfield, CT. That pump station had a peak pumping rate of 124 CFS. It is unknown what capacity these pump stations will require. The cost estimate also assumes interior drainage will be necessary to transmit water to the pump station. Again, a conceptual cost estimate generated by Tighe & Bond was used as basis for this interior drainage subfeature of work. There is a concern the Tighe & Bond estimates do not fully capture the cost of construction and do not correspond well with what is being called for in this project.	- It is likely the conceptual Tighe & Bond estimate will differ from what is ultimately designed/constructed for this particular project. The major subfeatures of work are captured in the estimate, though, and any differences in site conditions or pump capacity are expected to be moderate.	Moderate	Likely	3
EST-6	Non-Structural	- Non-structural costs were obtained from recent non-structural planning project, Pawcatuck River Coastal Storm Risk Management. The average of the 6 structure types generated in the Pawcatuck study were used to estimate costs for this project. There is a risk the typical residential structure types used in Pawcatuck are not representative of the structures in this project.	- It is possible the Pawcatuck "designs" differ from what is ultimately designed/constructed for this particular project. The major subfeatures of work are captured in the estimate, though, and any differences are expected to be marginal.	Marginal	Possible	1
EST-13	Planning, Engineering, & Design	- The PED costs are currently generated using a percentage of the construction cost. There is a concern this method isn't calculating enough PED funds to cover the cost of that phase.	- If significant subsurface exploration or analysis of the I-95 wall is necessary, it is possible the PED cost may be low. It is possible there could be an impact to this feature of work. If significant other work is required, the impact could be significant.	Significant	Possible	3
EST-14	Construction Management	- The S&A costs are currently generated using a percentage of the construction cost. There is a concern this method isn't calculating enough S&A funds to cover the cost of that phase.	- The S&A costs generated using the percentage method can cover several FTEs over several years. It is unlikely these costs are underestimated. Any impact is expected to be marginal.	Marginal	Unlikely	0
External Project Risks					**Maximum Project Growth**	**40%**
EX-1	General Conditions & Mob/Demob	- There is always potential for severe adverse weather to impact the project schedule and cost, especially when located in flood-prone areas such as coastal storm risk management projects. - Based on the final BCR, there is competition for funds for projects to move into PED and ultimately construction. Delays in funding have the potential to impact project cost. - While the cost estimate currently accounts for increases in material prices for steel tariffs, there is potential for other key materials to experience unexpected cost inflations such as concrete and fuel. - Given the current market conditions and the availability of contractors there is concern over market volatility and competition.	- One or more of these concerns is possible to occur given the location of the project, scope of the project, and the fact that it will require significant funding from the Fed and Non-Fed sponsor. The impact is expected to be moderate given one or more of the concerns could happen.	Moderate	Possible	2

EX-2	Wall 1	- There is always potential for severe adverse weather to impact the project schedule and cost, especially when located in flood-prone areas such as coastal storm risk management projects. - Based on the final BCR, there is competition for funds for projects to move into PED and ultimately construction. Delays in funding have the potential to impact project cost. - While the cost estimate currently accounts for increases in material prices for steel tariffs, there is potential for other key materials to experience unexpected cost inflations such as concrete and fuel. - Given the current market conditions and the availability of contractors there is concern over market volatility and competition.	- One or more of these concerns is possible to occur given the location of the project, scope of the project, and the fact that it will require significant funding from the Fed and Non-Fed sponsor. The impact is expected to be moderate given one or more of the concerns could happen.	Moderate	Possible	**2**
EX-3	Wall 2	- There is always potential for severe adverse weather to impact the project schedule and cost, especially when located in flood-prone areas such as coastal storm risk management projects. - Based on the final BCR, there is competition for funds for projects to move into PED and ultimately construction. Delays in funding have the potential to impact project cost. - While the cost estimate currently accounts for increases in material prices for steel tariffs, there is potential for other key materials to experience unexpected cost inflations such as concrete and fuel. - Given the current market conditions and the availability of contractors there is concern over market volatility and competition.	- One or more of these concerns is possible to occur given the location of the project, scope of the project, and the fact that it will require significant funding from the Fed and Non-Fed sponsor. The impact is expected to be moderate given one or more of the concerns could happen.	Moderate	Possible	**2**
EX-4	Post & Panel Closure Structure(s)	- There is always potential for severe adverse weather to impact the project schedule and cost, especially when located in flood-prone areas such as coastal storm risk management projects. - Based on the final BCR, there is competition for funds for projects to move into PED and ultimately construction. Delays in funding have the potential to impact project cost. - While the cost estimate currently accounts for increases in material prices for steel tariffs, there is potential for other key materials to experience unexpected cost inflations such as concrete and fuel. - Given the current market conditions and the availability of contractors there is concern over market volatility and competition.	- One or more of these concerns is possible to occur given the location of the project, scope of the project, and the fact that it will require significant funding from the Fed and Non-Fed sponsor. The impact is expected to be moderate given one or more of the concerns could happen.	Moderate	Possible	**2**
EX-5	Pump Station(s)	- There is always potential for severe adverse weather to impact the project schedule and cost, especially when located in flood-prone areas such as coastal storm risk management projects. - Based on the final BCR, there is competition for funds for projects to move into PED and ultimately construction. Delays in funding have the potential to impact project cost. - While the cost estimate currently accounts for increases in material prices for steel tariffs, there is potential for other key materials to experience unexpected cost inflations such as concrete and fuel. - Given the current market conditions and the availability of contractors there is concern over market volatility and competition.	- One or more of these concerns is possible to occur given the location of the project, scope of the project, and the fact that it will require significant funding from the Fed and Non-Fed sponsor. The impact is expected to be moderate given one or more of the concerns could happen.	Moderate	Possible	**2**
EX-6	Non-Structural	- There is always potential for severe adverse weather to impact the project schedule and cost, especially when located in flood-prone areas such as coastal storm risk management projects. - Based on the final BCR, there is competition for funds for projects to move into PED and ultimately construction. Delays in funding have the potential to impact project cost. - While the cost estimate currently accounts for increases in material prices for steel tariffs, there is potential for other key materials to experience unexpected cost inflations such as concrete and fuel. - Given the current market conditions and the availability of contractors there is concern over market volatility and competition.	- One or more of these concerns is possible to occur given the location of the project, scope of the project, and the fact that it will require significant funding from the Fed and Non-Fed sponsor. The impact is expected to be moderate given one or more of the concerns could happen.	Moderate	Possible	**2**
EX-13	Planning, Engineering, & Design			Negligible	Unlikely	**0**
EX-14	Construction Management			Negligible	Unlikely	**0**

Attachment 3

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

PROJECT: **CT Coastal Storm Damage Reduction Study**
PROJECT NO: P2 xxxxxx
LOCATION: Fairfield / New Haven, CT

DISTRICT: NAE District **PREPARED: 5/1/2019**
POC: CHIEF, COST ENGINEERING, Andrew Jo **UPDATED: 11/17/2019**

This Estimate reflects the scope and schedule in report; 0

New Haven - Alternative 3B Tentatively Selected Plan (TSP)

Program Year (Budget EC): 2021
Effective Price Level Date: 1 OCT 20

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-19** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
15	FLOODWAY CONTROL & DIVERSION STRU	$100,242	$45,335	45.2%	$145,576	3.2%	$103,453	$46,787	$150,240	$0	$150,240	15.9%	$119,930	$54,239	$174,169
	CONSTRUCTION ESTIMATE TOTALS:	$100,242	$45,335		$145,576	3.2%	$103,453	$46,787	$150,240	$0	$150,240	15.9%	$119,930	$54,239	$174,169
01	LANDS AND DAMAGES	$346	$40	11.4%	$385	3.2%	$357	$41	$397	$0	$397	6.1%	$378	$43	$422
30	PLANNING, ENGINEERING & DESIGN	$6,014	$2,264	37.7%	$8,279	3.8%	$6,245	$2,351	$8,596	$0	$8,596	7.8%	$6,735	$2,536	$9,270
31	CONSTRUCTION MANAGEMENT	$4,010	$1,171	29.2%	$5,181	3.8%	$4,163	$1,216	$5,379	$0	$5,379	20.7%	$5,026	$1,468	$6,494
	PROJECT COST TOTALS:	$110,611	$48,810	44.1%	$159,421		$114,217	$50,395	**$164,612**	$0	**$164,612**	15.6%	$132,069	$58,286	$190,355

ESTIMATED TOTAL PROJECT COST: **$190,355**

CHIEF, COST ENGINEERING, Andrew Jordan

PROJECT MANAGER, Byron Rupp

CHIEF, REAL ESTATE, Gaelen Daly

CHIEF, PLANNING, John Kennelly

CHIEF, ENGINEERING, David Margolis

CHIEF, OPERATIONS, Eric Pedersen

CHIEF, CONSTRUCTION, Sean Dolan

CHIEF, CONTRACTING, Sheila Winston-Vincuilla

CHIEF, PM-PB, Janet Harrington

CHIEF, DPM, Scott Acone

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

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

PROJECT: CT Coastal Storm Damage Reduction Study
LOCATION: Fairfield / New Haven, CT
This Estimate reflects the scope and schedule in report; 0

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Andrew Jordan

PREPARED: 5/1/2019
UPDATED: 11/17/2019

New Haven - Alternative 3B Tentatively Selected Plan (TSP)

Estimate Prepared: **1-Oct-19**
Effective Price Level: 1-Oct-19

Program Year (Budget EC): 2021
Effective Price Level Date: 1 OCT 20

		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
				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*
	ALTERNATIVE 3B													
11	**T-Wall 1**	$13,284	$6,133	46.2%	$19,417	3.2%	$13,710	$6,330	$20,040	2026Q1	15.9%	$15,893	$7,338	$23,231
11	**T-Wall 2**	$39,790	$18,371	46.2%	$58,161	3.2%	$41,065	$18,960	$60,024	2026Q1	15.9%	$47,605	$21,979	$69,584
11	**Post & Panel Closure Structures**	$3,635	$1,748	48.1%	$5,382	3.2%	$3,751	$1,804	$5,555	2026Q1	15.9%	$4,348	$2,091	$6,440
15	**Pump Stations**	$33,050	$16,367	49.5%	$49,417	3.2%	$34,109	$16,891	$51,000	2026Q1	15.9%	$39,542	$19,581	$59,123
19	**Residential Structure Elevations**	$0	$0	33.6%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
19	**Commercial Structure Floodproofing**	$0	$0	33.6%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
11	**General Conditions**	$10,482	$2,716	25.9%	$13,198	3.2%	$10,818	$2,803	$13,621	2026Q1	15.9%	$12,541	$3,249	$15,791
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$100,242	$45,335	45.2%	**$145,576**		$103,453	$46,787	$150,240			$119,930	$54,239	$174,169
01	LANDS AND DAMAGES	$346	$40	11.4%	$385	3.2%	$357	$41	$397	2023Q1	6.1%	$378	$43	$422
30	PLANNING, ENGINEERING & DESIGN													
6.0%	Project Management	$6,014	$2,264	37.7%	$8,279	3.8%	$6,245	$2,351	$8,596	2023Q1	7.8%	$6,735	$2,536	$9,270
0.0%	Planning & Environmental Compliance	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Engineering & Design	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Reviews, ATRs, IEPRs, VE	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Life Cycle Updates (cost, schedule, risks)	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Contracting & Reprographics	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Engineering During Construction	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Planning During Construction	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Adaptive Management & Monitoring	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Operations	$0	$0	37.7%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
4.0%	Construction Management	$4,010	$1,171	29.2%	$5,181	3.8%	$4,163	$1,216	$5,379	2026Q1	20.7%	$5,026	$1,468	$6,494
0.0%	Project Operation:	$0	$0	29.2%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Management	$0	$0	29.2%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$110,611	$48,810		$159,421		$114,217	$50,395	**$164,612**			$132,069	$58,286	**$190,355**