Elim Subsistence Harbor Feasibility Study
Appendix E: Cost Engineering
Elim, Alaska

November 2020

U.S. Army Corps of Engineers
Alaska District

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LIST OF TABLES

LIST OF EXHIBITS

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1. APPENDIX OVERVIEW

This Cost Engineering Appendix will be consolidated into the decision document, Integrated Feasibility Report and Environmental Assessment (IFR/EA), for Elim, Alaska. The purpose of the feasibility study is to evaluate alternatives for a potential construction contract. The Appendix discusses the cost assumptions, methodology, materials, labor, and equipment utilized in the contract construction cost estimates.

2. PROJECT TYPE, FEATURES, AND ALTERNATIVES

Six alternatives were evaluated for this report. Four of the alternatives are located at Elim Beach, and two alternatives are located at the Airport Point near Elim Airport. All the alternatives included breakwater construction and unique local service facilities (LSF), including boat launch, floating docks, mooring points, and upland improvements.

3. PRELIMINARY ALTERNATIVES COST ESTIMATE BASIS

This section summarizes the development of planning level cost estimates for the final array of action alternatives. The estimates were developed in Q1 2020 prices.

3.1. Purpose

There were a variety of alternatives for which costs were developed during the planning and alternative decision stages. Based on the design development, these estimates would be considered Class 4 for accuracy.

3.2. Quantities and Assumptions

This estimate is based on quantities and design sketches provided by the United States Army Corps of Engineers (USACE) CEPOA-EC-CW (Kloster) design engineer and included at the end of this Appendix in Exhibit 2.

3.3. Unit Prices

The unit prices used in Class 4 alternative estimates were, for the most part, determined using historical bid data, cost models used in similar types of project estimates, and current pricing for large cost items such as breakwater rock. These unit costs were adjusted to factor freight and local area mark-ups. The following assumptions were made during the formation of this estimate:

- Breakwater construction: Due to the potential construction site's remote location, all materials are required to be brought in by barge. Rubble mound breakwater

and fill material are assumed to be sourced from the Nome quarry located nearly 100 miles from the town of Elim. Once materials are barged to Elim, it will be placed using a barge-mounted crane and excavator. Two barge scows will be utilized during the construction due to the relatively long towing distance from Elim to the Nome quarry.

- Dredging: Dredge will be completed via a mechanical method by using a crane on a floating barge using clamshell, placing material in a split scow barge, and disposing in open water within 2 nautical miles of the project site. A large portion of the dredged material is assumed to require ripping before dredging may be completed.
- Local Service Facilities (LSF): Fill material, rock for roads, and upland structure are assumed to require quarry sourcing.
- Schedule: The construction is assumed to require 3 seasons to construct, with the larger harbors potentially requiring a 4th season.

Rock pricing is based on quotes from Cape Nome Quarry dated 03 March 2015. Attempts have been made to update the pricing but have not been recently successful:

- A-Rock: $206/Ton
- B-Rock: $83/Ton
- C-Rock: $62/Ton

As this is a Class 4 estimate, the following assumptions were made:

- Includes a 32% contingency
- Pre-Construction Engineering and Design (PED) and Supervision, Inspection, and Overhead (SIOH) are allowances
- The estimated index (date of development) is October 2019. No escalation is included.

3.4. Contingencies

Project risks include difficulty dredging in shallow water, difficulty dealing with rocky/consolidated material, weather, encountering marine mammals, and sourcing rock for the breakwater. Contingencies represent allowances to cover unknowns, uncertainties, and/or unanticipated conditions that cannot adequately evaluate the data on hand when the cost estimate is prepared. Still, it must be represented by a sufficient cost to cover the identified risks. An abbreviated risk analysis (ARA) has been prepared for the alternative cost estimates to calculate a contingency of 32% (Exhibit 4).

3.5. Summary

The six alternatives evaluated were estimated to range in costs from approximately $70 million to $150 million as seen in Table 1.

Table 1. Alternatives and Total Costs

Cost Description	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Mobilization and Demobilization	$6,000,000	$6,000,000	$6,000,000	$6,000,000	$6,000,000	$6,000,000
Breakwater and Seawalls	$30,121,000	$31,944,000	$32,610,000	$32,366,000	$37,109,000	$55,334,000
Navigation Ports & Harbors (Drill/Blast/Dredge) (GNF)	$1,169,000	$1,826,000	$2,679,000	$5,127,000	$1,350,000	$3,498,000
Navigation Ports & Harbors (Upland Fill)	$5,923,000	$23,655,000	$23,756,000	$24,649,000	$15,723,000	$31,825,000
Harbor Road	$1,344,000	$1,345,000	$1,345,000	$1,345,000	$7,850,000	$7,850,000
Navigation Ports & Harbors (Harbor Facilities)	$305,000	$233,000	$233,000	$365,000	$233,000	$1,545,000
PED	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000
Construction Management	$5,000,000	$5,000,000	$5,000,000	$5,000,000	$5,000,000	$5,000,000
Contingency	$16,158,900	$22,200,900	$22,686,900	$24,255,600	$23,179,500	$34,515,600
Total	**$70,021,000**	**$96,204,000**	**$98,310,000**	**$103,108,000**	**$100,445,000**	**$149,568,000**

4. RECOMMENDED PLAN DESIGN COST ESTIMATE

Alternative 5 was identifies as the Tentatively Selected Plan (TSP). Following concurrence with the selection at the Agency Decision Milestone (ADM), the plan was refined and optimized. This section summarizes the development of a Class 3 cost estimate for the refined Alternative 5 which is the Recommended Plan. The estimates were developed in Q4 2020 prices.

4.1. Purpose

Once Alternative 5 was selected as the project TSP and the ADM approval of the TSP was complete, the team reviewed the alternative with more scrutiny to optimize the project scope and cost.

4.2. Quantities and Assumptions

This estimate is based on revised quantities and design sketches provided by the United States Army Corps of Engineers (USACE) CEPOA-EC-CW (Kloster) design engineer and included at the end of this Appendix in Exhibit 5. For information on how the project design and scope was revised, please see Appendix C – Hydraulics and Hydrology.

4.3. Unit Prices

The unit prices used in the Class 3 Recommended Plan development estimate were determined by a combination of historical data, current material quotes, and cost models used in similar types of project estimates. These unit costs were adjusted to factor freight and local area mark-ups. A detailed breakdown of the costs can be viewed in attached Exhibit 6. The following assumptions were made during the formation of this estimate.

Mobilization and Demobilization: Mob/Demob costs were refined from a lump-sum allowance to an itemized breakdown, which resulted in a decreased overall cost. Mobilization originates from Seattle, WA, with arrival in Elim on June 1st for the ice-free construction season. Demobilization back to Seattle begins October 1st at the end of the construction season.

Breakwater Construction: Minor updates to the breakwater construction activities include updated rock costs from the Nome quarry and minor quantity updates from H&H. Assumptions on construction methodology include the following:

- Due to the harbor's shallow nature, the dredging crews will complete their work first to allow access by the breakwater construction crew.
- Updated rock costs as of December 2019 are as follows:
    - A-Rock: $142/Ton

    - B-Rock: $120/Ton
    - C-Rock: $55/Ton
- Rock placement will be conducted from a barge-mounted crane. Minimal interruption of work from tidal swings is anticipated due to the small tide swings of approximately 1.5 feet.
- Rock delivery will be conducted with 2 scows. While the rock placement crew is unloading 1 scow, the barge will be conducting a round trip cycle of rock delivery. Round trip material delivery is around 24 hours for the barge between Elim and Nome Quarry.
- Weather will play a role in constructing the breakwaters in unprotected waters and has been noted in the Cost and Schedule Risk Analysis (CSRA) and factored into the contingency.

Dredging: Dredging updates included a minor addition of material requiring blasting, and overall dredging quantities. No changes were made to Cost Engineering Dredge Estimating Program (CEDEP) files or unit prices. Current assumptions include:

- A large portion of the material will need to be pre-ripped before being mechanically dredged out. According to the geotechnical report, approximately 90% of the material can be ripped. This material consists of mainly dense alluvium or weathered rock. This type of material is anticipated to be moderately difficult to rip since it is not hard rock. If excessively difficult rock is discovered and ripping is no longer viable, then blasting will have to be more widely utilized. This possibility has been discussed and modeled in the CSRA.
- In some areas, below the dense alluvium and weathered rock, the bedrock will require blasting prior to mechanical dredging.
- Weather will play a role in dredging in unprotected waters and is noted in the CSRA and factored into the contingency.

LSF: The refinement of upland activity costs included the team's decision to allow for locally sourced fill material as opposed to fill sourced from Nome Quarry. Dredging activities were also included for LSF work.

Project Mark-ups: The project home office overhead (HOOH) percent was increased from 4% to 7% after discussion and consideration of the project's remote nature and the requirement for reach-back support. Project Mark-ups are as follows.

- Overtime Mark-ups - 22.22%
- Job Office Over Head - JOOH (running) - 15%
- Home Office Overhead - HOOH (running) - 7%
- Profit (Profit Weight Guidelines) - 9.72%
- Sub Profit (running) - 10%
- Bond (table) - 0.66%

4.4. Contingencies

Once Alternative 5 was selected at the ADM, the team held a CSRA meeting to discuss and further develop the risk involved with this alternative. The final contingency percentage derived from the Cost and Schedule Risk Analysis process was determined to be 28% and was applied to the project costs for the recommended plan. The CSRA file can be viewed in attachment Exhibit 7.

4.5. Summary

The scope required in the recommended plan resulted in a cost of $87,858,000, with a summary breakdown seen in Table 2.

Note that LSF and Federal Aids to Navigation (ATON) are shown in the Estimated Costs (Table 2) but are not included in the Project First Cost (Table 3) or the Fully Funded Cost (Table 4) because LSF costs are the responsibility of the sponsor and ATON costs will coordinated and paid by the United States Coast Guard.

Table 2. Recommended Plan Total Costs

		ESTIMATED COST Q4 2020 Price Level			
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*
10	Mob/Demob, BW Const. - GNF	$38,721	$10,842	28.0%	$49,563
12	Dredging - GNF	$8,592	$2,406	28.0%	$10,998
12	Mob/Demob, Dredging Const. - LSF	$1,845	$517	28.0%	$2,362
12	Upland Construction - LSF	$10,320	$2,890	28.0%	$13,210
12	ATON	$71	$20	28.0%	$91
	CONSTRUCTION ESTIMATE TOTALS:	$59,549	$16,674		$76,223
01	LANDS AND DAMAGES	$89	$22	25.0%	$111
30	PLANNING, ENGINEERING & DESIGN	$4,004	$1,121	28.0%	$5,125
31	CONSTRUCTION MANAGEMENT	$4,999	$1,400	28.0%	$6,399
	PROJECT COST TOTALS:	$68,641	$19,217	28.0%	$87,858

Table 3. Recommended Plan Estimated Costs

Civil Works Work Breakdown Structure		PROJECT FIRST COST (Constant Dollar Basis)					
			Program Year (Budget EC):			2021	
			Effective Price Level Date:			1 OCT 20	
							TOTAL
						Spent Thru:	FIRST
WBS	Civil Works	ESC	COST	CNTG	TOTAL	1-Oct-19	COST
NUMBER	Feature & Sub-Feature Description	(%)	($K)	($K)	($K)	($K)	($K)
A	B	G	H	I	J		K
10	Mob/Demob, BW Const. - GNF	3.0%	$39,879	$11,166	$51,045	$0	$51,045
12	Dredging - GNF	3.0%	$8,849	$2,478	$11,327	$0	$11,327
12	Mob/Demob, Dredging Const. - LSF	3.0%	$1,900	$532	$2,432	$0	
12	Upland Construction - LSF	3.0%	$10,629	$2,976	$13,605	$0	
12	ATON	3.0%	$73	$20	$94	$0	
	CONSTRUCTION ESTIMATE TOTALS	3.0%	$61,330	$17,172	$78,503	$0	$62,372
01	LANDS AND DAMAGES	3.0%	$92	$23	$115	$0	$115
30	PLANNING, ENGINEERING & DESIGN	4.6%	$4,187	$1,172	$5,360	$0	$5,360
31	CONSTRUCTION MANAGEMENT	4.6%	$5,228	$1,464	$6,692	$0	$6,692
	PROJECT COST TOTALS		$70,837	$19,832	$90,668	$0	$74,538

Table 4. Recommended Plan Fully Funded Costs

Civil Works Work Breakdown Structure		TOTAL PROJECT COST (FULLY FUNDED)			
WBS NUMBER	Civil Works Feature & Sub-Feature Description	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	L	M	N	O
10	Mob/Demob, BW Const. - GNF	23.0%	$49,048	$13,733	$62,781
12	Dredging - GNF	18.7%	$10,500	$2,940	$13,440
12	Mob/Demob, Dredging Const. - LSF	Not Included in the total project cost - LSF			
12	Upland Construction - LSF	Not Included in the total project cost - LSF			
12	ATON	Not Included in the total project cost			
	CONSTRUCTION ESTIMATE TOTALS:	22.2%	$59,548	$16,673	$76,221
01	LANDS AND DAMAGES	17.0%	$107	$27	$134
30	PLANNING, ENGINEERING & DESIGN	17.4%	$4,914	$1,376	$6,290
31	CONSTRUCTION MANAGEMENT	30.6%	$6,830	$1,912	$8,742
	PROJECT COST TOTALS:	0.8%	$71,399	$19,988	$91,387

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Exhibit 1 – Feasibility Study Sketches

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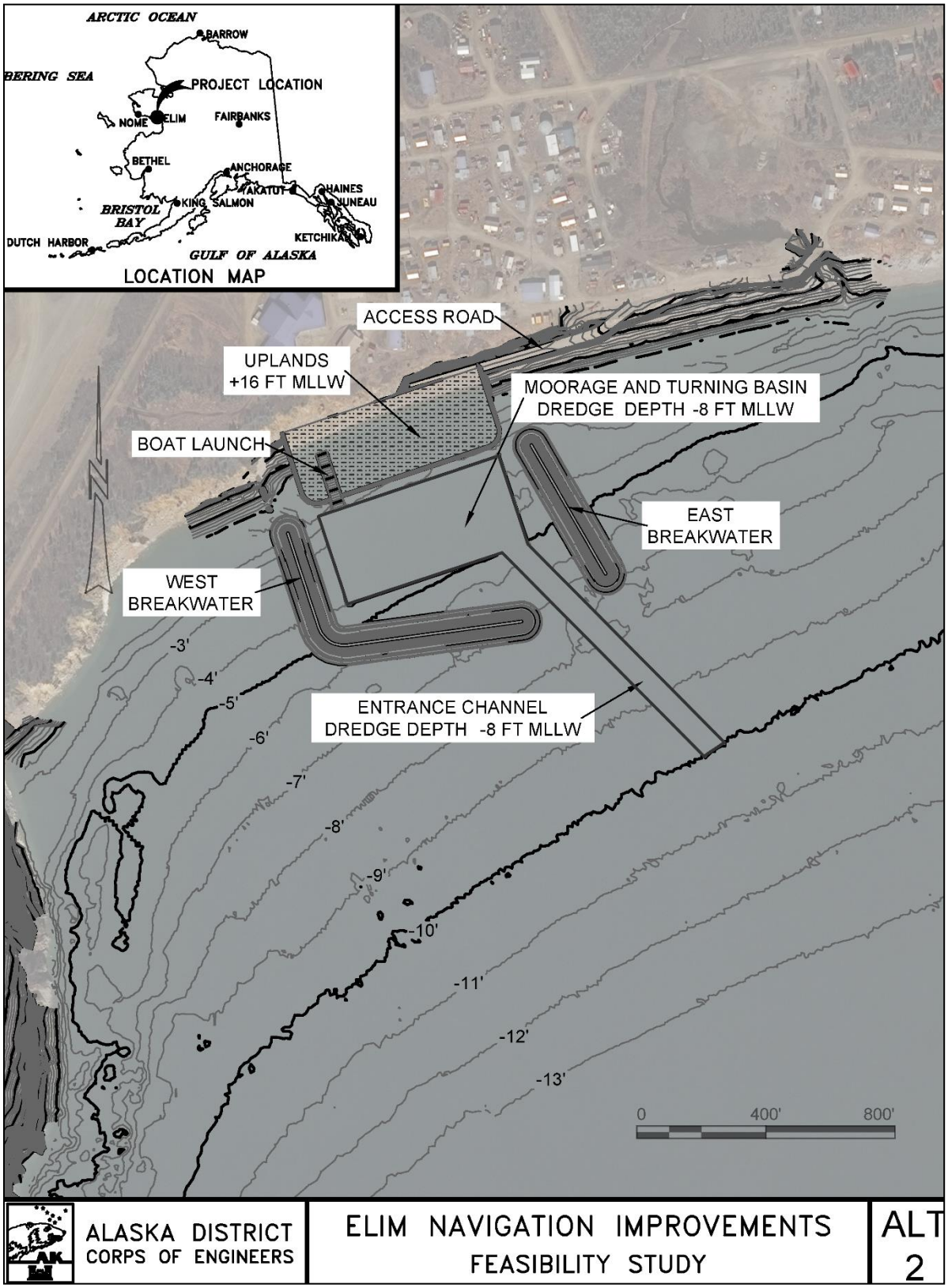
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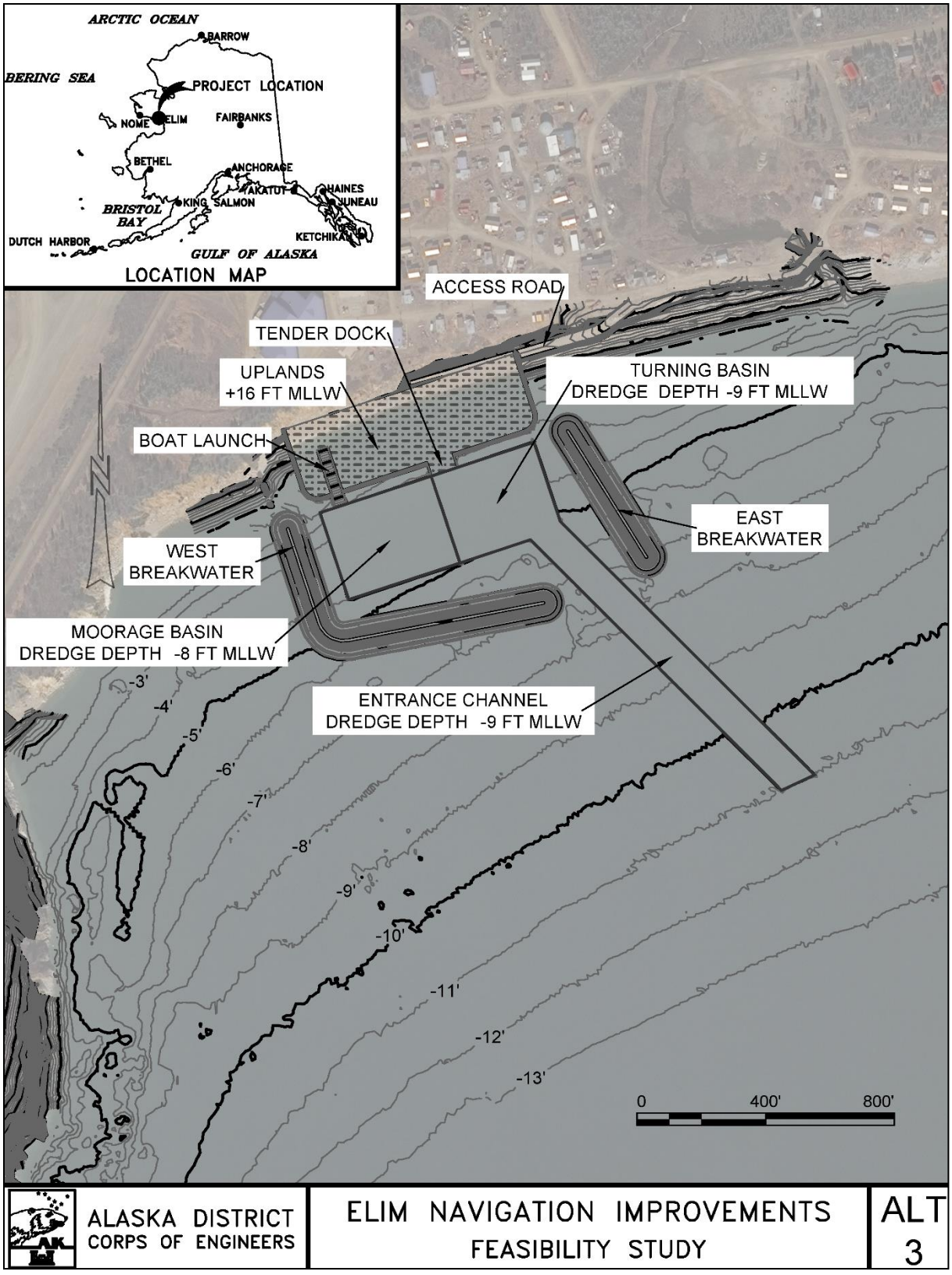
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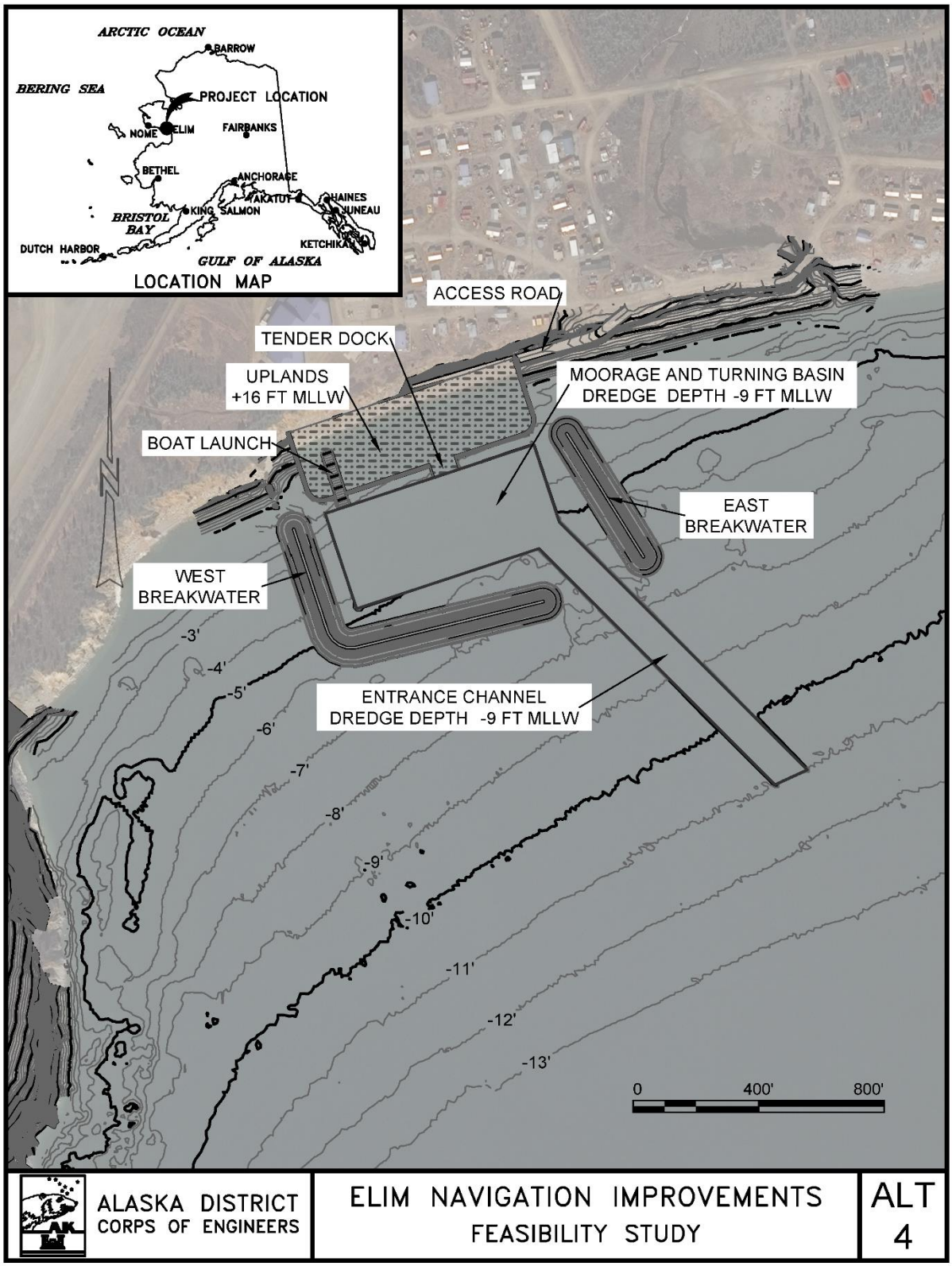
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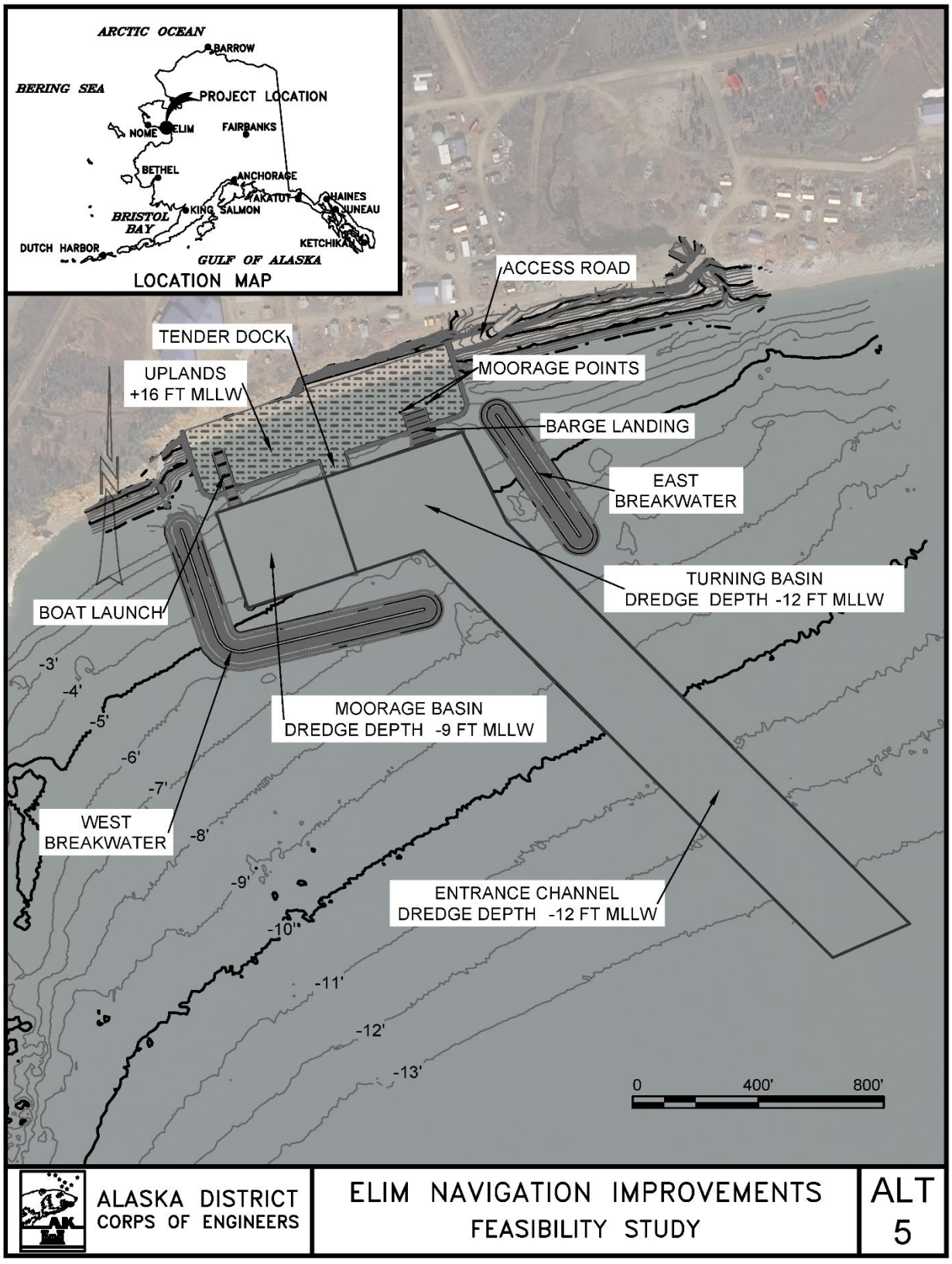
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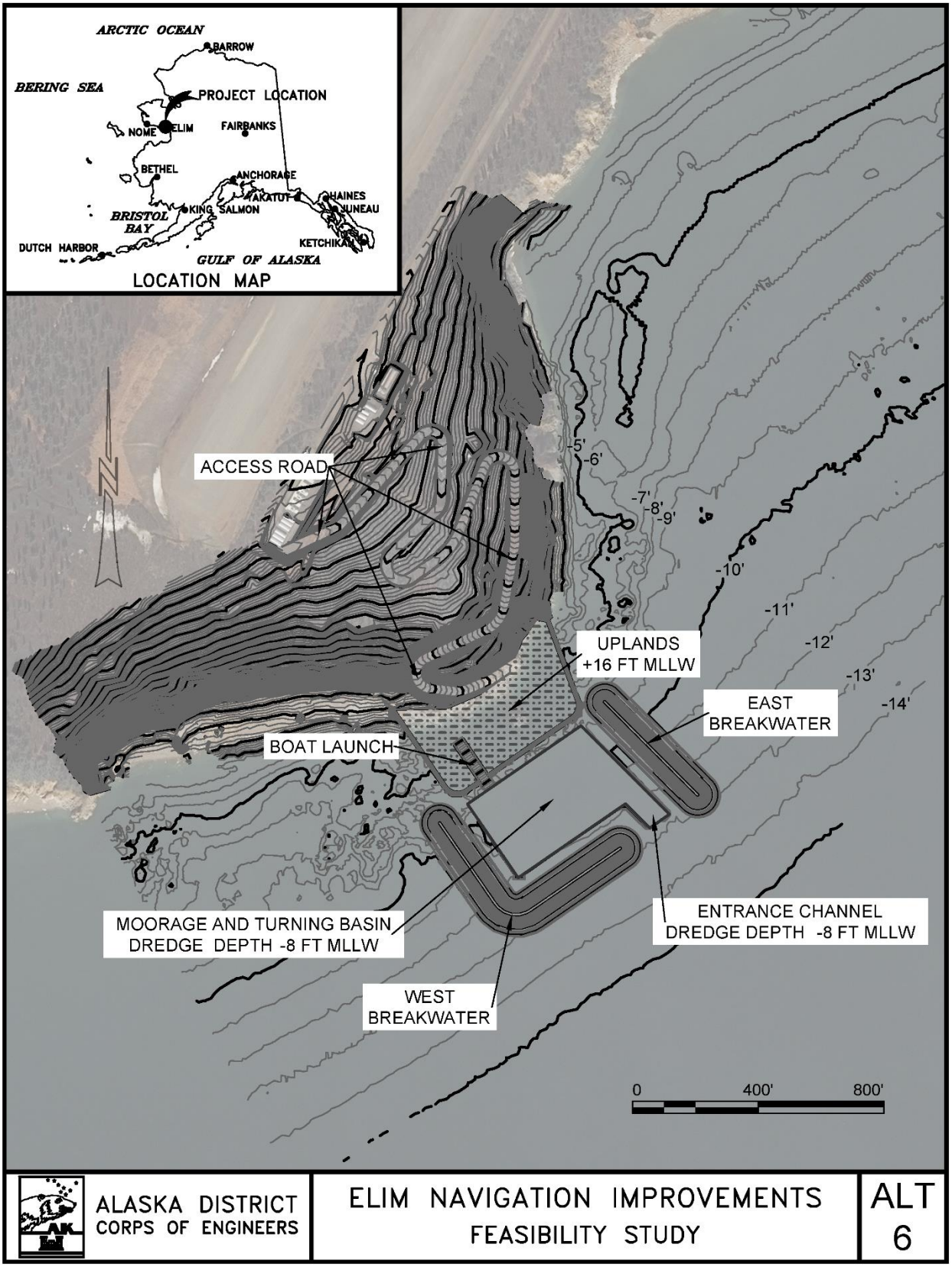
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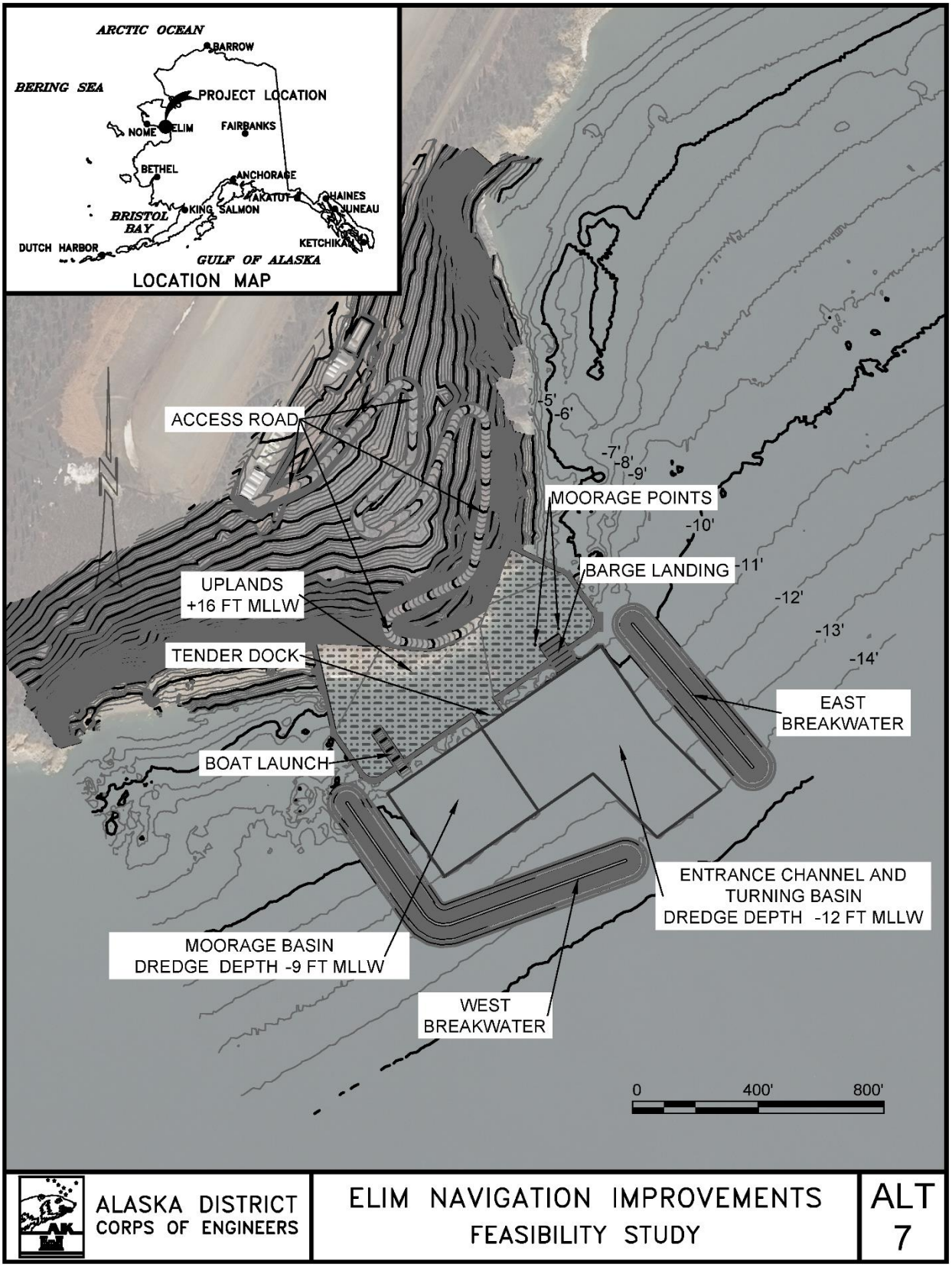
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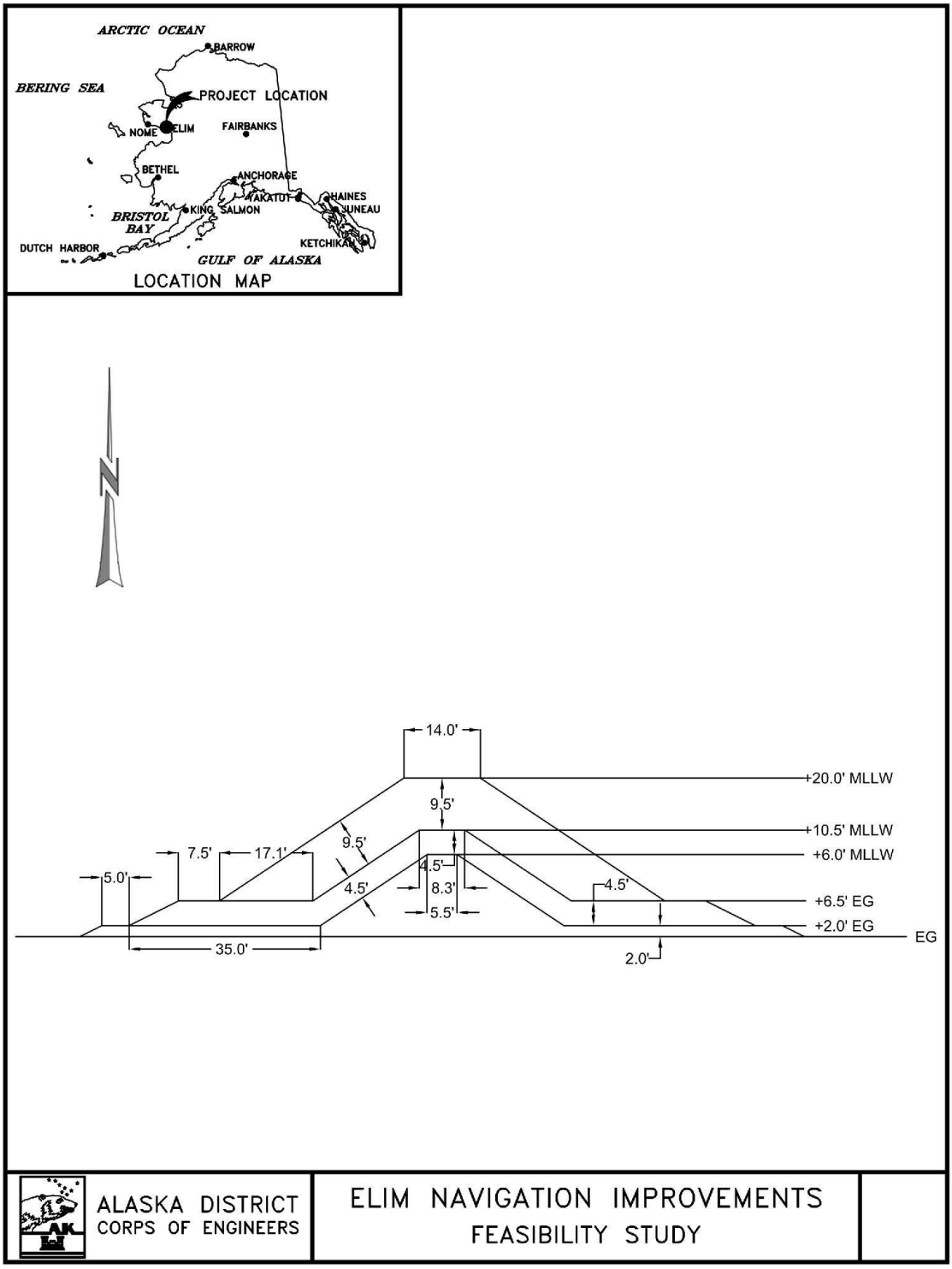
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Exhibit 2 – Preliminary Alternative Quantities

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Alternative 2		
Cost Share		
Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	30,255	W_A50 = 16000lb
west	20,210	
east	10,045	
B	27,682	W_B50 = 1600lb
west	18,143	
east	9,539	
Core	25,547	W_C50 = 80lb
west	17,165	
east	8,383	
Dredge - Basin and Entrance Channel		Assume blasting
Material	Volume (cy)	
Mechanical Dredge	9,539	
"ripping" Dredge	8,738	
	Surface Area (SF)	
Survey	528336	
Maintenance Dredging		
Material	Volume (cy)	Year
Mechanical Dredge	10,000	10 years
LERRDs		
Uplands		Note
Material	Volume (cy)	
Fill	83,162	
Aggregate Surface	2,599	6" Lift
Subbase	5,198	2 x 6" Lift
RipRap	2,322	3' of 500lb Riprap
Sheetpile (linear feet)	-	
Access Road		
Material	Volume (cy)	Note
E1	430.00	6" Lift
C1	900.00	2 x 6" Lift
Fill	3,300.00	
Cut	0.00	
Riprap	1,500	9" minus, Ditch Liner, 1' Layer
Excavation	120	
Bedding Layer	25	
24" CMP Culverts (L = 50 ft)	3	
Facilities		
Feature	Quantity	
Moorage Points	0	
Floating Dock	2	210 ft x 5 ft
Gangway	2	50 ft x 4 ft
Boat Launch	124' x 32'	13% slope

Alternative 3		
Cost Share		
Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	32,100	W_A50 = 16000lb
	21,939	
	10,161	
B	29,882	W_B50 = 1600lb
	20,094	
	9,788	
Core	26,491	W_C50 = 80lb
	18,101	
	8,391	
Dredge - Basin		**Assume blasting**
Material	Volume (cy)	
Mechanical Dredge	24,146	
"ripping" Dredge	2,525	
Dredge - Entrance Channel		
Material	Volume (cy)	
Mechanical Dredge	13,604	
"ripping" Dredge	12,614	
	Surface Area (SF)	
Survey	457315	
Maintenance Dredging		
Material	Volume (cy)	Year
Mechanical Dredge	20,000	15 years
LERRDs		
Uplands		
Material	Volume (cy)	
Fill	99,748	
Aggregate Surface	3,117	6" Lift
Subbase	6,234	2 x 6" Lift
RipRap	2,731	3' of 500lb Riprap
Sheetpile (linear feet)	207	look at Unalakleet for depth
Access Road		
Material	Volume (cy)	Note
E1	430.00	6" Lift
C1	900.00	2 x 6" Lift
Fill	3,300.00	
Cut	0.00	
Riprap	1,500	9" minus, Ditch Liner, 1' Layer
Excavation	120	
Bedding Layer	25	
24" CMP Culverts (L = 50 ft)	3	
Facilities		
Feature	Quantity	
Moorage Points	0	
Floating Dock	2	210 ft x 5 ft
Gangway	2	50 ft x 4 ft
Boat Launch	124' x 32'	13% slope

Alternative 4		
Cost Share		
Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	32,779	W_A50 = 16000lb
	22,622	
	10,157	
B	29,663	W_B50 = 1600lb
	20,074	
	9,588	
Core	27,943	W_C50 = 80lb
	19,333	
	8,609	
Dredge - Basin and Entrance Channel		Assume blasting
Material	Volume (cy)	
Mechanical Dredge	52,896	
"ripping" Dredge	19,166	
	Surface Area (SF)	
Survey	783877	
Maintenance Dredging		
Material	Volume (cy)	Year
Mechanical Dredge	20,000	15 years
LERRDs		
Uplands		
Material	Volume (cy)	
Fill	100,258	
Aggregate Surface	3,133	6" Lift
Subbase	6,266	2 x 6" Lift
RipRap	2,745	3' of 500lb Riprap
Sheetpile (linear feet)	207	look at Unalakleet for depth
Access Road		
Material	Volume (cy)	Note
E1	430.00	6" Lift
C1	900.00	2 x 6" Lift
Fill	3,300.00	
Cut	0.00	
Riprap	1,500	9" minus, Ditch Liner, 1' Layer
Excavation	120	
Bedding Layer	25	
24" CMP Culverts (L = 50 ft)	3	
Facilities		
Feature	Quantity	
Moorage Points	0	
Floating Dock	2	245 ft x 5 ft
Gangway	2	50 ft x 4 ft
Boat Launch	124' x 32'	13% slope

Alternative 5		
Cost Share		
Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	32,538	W_A50 = 16000lb
	22,259	
	10,279	
B	29,470	W_B50 = 1600lb
	19,836	
	9,634	
Core	27,684	W_C50 = 80lb
	19,011	
	8,673	
Dredge - Basin -9 -10		Assume blasting
Material	Volume (cy)	
Mechanical Dredge	28,996	
"ripping" Dredge	5,226	
		50% of the area
Dredge - Entrance Channel -12 -13		
Material	Volume (cy)	
Mechanical Dredge	65,167	
"Ripping" Dredge	57,202	
Blasting Dredge	1,758	
	Surface Area (SF)	
Survey	932352	
Maintenance Dredging		
Material	Volume (cy)	Year
Mechanical Dredge	51,000	30 years
LERRDs		
Uplands		
Material	Volume (cy)	
Fill	104,315	
Aggregate Surface	3,260	6" Lift
Subbase	6,520	2 x 6" Lift
RipRap	3,232	3' of 500lb Riprap
Sheetpile (linear feet)	207	look at Unalakleet for depth
Access Road		
Material	Volume (cy)	Note
E1	430.00	6" Lift
C1	900.00	2 x 6" Lift
Fill	3,300.00	
Cut	0.00	
Riprap	1,500	9" minus, Ditch Liner, 1' Layer
Excavation	120	
Bedding Layer	25	
24" CMP Culverts (L = 50 ft)	3	
Facilities		
Feature	Quantity	
Moorage Points	2	
Floating Dock	2	245 ft x 5 ft
Gangway	2	50 ft x 4 ft
Boat Launch	124' x 32'	13% slope

Alternative 6		
Cost Share		
Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	37,078	W_A50 = 16000lb
west	24,128	
east	12,950	
B	29,345	W_B50 = 1600lb
west	18,722	
east	10,623	
Core	37,121	W_C50 = 80lb
west	24,394	
east	12,726	
Dredge - Basin and Entrance Channel		Assume blasting
Material	Volume (cy)	
Mechanical Dredge	2,593	
"Ripping" Dredge	44	
LERRDs		
Uplands		
Material	Volume (cy)	
Fill	85,297	
	2,666	
	5,331	
RipRap	1,788	3' of 500lb Riprap
Sheetpile (linear feet)	-	
Access Road		
Material	Volume (cy)	Note
E1	1,761	6" Lift
C1	3,877	2 x 6" Lift
Fill	10,054	
Cut	38,779	Assume Blasting
Riprap	2,000	9" minus, Ditch Liner, 1' Layer
Excavation	370	
Bedding Layer	75	
24" CMP Culverts (L = 50 ft)	10	
Facilities		
Feature	Quantity	
Moorage Points	0	
Floating Dock	2	210 ft x 5 ft
Gangway	2	50 ft x 4 ft
Boat Launch	124' x 32'	13% slope

Alternative 7		
Cost Share		
Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	55,969	W_A50 = 16000lb
	37152.94	
	18816.28	
B	42,491	W_B50 = 1600lb
	27985.95	
	14505.27	
Core	55,212	W_C50 = 80lb
	35790.06	
	19421.65	
Dredge - Basin		Assume blasting
Material	Volume (cy)	
Mechanical Dredge	1,969	
"Ripping" Dredge	938	
Dredge - Entrance Channel		
Material	Volume (cy)	
Mechanical Dredge	2,258	
"Ripping" Dredge	20,054	
Blasting Dredge	83	
LERRDs		
Uplands		
Material	Volume (cy)	
Fill	159,833	
	4,995	
	9,990	
RipRap	3,232	3' of 500lb Riprap
Sheetpile (linear feet)	207	look at Unalakleet for depth
Access Road		
Material	Volume (cy)	Note
E1	1,761	6" Lift
C1	3,877	2 x 6" Lift
Fill	10,054	
Cut	38,779	Assume Blasting
Riprap	2,000	9" minus, Ditch Liner, 1' Layer
Excavation	370	
Bedding Layer	75	
24" CMP Culverts (L = 50 ft)	10	
Facilities		
Feature	Quantity	
Moorage Points	2	
Floating Dock	2	245 ft x 5 ft
Gangway	2	50 ft x 4 ft
Boat Launch	124' x 32'	13% slope
Fuel Header Relocation		

Exhibit 3 – Detailed Preliminary Alternative Costs

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Elim Harbor Construction Cost Estimate
Alternative 2

WBS No.	Feature Account / Item Description	UOM	Quantity	Unit Cost	Total Cost	Notes
Cost Share	**Breakwater**					
	Mod Demobe - Total Project - Assume 3 Seasons	EA	3	$ 2,000,000	$6,000,000	Allowance
	West Wall	LF				
	"A" - Rock	CY	20210	$ 547.00	$11,055,000	from Mii
	"B" - Rock	CY	18143	$ 266.00	$4,826,000	from Mii
	"C" - Rock	CY	17165	$ 243.00	$4,171,000	from Mii
	East Wall					
	"A" - Rock	CY	10045	$ 547.00	$5,495,000	from Mii
	"B" - Rock	CY	9539	$ 266.00	$2,537,000	from Mii
	"C" - Rock	CY	8383	$ 243.00	$2,037,000	from Mii
	Dredging					
	Dredge and Dispose-Basin, Ent Chan, Surveys	CY	9539	$ 19.00	$181,000	from Mii
	"Ripping" Dredge and Dispose-Basin, Ent Chan	CY	8738	$ 33.35	$291,000	Rip = $14.35/cyd to rip and $19/cyd to clam
	Survey (Assume $1/sf)	SF	528336	$ 1.32	$697,000	
			Sub-Total (Cost Share)		**$37,290,000**	
	Maintenance Dredging					
	Mobe	LS	1	$ 700,000.00	$700,000	Based on historical Nome Maint. Dredge Contract
	Dredge	CY	10000	$ 10.00	$100,000	
	Survey	SF	528336	$ 0.50	$264,168	
			Sub-Total (Maint Dredge)		**$1,100,000**	
LSF	**Upland**					
	Fill	CY	24494	$ 169.00	$4,139,000	Material all Assume to be barged in due to unknown nature of local fill material -- Sheetpile Costs from Nome
	RipRap	CY	96	$ 249.00	$24,000	
	Aggregate Surface	CY	2599	$ 145.00	$377,000	
	Subbase	CY	5198	$ 266.00	$1,383,000	
	Sheetpile	LF	-			
	Access road					
	E1	CY	430	$ 150.00	$65,000	
	C1	CY	900	$ 379.00	$341,000	
	Fill	CY	3,300	$ 169.00	$558,000	
	Cut	CY	0	$ 5.59	$0	
	Riprap	CY	1,500	$ 249.00	$374,000	
	Excavation	CY	120	$ 5.56	$667	
	Bedding Layer	CY	25	$ 150.00	$3,750	
	24" CMP Culverts (L = 50 ft)	LF	3	$ 529.00	$1,587	
					$1,344,004	
	Facilities					
	Moorage Points	EA	2	$ 35,844.00	$72,000	Used Fender Pile From Nome
	Floating Dock	EA	2	$ 28,067.00	$56,000	210 ft x 5 ft
	Gangway	EA	2	$ 25,831.00	$52,000	50 ft x 4 ft
	Boat Launch	EA	1	$ 125,000.00	$125,000	Cast In Place Concrete-perryville?
			Sub-Total (LSF)		**$7,572,004**	
	GNF + O&M + LSF (rounded)				$44,863,000	
	PED				$4,000,000	
	SIOH				$5,000,000	
	Estimate Contingency	28%			$15,081,640	Class 4 Estimate - ARA not used at this point
	Total Project Cost				**$68,944,640**	

Prepared by: CEPOA-EC-D-CE
Matt Collins
Jon Capua

Reviewed by: Karl Harvey

Quantity Input: Rebecca Kloster

Elim Harbor Construction Cost Estimate
Alternative 3

WBS No.	Feature Account / Item Description	UOM	Quantity	Unit Cost	Total Cost	Notes
Cost Share	**Breakwater**					
	Mod Demobe - Total Project - Assume 3 Seasons	EA	3	$ 2,000,000	$6,000,000	
	West Wall	LF				
	"A" - Rock	CY	21939	$ 547.00	$12,001,000	total A rock =
	"B" - Rock	CY	20094	$ 266.00	$5,345,000	total b rock =
	"C" - Rock	CY	18101	$ 243.00	$4,398,000	total c rock =
	East Wall					
	"A" - Rock	CY	10161	$ 547.00	$5,558,000	
	"B" - Rock	CY	9788	$ 266.00	$2,603,000	
	"C" - Rock	CY	8391	$ 243.00	$2,039,000	
	Dredging					
	Dredge and Dispose-Basin, Ent Chan, Surveys	CY	37750	$ 19.00	$717,000	from Mii
	"Ripping" Dredge and Dispose-Basin, Ent Chan	CY	15139	$ 33.35	$505,000	Rip = $14.35/cyd to rip and $19/cyd to clam
	Survey (Assume $1/sf)	SF	457315	$ 1.32	$604,000	
			Sub-Total (Cost Share)		**$39,770,000**	
	Maintenance Dredging					
	Mobe	LS	1	$ 700,000.00	$700,000	Based on historical Nome Maint.
	Dredge	CY	20000	$ 10.00	$200,000	
	Survey	SF	457315	$ 0.50	$229,000	
			Sub-Total (Maint Dredge)		**$1,200,000**	
LSF	**Upland**					
	Fill	CY	99748	$ 169.00	$16,857,000	
	RipRap	CY	2731	$ 249.00	$680,000	
	Aggregate Surface	CY	3117	$ 145.00	$452,000	
	Subbase	CY	6234	$ 266.00	$1,658,000	
	Sheetpile	LF	207	$ 19,364.00	$4,008,000	
	Access road					Material all Assume to be barged in due to unknown nature of local fill material -- Sheetpile Costs from Nome
	E1	CY	430	$ 150.00	$65,000	
	C1	CY	900	$ 379.00	$341,000	
	Fill	CY	3300	$ 169.00	$558,000	
	Cut	CY	0	$ 5.59	$0	
	Riprap	CY	1,500	$ 249.00	$374,000	
	Excavation	CY	120	$ 5.59	$1,000	
	Bedding Layer	CY	25	$ 150.00	$4,000	
	24" CMP Culverts (L = 50 ft)	LF	3	$ 529.00	$2,000	
	Facilities					
	Moorage Points	EA	0	$ 35,844.00	$0	Used Fender Pile From Nome
	Floating Dock	EA	2	$ 28,067.00	$56,000	210 ft x 5 ft
	Gangway	EA	2	$ 25,831.00	$52,000	50 ft x 4 ft
	Boat Launch	EA	1	$ 125,000.00	$125,000	Cast In Place Concrete
			Sub-Total (LSF)		**$25,233,000**	
			GNF + O&M + LSF (rounded)		$65,003,000	
			PED	(Allowance)	$4,000,000	
			SIOH	(Allowance)	$5,000,000	
			Estimate Contingency	28%	$20,720,840	Class 4 Estimate - ARA not used at this point
			Total Project Cost		**$94,724,000**	

Prepared by: CEPOA-EC-D-CE
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Quantity Input: Rebecca Kloster

Elim Harbor Construction Cost Estimate

Alternative 4

	WBS No.	Feature Account / Item Description	UOM	Quantity	Unit Cost	Total Cost	Notes
				Sub-Total (Cost Share)		**$41,289,000**	
Cost Share	**Breakwater**						
		Mod Demobe - Total Project - Assume 3 Seasons	EA	3	$ 2,000,000	$6,000,000	
		West Wall	LF				
		"A" - Rock	CY	22622	$ 547.00	$12,374,000	
		"B" - Rock	CY	20074	$ 266.00	$5,340,000	
		"C" - Rock	CY	19333	$ 243.00	$4,698,000	
		East Wall					
		"A" - Rock	CY	10157	$ 547.00	$5,556,000	
		"B" - Rock	CY	9588	$ 266.00	$2,550,000	
		"C" - Rock	CY	8609	$ 243.00	$2,092,000	
		Dredge and Dispose-Basin, Ent Chan, Surveys	CY	52896	$ 19.00	$1,005,000	from Mii
		"Ripping" Dredge and Dispose-Basin, Ent Chan	CY	19166	$ 33.35	$639,000	Rip = $14.35/cyd to rip and $19/cyd to dam (from Mii)
		Survey (Assume $1/sf)	SF	783877	$ 1.32	$1,035,000	
		Maintenance Dredging					
		Mobe	LS	1	$ 700,000.00	$700,000	Based on historical Nome Maint. Dredge Contract
		Dredge	CY	20000	$ 10.00	$200,000	
		Survey	SF	783877	$ 0.50	$392,000	
				Sub-Total (Maint. Dredge)		**$1,300,000**	
LSF	**Upland**						
		Fill	CY	100258	$ 169.00	$16,944,000	
		RipRap	CY	2745	$ 249.00	$683,000	
		Aggregate Surface	CY	3133	$ 145.00	$454,000	
		Subbase	CY	6266	$ 266.00	$1,667,000	
		Sheetpile	LF	207	$ 19,364.00	$4,008,000	
		Access road					
							Material all Assume to be barged in due to unknown nature
		E1	CY	430	$ 150.00	$65,000	of local fill material -- Sheetpile Costs from Nome
		C1	CY	900	$ 379.00	$341,000	
		Fill	CY	3,300	$ 169.00	$558,000	
		Cut	CY	0.00	$ 5.59	$0	
		Riprap	CY	1,500	$ 249.00	$374,000	
		Excavation	CY	120	$ 5.59	$1,000	
		Bedding Layer	CY	25	$ 150.00	$4,000	
		24" CMP Culverts (L = 50 ft)	LF	3	$ 529.00	$2,000	
		Facilities					
		Moorage Points	EA	0	$ 35,844.00	$0	Used Fender Pile From Nome
		Floating Dock	EA	2	$ 28,067.00	$56,000	210 ft x 5 ft
		Gangway	EA	2	$ 25,831.00	$52,000	50 ft x 4 ft
		Boat Launch	EA	1	$ 125,000.00	$125,000	Cast In Place Concrete
				Sub-Total (LSF)		**$25,334,000**	

GNF + O&M + LSF (rounded)		$66,623,000	
PED	(Allowance)	$4,000,000	
SIOH	(Allowance)	$5,000,000	
Estimate Contingency	28%	$21,174,440	Class 4 Estimate - ARA not used at this point
Total Project Cost		**$96,797,000**	

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Reviewed by: Karl Harvey

Quantity Input: Rebecca Kloster

Elim Harbor Construction Cost Estimate
Alternative 5

	WBS No.	Feature Account / Item Description	UOM	Quantity	Unit Cost	Total Cost	Notes
Cost Share		**Breakwater**					
		Mod Demobe - Total Project - Assume 3 Seasons	EA	3	$ 2,000,000	$6,000,000	
		West Wall	LF				
		"A" - Rock	CY	22259	$ 547.00	$12,176,000	
		"B" - Rock	CY	19836	$ 266.00	$5,276,000	
		"C" - Rock	CY	19011	$ 243.00	$4,620,000	
		East Wall					
		"A" - Rock	CY	10279	$ 547.00	$5,623,000	
		"B" - Rock	CY	9634	$ 266.00	$2,563,000	
		"C" - Rock	CY	8673	$ 243.00	$2,108,000	
		Dredge and Dispose-Basin, Ent Chan, Surveys	CY	94163	$ 19.00	$1,789,000	from Mii
		"Ripping" Dredge and Dispose-Basin, Ent Chan	CY	62429	$ 33.35	$2,082,000	Rip = $14.35/cyd to rip and $19/cyd to clam (from Mii)
		Blasting	SF	1758	$ 14.40	$25,000	
		Survey (Assume $1/sf)	SF	932352	$ 1.32	$1,231,000	
				Sub-Total (Cost Share)		**$43,493,000**	
		Maintenance Dredging					
		Mobe	LS	1	$ 700,000.00	$700,000	Based on historical Nome Maint. Dredge Contract
		Dredge	CY	75000	$ 10.00	$750,000	
		Survey	SF	932352	$ 0.50	$466,176	
				Sub-Total (Maint. Dredge)		**$2,000,000**	
LSF		**Upland**					
		Fill	CY	104315	$ 169.00	$17,629,000	
		RipRap	CY	3232	$ 249.00	$805,000	
		Aggregate Surface	CY	3260	$ 145.00	$473,000	
		Subbase	CY	6520	$ 266.00	$1,734,000	
		Sheetpile	LF	207	$ 19,364.00	$4,008,000	
		Access road					
		E1	CY	430	$ 150.00	$65,000	Material all Assume to be barged in due to unknown nature of local fill material -- Sheetpile Costs from Nome
		C1	CY	900	$ 379.00	$341,000	
		Fill	CY	3300	$ 169.00	$558,000	
		Cut	CY	0	$ 5.59	$0	
		Riprap	CY	1500	$ 249.00	$374,000	
		Excavation	CY	120	$ 5.59	$1,000	
		Bedding Layer	CY	25	$ 150.00	$4,000	
		24" CMP Culverts (L = 50 ft)	LF	3	$ 529.00	$2,000	
		Facilities					
		Moorage Points	EA	2	$ 35,844.00	$72,000	Fender Pile From Nome - look at denali comm. proj
		Floating Dock	EA	2	$ 28,067.00	$56,000	210 ft x 5 ft
		Gangway	EA	2	$ 25,831.00	$52,000	50 ft x 4 ft
		Fuel Header	LF	300	$ 200.00	$60,000	ALLOWANCE - 150' extention only
		Boat Launch	EA	1	$ 125,000.00	$125,000	Cast In Place Concrete
				Sub-Total (LSF)		**$26,359,000**	

GNF + O&M + LSF (rounded)			$71,852,000
PED	(Allowance)		$4,000,000
SIOH	(Allowance)		$5,000,000
Estimate Contingency	28%		$22,638,560 Class 4 Estimate - ARA not used at this point
Total Project Cost			**$103,491,000**

Prepared by: CEPOA-EC-D-CE
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Reviewed by: Karl Harvey

Quantity Input: Rebecca Kloster

Elim Harbor Construction Cost Estimate
Alternative 6

WBS No.	Feature Account / Item Description	UOM	Quantity	Unit Cost	Total Cost	Notes
Cost Share	**Breakwater**					
	Mod Demobe - Total Project - Assume 3 Seasons	EA	3	$ 2,000,000	$6,000,000	
	West Wall	LF				
	"A" - Rock	CY	24128	$ 547.00	$13,198,000	
	"B" - Rock	CY	18722	$ 266.00	$4,980,000	
	"C" - Rock	CY	24394	$ 243.00	$5,928,000	
	East Wall					
	"A" - Rock	CY	12950	$ 547.00	$7,084,000	
	"B" - Rock	CY	10623	$ 266.00	$2,826,000	
	"C" - Rock	CY	12726	$ 243.00	$3,093,000	
	Entrance Channel and Manuver Basin Area	SF	158364			
	Drill and Blast 50% of Area	SF	79182	$ 14.41	$1,141,000	
	Dredge and Dispose-Basin, Ent Chan	CY	0	$ 18.69	$0	
	Survey (Assuming $1/SF)	SF	158364	$ 1.32	$209,000	
			Sub-Total (Cost Share)		**$44,459,000**	
LSF	**Upland**					
	Fill	CY	85297	$ 169.00	$14,415,000	
	RipRap	CY	1788	$ 249.00	$445,000	
	Aggregate Surface	CY	2666	$ 145.00	$387,000	
	Subbase	CY	1788	$ 266.00	$476,000	
	Sheetpile	LF	0	$ 19,364.00	$0	Cost From Nome
	Access road					
	E1	CY	1761	$ 150.00	$264,000	
	C1	CY	3877	$ 379.00	$1,470,000	
	Fill	CY	10054	$ 169.00	$1,699,000	Use Material From Cut
	Cut - Drill and Blast	CY	60000	$ 65.00	$3,900,000	
	Riprap	CY	2000	$ 249.00	$498,000	
	Excavation	CY	370	$ 5.59	$2,000	
	Bedding Layer	CY	75	$ 150.00	$11,000	
	24" CMP Culverts (L = 50 ft)	LF	10	$ 559.00	$6,000	
	Facilities					
	Moorage Points	EA	0	$ 35,844.00	$0	Used Fender Pile From Nome
	Floating Dock	EA	2	$ 28,067.00	$56,000	210 ft x 5 ft
	Gangway	EA	2	$ 25,831.00	$52,000	50 ft x 4 ft
	Boat Launch	EA	1	$ 125,000.00	$125,000	
			Sub-Total (LSF)		**$23,806,000**	
	GNF + LSF (rounded)				$68,265,000	
	PED		(Allowance)		$4,000,000	
	SIOH		(Allowance)		$5,000,000	
	Estimate Contingency	28%			$21,634,200	Class 4 Estimate - ARA not used at this point
	Total Project Cost				**$98,899,000**	

Prepared by: CEPOA-EC-D-CE
Matt Collins
Jon Capua

Reviewed by: Karl Harvey

Quantity Input: Rebecca Kloster

Elim Harbor Construction Cost Estimate
Alternative 7

WBS No.	Feature Account / Item Description	UOM	Quantity	Unit Cost	Total Cost	Notes
Cost Share	**Breakwater**					
	Mod Demobe - Total Project - Assume 3 Seasons	EA	3	$ 2,000,000	$6,000,000	
	West Wall	LF				
	"A" - Rock	CY	37153	$ 547.00	$20,323,000	
	"B" - Rock	CY	27986	$ 266.00	$7,444,000	
	"C" - Rock	CY	35790	$ 243.00	$8,697,000	
	East Wall					
	"A" - Rock	CY	18816	$ 547.00	$10,293,000	
	"B" - Rock	CY	14505	$ 266.00	$3,858,000	
	"C" - Rock	CY	19422	$ 243.00	$4,719,000	
	Entrance Channel and Manuver Basin Area	SF	411000			
	Drill and Blast 50% of Area	SF	205500	$ 14.38	$2,955,000	
	Basin -9 / -10MLLW	CY	0	$ 18.52	$0	
	Entrance Channel -12 / -13 MLLW	CY	0	$ 18.73	$0	
	Survey (Assuming $1/SF)	SF	411000	$ 1.32	$543,000	
			Sub-Total (Cost Share)		**$64,832,000**	
LSF	**Upland**					
	Fill	CY	159833	$ 169.00	$27,012,000	
	RipRap	CY	3232	$ 249.00	$805,000	
	Aggregate Surface	CY	0	$ 145.00	$0	
	Subbase	CY	0	$ 266.00	$0	
	Sheetpile	LF	207	$ 19,364.00	$4,008,000	Cost From Nome
	Access road					
	E1	CY	1761	$ 150.00	$264,000	
	C1	CY	3877	$ 379.00	$1,470,000	
	Fill	CY	10054	$ 169.00	$1,699,000	Use Material From Cut
	Cut - Drill and Blast	CY	60000	$ 65.00	$3,900,000	
	Riprap	CY	2000	$ 249.00	$498,000	
	Excavation	CY	370	$ 5.59	$2,000	
	Bedding Layer	CY	75	$ 150.00	$11,000	
	24" CMP Culverts (L = 50 ft)	LF	10	$ 559.00	$6,000	
	Facilities					
	Moorage Points	EA	2	$ 35,844.00	$72,000	Used Fender Pile From Nome
	Floating Dock	EA	2	$ 28,067.00	$56,000	210 ft x 5 ft
	Gangway	EA	2	$ 25,831.00	$52,000	50 ft x 4 ft
	Fuel	LF	6200	$ 200.00	$1,240,000	start at tank farm end at shoreline (3100lf x2 lines @$200 / lf)
	Boat Launch	EA	1	$ 125,000.00	$125,000	
			Sub-Total (LSF)		**$41,220,000**	

GNF + LSF (rounded)		$106,052,000
PED	(Allowance)	$4,000,000
SIOH	(Allowance)	$5,000,000
Estimate Contingency	28%	$32,214,560 Class 4 Estimate - ARA not used at this point
Total Project Cost		**$147,267,000**

Prepared by: CEPOA-EC-D-CE
Matt Collins
Jon Capua

Reviewed by: Karl Harvey

Quantity Input: Rebecca

Kloster

Exhibit 4 – Preliminary Alternative Abbreviated Risk Analysis

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Abbreviated Risk Analysis

Project (less than $40M): **Elim Tribal Harbor Sec 205** **Alternative: All**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Moderate Risk: Typical Project Construction Type** **Meeting Date: 11/15/2019**

Total Estimated Construction Contract Cost = **$ 70,578,400**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
1	32 01 MOB, DEMOB & PREPARATORY WORK	**Mob/Demob**	$ 6,000,000		10.99%	$ 659,696	$ 6,659,696
2	10 BREAKWATERS AND SEAWALLS	**Rubble Mound Breakwater**	$ 32,810,937		38.78%	$ 12,725,698	$ 45,536,635
3	12 NAVIGATION, PORTS AND HARBORS	**Dredging & Disposal - Basin and Ent Channel**	$ 5,384,007		25.72%	$ 1,384,887	$ 6,768,894
4	12 NAVIGATION, PORTS AND HARBORS	**Upland Fill and Riprap**	$ 20,640,853		38.24%	$ 7,892,984	$ 28,533,837
5	12 NAVIGATION, PORTS AND HARBORS	**Access Road**	$ 1,369,770		8.97%	$ 122,928	$ 1,492,698
6	13 NAVIGATION, PORTS AND HARBORS	**Upland Sheet Pile**	$ 4,008,348		37.51%	$ 1,503,354	$ 5,511,702
7	20 BUILDINGS, GROUNDS, AND UTILITIES	**Facilities (mooring points, fuel lines, docks, launc**	$ 364,484		17.18%	$ 62,601	$ 427,085
8			$ -		0.00%	$ -	$ -
9			$ -		0.00%	$ -	$ -
10			$ -		0.00%	$ -	$ -
11			$ -		0.00%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ 1	*0.0%*	0.00%	$ -	$ 1
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 4,000,000		11.41%	$ 456,304	$ 4,456,304
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 5,000,000		9.09%	$ 454,564	$ 5,454,564
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ -	0.00%	$ -	$ -	
Total Construction Estimate	$ 70,578,400	34.50%	$ 24,352,146	$ 94,930,546	
Total Planning, Engineering & Design	$ 4,000,000	11.41%	$ 456,304	$ 4,456,304	
Total Construction Management	$ 5,000,000	9.09%	$ 454,564	$ 5,454,564	
Total Excluding Real Estate	**$ 79,578,400**	**32%**	**$ 25,263,014**	**$ 104,841,414**	

	Base	**50%**	**80%**
Confidence Level Range Estimate ($000's)	$79,578k	$94,736k	$104,841k

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

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

Elim Tribal Harbor Sec 205 All

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 15-Nov-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	Mob/Demob	Typical breakwater and dredging projects and alternatives have different scopes could have more or less than 3 yr durations for m/d	scopes are similar enough in size and complexity that for alternative decision stage, 3 yrs is reasonable assumption for all alts.	Negligible	Unlikely	0
PS-2	Rubble Mound Breakwater	Design changes or modifications could potentially cause scope growth and cause design/construction to increase	The design is unlikely to increase as the need of the community do not dictate any larger or more expensive of a harbor	Negligible	Unlikely	0
PS-3	Dredging & Disposal - Basin and Ent Channel	Design changes or modifications could potentially cause scope growth and cause design/construction to increase	The design is unlikely to increase as the need of the community do not dictate any larger or more expensive of a harbor	Negligible	Unlikely	0
PS-4	Upland Fill and Riprap	Design changes or modifications could potentially cause scope growth and cause design/construction to increase	The design is more likely to decrease in size as the needs of the community are refined and their ability to pay for the work is fleshed out.	Negligible	Unlikely	0
PS-5	Access Road	Design changes or modifications could potentially cause scope growth and cause design/construction to increase	The work is very minimal and straightforward, with a more likely change to decrease as the project is refined and the community's ability to pay for the work is fleshed out.	Negligible	Unlikely	0
PS-6	Upland Sheet Pile	- large gaps in design development for these features of work. Not much is known at this time on required scope or how they will be designed, managed, or constructed	-Possible that the local sponsor will require this work to be done in conjunction with the federal portions. - Scope drives cost so without good developed scopes, the overall basekune costs and schedules are at risk of growing	Moderate	Likely	3
PS-7	Facilities (mooring points, fuel lines, docks, launch)	Design changes or modifications could potentially cause scope growth and cause design/construction to increase	Given the limited budget for the LSF items in the project, there is little chance the scope will increase, with a more likely chance of items being deleted.	Negligible	Unlikely	0
PS-8	0			Negligible	Unlikely	N/A
PS-9	0			Negligible	Unlikely	N/A
PS-10	0			Negligible	Unlikely	N/A
CON-1	Mob/Demob	Mob-demobe = currently assume 3 seasons x $2M each. Using historical costs.	Small possibility seasons of work could change dependent of contractor selected.	Marginal	Possible	1

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
CE-2	Rubble Mound Breakwater	• Sequencing of construction. Building of breakwater before or after dredging • extra handling due to method of construction •	• extra handling (moderate/likely)	Moderate	Likely	3
CE-3	Dredging & Disposal - Basin and Ent Channel	-no current geotech data for basin. Some old data shows bedrock but unknown if it's blasting or just ripping required - shutdown days due to weather - impact of weather due to sequencing of breakwater - dredge disposal	• assumed ripping would work, but could cause issues if blasting would be required • shut down days (moderate/likely) • dredge sequencing due to breakwater construction sequencing (moderate/likely) • dredge disposal in assued to be close to shore split scow dump (moderate/unlikely)	Moderate	Likely	3
CE-4	Upland Fill and Riprap	• large area that will required lots of fill to be imported and rehandled • possibility of contaminated material	•possible that local source could be used, but no data on it. (significant/likely) • costs to handle contaminated material (marginal/likely)	Moderate	Likely	3
CE-5	Access Road	Construction costs for the access road could increase.	The construction of the access road is very simple with little possibility of cost growth.	Negligible	Unlikely	0
CE-6	Upland Sheet Pile	Costs during the construction of the sheet pile wall could increase due to unknown soil conditions.	With good historical data from nearby construction and relatively simple scope requirements, there is no major reason to be concerned.	Marginal	Unlikely	0
CE-7	Facilities (mooring points, fuel lines, docks, launch)	Construction costs for the facility items could increase for unknown reasons	The facilities items of this project are of simple construction and there is strong historical data for their costs.	Moderate	Unlikely	1
CE-8	0			Negligible	Unlikely	N/A
CE-9	0			Negligible	Unlikely	N/A
CE-10	0			Negligible	Unlikely	N/A
CE-11	0			Negligible	Unlikely	N/A
CE-12	Remaining Construction Items			Negligible	Unlikely	N/A
CE-13	Planning, Engineering, & Design	PED could reveal some as-of-yet unidentified item that increases the difficulty of construction and thus design time.	There is nothing to substantiate this other than previous historical PED processes.	Marginal	Unlikely	0
CE-14	Construction Management	Project construction could extend in length if dredging or barrier construction design is more difficult than anticipated	All activities associated with this project are well documented construction wise and are not anticipated to be overly technical or difficult to construct.	Marginal	Unlikely	0
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	Mob/Demob	Dredging and pre-ripping requires somewhat specialty equipment that needs to come from out of state.	Costs used are based on solid historical data on known availability of contractors capable of completing the work.	Negligible	Unlikely	0
SC-2	Rubble Mound Breakwater	The construction of the breakwater cost could increase depending on the construction method.	There is little to no concern about securing a good contractor capable of completing the work.	Negligible	Unlikely	0
SC-3	Dredging & Disposal - Basin and Ent Channel	The ripping work always has the potential for cost increases based on the inherent method of the work.	The ripping work is only half of the costs for	Negligible	Unlikely	0
SC-4	Upland Fill and Riprap	The construction of the breakwater cost could increase depending on the construction method.	Fill and rip rap backfill work is not a complicated activity and most likely there will be a local source of fill material accessible.	Marginal	Unlikely	0
SC-5	Access Road	The cost of the access road could increase depending on the construction method.	As this is simple work that most likely a local contractor will complete (and have completed in the area recently) there is little chance of this cost increasing.	Negligible	Unlikely	0
PS-11	0			Negligible	Unlikely	N/A
PS-12	Remaining Construction Items			Negligible	Unlikely	N/A
PS-13	Planning, Engineering, & Design	Scope growth affecting the length or level of effort during PED could cause an increase in cost.	Project Design has the potential for design changes or extended length based on environmental report due.	Marginal	Possible	1

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
PS-14	Construction Management	If scope growth occurs the schedule will increase also, driving up SIOH costs	A good PED process will provide a thorough project design that should prevent scope growth.	Marginal	Unlikely	0
Acquisition Strategy				**Maximum Project Growth**		**30%**
AS-1	Mob/Demob	Mobe/Demobe costs could vary due undecided method of acquisition; sole source vs. open bidding could bring show variances due to contractor origin locations.	There is good historical evidence validating the chosen ROM for mobe/demobe even when considering varying methods of acquisition.	Negligible	Unlikely	0
AS-2	Rubble Mound Breakwater	• no chiefs report till spring 21, WRDA sequencing pushing authorization until 23	• timing of starting PED would push project further right and increase escalation. (marg/likely)	Marginal	Likely	2
AS-3	Dredging & Disposal - Basin and Ent Channel	There is a possibility that this may go sole source and thus could increases the cost of the overall contract for dredging.	This is always a possibility based on Alaska's unique construction climate, but it is largely built into the overall costs already based on historical data.	Marginal	Unlikely	0
AS-4	Upland Fill and Riprap	The costs for the fill and riprap could fluctuate based on the method of contractor acquisition.	The costs for the fill and riprap are already priced at the worst case scenario of being delivered from Nome quarry. If there is to be any cost movement it should be down as better sources are fleshed out.	Marginal	Unlikely	0
AS-5	Access Road	The costs for the fill and road construction could fluctuate based on the method of contractor acquisition.	The costs for the fill for the access road are already priced at the worst case scenario of being delivered from Nome quarry. If there is to be any cost movement it should be down as better sources are fleshed out.	Marginal	Unlikely	0
AS-6	Upland Sheet Pile	There is a possibility that this may go sole source and thus could increases the cost of the overall contract for dredging.	This is always a possibility based on Alaska's unique construction climate, but it is largely built into the overall costs already based on historical data.	Marginal	Possible	1
AS-7	Facilities (mooring points, fuel lines, docks, launch)	The costs for the facilities could fluctuate based on the method of contractor acquisition.	This is always a possibility based on Alaska's unique construction climate, but it is largely built into the overall costs already based on historical data.	Marginal	Unlikely	0
AS-8	0			Negligible	Unlikely	N/A
AS-9	0			Negligible	Unlikely	N/A
AS-10	0			Negligible	Unlikely	N/A
AS-11	0			Negligible	Unlikely	N/A
AS-12	Remaining Construction Items			Negligible	Unlikely	N/A
AS-13	Planning, Engineering, & Design	The method of procurement could drive up the planning costs based on level of effort to advertise.		Marginal	Unlikely	0
AS-14	Construction Management	None	SOIH costs should not increase based on the acquisition strategy.	Negligible	Unlikely	0
Construction Elements				**Maximum Project Growth**		**25%**
SC-6	Upland Sheet Pile	The cost of the sheetpile construction could increase depending on the construction method.	Sheetpile work is a very tried and true construction method and it is not anticipated to have any major issues.	Marginal	Unlikely	0
SC-7	Facilities (mooring points, fuel lines, docks, launch)	The cost of the facilities could increase depending on the construction method.	The facilities construction work is not a complicated activity and the costs are well supported by historical data.	Marginal	Unlikely	0

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
SC-8	0			Negligible	Unlikely	N/A
SC-9	0			Negligible	Unlikely	N/A
SC-10	0			Negligible	Unlikely	N/A
SC-11	0			Negligible	Unlikely	N/A
SC-12	Remaining Construction Items			Negligible	Unlikely	N/A
SC-13	Planning, Engineering, & Design	There could be a construction activity in the project that become more difficult to engineer than originally anticipated.	There is nothing to substantiate this as of yet.	Marginal	Unlikely	0
SC-14	Construction Management	An activity that becomes overly complicated could up the overall project schedule and drive up SIOH costs.	There is nothing to substantiate this as of yet.	Marginal	Unlikely	0
Technical Design & Quantities				**Maximum Project Growth**		**30%**
T-1	Mob/Demob	No known concerns associated with mobe/demobe	Design and Quantities does not apply to mobe/demobe	Negligible	Unlikely	0
T-2	Rubble Mound Breakwater	• no design of armored toe in current design • may need to add stub breakwaters connected to shore outside footprint. • nose of breakwater needs to be pushed offshore ~50'	• necessity of armored toe would increase rock quantities by 3 rocks in cross-section (moderate/likely.). • (moderate/poss.) • moderate/very likely	Moderate	Likely	3
T-3	Dredging & Disposal - Basin and Ent Channel	• dredging material requires boreholes to determine final dredge materials. • possibility of design changes for uplands facilities	• possibility of material requiring blasting as opposed to ripping. • design quantities could fluctuate based on location of uplands facility being moved further into water or higher up shore. (moderate/likely)	Moderate	Likely	3
T-4	Upland Fill and Riprap	• size of riprap for uplands increasing in size	• due to wave size riprap might have to increase above 500 lbs.	Moderate	Very LIKELY	4
T-5	Access Road	• overall length of road is too long (conflicts with uplands) • need for protection		Negligible	Likely	1
T-6	Upland Sheet Pile	• design of sheetpile does not exist.	Design and quantities will be developed in PED.	Moderate	Very LIKELY	4
T-7	Facilities (mooring points, fuel lines, docks, launch)	• boat launch and and barge landing – need to be longer and deeper. Baseline concept designs are not long and deep enough. • mooring points – may need to be socketed piles. Currently parametric costs used. • fuel header. No design, used parametric costs.	• more in depth design and conversations with customer will determine path forward •fuel header. No design, used parametric costs.	Marginal	Likely	2
T-8	0			Negligible	Unlikely	N/A
T-9	0			Negligible	Unlikely	N/A
T-10	0			Negligible	Unlikely	N/A
T-11	0			Negligible	Unlikely	N/A

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
T-12	Remaining Construction Items			Negligible	Unlikely	N/A
T-13	Planning, Engineering, & Design	An feature of work in the project could become overly complicated and could drive up the PED costs by increased design demand or an increased timeline to completion.	There is nothing to substantiate this as of yet.	Marginal	Unlikely	0
T-14	Construction Management	Project construction could extend in length if dredging or barrier construction design is more difficult than anticipated	All activities associated with this project are well documented construction wise and are not anticipated to be overly technical or difficult to construct.	Marginal	Unlikely	0
Cost Estimate Assumptions				**Maximum Project Growth**		**35%**
EST-1	Mob/Demob	Cost estimate assumptions for mobe/demobe could be wrong	Incorrect assumptions are always a possibility; however, there is a large amount of historical data to support our assumption	Negligible	Unlikely	0
EST-2	Rubble Mound Breakwater	- rock price variation and availability - breakwater foundation	- utilizing historic cost can pose a risk and inability to use Nome - change in design of breakwater foundation due to unknown geology (mod./unlikely)	Moderate	Possible	2
EST-3	Dredging & Disposal - Basin and Ent Channel	- survey verification costs	- frequency of surveys can fluctuate	Marginal	Possible	1
EST-4	Upland Fill and Riprap	Upland Fill and riprap costs could be incorrect based on current plan.	Costs are estimated based on importing all material from Nome quarry. Since the work is LSF the material could be sourced locally and costs would drop, not increase.	Negligible	Unlikely	0
EST-5	Access Road	Access road costs could be incorrect based on current plan.	Costs are estimated based on importing all material from Nome quarry. Since the work is LSF the material could be sourced locally and costs would drop, not increase	Negligible	Unlikely	0
EST-6	Upland Sheet Pile	Sheet pile costs could be incorrect based on current plan.	Sheet pile costs are based on Nome recently completed sheet pile work and not likely to vary greatly	Marginal	Unlikely	0
EST-7	Facilities (mooring points, fuel lines, docks, launch)	Facilities construction costs could be incorrect based on current plan	Costs for facilities are based on well established costs for similar facilities around Alaska and the scope is not very large.	Negligible	Unlikely	0
EST-8	0			Negligible	Unlikely	N/A
EST-9	0			Negligible	Unlikely	N/A
EST-10	0			Negligible	Unlikely	N/A
EST-11	0			Negligible	Unlikely	N/A
EST-12	Remaining Construction Items			Negligible	Unlikely	N/A
EST-13	Planning, Engineering, & Design	PED length and costs are based on historical data and PM assumptions	It is possible PED could overrun the time period allotted if some unknown is discovered.	Marginal	Possible	1
EST-14	Construction Management	Staffing costs are historical	costs for staffing this project is based on historical costs for running a project in a far-flung area of Alaska and thus not anticipated to fluctuate greatly.	Marginal	Unlikely	0

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
External Project Risks				**Maximum Project Growth**		**40%**
EX-1	Mob/Demob	Fuel prices or some other factor could affect the contractors estimate for mobe/demobe costs	As of now, the current costs are based on current historical data and support the price with a cost escalation that is not likely to be more than marginal.	Marginal	Possible	1
EX-2	Rubble Mound Breakwater	• Rock procurement is limited to one source and getting reliable, current rock quotes has not been successful as of yet. • susceptibility of construction method to inclement weather (wave height). • potential for project delay from decision to put off environmental study/compliance until PED.	• Rock prices could fluctuate or escalate from what is currently being used for the estimate. (significant/likely) • weather/wave height could effect construction duration. • environmental considerations (significant/possible)	Significant	Possible	3
EX-3	Dredging & Disposal - Basin and Ent Channel	• Dredge disposal site has not been identified as of yet • impact of Nome harbor construction on econ. Benefits for Elim	• potential for issues securing dredge disposal site • Nome influence on Elim (moderate/unlikely)	Marginal	Possible	1
EX-4	Upland Fill and Riprap	• Fill procurement is limited to one source and getting reliable, current fill quotes has not been successful as of yet.	• Fill prices could fluctuate or escalate from what is currently being used for the estimate.	Significant	Possible	3
EX-5	Access Road	Fill to complete the access road will possibly be imported from Nome quarry.	Although it is possible that fill material will have to be imported from Nome quarry, it is looking a less likely possibility as the project is developed and the amount of fill is not that large.	Negligible	Possible	0
EX-6	Upland Sheet Pile	Supply of sheetpile might be difficult to Elim.	Although the supply of sheetpile to Elim has the potential for disruption, the costs that have been utilized are for Nome which is very close geographically and therefore and substantiated.	Marginal	Unlikely	0
EX-7	Facilities (mooring points, fuel lines, docks, launch)	• Sewage outfall – no consideration currently in any of the appendices, costs, scope etc., need to address how/what to deal with in future study reports. LEERD • Real estate – if we go upland with staging area and access road, will need to deal with some real estate costs. no huge risk with having to buy private land.		Marginal	Likely	2
EX-8	0			Negligible	Unlikely	N/A
EX-9	0			Negligible	Unlikely	N/A
EX-10	0			Negligible	Unlikely	N/A
EX-11	0			Negligible	Unlikely	N/A
EX-12	Remaining Construction Items			Negligible	Unlikely	N/A
EX-13	Planning, Engineering, & Design	Community influence on the project.	Given the restrictive nature of the local sponsors budget, the project is not likely to increase in scope and thus PED length or cost.	Negligible	Unlikely	0

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
EX-14	Construction Management	Staffing for project construction.	Finding qualified staff able to travel to Elim to oversee construction might prove to be difficult.	Marginal	Possible	1

Exhibit 5 – Recommended Plan Sketch

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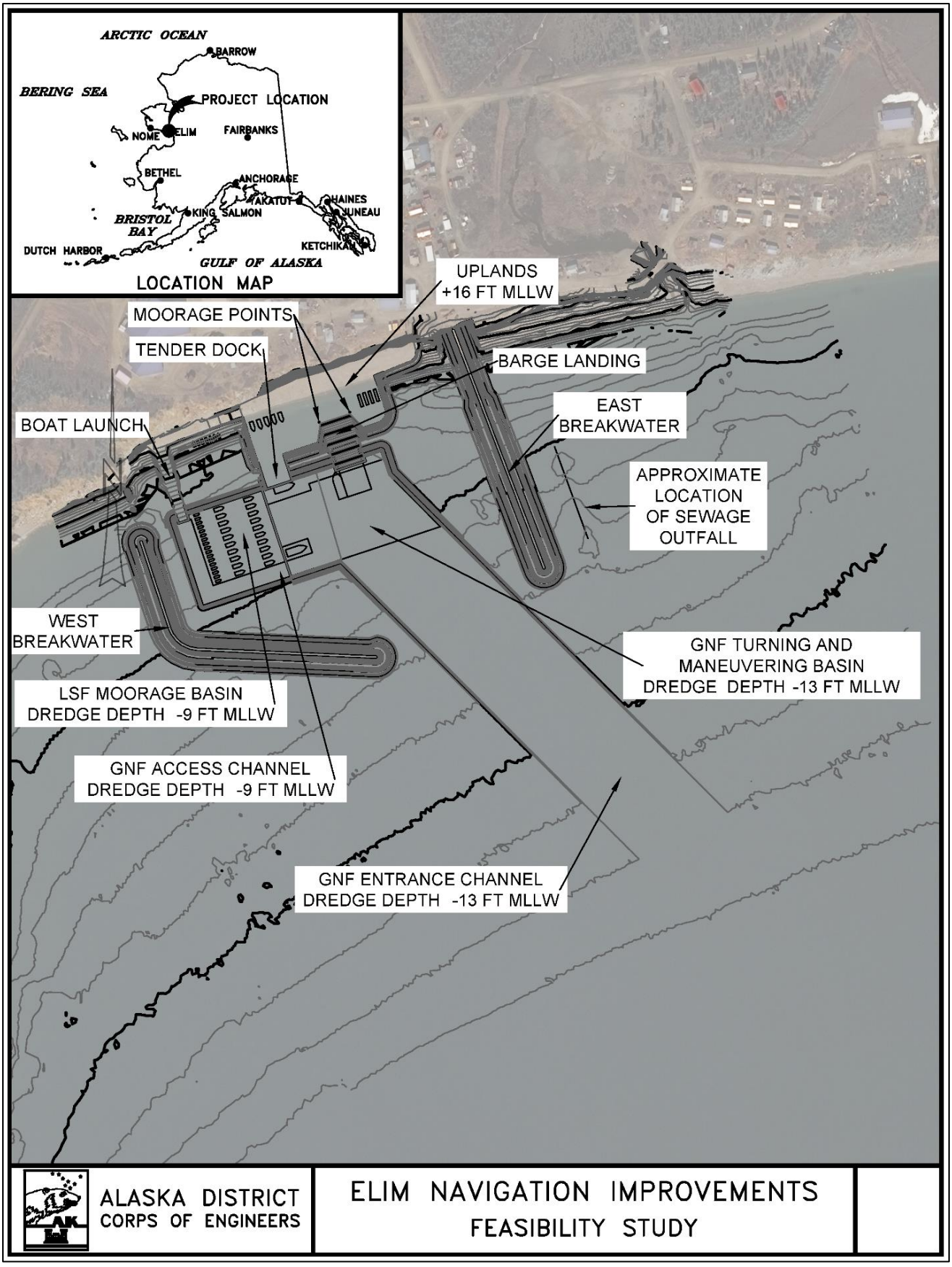
ARCTIC OCEAN
BARROW
BERING SEA
PROJECT LOCATION
NOME
ELIM
FAIRBANKS
BETHEL
ANCHORAGE
HAINES
AKATUT
JUNEAU
BRISTOL BAY
KING SALMON
DUTCH HARBOR
KETCHIKAN
GULF OF ALASKA
LOCATION MAP
UPLANDS +16 FT MLLW
MOORAGE POINTS
TENDER DOCK
BARGE LANDING
EAST BREAKWATER
BOAT LAUNCH
APPROXIMATE LOCATION OF SEWAGE OUTFALL
WEST BREAKWATER
GNF TURNING AND MANEUVERING BASIN DREDGE DEPTH -13 FT MLLW
LSF MOORAGE BASIN DREDGE DEPTH -9 FT MLLW
GNF ACCESS CHANNEL DREDGE DEPTH -9 FT MLLW
GNF ENTRANCE CHANNEL DREDGE DEPTH -13 FT MLLW
ALASKA DISTRICT
CORPS OF ENGINEERS
ELIM NAVIGATION IMPROVEMENTS
FEASIBILITY STUDY

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Exhibit 6 – Detailed Recommended Quantities

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Recommended Plan - Alternative 5		
West Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	26,576	W_A50 = 16000lb
B	18,872	W_B50 = 1600lb
Core	17,128	W_C50 = 80lb
East Breakwater - Crest +20.0 ft MLLW		
Material	Volume (cy)	
Armor	20,501	W_A50 = 16000lb
B	14,705	W_B50 = 1600lb
Core	11,423	W_C50 = 80lb
Dredge - GNF (Entrance Channel, Maneuvering Basin, Interior Channel)		
Material	Volume (cy)	
Mechanical Dredge	46,654	Dredge Area: 780,405 sf
"Ripping" Dredge	107,751	
Blasting Dredge	6,713	
Dredge - LSF (Maneuvering Basin Offset, Moorage Basin)		
Material	Volume (cy)	
Mechanical Dredge	5,752	Dredge Area: 77,967 sf
"Ripping" Dredge	17,621	
Blasting Dredge	1,154	
Maintenance		
Material	Volume (cy)	Interval
Mechanical Dredge	40,000	20years
Armor Replacement	1,177	25 years
Uplands		
Material	Volume (cy)	
Fill	50,149	
Aggregate Surface	1,883	6" Lift
Subbase	3,766	2 x 6" Lift
Armor	1,558	1500 lb
RipRap	1,371	150 lb
Sheetpile (linear feet)	276	
Access Road		
Material	Volume (cy)	Note
E1	12	6" Lift
C1	24	2 x 6" Lift
Fill	24	
Cut	-	
Excavation	-	
Bedding Layer	25	
24" CMP Culverts (L = 50 ft)	50	
Facilities		
Feature	Quantity	
Moorage Points	2	
Fuel Header (lf)	300	
Boat Launch	1	250 ft x 35 ft

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Exhibit 7 – Detailed Recommended Plan Costs

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Elim Harbor Construction Cost Estimate
Recommended Plan - Alt 5 Optimized

WBS No.	Feature Account / Item Description	UOM	Quantity		Unit Cost	Total Cost	Notes
Cost Share	**Breakwater**						
	Mod Demobe - Total Project - 85% of Total Costs						
	Mob/Demob Breakwater & Dredging	EA	3	$	701,716	$2,105,147	
	Mob/Demob Drill and Blast	EA	1	$	1,020,585	$1,020,585	
	West Breakwater						
	"A" - Rock	CY	26,576	$	406.64	$10,806,771	
	"B" - Rock	CY	18,872	$	328.91	$6,207,088	
	"C" - Rock	CY	17,128	$	189.44	$3,244,732	
	East Breakwater						
	"A" - Rock	CY	20,501	$	406.64	$8,336,645	
	"B" - Rock	CY	14,705	$	328.91	$4,836,582	
	"C" - Rock	CY	11,423	$	189.44	$2,163,899	
	Navigation Aids and Marker Foundations	EA	2	$	35,334.00	$70,668	
	Dredging						
	Dredge and Dispose-Basin, Ent Chan, Surveys	CY	46,654	$	22.26	$1,038,518	
	"Ripping" Dredge and Dispose-Basin, Ent Chan	CY	107,751	$	59.16	$6,374,527	
	Blasting	SF	6,713	$	17.74	$119,096	
	Survey	SF	780,405	$	1.36	$1,061,351	
				Sub-Total (Cost Share)		**$47,385,609**	
LSF							
	Dredging						
	Mod Demobe - Total Project - 15% of Total Costs						
	Mob/Demob Breakwater & Dredging	EA	3	$	123,832	$371,497	
	Mob/Demob Drill and Blast	EA	1	$	180,103	$180,103	
	Dredge and Dispose-Basin, Ent Chan, Surveys	CY	5,752	$	22.26	$128,037	
	"Ripping" Dredge and Dispose-Basin, Ent Chan	CY	17,621	$	59.16	$1,042,460	
	Blasting	SF	1,154	$	15.79	$18,226	
	Survey	SF	77,967	$	1.36	$106,036	
	Upland						
	Fill	CY	50,149	$	47.72	$2,393,119	
	Armor - 1500lb	CY	1,558	$	327.63	$510,316	
	Base Layer - 150 lbs	CY	1,371	$	235.80	$323,369	
	Aggregate Surface	CY	1,883	$	149.75	$282,012	
	Subbase	CY	3,766	$	275.50	$1,037,653	
	Sheetpile	LF	276	$	19,923.40	$5,498,858	
	Access road						
	E1	CY	12	$	156.96	$1,904	
	C1	CY	24	$	230.49	$5,592	
	Fill	CY	24	$	47.72	$1,158	
	Cut	CY	-	$	-	$0	
	Riprap	CY	-	$	-	$0	
	Excavation	CY	-	$	-	$0	
	Bedding Layer	CY	25	$	170.00	$4,250	
	24" CMP Culverts (L = 50 ft)	LF	50	$	66.00	$3,300	
	Facilities						
	Moorage Points	EA	2	$	37,034.00	$74,068	Fender Pile From Nome
	Fuel Header	LF	300	$	203.90	$61,170	
	Boat Launch	EA	1	$	124,096.00	$124,096	Cast In Place Concrete
				Sub-Total (LSF)		**$12,167,224**	
					GNF + LSF	$59,552,833	
					Lands and Damages	$112,000	
				PED	(Allowance)	$4,000,000	
				SIOH	(Allowance)	$5,000,000	
				Estimate Contingency	28%	$19,226,000	Based on CSRA
					Total Project Cost	**$87,891,000**	
					Total O&M Costs - No Markup	**$4,300,000**	
	Maintenance Dredging						
	Mobe	LS	1	$	700,000.00	$700,000	Based on historical Nome Maint. Dredge Contract
	Dredge	CY	40,000	$	10.00	$400,000	Every 18 years
	Survey	SF	858,373	$	0.50	$429,186	Every 25 years
	Maintenance Armor Replacement						
	Mobe	LS	1	$	2,000,000.00	$2,000,000	
	Dredge	CY	1,177	$	572.00	$673,202	
				Sub-Total (Maint.)		**$4,300,000**	

Prepared by: CEPOA-EC-D-CE
Matt Collins
Jon Capua

Reviewed by: Karl Harvey

Quantity Input: Rebecca Kloster

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Exhibit 8 – Recommended Plan Cost and Schedule Risk Analysis

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Contingency on Base Estimate	80% Confidence Project Cost	
Base Construction Estimate	**$58,850,016**	
Baseline Estimate Cost Contingency Amount ->	$16,478,004	**28%**
Baseline Estimate Construction Cost (80% Confidence) ->	**$75,328,020**	

Contingency on Schedule	80% Confidence Project Schedule	
Project Base Schedule Duration ->	**80.1 Months**	
Schedule Contingency Duration ->	9.6 Months	12%
Project Schedule Duration (80% Confidence) ->	**89.7 Months**	

Elim Tribal Subsistence Harbor

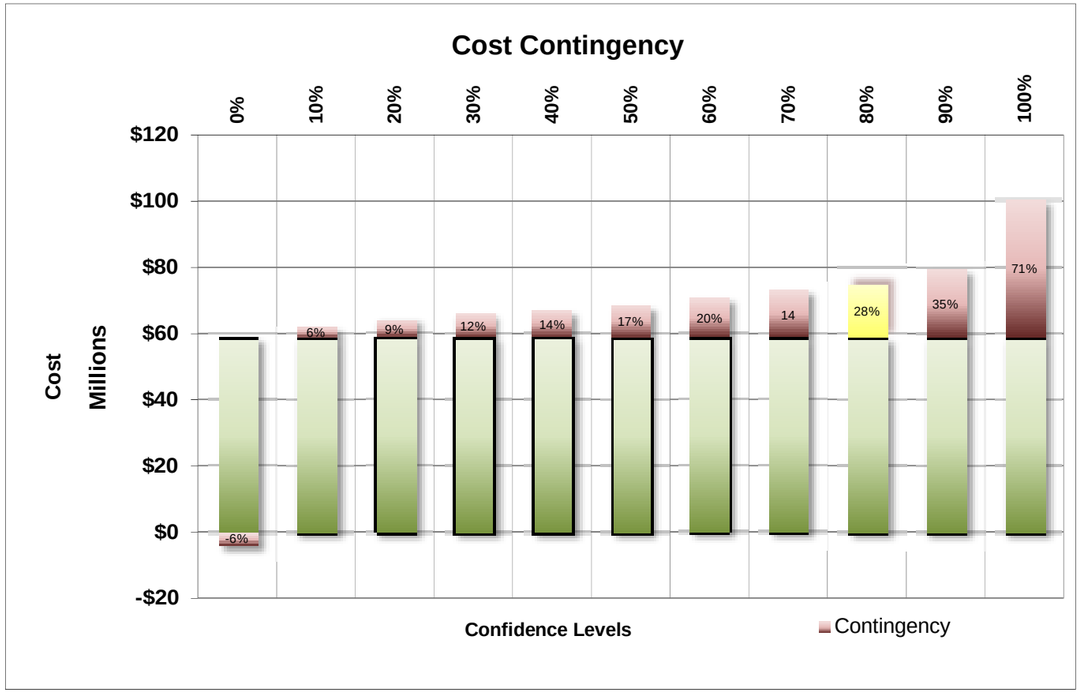
- PROJECT CONTINGENCY DEVELOPMENT -

INITIAL CONSTRUCTION

Contingency Analysis

Base Case Estimate (Excluding 01)	$58,850,016

Confidence Level	Contingency Value	Contingency
0%	-3,531,001	-6%
10%	3,531,001	6%
20%	5,296,501	9%
30%	7,062,002	12%
40%	8,239,002	14%
50%	10,004,503	17%
60%	11,770,003	20%
70%	14,124,004	24%
80%	**16,478,004**	**28%**
90%	20,597,506	35%
100%	41,783,511	71%

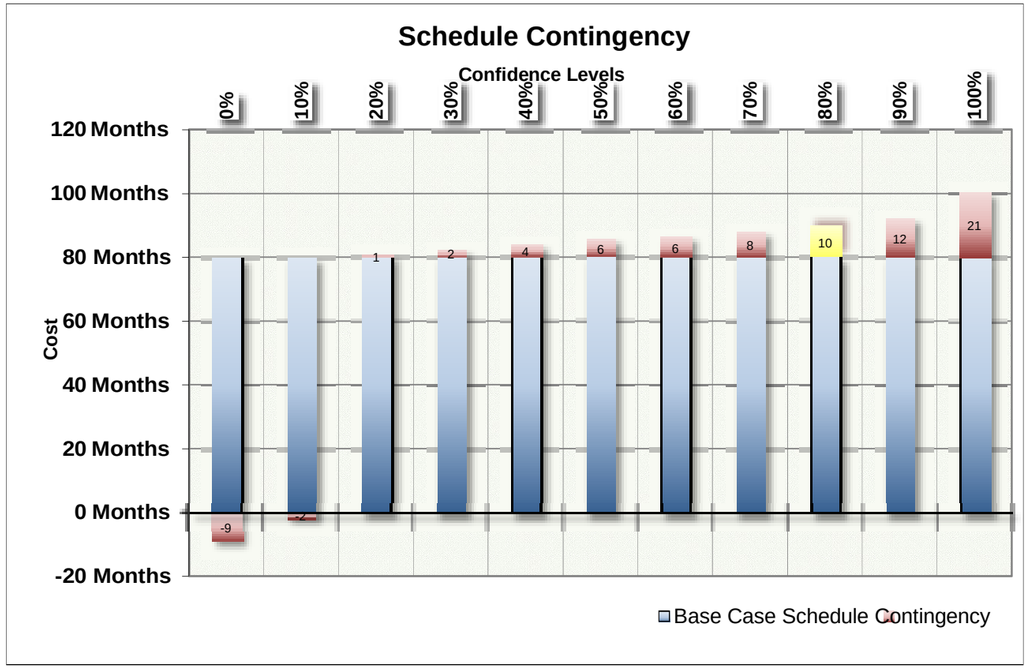


Elim Tribal Subsistence Harbor

- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

Base Case Schedule	80.1 Months	
Confidence Level	**Contingency Value**	**Contingency**
0%	**-9 Months**	**-11%**
10%	**-2 Months**	**-2%**
20%	**1 Months**	**1%**
30%	**2 Months**	**3%**
40%	**4 Months**	**5%**
50%	**6 Months**	**7%**
60%	**6 Months**	**8%**
70%	**8 Months**	**10%**
80%	**10 Months**	**12%**
90%	**12 Months**	**15%**
100%	**21 Months**	**26%**



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				Project Cost			Schedule			Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Suggested Risk Reduction Measures
Organizational and Project Management Risks (PM)																												
PM 1	Project funding	project requires local sponsor to fund a large cost to move this project forward. Is that realistic?	.local sponsor has committed to pursuing their part of the project and is confident they can get funding. If funding is not identified by GNF or local (this is possible), project will not go forward. If in the future it did, the cost would be adjusted for escalation so impact would be neg	Possible	Marginal	**Low**	Possible	Marginal	**Low**																			
PM 1	Project chance of being approved	Project might get to congress and not obtain approval due to current administration not prioritizing this type of project or any other reason	.If project is not funded by congress than project is delayed to a future year and cost incurred are escalation.	Possible	Marginal	**Low**	Possible	Marginal	**Low**																			
Contract Acquisition Risks (CA)																												
CA1	Congressional Authorization Delay	Delay in congressional authorization if WRDA is only every even year	This delay in authorization could cause a delay in getting to PED phase which would change current scheduled construction year and escalation estimates.	Possible	Marginal	**Low**	Likely	Moderate	**Medium**								0 Months	0 Months	12 Months	$0	$0	$1,358,600	100%	$0	100%	0 Mo	If congress must wait an additional year for approval it would add 12 months onto the schedule and increase project escalation.	

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				Project Cost			Schedule			Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule				
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Suggested Risk Reduction Measures
CA2	Bidder Competition Risk	Low number of interested bidder causes an increase in contract cost	Due to the remote nature of the project and possible funding limitations, not many contractors may be interested or capable to complete the work and thus there might be a low bidder turn-out and an associated increase in contract cost.	Possible	Marginal	**Low**	Likely	Moderate	**Medium**					-$4,345,600	$0	$8,691,200							100%	$0	100%	0 Mo	Assume - 5% to 10% swing in contract cost due to low bidder competition.	Conduct industry day meetings with contractors to get a strong feel for the current market and number of interested bidders.
CA3	Split contract into multiple contracts for piecemeal award	Contract could be written such that multiple awards for major features of work could be awarded individually to complete the work separately.	Due to the remote and small village this method of contract award was not supported by the PDT. When completing work in a small village it is necessary for there to be a Prime contractor procuring and providing local resources for their crews and their subcontractors.	Unlikely	Moderate	**Low**	Unlikely	Marginal	**Low**																				
Civil/Site Design (CV)																													
CV1	Increase in armor rock quantity.	Potential need for armor toe to be added to the inside of the breakwater.	Event could occur if it is determined that ice shove events could occur inside of harbor. Could also occur is ice shove event occurs from the south east.	Unlikely	Marginal	**Low**	Unlikely	Marginal	**Low**														100%	$0	100%	0 Mo		

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				Project Cost			Schedule			Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule				
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Suggested Risk Reduction Measures
CV2	Increase in armor rock quantity.	Potential need for armor toe to be added to the inside of the breakwater.	In the even soft material is discovered there was be a need for extra armor to be added to the break water for stability.	Unlikely	Marginal	Low	Unlikely	Marginal	Low														100 %	$0	100 %	0 Mo		
CV3	Use of smaller armor rock	Possible for smaller armor rock to be utilized while maintaining the same benefits/stability.	Research on existing projects should be conducted to determine whether smaller ice rock can be utilized for the break water.	Likely	Negligible	Low	Unlikely	Negligible	Low														100 %	$0	100 %	0 Mo		
CV4	dredge geotech information	Information pertaining to the near shore geotech conditions of the dredge material is still incomplete.	No boreholes exist for the near shore geotech area and the geophysical survey does not cover the entire dredge prism. Once information is obtained it could affect dredging costs estimates during PED phase by redefining the geotech assumptions and requiring more ripping	Likely	Moderate	Medium	Unlikely	Negligible	Low					$0	$0	$722,000							100 %	$0	100 %	0 Mo	Assume that new geotech information increases the need for ripping. Current Design calls for pre-ripping 36% of dredge material. Assume double the ripping quantity.	Obtain geotech information as soon as possible.

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				Project Cost			Schedule			Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Suggested Risk Reduction Measures
CV5	Revetment design around uplands	Will armor rock need to be designed for wave or ice loads	Current assumption is that due to the revetment is interior to the break water there is no design consideration of wave or ice resistance. If designs change during PED and the revetment becomes exposed to those actions than armor rock will need to be increased to provide adequate protection.	Possible	Moderate	**Medium**	Unlikely	Negligible	**Low**					$0	$0	$9,750,000							21%	$0	100 %	0 Mo	Qty. of rock increase from H&H for revetment redesign if required.	H&H determine requirements and develop more in depth design.
CV6	dredge geotech information	Information pertaining to the near shore geotech conditions of the dredge material is still incomplete.	No boreholes exist for the near shore geotech area and the geophysical survey does not cover the entire dredge prism. Once information is obtained it could affect dredging costs estimates during PED phase by redefining the geotech assumptions and requiring more Blasting	Likely	Moderate	**Medium**	Unlikely	Negligible	**Low**					$0	$0	$10,200,000							100 %	$0	100 %	0 Mo	Assume that new geotech information increases the need for blasting. Current Design calls for minimal blasting. Assume 50% material must be blasted prior to dredging. Increases Blasting costs from $120,000 to $10.2 million	Obtain geotech information as soon as possible.

Elim - CSRA 10-05-2020.xlsmElim - CSRA 10-05-2020.xlsmRiskModel

				Project Cost			Schedule			Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussion on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility/ POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS)(Min)	Likely Added Cost (CS)	High Variance (CS)(80%H)	Event Prob (PC)	Simulated Cost(C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Suggested Risk Reduction Measures
Lands and Damages (LD)																											
LD1	Current land information is lacking; i.e. appraisals, current disposition, or availability.	Lack of information could cause costs or availability to fluctuate as project defines needs.	Native corporation is the owner and will need to be engaged to determine availability.	Possible	Negligible	Low	Possible	Marginal	Low														100%	$0	100%	0 Mo		
Regulatory Environmental Risks (RG)																											
RG 1	Delay to IHA acquisition	Could be 9 months for IHA to review	Need to Develop blasting plan and submit for 9 months NOAA HQ	Very Likely	Marginal	Medium	Very Likely	Marginal	Medium								0 Months	0 Months	3 Months	$0	$0	$276,000	100%	$0	100%	0 Mo	PED costs are ~$138,000. Assume permitting process is delayed 3 months due to contractor means and methods change. 2 x $138,000	
RG 1	Marine mammal habitat mitigation	Marine mammal habitat mitigation due to blasting requirements	If blasting is required than environmental restrictions will require habitat mitigation to protect marine mammals	Possible	Moderate	Medium	Possible	Marginal	Low					$0	$0	$500,000							100%	$0	100%	0 Mo	Assume bubble curtain is used around the blasting site and observers are deployed around the area to watch for mammals.	
Construction Risks (CO)																											
CO 1	Construction of break water	Sequencing of construction of rubble mound break water	Construction sequencing will have been determined and researched during PED. If the contractor determined it is more efficient to perform the work in a different manner, which could affect permitting and approvals.	Possible	Moderate	Medium	Possible	Moderate	Medium								0 Months	0 Months	4 Months	$0	$0	$276,000	100%	$0	100%	0 Mo	PED costs are ~$138,000. Assume permitting process is delayed 2 months due to contractor means and methods change. 2 x $138,000.	Conduct industry day meetings to get a feel for most anticipated means and methods.

CO 2	Breakwater vs. channel construction	Sequencing of construction of rubble mound break water vs dredging of channel.	If Construction sequencing of breakwater vs dredging of the channel is prescriptive per the contract, during an event (i.e. weather or sea fluctuations) there is the possibility the contractor could claim a change order for time and money.	Possible	Marginal	**Low**	Possible	Marginal	**Low**																	100 %	$0	100 %	0 Mo		
Estimate and Schedule Risks (ES)																															
ES1	Rock material costs	Potential for rock costs to fluctuate from current quotes.	Project construction is 5+ years out and forecasting rock costs is no guaranteed. **** If rock costs bust the estimate there is potential for the project to need to be re-advertised.	Very Likely	Significant	**High**	Possible	Marginal	**Low**					$0	$0	$4,500,000								100 %	$0	100 %	0 Mo	Cost delta considers the historical fluctuation of rock sourced from Nome quarry based on local demand and changing quarry ownership. $4.5 mil accounts for delta from 2015 quote to 2019 quote where costs decreased.	Obtain new rock quotes as PED proceeds.

ES2	Fill material Costs	If no local fill material is available than costs would increase	Current costs consider material sourced locally and affordably. If that source is not acceptable, then costs would increase greatly to obtain from the quarry.	Possible	Significant	**Medium**	Unlikely	Marginal	**Low**					$7,650,000	$0	$15,300,000							21%	$0	100%	0 Mo	Current TSP Alt 5 considers material for the backfill of the LSF upland structure to be sourced from the local quarry due to uncertainty of local sourced material. TSP alt 5 optimized allows for material sourced from the local source. $15,300,000 million is the difference in cost to purchase and barge in material from local quarry.	
ES3	Class 3 Estimate Assumptions	Current Cost estimate is level 3.	January 2018 estimate has been updated to Level 3. Quantities are well developed. Historical costs and production rates were available. Discussions were held with contractor. Estimate is considered moderate risk.	Possible	Moderate	**Medium**	Possible	Marginal	**Low**	Triangular	N/A -Not Modeled	Cost Engineering	Contract Cost	-$1,698,250	$0	$2,717,201							100%	$0	100%	0 Mo		Developing the estimate to a class 2 level will decrease the accuracy range.
External Risks (EX)																													
EX1	Additional Mob	Extra mob due to weather delay, environmental permitting,		Unlikely	Critical	**Medium**	Possible	Moderate	**Medium**								0 Months	0 Months	12 Months	$0	$0	$951,666	100%	$0	100%	0 Mo	Current estimate is based on 3 mobilizations. If a fourth one is needed due to the inability to complete work in 3 years.	