US Army Corps
of Engineers®
Alaska District

Integrated Feasibility Report and
Environmental Assessment

Elim Subsistence Harbor
Elim, Alaska

November 2020

This page was intentionally left blank.

Integrated Feasibility Report and Environmental Assessment

Elim Subsistence Harbor

Elim, Alaska

Prepared by

United States Army Corps of Engineers

Alaska District

November 2020

This page was intentionally left blank.

EXECUTIVE SUMMARY

The Elim Subsistence Harbor Study, Integrated Feasibility Report and Environmental Assessment (IFR/EA) was prepared under authority granted by Section 203 of the Water Resources Development Act (WRDA) of 2000, Tribal Partnership Program, as amended by Section 1031(a) of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), and Section 1121 of the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN/WRDA 2016). This study also utilized the authority of Section 2006 of WRDA 2007, Remote and Subsistence Harbors, as amended by Section 2104 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014) and further amended by Section 1105 of WRDA 2016. The Section 2006 authority states that the Secretary may recommend a project without demonstrating that the improvements are justified solely by National Economic Development (NED) benefits if the Secretary determines that the improvements meet specific criteria detailed in the authority. The Section 2006 provision allows for the recommendation of harbor navigation improvements based on long-term community viability benefits within the region served by the project. This study meets the Section 2006 criteria. The study is cost-shared in accordance with the ability to pay provisions within Section 203, as amended. Due to the need to obtain a letter of authorization (LOA) in Preconstruction Engineering and Design (PED), a policy exception for Marine Mammal Protection Act/Endangered Species Act (MMPA/ESA) was approved by Headquarters, Unites States Army Corps of Engineers (HQUSACE) on 05 October 2020.

Elim is located on the northwest shore of Norton Bay on the Seward Peninsula, 96 miles east of Nome, and 460 miles northwest of Anchorage. The purpose of this study is to identify a feasible solution that provides safe, reliable, and efficient navigation, access, and moorage for the subsistence and commercial fleet and tenders, as well as fuel and freight barges serving the community of Elim, Alaska. Elim has no moorage, harbor, or boat landing infrastructure. The lack of infrastructure affects commercial and subsistence fishers, tender vessels, and the barges delivering fuel and freight to the community. Navigation-related issues at Elim result from transportation inefficiencies and vessel damages with barges unable to land at Elim except during high tide; fuel barges floating long hoses on the water surface to offload fuel, which carries a higher risk for spillage and environmental consequences; and loss of commercial fish due to the inefficiencies associated with fish buying stations and tender operations. Marine infrastructure at Elim would enhance the community's long-term viability and improve efficiency by providing direct access and moorage for all these vessels and by providing safer operations for residents.

The cultural identity of Alaska Native Tribes is highly dependent upon subsistence activities tied to specific locations, and in-depth historical knowledge of land and subsistence resources. The availability and affordability of fuel and other essential goods are critical. Many rural economies in Alaska, including that which exists at Elim, can be characterized as mixed subsistence-cash economies. The subsistence and cash sectors are interdependent and mutually supportive. The ability to successfully participate in subsistence activities is highly dependent on the opportunity to earn some form of monetary income and access the resources. Without a safe and functioning harbor, limited access to subsistence resources and high costs of basic essential goods and building materials, coupled with limited economic opportunities, compound the threats to community viability. Factors impacting community viability include (but are not limited to): costs to add or replace critical infrastructure, food security, access to subsistence resources, and the need to address mental health and substance abuse by a strengthened sense of identity through revived participation in traditional subsistence practices.

Four preliminary sites were identified: Elim Beach, Airport Point, Iron Creek, and Moses Point. Subsequent screening resulted in two sites: Elim Beach and Airport Point, being carried forward for analysis. In addition to a No Action plan (Alternative 1), six alternatives (Alternatives 2–7) were initially evaluated. Alternatives at Airport Point (Alternatives 6–7) were eliminated because there were little or no added benefits with a substantial increase in cost for these alternatives. NED analysis was conducted, but no NED plan was identified. Under Section 2006, the project delivery team (PDT) can utilize a Cost-Effectiveness/Incremental Cost Analysis (CE/ICA) to support plan selection. The CE/ICA produced two best buy alternatives for the project other than the No Action plan (Alternatives 2 and 5). Alternative 5 provided the most effective and complete approach to addressing the problem and objectives, while also efficiently realizing the specified opportunities compared to cost and being environmentally acceptable.

Alternative 5 was endorsed as the Recommended Plan at the Agency Decision Milestone in July 2020. The Recommended Plan was optimized based on Alternative 5 with optimization from review comments and community input. All comments that were received during the review process would impact each alternative in the same fashion, so reformulation based on design comments was not required and only Alternative 5 was optimized. The differences between Alternative 5 presented in Section 5.5 “Description of Alternative Plans” and Section 7 “Recommended Plan” is due to these changes from optimization. The following alterations were made during optimization:

- The east breakwater was straightened and attached to shore for ease of construction and to limit circulation impacts within the harbor resulting in a design that consists of the east rubble-mound breakwater 820 feet (ft) long and the west rubble-mound breakwater 986 ft long. That would provide a 1.4-acre moorage basin for 50 boats ranging in length from 18 ft to 32 ft, an interior channel to provide access to the boat launch, and a 2.5-acre turning and maneuvering basin for the tenders and tug and barge. This plan would provide shelter from waves propagating out of the west through southwest and from the east.

- The entrance channel width was widened from 250 ft to 300 ft to meet recommendations in EM 1110-2-1615 (USACE 1984).
- The required safety clearance for channels with a hard bottom was adjusted from 2 ft to be 3 ft (USACE 1984).
- An armored toe was added to the breakwater's oceanside to provide greater resiliency from the movements of shorefast ice.
- The uplands were reduced, while providing the same level of benefits, to 1 acre for temporary uplands boat moorage and vehicle and trailer parking. The uplands would need to be armored to withstand the force of the largest waves expected within the harbor.
- The access road layout was modified to tie into a planned laydown pad towards the west end of Front Street, shortening the road to 250 ft running along the base of the bluff.
- The boat launch's elevation was altered from +16 ft Mean Lower Low Water (MLLW) to +10 ft MLLW while maintaining a lower elevation of -5 ft MLLW and a 13% slope.
- The barge landing was widened from 70 ft to 100 ft with a 1:4 slope from -8 ft MLLW up to +16 ft MLLW to allow for barge loading and unloading.

The Recommended Plan includes a harbor at Elim Beach sized to accommodate one 160-ft barge and associated 86-ft tug, two tenders, and 50 vessels varying in size from 18 ft to 32 ft. The plan consists of a 300 ft wide entrance channel with a dredging depth of -13.0 ft MLLW, two rubble-mound breakwaters that encompass a 1.4 acres moorage basin to accommodate the 50 vessels, and an interior channel to provide access to the boat launch with a dredging depth of -9.0 ft MLLW. And a 2.5-acre turning and maneuvering basin with a dredging depth of -13.0 ft MLLW to provide access to a tender dock, a barge landing with two moorage points, and space for the tender and barge and tug to turn. The west breakwater would be approximately 986 ft long and the east breakwater approximately 820 ft long. The eastern breakwater would be attached to the land. Also included in the project is approximately 1 acre of uplands for upland boat moorage and vehicle and trailer parking, a road approximately 250 ft in length to connect the uplands to the boat launch, and an extension to the existing fuel header currently located on the bluffs above Elim Beach. The fish buying station would also be relocated from Moses Point to Elim. It is anticipated that approximately 40,000 cubic yards (cy) of maintenance dredging will be required every 20 years. It is anticipated that approximately 1,177 cy of the armor stone will need to be replaced every 25 years due to the possibility of an ice ride up.

The project costs of the Recommended Plan are based on the design optimization of Alternative 5. As presented in the following Pertinent Data section, the project's first costs differ from the Alternative 5 project costs presented in the Economics Analysis comparing the full suite of alternatives.

Based on the CE/ICA, the Recommended Plan would provide for 5,544 Opportunity Days to support the subsistence fleet, commercial fleet, and the fuel and cargo barge. These additional days would allow for the more efficient delivery of fuel and goods to the community and increase opportunities to harvest subsistence and commercial resources.

The Recommended Plan has a project first cost of $74,538,000 (1 October 2020 price level). The Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) costs for the project are estimated at $6,075,000 or $214,000 annually, of which $131,000 annually is General Navigation Features (GNF) OMRR&R and $83,000 annually is Local Service Facilities (LSF) OMRR&R. The total average annual equivalent cost for the Recommended Plan is $3,451,000. With net annual equivalent benefits of $1,107,000, the project’s benefit-cost ratio is 0.32, and net annual National Economic Development benefits are -$2,344,000.

PERTINENT DATA

Recommended Plan: Alternative 5, Elim Beach: Commercial and Subsistence Fleet with 2 Tenders and Fuel and Freight Barge Access	
Breakwaters	
Armor Rock	47,077 cy
B Rock	33,577 cy
Core Rock	28,551 cy
New Work Dredge Quantities	
General Navigation Features	161,118 cy
Local Service Facilities	24,527 cy
Total Dredge Volume	185,645 cy
Maintenance Dredge Quantity and Frequency	
Assumes dredge every 20 years	40,000 cy
Rock Maintenance Quantity and Frequency	
Assumes 2.5% armor stone replaced every 25 years	1,177 cy
Uplands	
Fill	50,149 cy
Revetment – Armor Rock	1,558 cy
Revetment – B Rock	1,371 cy

Economics	
Item	**Total ($)**
Average Annual Equivalent Cost	$3,451,000
Average Annual Equivalent Benefit	$1,107,000
Net Annual National Economic Development Benefits	($2,344,000)
Benefit-Cost Ratio	0.32

Cost Share Table (October 1, 2020 Price Levels, Program Year (FY) 2021)[1]				
WBS Number	General Navigation Features (GNF)	Project Cost w/ Contingency	Federal Share	Non-Federal Share
	Mobilization/Demobilization	$4,121,000	$3,709,000	$412,000
10	Breakwaters	$46,924,000	$42,232,000	$4,692,000
12	Navigation Ports and Harbors	$11,327,000	$10,194,000	$1,133,000
30	Preconstruction, Engineering & Design (PED)[2]	$5,360,000	$4,824,000	$536,000
31	Construction Management (S&I)[2]	$6,692,000	$6,023,000	$669,000
1	Lands, Easements, Rights-of Way, Relocations (LERR) Reviews	$7,000	$6,000	$1,000
	Subtotal Construction of GNF	**$74,430,000**	**$66,987,000**	**$7,443,000**
1	Lands, Easements, Right-of-Ways, Relocations (LERR)[3]	$108,000		$108,000
	Section 1156 Waiver[4]		$511,000	($511,000)
	Ability to Pay reduction to 25% of normal share[5]		$5,199,000	($5,199,000)
	Total Project First Costs	**$74,538,000**	**$72,697000**	**$1,841,000**
12	Aids to Navigation[6]	$94,000	$94,000	
	10% Payback		($7,443,000)	($7,443,000)
	Credit for LERR[7]		$108,000	($108,000)
	Reduction of Post-Construction 2.5% Payback (25% of 10% IAW Ability to Pay rule)[5, 8]		5,501,250	($5,501,250)
	Mobilization/Demobilization-LSF	$726,000		$726,000
	Roads and Docks-LSF	$13,605,000		$13,605,000
12	Navigation Ports and Harbors- LSF	$1,706,000		$1,706,000
30	Preconstruction, Engineering & Design (PED)- LSF	$1,373,000		$1,373,000
31	Construction Management (S&I)-LSF	$1,718,000		$1,718,000
	Total Cost Apportionment	**$93,760,000**	**$70,957,250**	**$22,802,750**

1. Cost is based on Project First Cost (constant dollar basis) on the Total Project Cost Summary Spreadsheet, at an effective price level 1 Oct 2020 (Cost Appendix). Aids to Navigation broken out and shown as a separate cost. Reported costs are rounded and the reported sum is greater or less than the sum of the line items because of rounding errors.
2. PED and Construction cost-sharing totals are reflected as 90% Federal/10% non-Federal.
3. These include LERR and Real Estate administrative costs with escalation from the TPCS.
4. In accordance with Section 1156 of WRDA 1986, as amended, the Federal Government will waive up to the first $511,000 $511,000 of Design and Construction local cost-share (before the Ability to Pay provision is employed.)
5. Section 203 of WRDA 2000, as amended, provided that cost-share agreements for such studies are subject to a Tribe's ability to pay, as determined by the Secretary of the Army in accordance with procedures to be established by the Secretary.
6. Aids to Navigation are reflected as a Federal cost but are coordinated and paid for by the United States Coast Guard.
7. Credit is given for the incidental costs borne by the non-Federal sponsor for lands, easements, rights of way, and relocations (LERR) per Section 101 of WRDA 86, not to exceed 10% of the GNF.
8. The non-Federal sponsor shall pay an additional 10% of the costs of GNF of the NED plan, pursuant to Section 101 of WRDA 86. The value of LERR shall be credited toward the additional 10% payment except in the case of LERR for LSF.

LIST OF ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ACP	Alaskan Arctic Coastal Plain
ACS	American Community Survey
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADLWD	Alaska Department of Labor & Workforce Development
ADM	Agency Decision Milestone
ADNR	Alaska Department of Natural Resources
AEP	Annual Exceedance Probability
AHRS	Alaska Heritage Resources Survey
ALUC	Alaska Land Use Council
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
ANTHC	Alaska Native Tribal Health Consortium
ATON	Aids to Navigation
APE	Area of Potential Effect
ARNG	Army National Guard
ARRA	American Recovery and Reinvestment Act
AS	Alaska Statutes
ASCE	American Society of Civil Engineers
ATV	All-Terrain Vehicle
AVEC	Alaska Village Electric Corporation
BA	Biological Assessment
BCR	Benefit-Cost Ratio
BMPs	Best Management Practices
BOEM	Bureau of Ocean Energy Management
C	Celsius
CAA	Clean Air Act
CAFF	Conservation of Arctic Flora and Fauna
CAP	Continuing Authorities Program
CDP	Census Designated Place(s)
CDQ	Community Development Quotas
CEDEP	Cost Engineering Dredge Estimating Program
CE/ICA	Cost-Effectiveness and Incremental Cost Analysis
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, Liability Act
CFR	Code of Federal Regulations
CH	Critical Habitat
CO	Carbon Monoxide
CSRA	Cost and Schedule Risk Analysis
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CY	Cubic Yards

dB	Decibel
dBA	A-weighted decibel
DCRA	Division of Community and Regional Affairs
DEFRA	Department for Environment, Food and Rural Affairs
DDN-PCX	Deep Draft Navigation Center of Expertise
DPS	Distinct Population Segment
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EJ	Environmental Justice
E.O.	Executive Order
EPA	Environmental Protection Agency
E.O.	Executive Order
EQ	Environmental Quality
ER	Engineer Regulations
EJ	Environmental Justice
ESA	Endangered Species Act
Etc.	Et Cetera
F	Fahrenheit
FCSA	Federal Cost Sharing Agreement
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Regulation
ft	Foot/Feet
FUDS	Formerly Used Defense Site
FWCA	Fish and Wildlife Coordination Act
FWOP	Future Without Project
FWP	Future With Project
GMSL	Global Mean Sea Level
GNF	General Navigation Feature
HAPC	Habitat areas of particular concern
HF	High Frequency
H&H	Hydraulics and Hydrology
HOOH	Home Office Overhead
HTRW	Hazardous, Toxic, and Radiological Waste
IDC	Interest During Construction
IFR/EA	Integrated Feasibility Report and Environmental Assessment
IHA	Incidental Harassment Authorization
IPPC	Intergovernmental Panel on Climate Change
IRA	Indian Reorganization Act
kHz	Kilohertz
km	Kilometer
km/h	Kilometers per hour
LBS	Pounds
LE	Cumulative sound exposure level

LEDPA	Least Environmentally Damaging Practicable Alternative
L_{eq}	Time-weighted noise intensity level
LERR	Lands, Easements, Rights of Way, and Relocations
LERRD	Lands, Easements, Rights of Way, Relocations, and Disposal Area
LF	Low Frequency
L_{max}	Average maximum noise intensity level
LSF	Local Service Facilities
MBTA	Migratory Bird Treaty Act
MF	Medium Frequency
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MPRSA	Marine Protection, Research and Sanctuaries Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MTL	Mean Tide Level
N/A	Not Applicable
NAAQS	National Ambient Air Quality Standards
NED	National Economic Development
NEPA	National Environmental Policy Act
nm	Nautical miles
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fisheries Management Commission
NFS	Non-Federal Sponsor
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrous oxides
NPS	National Park Service
NRC	National Research Council
NRHP	National Register of Historic Places
NSEDC	Norton Sound Economic Development Corporation
NSSP	Norton Sound Seafood Products
NTU	Nephelometric Turbidity Unit
O_3	Ozone
O&M	Operation and Maintenance
OCT	Opportunity Cost of Time
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
OSE	Other Social Effects
PAME	Protection of the Arctic Marine Environment
Pb	Lead
PCE	Primary Constituent Element
PED	Preconstruction Engineering and Design
pH	Power of Hydrogen

PK	Peak sound level
PM_{10}	Particulate matter 10 micrometers or less in diameter
$PM_{2.5}$	Particulate matter 2.5 micrometers or less in diameter
PPA	Project Partnership Agreement
PSO	Protected Species Observer
PSU	Practical Salinity Unit
PTS	Permanent Threshold Shift
R	Republican
RECONS	Regional Economic System
RED	Regional Economic Development
ROI	Region of Influence
ROM	Rough Order of Magnitude
RSLC	Relative Sea Level Change
SHPO	State Historic Preservation Officer
SIOH	Supervision, Inspection, and Overhead
SLC	Sea Level Change
SO_2	Sulfur dioxide
TSP	Tentatively Selected Plan
TTS	Temporary Threshold Shift
μParms	Micropascals (expressed in root mean square)
U.S.	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USD-HUD	United States Department of Housing and Urban Development
USDOT	United States Department of Transportation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USN	United States Navy
VLM	Vertical Land Movement
VOC	Vessel Operating Costs
WCSC	Waterborne Commerce Statistics Center
WRDA	Water Resources Development Act
WSDOT	Washington State Department of Transportation

TABLE OF CONTENTS

*NEPA required sections

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1. INTRODUCTION

1.1. Scope of Study

This study evaluates the feasibility and environmental effects of implementing navigation improvements at Elim, Alaska. USACE Engineer Regulation (ER) 1105-2-100, “Planning Guidance Notebook,” defines the contents of feasibility reports for navigation improvements. ER 200-2-2, “Procedures for Implementing NEPA,” directs the contents of environmental assessments. This document presents the information required by both regulations as an Integrated Feasibility Report and Environmental Assessment (IFR/EA). It also complies with the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA, 42 U.S.C. 4321 et seq.).

1.2. Project & Study Authority

Section 203 of the Water Resources Development Act (WRDA) of 2000 Tribal Partnership Program as amended by Section 1031(a) of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), and Section 1121 of the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN/WRDA 2016), provides authority for the United States Army Corps of Engineers (USACE) in cooperation with Indian tribes (Section 1.4, “Key Stakeholders”) and heads of other Federal agencies to study and determine the feasibility of carrying out projects that will substantially benefit Indian tribes. Section 203, as amended, states:

> “*In cooperation with Indian tribes and the heads of other Federal agencies, the Secretary may carry out water-related planning activities, or activities relating to the study, design, and construction of water resources development projects that—*
>
> *(A) will substantially benefit Indian tribes; and*
>
> *(B) are located primarily within Indian country (as defined in Section 1151 of title 18, United States Code) or in proximity to Alaska Native villages.”*

Section 203 further states:

> *“On the request of an Indian tribe, the Secretary shall conduct a study on, and provide to the Indian tribe a report describing, the feasibility of a water resources development project described in paragraph (1).”*

1.2.1. Additional Study Guidelines

In accordance with Section 1156 of WRDA 1986, as amended, the Federal Government will waive up to the first $455,000 of study execution from study cost-share requirements.

Implementation guidance for Section 1031(a) of WRRDA 2014 and Section 1121 WRDA 2016, Tribal Partnership Program (TPP), was issued on 5 February 2018. Section 203, as originally enacted in WRDA 2000, provided that cost-share agreements for such studies are subject to the ability of a Tribe to pay, as determined by the Secretary of the Army in accordance with procedures to be established by the Secretary. Meeting the ability to pay criteria could result in further cost-sharing requirements of the local sponsor, in addition to the initial $455,000 being waived. One of the non-Federal sponsor's, the Native Village of Elim, does meet the ability to pay criteria.

Section 1121 of WIIN/WRDA 2016 further amended Section 203 to expand the planning activities that the Secretary may carry out and to authorize the Secretary to undertake the design and construction of a project formulated under the Tribal Partnership Program (TPP) that the Secretary determines to be feasible if the Federal share is not more than $10,000,000. Section 303 of WRDA 2020 adjusted the Federal share to not more than $18,500,000. If the Federal share is not more than $18,500,000, completion of a Chief's Report is not needed. A project whose Federal share exceeds $18,500,000 may only be carried out upon further Congressional authorization and requires completion of a Chief's Report. This study, with a certified project first cost of $74,538,000, cannot be exempt from a Chief's report, and therefore a Chief's report will be completed.

Section 2006 of WRDA 2007 provides for project justification to be pursued via Remote and Subsistence Harbors, as modified by Section 2104 of WRRDA 2014 and Section 1105 of WRDA 2016 if sufficient National Economic Development (NED) benefits for project justification are not identified. The Remote and Subsistence Harbors authority specifically states that in conducting a study of harbor and navigation improvements, the Secretary may recommend a project without demonstrating that the improvements are justified solely by NED benefits if the Secretary determines that the improvements meet specific criteria detailed in the authority. The following are the criteria outlined in the authority:

The community to be served by the improvements is at least 70 miles from the nearest surface accessible commercial port and has no direct rail or highway link to another community served by a surface accessible port or harbor; or the improvements would be located in the State of Hawaii or Alaska, the Commonwealth of Puerto Rico, Guam, the Commonwealth of the Northern Mariana Islands, the United States Virgin Islands; or American Samoa;

The project meets this criterion as Elim is located in the State of Alaska.

The harbor is economically critical such that over 80% of the goods transported through the harbor would be consumed within the community served by the harbor and navigation improvement, as determined by the Secretary, including consideration of information provided by the non-Federal interest; and

The project meets this criterion. The community that is to be served by the navigation improvements is Elim, Alaska. Based upon weight, commodities transported in the future with-project condition were analyzed to determine that over 80 percent of the goods transported through the harbor (after construction) would be consumed within the community. Using available data from the Waterborne Commerce Statistics Center (WCSC), the basis of consumption is metric tons. Approximately 84 to 92 percent of the goods transported through the proposed harbor are consumed in Elim. To provide economic opportunities in Elim, consistent with the authority and study objectives, alternatives supporting commercial fishery exports from Elim are considered. These exports are projected to weigh less than 20 percent of the total tonnage going through the harbor when considering the market and institutional factors such as Community Development Quotas (CDQ) and associated export prices. Imports include the weight of fuel, freight, and construction materials, while exports included the weight of raw fish. Exports are estimated to range from 8 to 16 percent of the total weight of goods transported through the harbor. These estimates are conservative, given the analysis accounts for the projected growth in exports but assumes that the imports would remain the same.

The long-term viability of the community in which the project is located, or the long-term viability of a community that is located in the region that is served by the project and that will rely on the project, would be threatened without the harbor and navigation improvement.

The project meets this criterion. Remote Alaska communities face challenges that are complex and multifaceted. Rural economies in Alaska, including that which exists in Elim, can be characterized as mixed subsistence-cash economies in which the subsistence and cash sectors are interdependent and mutually supportive. Access to resources and the opportunity to earn some form of cash income are foundational for continued viability. Without a safe and functioning harbor, limited access to subsistence resources coupled with limited economic opportunities compounds the threats to community viability. The costs of basic essential goods required to support a subsistence lifestyle would remain prohibitively high. Reductions in the costs of such *basic essential goods are essential to community viability. The cultural identity of Alaska Native Tribes is highly dependent upon subsistence activities tied to specific locations and in-depth historical knowledge of land and marine subsistence resources. Given the social and cultural value of subsistence activities to tribal identities, the inaccessibility of subsistence resources can threaten communities. While population estimates suggest that Elim's population is stable, the population alone is not an adequate indicator of a viable community. The viability of a community is based on its ability to survive and thrive. When wage-paying employment is limited, coupled with lower than state average wages, a stable population in a remote community is still severely threatened.*

In considering whether to recommend a project under the criteria above, the Secretary will consider the benefits of the project to the categories listed below.

- Public health and safety of the local community and communities that are located in the region to be served by the project and that will rely on the project, including access to facilities designed to protect public health and safety;
- Access to natural resources for subsistence purposes;
- Local and regional economic opportunities;
- The welfare of the regional population to be served by the project; and
- Social and cultural value to the local community and communities located in the region to be served by the project, and that will rely on the project.

As indicated in the above narratives and throughout the report, navigation improvements at Elim would benefit each of the above listed categories. The project's benefits would provide positive effects for the community's social well-being, which extend beyond the NED benefits. Social well-being effects reflect a complex set of relationships and interactions between a proposed plan and the social and cultural setting in which these are received and acted upon (USACE 2000, Appendix D). For this study, these benefits are considered from a quantitative and qualitative perspective. In particular, the analysis uses the Cost-Effectiveness and Incremental Cost Analysis (CE/ICA) metric of Opportunity Days, which quantifies the occurrence of beneficial effects to quantify in non-monetary terms the contributions of a navigation project to social and economic opportunity benefit categories (listed above). These social well-being effects are expanded upon in Appendix D: Economics.

1.3. Non-Federal Sponsor

The Native Village of Elim (Tribe) is the Federally-recognized Tribe associated with the community of Elim. Tribal members comprise approximately 98% of the community population. The Tribe is the cost-sharing non-Federal sponsor (NFS) of this feasibility study. The Feasibility Cost Sharing Agreement (FCSA) was executed on 23 March 2018.

1.4. Key Stakeholders

Although there are multiple stakeholders in the proposed project, the key stakeholders are identified as the Native Village of Elim, the Elim Native Corporation, the City of Elim, Kawerak, Incorporated, and USACE (Figure 1). The community of Elim is located at the former Malemiut Inupiat village of *Nuviakchak*, which had been abandoned sometime before 1910. In 1914, Reverend L. E. Ost founded a Covenant mission and school at *Nuviakchak*, calling it the Elim Mission Roadhouse. A United States Post Office was established at Elim in 1943. Today, Elim is an Inupiat village with a fishing and subsistence lifestyle (BIA 1975; Kawerak 2020a).

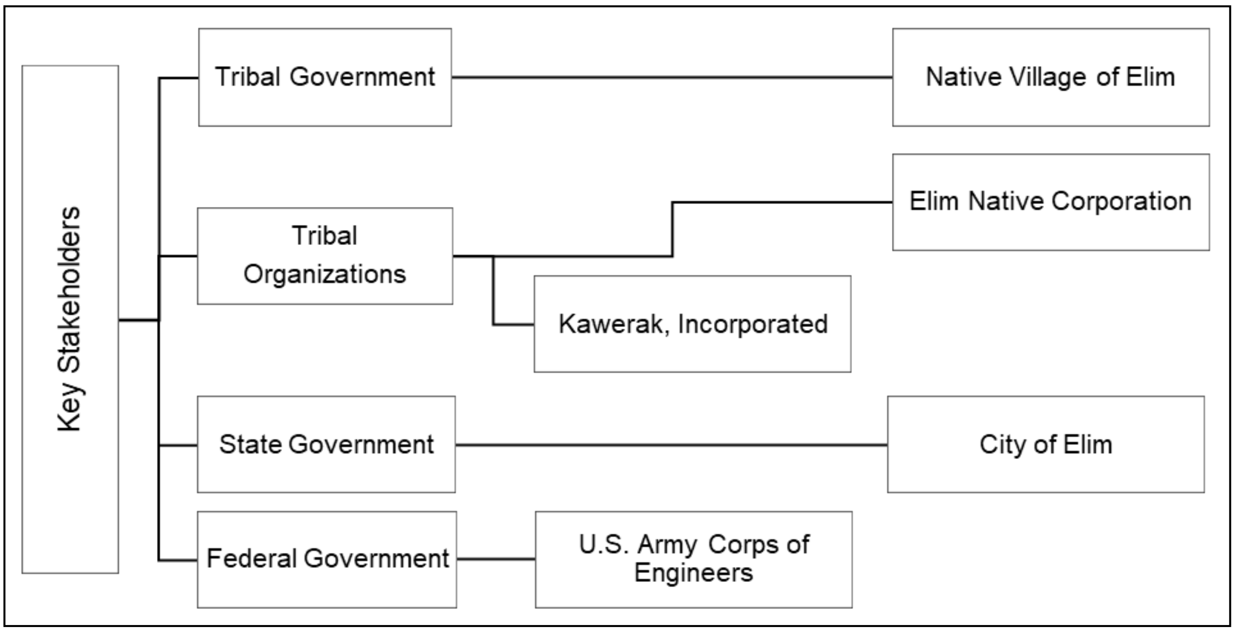

Figure 1. Overview of Key Stakeholders, Distinguishing between Regional and Local Levels

The Native Village of Elim (Tribe) is the Federally-recognized Tribe and local tribal government for the community of Elim. According to the most recent census data, approximately 98% of Elim community members identify as Alaska Native. Therefore, for this report, the term “community” will be used interchangeably with “Native Village of Elim.” The Native Village of Elim was first formed under the Alaska amendments of the Indian Reorganization Act (IRA) of 1934. Elim drafted an IRA Constitution and voted 28-0 to ratify the Secretary of the Interior’s approval on 24 November 1939 (BIA 1940; Mitchell 1997:275). The Elim IRA Council was formed and served as the only political body in Elim until Alaska became a state in 1959 (BIA 1975).

The Elim Native Corporation (ENC) is a for-profit Alaska Native organization formed under Section 8 of the Alaska Native Claims Settlement Act (ANCSA). After the ENC was formed, its shareholders, by a majority vote, elected to take both surface and subsurface fee simple title to the former Norton Bay Native Reserve under Section 19(b) of ANCSA ((P.L. 92-203) and Section 19(c) of ANCSA as amended (P.L. 106-194), forming the ENC (BIA 1975). Exercising the Section 19(b) option of ANCSA of 1971 removed ENC's eligibility for any distributions from Bering Strait Native Corporation (BSNC) and removed ENC's shareholders' eligibility to become regional corporation shareholders (GAO 2012:7). The Norton Bay Native Reserve, originally established by Executive Orders 2508 and 2525 in 1917 and partially revoked by Executive Order 5207 in 1929, encompassed 316,000 acres.

The City of Elim (City) is the local State government for the community of Elim. The City of Elim was incorporated in 1970. It was formerly a fourth-class city but automatically became a second-class city on 10 September 1972 due to revisions in Alaska Statute 29.08.050(a).

Kawerak, Incorporated (Kawerak) is a non-profit Alaska Native corporation that was incorporated under Alaska State law in 1973. Kawerak was originally organized by the Bering Straits Native Association, which was formed in 1967 as an association of the Native Villages in the Bering Strait Region (Kawerak 2020b). The Association was formed to advocate for the passage of ANCSA. Following the passage of ANCSA, Kawerak was organized to provide health and other important social services to Alaska Native peoples in the Bering Strait Region.

There is no regional State government organization in the area. The City lies within the Nome Census Area of the Unorganized Borough of Alaska. The Nome Census Area covers 22,970 square miles and roughly equates to what is known as the "Bering Strait Region."

USACE is a Federal agency within the Department of Defense.

Other important Stakeholder Organizations in the region include:

- Norton Sound Economic Development Corporation (NSEDC)
- Bering Straits Native Corporation (BSNC)
- Norton Sound Health Corporation (NSHC)
- Bering Straits Regional Housing Authority (BSHA)

1.5. Congressional District

The study area is in the Alaska Congressional District, which has the following Congressional delegation:

- Senator Lisa Murkowski, Republican (R);
- Senator Dan Sullivan, (R);
- Representative Don Young, (R).

1.6. Related Reports and Studies

A Continuing Authorities Program (CAP) Section 107 study was initiated in 2013 but was not completed due to a lack of sufficient NED benefits. USACE also conducted the Alaska Baseline Erosion Assessment (USACE 2009), Elim Erosion Information Paper in February 2008.

1.7. Alaska Tribal Communities

The indigenous peoples of Alaska occupy all regions of the state. Today “Alaska Native” is the accepted general term for the indigenous peoples of Alaska (Williams 2009:4). Alaska Natives have occupied the landscape and traditionally used the land and marine resources for more than 10,000 years. Traditional knowledge, oral histories, and archaeological evidence tell of cultural continuity, diversity, and complex and resilient history. Today there are 20 different Alaska Native languages and approximately 50 different dialects spoken in the state. The 229 Federally-recognized tribes in Alaska represent eight broad cultural groups: Athabascan, Tlingit/Haida/Tsimsian, Siberian Yupik, Yup’ik/Cup’ik/Yupiaq, Iñupiaq, Alutiiq/Sugpiaq, Unangax, and Eyak (Williams 2009:9). The majority of these Federally-recognized tribes reside in more than 200 Alaska Native villages (Figure 2). Alaska Natives make up nearly 20% of the total population of Alaska.

Figure 2. A Map of Federally-Recognized Tribes in Alaska (BIA 2016)

No treaties exist between Alaska Natives and the United States (U.S.) government. The U.S. purchased what is now the State of Alaska from Russia in the 1867 Treaty of Cession. It is characterized as a “quit claim,” meaning that, where Alaska Natives held their lands by aboriginal title under Russian rule, their aboriginal possession continued under U.S. rule unless extinguished by treaty or subsequent Federal legislation (Case and Voluck 2012:62). Alaska Natives were granted U.S. citizenship in the Citizenship Act of 1924. It was not until the List Act of 1994 that the sovereign status of Alaska Native villages was recognized and Alaska Natives were definitively identified as members of “Indian tribes” under United States law (Case and Voluck 2012:168).

Alaska Native leaders participated in and helped guide the passage of ANCSA of 1971, seeking to maintain control over their traditional lands. ANCSA formally extinguished aboriginal and statute-based Alaska Native title, use, and occupancy rights to all lands in Alaska, except for the Metlakatla Indian Community Federal Reservation on Annette Island. Instead of aboriginal title, monies from the U.S. government and control of a percentage of Alaska Native traditional lands was transferred to Alaska Native Corporations formed under ANCSA. These two tiers of Alaska Native Corporations and the apportioned land was to be held collectively for the benefit of Alaska Natives. The first tier of corporations created by ANCSA is the regional corporations. The Act divided Alaska into twelve geographic regions based on “common heritage” and created a thirteenth regional corporation (now defunct) for those Alaska Natives living outside of the state. Each regional corporation was required to incorporate under the laws of the State of Alaska as a for-profit business. The second tier of the corporate organization were local corporations associated with eligible Alaska Native villages. These village corporations were also required to incorporate as either for-profit or non-profit businesses. The majority chose to incorporate as for-profit corporations. Both regional and village corporations were entitled to select and hold land, with most village corporations holding fee title to surface estate only and regional corporations controlling both surface and subsurface estates (Case and Voluck 2012; Mitchell 2001).

There are at least three types of Federally-recognized Alaska Native governments: (1) traditional governing councils, (2) IRA governing councils, and (3) the Tlingit and Haida Central Council (Case and Voluck 2012:326). As noted above in Section 1.4, the Native Village of Elim is an IRA Council. As defined in the Indian Self-Determination Act of 1975, at least three different entities qualify as tribes: ANCSA regional corporations, ANCSA village corporations, and Federally-recognized Native communities (Case and Voluck 2012:339). The “twelve Native nonprofit associations… described in Section 7 of the Claims Act as ‘existing Native associations’… have been administratively determined to be tribal organizations… under the Indian Self-Determination Act” (Case and Voluck 2012:346). Only Federally-recognized Native communities hold a government-to-government relationship with the Federal government.

Lands and natural resources are central to the Alaska Native way of life and form the core and basis of their cultural identities. In addition to shaping their worldview and underlying cultural values and beliefs, traditional ties to the land help maintain kinship organizations and form the basis for traditional social and governmental institutions. Alaska Natives maintain their own forms of traditional governments and sovereignty as Federally-recognized tribes. Alaska Native Tribes continue to occupy the lands of their ancestors and use the lands and marine environment to practice a subsistence lifestyle. Alaska Natives maintain control of their traditional lands and manage them for the benefit of their families, villages, kin groups, and region through their tribal governments, as well as through village and regional corporations.

1.8. Study Location

Elim is located on the northwest shore of Norton Bay on the Seward Peninsula, approximately 96 miles east of Nome and 460 miles northwest of Anchorage (Figure 3 and Figure 4). It lies at approximately 64.6 degrees North Latitude, -162.3 degrees West Longitude. Elim is located in the Nome Census Area, the Cape Nome Recording District, and the area encompasses 2.4 square miles of land.

Figure 3. Location of Elim, Alaska

Figure 4. Elim with Relevant Landmarks

1.8.1. Climatology, Meteorology, and Hydrology

Detailed information on baseline climate conditions can be found in Appendix C: Hydraulics and Hydrology. The following information is included to address the information needed to understand the conditions at Elim.

Elim has semi-diurnal tides with two high waters and two low waters each lunar day. The tidal parameters in Table 1 were determined using the National Oceanic and Atmospheric Administration (NOAA) Tidal Benchmarks at Elim Norton Sound (Station ID 9468863). The tidal datum was determined over a 1-month period in September 2012 based on the 1983-2001 tidal epoch. The highest and lowest water level observations were not reported. Still, they could be much higher and lower than the determined Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW) due to storm surge and/or isostatic (inverted barometer) effect.

Table 1. Tidal Datum Elevations Relative to MLLW – Elim

Parameter	Elevation [ft]
Mean Higher High Water (MHHW)	2.62
Mean Sea Level (MSL)	1.45
Mean Tide Level (MTL)	1.28
Mean Lower Low Water (MLLW)	0.00

Measured current data is not available for Norton Sound offshore of Elim. In the summers of 2018 and 2019, Alaska Ocean Observing System deployed a Waverider Buoy to collect ocean current data off the coast of Nome in a water depth of 59.7 feet (ft) (Alaska Ocean Observing System, 2018-2019). It is assumed that current data at Nome is an appropriate estimate of current speeds at Elim. Average current velocities are in the range of 0.5 knots, with a maximum observed current speed of 2.3 knots, with a predominant direction from the west. It is assumed that the dominant current direction at Elim is from the southwest due to the sheltering effect of Cape Darby to the west of Elim (Figure 3).

Ice conditions within the project area include sea ice and land-fast (shorefast) ice. For the Elim area, sea ice formation typically occurs in mid-November each year; however, there have been years in which freeze-up in Norton Sound took place in mid-October or as late as December. Spring break-up typically occurs in late May. Shorefast ice is sea ice of any origin that remains attached to shoreline features along the coast. Shorefast ice typically extends out from shore from 0.5 miles to approximately 7 miles depending on seasonal conditions. Near shore, the ice tends to be relatively smooth out to about 0.25 miles. From there, the ice tends to become buckled offshore, where the influence of pressure ridges is evident (Figure 5).

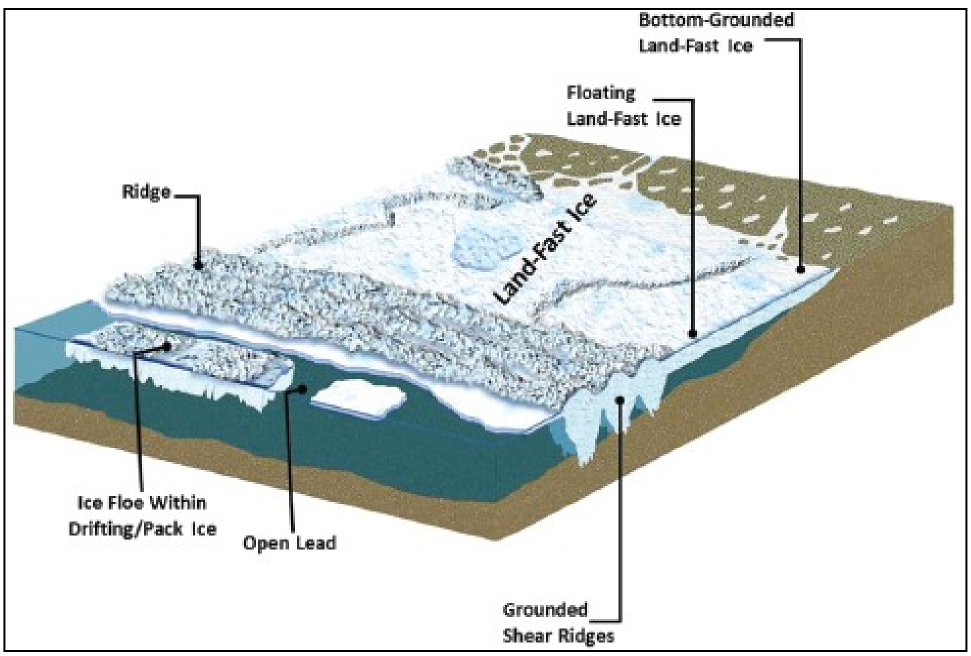

Figure 5. Cross-Section of Typical Arctic and Subarctic Ice Zones (TRB and NRC 2014)

Elim Airport hosts a weather station that has been operational since 2012. The average wind speed is approximately 8 miles per hour (mph), predominantly from the south-southwest, in the summer (June–August) and approximately 10 mph, predominantly from the north, in the fall (September–November).

1.8.2. Climate Change

NOAA began publishing an annual, peer-reviewed Arctic Report Card in 2006. The Report Card is a “source for clear, reliable, and concise environmental information on the current state of different components of the Arctic environmental system relative to historical records” (Osborne, Richter-Menge, & Jeffries 2018). The 2018 Report Card states that the Arctic sea ice cover is continuing to decline in the summer maximum extent and winter minimum extent (Perovich et al. 2018). With a decreased sea ice extent, there is an increase in time that the sub-Arctic (i.e., Norton Sound) is ice-free or has limited sea ice coverage.

According to the Fourth National Climate Assessment, a warming trend relative to average air temperatures was recorded from 1925–1960 (Wuebbles et al. 2019). A trend of increasing temperatures starting in the 1970s has been identified and is projected to continue throughout Alaska. The largest temperature increases have been found in winter months with average minimum temperature increases of around 2°F statewide.

USACE requires that planning studies and engineering designs consider alternatives that are formulated and evaluated for project impacts over a range of possible future rates of sea level change (SLC) over the life of the project and out to the adaptation horizon of 100-years post-construction. Guidance for addressing SLC is in ER 1100-2-8162 and Engineer Pamphlet (EP) 1100-2-1. Details of the SLC evaluation are presented in Appendix C: Hydraulics and Hydrology. The evaluation considers three local relative sea level change (RSLC) scenarios, “low,” “intermediate,” and “high” over a 100-year period of analysis. The “low” rate is the historic SLC based on local or nearby tide gauge data, if available. The “intermediate” and “high” rates are computed using the modified National Research Council (NRC) Curve I and modified NRC Curve III, respectively.

There is no local sea level trend data for Elim. The Intergovernmental Panel on Climate Change (IPCC) estimates global mean sea level (GMSL) change; referred to as GMSL Rise. Due to Elim’s sub-Arctic location and the lack of local data and analysis, the GMSL Rise was deemed an inappropriate base SLC to use to estimate the RSLC in Elim.

Nome, Alaska (AK), is approximately 96 miles west of Elim (Figure 3). It has the closest and longest tide gage record in Norton Sound from 1992 to the present. This data more accurately accounts for changes in ocean temperature, salinity, winds, and ocean circulation in the region that affect RSLC, which are not well represented by GMSL change.

The Nome USACE Sea Level Tracker estimated RSLC of +0.0149 ft/yr. This estimated value was used as the basis for forecasting RSLC in Elim. This estimate was based on available continuous data from August 1997–August 2019. The Nome RSLC rate was adjusted to remove the estimated effect of vertical land movement (VLM) in Nome and add the estimated effect of VLM in Elim. The estimated sea level trend for Elim is +0.0150 ft/yr. For a 50-year project life cycle, a project in Elim could be exposed to sea level rise as much as +3.80 ft (Figure 6) after construction, assuming construction in 2025.

An increase in mean sea level at Elim would cause an increase in the depth-limited wave height and the rate of overtopping and flooding of potential navigation improvements. To account for sea level change impacts to the proposed project area, the intermediate RSLC curve at year 50-year, +1.86 ft, was added to the total water level. Further investigation into the impacts of the three curves through a 100-year adaptation horizon was done and can found in Appendix C: Hydraulics and Hydrology.

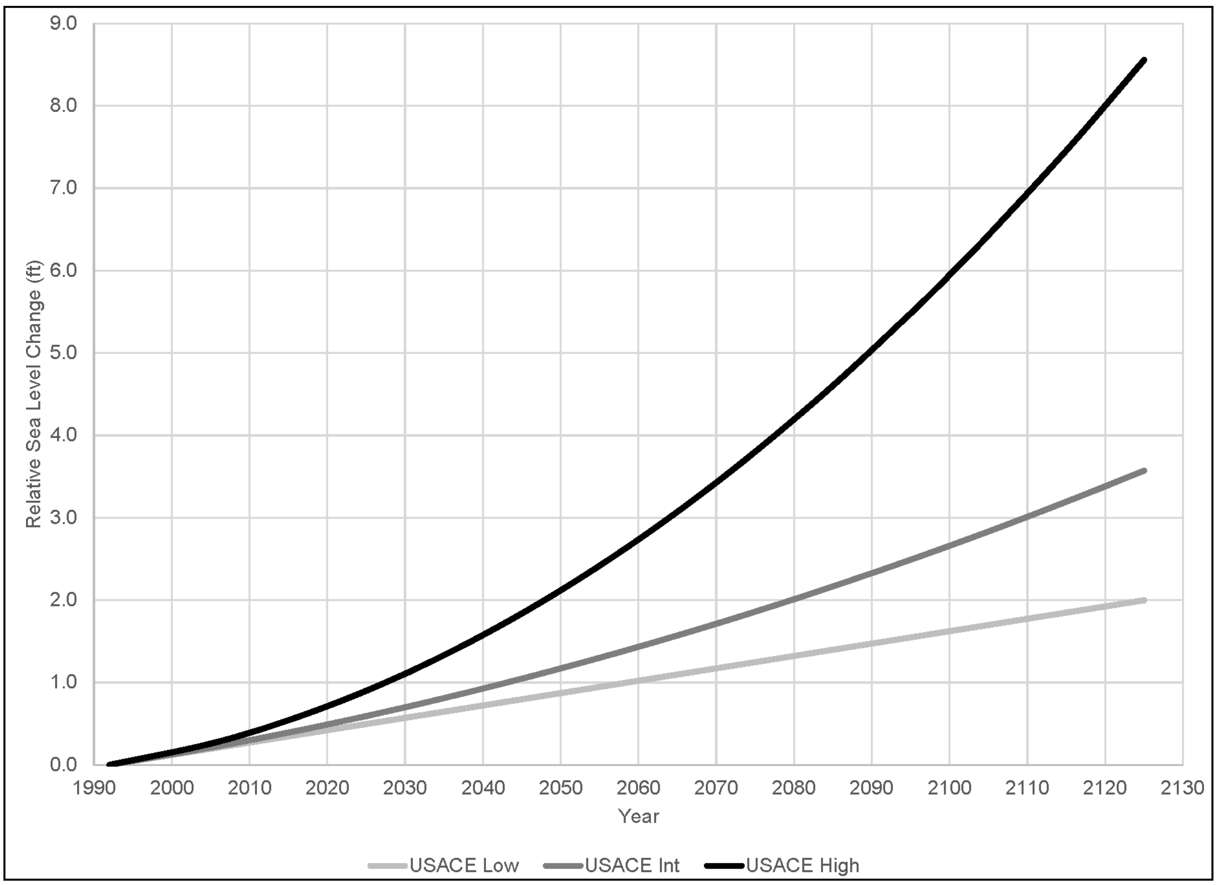

Figure 6. Relative Sea Level Change Scenarios for Elim, AK

2. PLANNING CRITERIA, PURPOSE & NEED FOR PROPOSED ACTION*

2.1. Problem

2.1.1. Problem Statement

Elim has no moorage, harbor, or barge landing infrastructure, which affects commercial and subsistence fishers, vessels which transport fish from the fish buying station to the fish processing plant known as tenders, and the barges delivering fuel and freight to the community. There are no constructed or natural facilities at the proposed project site. All proposed areas for improvement are previously existing shoreline. Elim Beach is currently used for temporary subsistence and commercial boat storage, with vessels being pulled up onto the beach. Freight barges currently run up on to Elim Beach, east of Elim Creek (Figure 4 and Figure 7) for offloading freight during high tide, or goods are lightered in from near shore. The freight barges must wait for high tide to run up on the beach and offload quickly or become stranded and wait until the next high tide to leave. While unloading, a tugboat must push the freight barge against the shore and remain idling to hold the barge in place. The fuel barge double anchors off-shore and must float a hose across open water to deliver fuel. Personnel drag the hose by hand across the beach and up an incline over a bluff to the current location of the fuel header.

Moses Point is approximately 10 miles northeast of Elim along a gravel road that is susceptible to storms and coastal erosion, is utilized for commercial and subsistence activities; however, the distance from the village and the propensity for the road to becoming impassable during bad weather leads to many missed opportunities for such activities based from the Moses Point area. Commercial and subsistence vessels are also susceptible to damage in storms while stored at Moses Point or at Elim Beach (Figure 7). The existing vessel operations at Elim Beach and Moses Point and the risks and resulting damages are further described in Section 3.3.4 and Appendix D Sections 6.1.1, and 6.1.2. Marine infrastructure at Elim would improve efficiency for all these vessels, reduce damages to vessels, provide safer operations for residents, and enhance the long-term viability of the community. The proposed features would ensure vessels have safe access during a larger period of time but would not artificially convert the area to a navigable waterway.

2.2. Purpose and Need

The purpose of the project is to improve the safe accessibility of marine navigation to the community of Elim, Alaska. The need for the project is to reduce hazards in order to provide safer navigation for subsistence vessels, fuel barges, cargo vessels, and a limited commercial fleet, all of which are critical to the long term viability of the community and the mixed subsistence-cash economy at Elim.

Figure 7. Vessels of Elim Fleet, Clockwise from Top Left: Barge and Tug, Commercial Fishing Vessels, Subsistence Vessels, and Tender

The lack of a harbor at Elim reduces subsistence opportunities, impacts the delivery of goods to the community, and threatens the long-term viability of the community. Because of its remote location, the cost of living and basic goods in Elim is high and the delays of delivery exacerbate the community’s limited access to essential goods.

The cultural identity of Alaska Native communities is closely tied to subsistence activities associated with specific locations and in-depth historical knowledge of land and subsistence resources. Rural economies in Alaska, including Elim, can be characterized as mixed subsistence-cash economies in which the subsistence and cash sectors are interdependent and mutually supportive. The ability to successfully participate in subsistence activities is highly dependent on the opportunity to earn some form of monetary income and access the resources needed to engage in subsistence activities. Without a safe and functioning harbor, economic opportunities in the community would continue to be hindered, and the costs of basic essential goods required to support a subsistence lifestyle would remain prohibitively high.

2.3. Opportunities

This study is focused on the feasibility of providing navigation improvements at Elim, Alaska. Opportunities to address problems for this study include the following:

- Reduce damages to vessels caused by storms and beaching vessels;
- Improve the efficiency of commercial fishing, marine subsistence activities, and barge deliveries;
- Reduce the costs of goods and services in Elim;
- Improve the safety of marine subsistence activities, commercial fishing, and barge deliveries;
- Increase the ability to participate in commercial fisheries in the region (e.g., crabbing);
- Increase fishing-based investments to increase jobs in Elim (shore-based processing);
- Improve the long-term viability of the community of Elim.

2.4. National Objectives

The Federal objective for water and related land resources project planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units.

2.5. Study Objectives

The overarching objective of this study is to improve navigation efficiency at Elim and to realize any associated opportunities that may arise from improving the quality of life for the residents of Elim. The effects of all objectives are expected to begin to be realized at the completion of project construction in 2027 and expected to continue to be realized throughout the 50-year period of analysis.

Planning objectives for the study include the following:

a. Provide safe, reliable, and efficient waterborne transportation systems for the movement of commerce (including commercial fishing) and subsistence in Elim.
b. Support the long-term viability of Elim.

2.6. Study Constraints

No legal constraints have been identified during the study, but the following considerations have been identified:

a. Avoid or minimize impacts to existing commercial and subsistence fisheries;
b. Avoid or minimize impacts to historic sites and/or sites of cultural importance;

c. Avoid or minimize impacts to critical infrastructure including the airport, access roads, fuel header, and tank farm; and
d. Avoid or minimize impacts to environmental resources and environmental quality.

2.7. National Evaluation Criteria

The Water Resources Council's Federal Principles and Guidelines document establishes four criteria for the evaluation of water resources projects (WRC 1983). These criteria and their definitions are explained below.

2.7.1. Acceptability

Acceptability is defined as the viability and appropriateness of an alternative from the perspective of the Nation's general public and consistency with existing Federal laws, authorities, and public policies. It does not include local or regional preferences for particular solutions or political expediency.

2.7.2. Completeness

Completeness is defined as the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale.

2.7.3. Effectiveness

Effectiveness is defined as the extent to which an alternative alleviates the specified problems and achieves the specified opportunities.

2.7.4. Efficiency

Efficiency is defined as the extent to which an alternative alleviates the specified problems and realizes the specified opportunities at the least cost.

2.8. Study Specific Evaluation Criteria

According to the USACE's Implementation Guidance (Section 1105 of WRDA 2016), if there is no NED plan and/or the selection of a plan other than the NED plan is based in part or whole on non-monetary units, the recommendation will be supported by a Cost-Effectiveness/Incremental Cost Analysis (CE/ICA). In addition, the Multiple Criteria Decision Analysis (MCDA) is used to account for benefit intricacies in the framework of CE/ICA. MCDA is a decision aiding tool and allows for analysis of multiple accounts. The selection of criteria for the MCDA is based on key benefits that are non-monetary but support community viability and meet the planning objectives. The metric for this study and the results of the NED, CE/ICA, and MCDA analysis are presented in

Appendix D: Economics and Section 6, “Comparison & Selection of Plans” of this IFR/EA.

Additionally, a study-specific criterion to be considered is potential conflicts with dredging during peak fishing seasons or during spawning or migration events.

2.9. Long Term Viability of Community

This section discusses the long-term viability of the community. Elim is an Alaska Native Village; the associated Federally-recognized Tribe is the Native Village of Elim. Tribal members comprise approximately 98% of the community population. Remote Alaska Native villages face challenges that are complex and multifaceted. Factors impacting community viability include (but are not limited to): economics, health and safety, cultural and social value, food security and access to resources for subsistence, costs to add or replace critical infrastructure, and outmigration. While population estimates suggest that Elim’s population is stable, the population alone is not an indicator of a viable community. The viability of a community is based on its ability to survive and thrive. When wage-paying employment is limited, coupled with lower than state average wages, a stable population in a remote community is still severely threatened. More on these overarching socio-economic factors are presented in the following sections (Sections 2.9.1–2.9.8). Understanding the unique nature of remote Alaska and how navigational improvements at Elim could strengthen the resiliency of the community is critical to understanding how the project supports community viability.

2.9.1. Health and Safety

A key component of community viability is the health and safety of community members. An important basic human need is for personal and group safety (Maslow 1943). When conditions are unsafe or unhealthy, it can cause stress and dissatisfaction among those affected. An important way Alaskan communities promote health is through participation in the traditional harvesting and consumption of subsistence resources. Subsistence activities provide for traditional, healthy foods and are especially important for food security and food sovereignty in remote communities like Elim. Subsistence opportunities are identified as being correlated with community strength in the project region (McDowell Group 2019).

Elim relies on vessels for subsistence activities during the open-water seasons and faces challenges to subsistence activities due to the lack of safe navigational access. Improved access for commercial vessels could reduce the risk of boat accidents at Moses Point during open fishing seasons. When there is a vessel in distress, the existing conditions make it challenging to mobilize search and rescue efforts safely. Response vessels often wait for better weather and wave conditions to launch from Moses Point or Elim Beach (USACE Public Meeting 2018). The longer the delay in launching response vessels, the greater the risks are for the vessel in distress. Improved navigational access would reduce these safety risks.

2.9.2. Cultural Identity

The importance of the subsistence lifestyle in Alaska, especially among Alaska Native communities, cannot be overstated. Subsistence is incredibly significant, playing an important role not only in food security and food sovereignty but in the elaboration and maintenance of cultural identity. The ability to participate in a subsistence lifestyle and access subsistence resources is critical to community viability. This concept is further discussed in Appendix D Section 3.5.

2.9.3. Critical Infrastructure

One aspect contributing to the viability of a community is the need to construct or replace aging or threatened critical infrastructure. High costs associated with building materials in remote Alaska communities impede necessary upgrades, leading to increased difficulties such as overtaxing aging infrastructure and, in some instances, an increased risk of failure. Examples of critical infrastructure include housing, water and sewer services, transportation facilities (airstrips, ports, barge landings), schools and medical clinics, bulk fuel facilities, and other public structures required for the health and welfare of a community.

2.9.3.1. Housing Security

Having a safe and reliable shelter is key to the public safety and viability of a community. The Bering Strait Community Needs Assessment identified housing challenges in Elim (McDowell Group 2019). Identified challenges include aging housing stock, overcrowding, affordability, and air quality. According to the report, these issues add to existing social and health concerns and lead to homelessness for some residents. Moreover, potential employers identify housing availability as a key concern to employee recruitment. Navigational challenges experienced by the community negatively impact housing security. Additional discussion on housing security can be found in Appendix D: Economics.

2.9.3.2. Water and Sewer Services

The need for improved water and sewer services is wide-reaching throughout the region. Even with a complete piped water system in Elim recorded by McDowell, the adequacy of the water system in the community is limited. The USACE study team observed holes and slices on the community water tank toward the lower half of the exterior, cutting at least the insulation of the tank and possibly further (Site Visit, April 2019). Lack of water and sewer services leads to increased concerns for health and sanitation, and a link has been shown with an increased regional incidence of respiratory illnesses as a result (McDowell Group 2019). According to the American Society for Civil Engineers Infrastructure Report Card for Alaska, the lack of access to water and wastewater services “affects the health of Alaskan residents with Alaska having some of the highest rates of pneumococcal, respiratory tract, and gastrointestinal infections in the United States” (American Society of Civil Engineers (ASCE) 2017).

2.9.3.3. Transportation

Limited and unreliable transportation impacts the region through scarcity and isolation. No roads connect the region to the rest of the state of Alaska, and most communities are isolated from each other, at least seasonally. Air transportation is expensive and weather dependent. Among other challenges, this leads to increased costs for basic goods and services. Additional discussion on transportation can be found in Appendix D: Economics.

2.9.4. Outmigration

While population estimates suggest that Elim’s population is stable, the population alone is not an indicator of a viable community. The viability of a community is based on its ability to survive and thrive. When wage-paying employment is limited, coupled with lower than state average wages, a stable population in a remote community is still severely threatened. More on these overarching socio-economic factors are presented in the following sections.

2.9.5. Poverty and Distressed Communities

There is an annual update conducted on the communities that are distressed in the state. Distressed status is determined by comparing the average income of a community or Census Designated Place (CDP) to full-time minimum wage earnings, the percentage of the population earning greater than full-time minimum wage earnings, and a measure of the percentage of the population engaged in year-round wage and salary employment. Elim is listed as a distressed community in the Distressed Communities Report dated June 2018 (Denali 2018). Data for unemployment rates are sparse but indicate higher rates than the regional hub of Nome, which is 11.6% compared to the overall state unemployment rate of 6.6%. In Elim, 26% of residents are below the poverty line, compared to 10% of Alaska residents (McDowell Group 2019). Income and the cost of living influence the community’s livelihood and viability. An analysis of employment, income, and cost of living in Elim is discussed in Appendix D: Economics.

2.9.6. Food Security

A combination of factors influences food security for villages in remote Alaska. Individuals utilize tools (boats, snowmobiles, all-terrain vehicles (ATV), etc.) to access subsistence harvest sites, which require fuel to operate, often at high costs to the consumer. While subsistence foods are preferred on both a cultural and nutritional basis, community members rely on a combination of packaged and subsistence foods for their survival. Access to subsistence food resources is changing as a result of shifting climate and changes in sea ice. Food security and nutrition are a concern throughout the region and are only further impacted by navigational inefficiencies leading to higher costs of goods and fuel. A full discussion on food security can be found in Appendix D: Economics.

2.9.7. Climate Change

The impacts of climate change are being experienced in coastal Alaska with a high degree of severity. Shore-fast sea ice (which historically has protected villages from storm-driven wave action) is forming for shorter durations if at all, leaving the communities exposed to environmental challenges such as erosion and flooding. Homes and infrastructure are also being damaged by thawing permafrost. Access to subsistence resources is changing as the sea ice environment changes, which impacts traditional practices. Villages are having to adapt to these increasing threats, and some are even being driven to relocate as climate change impacts overwhelm their ability to adjust. Statewide cost estimates on the impact to public infrastructure from thawing permafrost, erosion, and flooding have been forecast at a possible $5.6–$7.6 billion through 2080 for Alaska. While that damage estimate is calculated for the entire state, the analysis highlights that “Alaska coastal and riverine infrastructure is particularly vulnerable to flooding and erosion induced by climate change” (Larsen et al. 2008). Therefore, construction costs to armor, floodproof, or even relocate critical infrastructure is likely to be significantly higher in Elim than in other interior locations within the state. Increasing barge Opportunity Days at Elim would reduce the costs of shipping materials for floodproofing and armoring critical infrastructure.

2.9.8. “Stemming From” Effects

Feedback from focus group interviews and other information gathered during the study identified effects stemming from the more efficient barge deliveries in Elim. These effects tie directly into the Section 2006 considerations of public health and safety, regional economy, access to subsistence resources, welfare, and cultural values. They also tie directly to the drivers of viability discussed above of economy, infrastructure, relocation, subsistence, and outmigration. Further details on “stemming from effects” are found in Section 6.7.1.6, Comparison & Selection of Plans.

With improved access to Elim through navigational improvements, there is the potential for efficiencies to be gained when addressing these long-term viability concerns throughout the region.

3. BASELINE CONDITIONS/AFFECTED ENVIRONMENT*

The existing fleet at Elim can consist of approximately 50 subsistence and commercial vessels, 2 fishing tenders, and a barge and tug in the area at any one time. Under current conditions, adverse wave conditions limit vessel access to the area of safe moorage within the mouth of the Kwiniuk River at Moses Point. Wind and wave data from the ongoing Wave Information Study for Alaska (published by the Engineering Research and Development Center's Coastal Hydraulics Laboratory) indicate that waves produce inaccessible conditions at Moses Point 31.6% of the time during the harvest season across all vessel classes. Waves produce unmoorable conditions during 19% of the harvest season at Moses Point. Other constraints include weather, such as times of high wind or heavy seas force vessels to seek refuge at Moses Point, which, itself, can be inaccessible from Elim due to flooding of the access road. Fuel and cargo barges delivering to Elim incur higher costs due to anticipated delays and increased operating costs associated with delivering to the community. Barges often wait offshore until conditions at Elim are safe to deliver cargo. The Elim subsistence fleet, consisting mainly of small craft, is limited in the ability to launch from Elim Beach due to the dangerous conditions often occurring along the shore. Often the subsistence fleet opts to launch from Moses Point, which is a drive of 20–30 minutes from the community when the road is passable.

3.1. Physical Environment

Elim falls within the transitional climate zone, characterized by tundra interspersed with boreal forests and weather patterns of long, cold winters and shorter summers. Norton Sound is ice-free generally between late May and mid-November. Summers are cool and rainy; winters are cold and dry. Storms within the region during the summer and fall months result in extended periods of cloudiness and rain. The average daily summer temperature variation is slight due to maritime influence. Total average annual precipitation (rain and melted snow water) is 16.1 inches, with 60 inches of snow. Summer average temperatures range between 40°F and 60°F, and average winter temperatures range between -5°F and 15°F.

3.1.1. Soils & Sediments

The soil classification from beach test pits along Elim Beach (USACE 2018) indicates that the available sediment is varied from poorly to well-graded gravel with sand, cobbles, and boulders. Bedrock outcrops consisting of weathered limestone were observed at the east and west ends of the beach and approximately halfway between these. Elim Beach included sub-angular to sub-rounded gravel, fine to coarse sand, and cobbles ranging in size from 3 to 12-inches and boulders ranging in size up to 6 ft in diameter. Observing from the surface, the volume of cobbles and boulders ranged from 10–75% at various locations along the beach. Fragments of weathered limestone bedrock were observed at the west and east ends of the beach and throughout the area.

The nearshore in front of Elim appears to have three distinct layers consisting of loose alluvium at the surface, varying in thickness from nonexistent to about 3 ft; a layer of dense alluvium or weathered bedrock with an interpreted thickness of 2–9 ft; and bedrock. Side-scan imagery indicates that there are large boulders or outcrops along the shoreline of Airport Point but few features away from shore at either Airport Point or along the beach in front of Elim (Elim Beach). Bedrock depths appear variable, with a few outcrop exposures appearing at the seabed near the Airport Point shoreline to approximately 36 ft below sea level offshore. The interpreted thicknesses of geologic layers from on shore to offshore with the transition between the on shore and offshore datasets appears relatively smooth. Based on the geologic history of glacial deposition and erosion, as well as current coastal processes, it is reasonable to assume the sediment layering, and bedrock geometry does not vary significantly from where geophysical data does exist.

Sediment movement is mostly limited to the pocket beach in front of Elim Beach between Airport Point and the headlands east of the community. The Alaska Baseline Erosion Assessment, Elim Erosion Information Paper (USACE 2009) indicates most erosion occurs where the shore is at its lowest elevation. The region of erosion is about 800 ft along the coast (Figure 8), experiencing 1-2 ft of shoreline loss over the few years prior to the assessment. However, it should be noted that the Elim Erosion Information Paper was completed based on a survey completed by the community, no data collection or data analysis was completed for the Elim Erosion Information Paper and it represents a snapshot in time from 2008. The Alaska Baseline Erosion Assessment placed Elim in the group of communities that needed to be monitored for future erosion. Based on field observations and a limited analysis performed by the Engineering Research and Development Center, Field Research Facility using CoastSat (Appendix C: Hydraulics and Hydrology), the erosion anticipated in the Elim Erosion Information Paper has not been realized and the shoreline appears to be stable. Erosion in the vicinity of Elim Beach is characterized as a low risk to the west of the project area within the Risk and Uncertainty Summary (Table 35) and the sponsor indicates that the area around the project will continue to be monitored through the existing Asset Management Program, including informal community reporting for erosion in both the short and long term.

Figure 8. Elim Baseline Erosion Assessment, Elim Erosion Information Paper- Linear Extent of Erosion (USACE 2009)

There are no existing sediment transport models or studies of the Elim area. Wave processes can cause sediment to move either in the cross-shore direction (on shore or offshore) or along the coast. In most coastal systems, longshore sediment transport processes are more important for changes to the local sediment budgets on long (greater than annual) time scales relative to cross-shore processes. The net average longshore sediment transport rate at Elim is estimated to be 5,205 cubic yard per year (cy/yr) towards the northeast, using CERC Formula, a widely-used method of computing longshore sediment transport rates from the USACE Coastal Engineering Manual. Details of the longshore sediment transport modeling are presented in Appendix C: Hydraulics and Hydrology.

No quantitative analysis of the cross-shore sediment transport was performed. Analysis of available satellite imagery available for Elim does not indicate any significant trends in shoreline change at Elim. During major storms, which are likely infrequent based on the geometry of Elim Beach and the fairly uniform alongshore morphology, there could be drastic cross-shore morphology changes. Based on the qualitative data available, it is assumed that longshore sediment transport dominates sediment transport along Elim Beach and obscures any signal of cross-shore sediment transport.

3.1.1.1. Hazardous, Toxic, and Radiological Waste (HTRW) Issues for Sediment

The project footprint has not been sampled for chemical contaminants. The proposed project is along an unimproved beach, currently used to launch small watercraft and land cargo barges. While small fuel spills may have occurred on the beach, there is no record of significant discharges of contaminants in the intertidal zone.

The Alaska Department of Environmental Conservation (ADEC) has identified several contaminated sites within several hundred feet inland of the project area (ADEC 2020). A small fuel tank farm (Figure 9) was operated by the Alaska Village Electric Corporation (AVEC) before the construction of the current, larger AVEC facility west of the village. The aboveground storage tanks were removed from the small tank farm in 2012. A small area of stained soil, approximately 3 ft by 4 ft, was identified during a 2009 site visit. Still, the former tank farm site has never been sampled, and contaminated subsurface soil and groundwater are possible. This site is approximately 350 ft from the shoreline.

Diesel fuel-contaminated soil was encountered during the preparation of the foundation at the new high school (Figure 9). In 2001, 3,000 cubic yards (cy) of bedrock and soil were removed, but some fuel contamination remains in bedrock fissures that could not be reached during excavation. No evidence of seepage of contamination has been observed along the beach bluff immediately south of the school. ADEC determined that there is no unacceptable risk to human health or the environment and conditionally closed the site in 2007 (ADEC 2020). This site is approximately 200 ft from the shoreline.

A site on the north edge of the community consists of the current city shop and storage area for broken equipment, disabled vehicles, used oil, and batteries (Figure 9). An ADEC inspection (2013) identified heavily stained soil within a bermed area that once held aboveground fuel storage tanks. A former landfill closed in 1980 is also in this area. This site is approximately 790 ft from the shoreline.

Another closed landfill exists immediately northeast of Elim School, approximately 520 ft from the shoreline (Figure 9). The community's active landfill is located on Moses Point Road, roughly 2 miles northeast of Elim (ADEC 2013).

The community septic system discharges primary-treated sewage from the west side of Elim into Norton Bay a few hundred feet east of the project site (Figure 9). The exact point of discharge is unknown, as the pipe has reportedly been damaged offshore. The shoreline septic tanks that feed the outfall pipeline have a history of overflowing (IHS 2005).

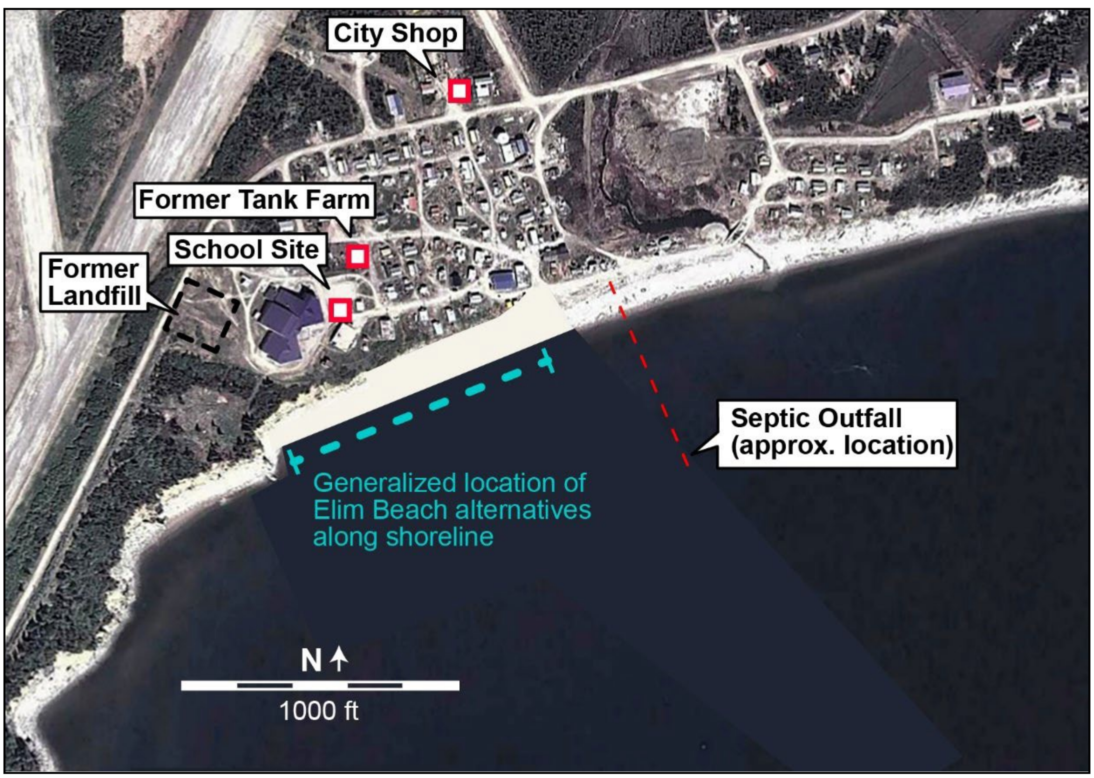

Figure 9. ADEC-Identified Potential and Formerly Contaminated Areas

At Nome Harbor, 96 miles to the west, Snake River has deposited into the estuarine and marine environments sediment rich in naturally occurring arsenic, which has complicated efforts to dredge and expand the harbor. The marine sediments at Elim are unlikely to contain the high levels of arsenic or other metals such as observed within Snake River and its discharge into Nome Harbor. The Snake River watershed encompasses over 86 square miles and has been heavily disturbed by surface mining for more than a century. Elim Creek is a minor stream draining roughly 5 square miles of mostly undisturbed forest and shrub wetlands.

3.1.2. Bathymetry

The nearshore bathymetry (Figure 10) in front of Elim is relatively flat and shallow. Waves impacting the shoreline during normal tidal levels are depth-limited, i.e., wave heights are limited by the depth of the water column. No quantitative analysis of the cross-shore sediment transport was performed for this study, although a qualitative assessment of cross-shore processes for the project site was evaluated. The beach material is coarse and heterogeneous (USACE 2018), which is not typical of low energy systems, but could indicate a local source of the material such as the headlands to the east and west or ice-rafting of material during the winter. Based on the analysis of the available survey data, there is a shallow sandbar located at or below the intertidal zone, at approximately -1–0 ft MLLW. Still, there is no indication of any complex offshore morphology or steep foreshore indicative of high energy gravel beaches.

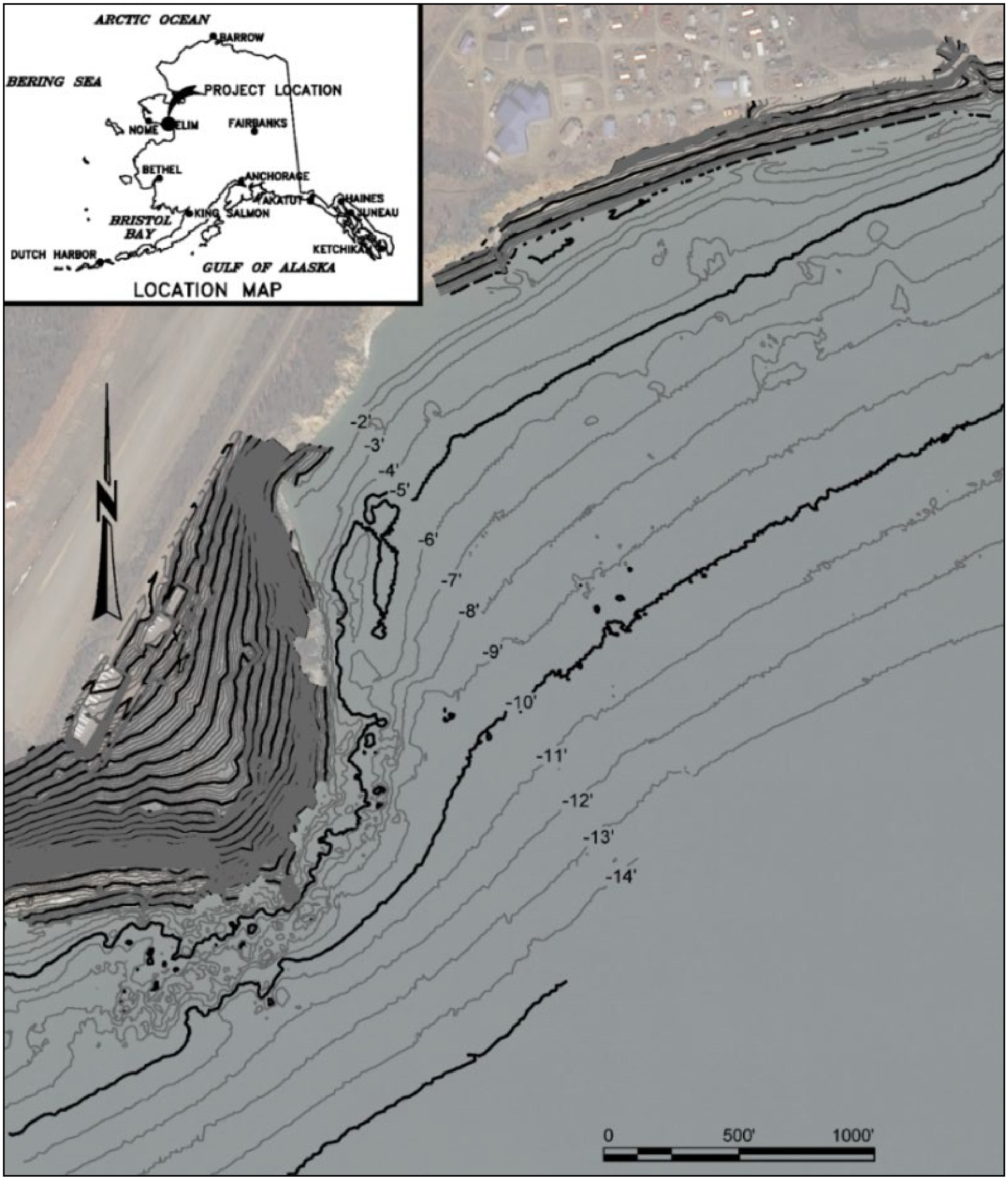

Figure 10. Bathymetry at Airport Point and in front of Elim (Datum is 0 ft Mean Lower Low Water)

3.1.3. Water Quality

Water quality studies have not been carried out specifically at Elim. A study of general water quality in northern Norton Sound (Hood & Burrell 1974) found uniformly high dissolved oxygen concentrations, including in bottom waters, due to the mixing effects of storms. Concentrations of nutrients such as phosphorus and nitrogen were extremely high due to the influx of sediment and dissolved matter from the Yukon River into Norton Sound. Measurements of pH were within the slightly-basic norm (pH 7.7-8.1) for coastal marine waters. Salinity in Norton Sound is seasonally variable, especially in nearshore waters. Summer surface water salinities can be less than 20 practical salinity units (PSUs; equivalent to the concentration of sodium and chloride ions expressed in parts-per-thousand; the average salinity of oceanic seawater is 35.5 PSUs) due to the influx of fresh water from streams and subsurface seeps. Water column salinity increases to a maximum of 34 PSUs in winter, as freshwater sources freeze, and sea ice formation concentrates dissolved ions in the unfrozen seawater. The formation of sea ice also leads to salinity stratification, as the water column is isolated from the mixing effect of wind.

3.1.4. Air Quality

Air quality at Elim is presumed to be generally good due to its isolation and the low number of emission sources present. There is no established ambient air quality monitoring program at Elim and no current existing data to compare with the National Ambient Air Quality Standards (NAAQS) established under the Clean Air Act (CAA). These air quality standards include concentration limits on the “criteria pollutants” carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), nitrogen oxides (NO_x), lead (Pb), and particulate matter (PM_{10}, $PM_{2.5}$). The Elim area is designated as “unclassified” under the CAA, as insufficient information exists for an “attainment” or “nonattainment” classification.

Particulate matter, in the form of dust lofted from unpaved roads and trails, is a major air quality concern in Alaskan rural and smaller communities (ADEC 2018). Many of Elim’s streets have recently been paved, although outlying roads to the airport, fuel storage area, and to Moses Point are unpaved. Wood-burning stoves also generate particulates year around and can create a haze over the village during calm winds. Emissions from vehicles (e.g., trucks and snow machines) and construction equipment are expected to have a minimal impact on air quality at Elim due to their low number and sporadic use. The community power plant is near the existing tank farm, on high land well to the west of the community center.

Aggregate air emissions from vessels at Elim are expected to be highly seasonal and negligible from November through April. Vessel operations consist primarily of subsistence vessels and commercial fishing vessels with an occasional fuel barge anchoring in the harbor and an occasional freight barge landing on Elim Beach.

3.1.5. Noise

Ambient noise at Elim is low due to limited vehicle traffic. Most boat-launching currently happens at Moses Point, approximately 10 miles northeast of town by road, with only a few skiffs operating off Elim Beach. Construction machinery working on local projects and occasional barge landings sporadically increase noise during summer months. The small planes using the airport generally do not overfly the community and add little to the existing noise levels.

3.1.6. Aesthetics

Elim residents currently enjoy an unimpeded view of Norton Sound. The coastal bluff restricts the view of the beach from most homes.

3.2. Biological Resources

The construction region of influence (ROI) identified for biological resources in this study is shown in Figure 11. It consists of a zone extending 75 meters in all seaward directions from the dredging and breakwater footprints of the largest alternative (Alternative 5); the 2,000-ft by 2,000-ft dredged material disposal site located approximately 2 nautical miles offshore; and the presumptive route of barge or scow carrying dredged material to the disposal site.

Figure 11. Construction Region of Influence at Elim

An additional ROI identified is the presumptive route of project vessels transiting between Anchorage and Elim via Nome (Figure 12). This ROI is primarily intended to assess potential effects on protected species beyond Norton Sound from vessels delivering goods, construction materials, and/or personnel to Elim for the project. The base image of Figure 12 is a screen-shot from the website MarineTraffic.com showing the transit lines (dark blue) of all 2017 tugboat traffic within that view. The yellow dotted line traces a “most traveled” direct route from Anchorage to Nome, passing through Cook Inlet, hugging the protected south coast of the Alaska Peninsula, and then turning north into the Bering Sea at Unimak Pass.

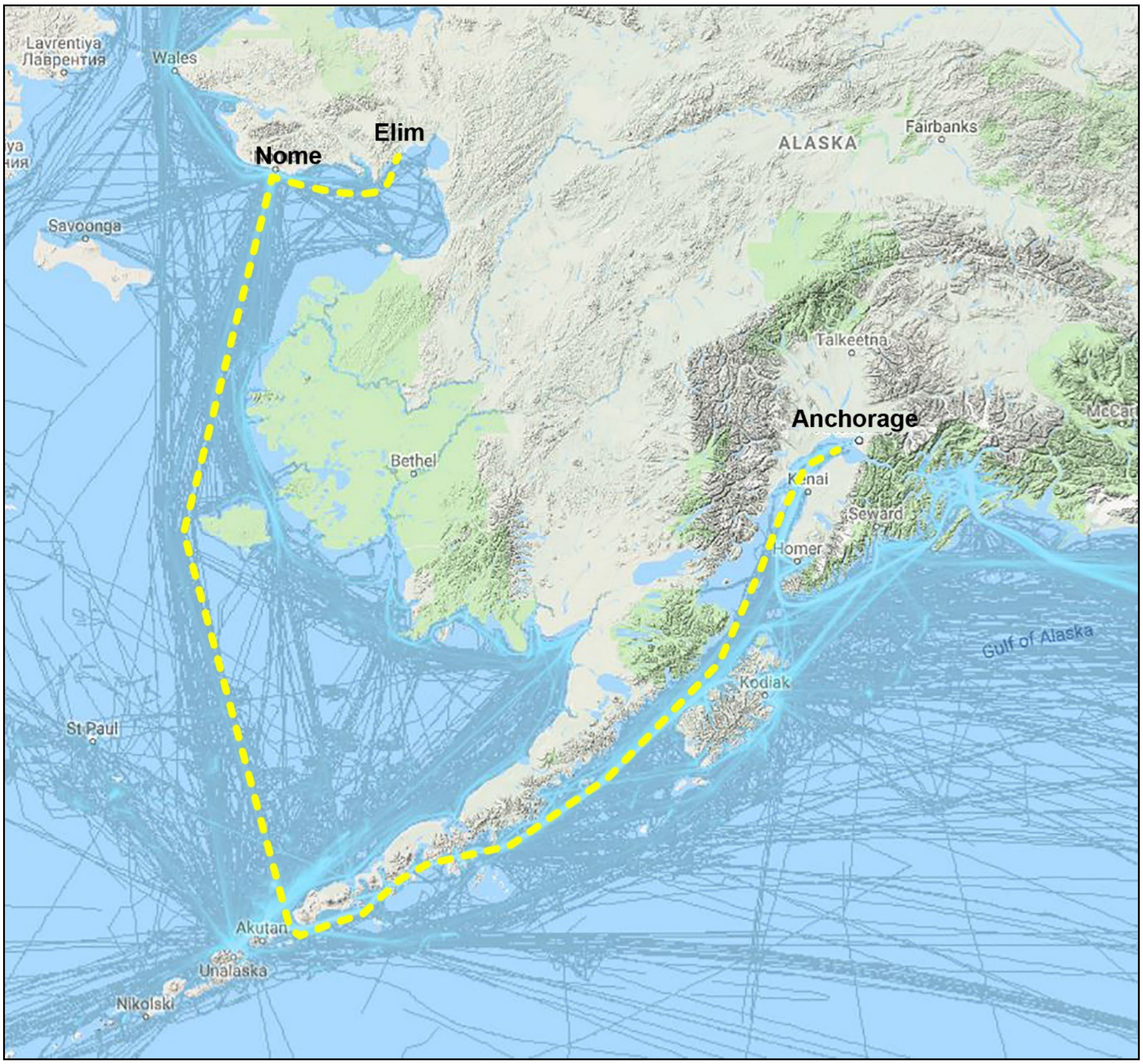

Figure 12. Transit ROI for Protected Species

3.2.1. Habitat and Wildlife

3.2.1.1. Primary Productivity

In the northern Bering Sea, the conversion of solar energy into biochemical energy (i.e., primary production) is carried out mostly by microscopic algae, or phytoplankton. Primary production is highly seasonal in this region and closely linked to sea ice cover and thickness. The spring retreat of sea ice exposes more open sea to more light from the lengthening days, triggering a spring phytoplankton bloom. Phytoplankton blooms may also occur under sea ice that is relatively thin and not covered by snow. During the formation of sea ice in the fall, phytoplankton is sequestered in brine channels within the ice and can survive the winter to be released back into the water column as the ice melts in the spring. Phytoplankton is consumed by zooplankton, which in turn, feeds many small and juvenile fish. Excess phytoplankton falls to the seafloor as organic matter and feeds organisms such as crabs and mollusks (Oceana and Kawerak, Inc. 2014; Smith et al. 2017).

3.2.1.2. Benthic Habitat

The benthic (i.e., seafloor) ecology of Norton Sound is dominated by invertebrates such as sea stars and crab instead of demersal fish (i.e., fish living on or near the seafloor) as is typical elsewhere in the Bering Sea. Norton Sound epibenthic (i.e., living on the seafloor surface) and demersal fauna have been monitored triennially by trawl studies since 1976 by the National Marine Fisheries Service (NMFS) and the Alaska Department of Fish and Game (ADFG). A retrospective analysis (Hamazaki et al. 2005) of these trawl studies from 1976 to 2002 identified the major groups of organisms collected (Table 2) and their relative abundance.

Table 2. Norton Sound Epibenthic and Demersal Species Identified during NMFS/ADFG Trawl Surveys (Adapted from Hamazaki et al. 2005)

Group	No. of Identified Species	Major Species (common names)	2002 Catch-per-unit-effort, (kg/km^2)
Sea Stars	16	Northern Pacific seastar, black-spine star, mottled star	6,773
Crabs	10	Helmet crab, red king crab, blue king crab	145
Snails	49	Neptune whelk, left-handed whelk, tritonid nudibranch	161
Tunicates	20	‘Sea potato’ tunicate, ‘sea peach’ tunicate, spiny-headed tunicate	159
Flatfish	9	Starry flounder, yellowfin sole, Pacific halibut	484
Cods	5	Saffron cod, walleye pollock, Pacific cod	396
Sculpins	28	Plain sculpin, warty sculpin, Arctic sculpin	131
Notes: (kg/km2) = kilograms per kilometer square			

Similar studies in Norton Sound have found sea stars and related organisms (echinoderms such as basket stars and sea urchins) to make up about 80% of the invertebrate biomass. The northern Pacific seastar (*Asterias amurensis*) is indigenous to the Asian Pacific coast and is considered an invasive species in Alaskan waters. Other epibenthic invertebrates present include amphipods, shrimp, and soft corals (RJW 2013). Benthic invertebrates are an important food source for commercially important crab species, fishes, and marine mammals.

Red king crab (*Paralithodes camtschaticus*) is an essential Norton Sound benthic invertebrate for human use. The Norton Sound red king crab stock appears to be isolated from other Bering Sea stocks of this species; it lives in relatively shallow water and is confined under sea ice for 5–6 months each year. Adult and sub-adult crabs migrate into coastal waters in late fall and winter, then return to deeper waters when nearshore ice breaks up in spring, and coastal water temperatures rise, and salinities decrease (RJW 2013).

Organisms living under the surface of marine sediment of western Norton Sound include polychaete worms, sand dollars, and mollusks such as clams and cockles. These mollusks are important prey for sea stars and walrus, as well as crab and flatfish (Fukuyama and Oliver 1985, RJW 2013).

Six species of demersal fish have made up the bulk of fishes caught in Norton Sound benthic trawl studies: saffron cod, Arctic cod, starry flounder, yellowfin sole, Alaska plaice, and plain sculpin. Saffron cod is a vital subsistence resource, harvested mainly in winter, and a major prey species for marine mammals. Arctic cod tend to be distributed farther offshore than saffron cod but do inhabit shallower nearshore waters in winter. Yellowfin sole display a seasonal distribution opposite of the cod species, moving into inshore waters to spawn during spring and summer and returning to deeper offshore waters in the fall and winter. Juvenile yellowfin sole remains in shallow, nearshore areas for several years (RJW 2013).

In July 2019, the USACE employees used a towed underwater video camera to observe and record the seafloor substrate and habitat types offshore of Elim and Airport Point. The locations and orientations of the video transects are shown in Figure 13. Figure 14 provides representative screenshots of the different types of substrate and benthic habitat encountered.

The seafloor observed along the transects was predominantly sand, featureless except for wave ripples and tracks from various benthic organisms. The only organisms seen on the sand surface were occasional sea stars (probably *Asterias* sp.) and a single unidentified crab. Fragments of mollusk shells on the sand surface indicated clams or cockles living within the sand. Numerous unidentified sea jellies and salmonid fish appeared on the videos.

Scattered areas of cobbles and low-relief rock slabs appeared in some areas, increasing in the more easterly transects (Figure 13). The low-relief rock substrates tended to support little or algae or other marine growth. By contrast, higher-relief boulders and bedrock outcroppings, especially around Airport Point, supported dense communities of marine algae and invertebrates such as anemones and crabs (Figure 14).

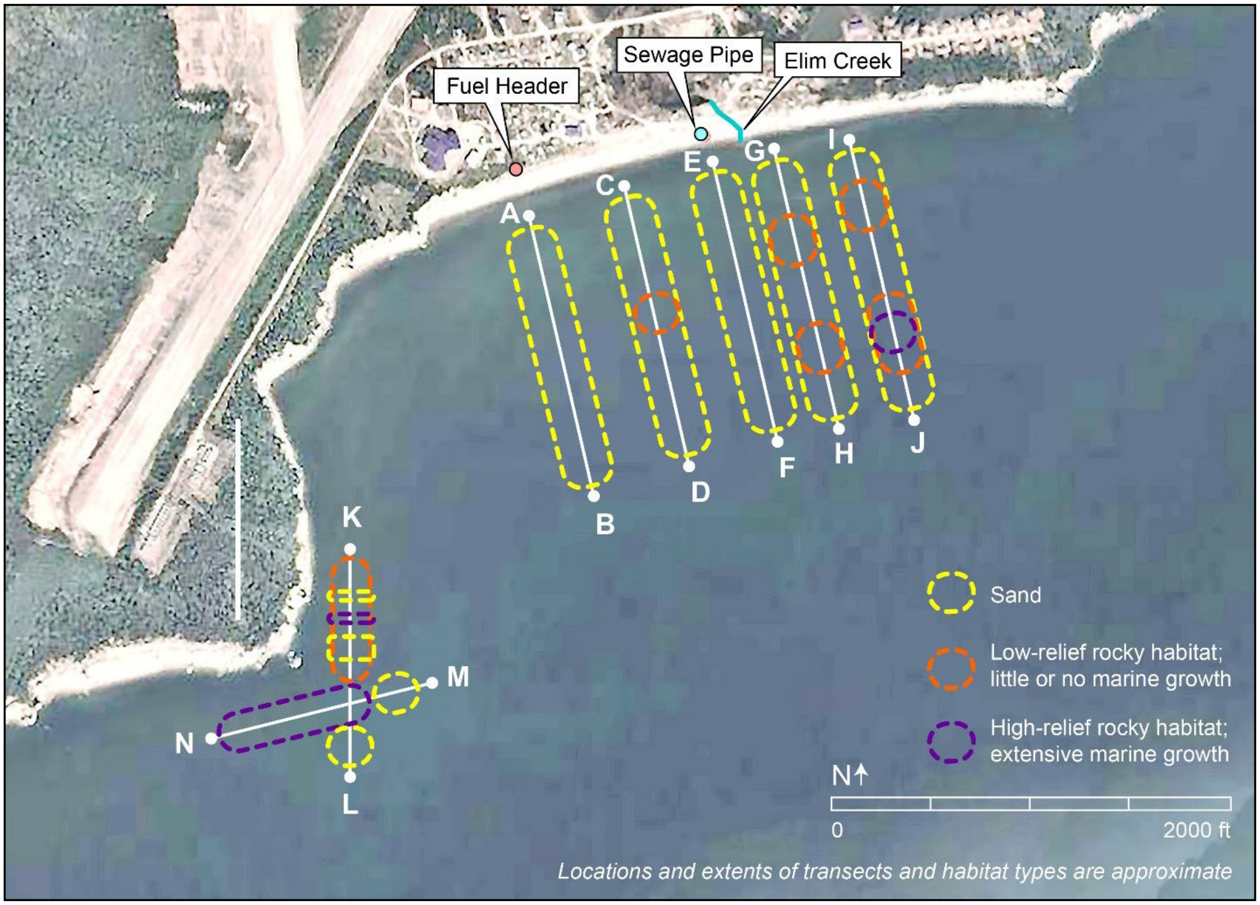

Figure 13. Underwater Video Transects Performed 22 July 2019 and the Generalized Substrate Encountered

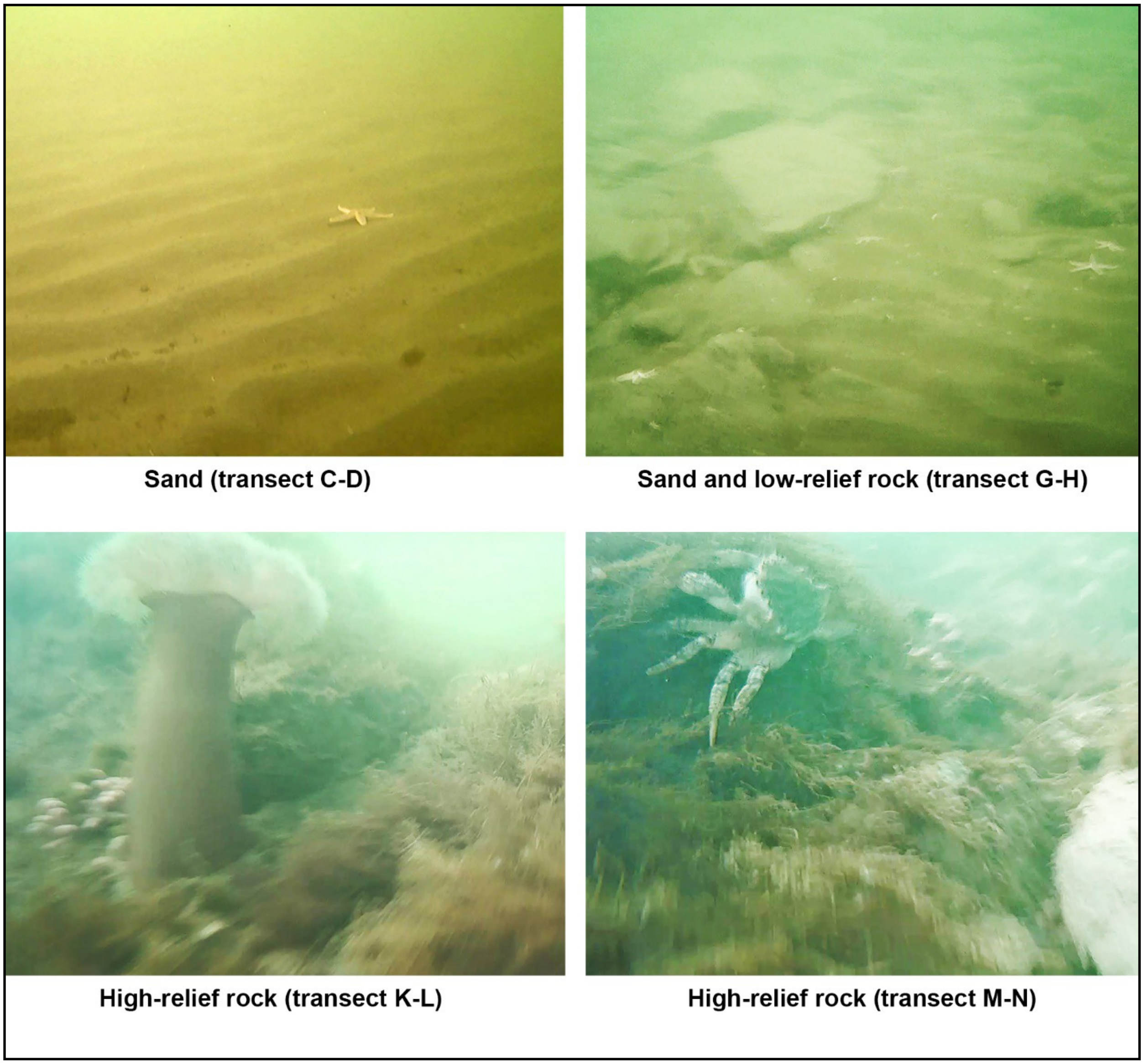

Figure 14. Screenshots from the July 2019 Underwater Videos Representative of the Different Substrates and Benthic Habitats Encountered

3.2.1.3. Pelagic Fishes

Major non-benthic marine species include ocean-run Pacific salmon, of which all five species are present in Norton Sound. Chum salmon and pink salmon are the most abundant species in this area, while coho, chinook, and sockeye are much less common or widespread. Salmon and their habitat are discussed in more detail below in Section 3.2.4.

Dolly Varden char (*Salvelinus malma*) is another anadromous salmonid, widespread, and abundant in the waterways of the Seward Peninsula. Dolly Varden spawn in the autumn in freshwater streams. Juveniles spend 2–4 years in freshwater, after which period some migrate to the marine environment to feed during the summer, then return to freshwater to spawn and spend the winter. Unlike Pacific salmon, Dolly Varden may spawn multiple times during their lives, though individuals rarely survive to spawn more than three times. This species is an important subsistence fish in northwest Alaska and a popular sport fish (ADFG 2019b).

Pacific herring appear along the Bering Sea coast immediately after ice breakup in mid-May to early June, with peak spawning occurring during the first half of June. Spawning is primarily in intertidal and shallow subtidal areas, with rockweed (*Fucus* sp.), eelgrass, or bare rock serving as the substrate. The major herring spawning areas are in the eastern and southern parts of Norton Sound, where suitable spawning substrate is more available (ADFG 2012; RJW 2013). The algae-populated, high-relief rocky substrate observed near Elim is most likely used by spawning herring.

Capelin, sand lance, and smelt are abundant, widespread forage fishes that play a crucial role in Bering Sea food webs. They serve as prey species for larger fish, birds, and marine mammals. Capelin and sand lance spawn in sandy intertidal habitats, while smelt prefers aquatic plants and rocky substrates (RJW 2013; Smith et al. 2017).

3.2.1.4. Coastal Birds

There are several important bird concentration areas that bracket Elim. The National Audubon Society designated several "important bird areas" along the north and east coasts of Norton Sound and are identified in Figure 15 (Audubon Alaska 2014). The extensive wetlands and lagoons surrounding the outlets of the Kwik, Kwiniuk, and Tubutulik Rivers begin roughly 6 miles to the northeast of the project site. This area provides a breeding habitat for many thousands of waterfowl, including Canada goose, brant, common eider, long-tailed duck, and common loon. About 25 miles to the west, the delta formed where the Fish River enters Golovin Lagoon is heavily used by swans, geese, wigeons, and shorebirds such as dunlin and western sandpipers. The headlands at the entrance of Golovin Bay, Rocky Point, and Cape Darby host colonies of cliff-nesting seabirds such as horned and tufted puffins, pelagic cormorants, and glaucous gulls (NOAA et al. 2002). Offshore waters of Norton Sound south of Elim include critical habitat (CH) for spectacled eiders (discussed further in Section 3.2.2.1, "Endangered Species Act and Critical Habitat").

Within the Norton Bay ROI, significant coastal bird habitat is much less in evidence. Small numbers of gulls, cormorants, and diving ducks use the cove in front of Elim, while flocks of waterfowl can often be seen flying offshore. The beach in front of Elim is heavily used by people and is unlikely to provide a nesting habitat for ground-nesting birds.

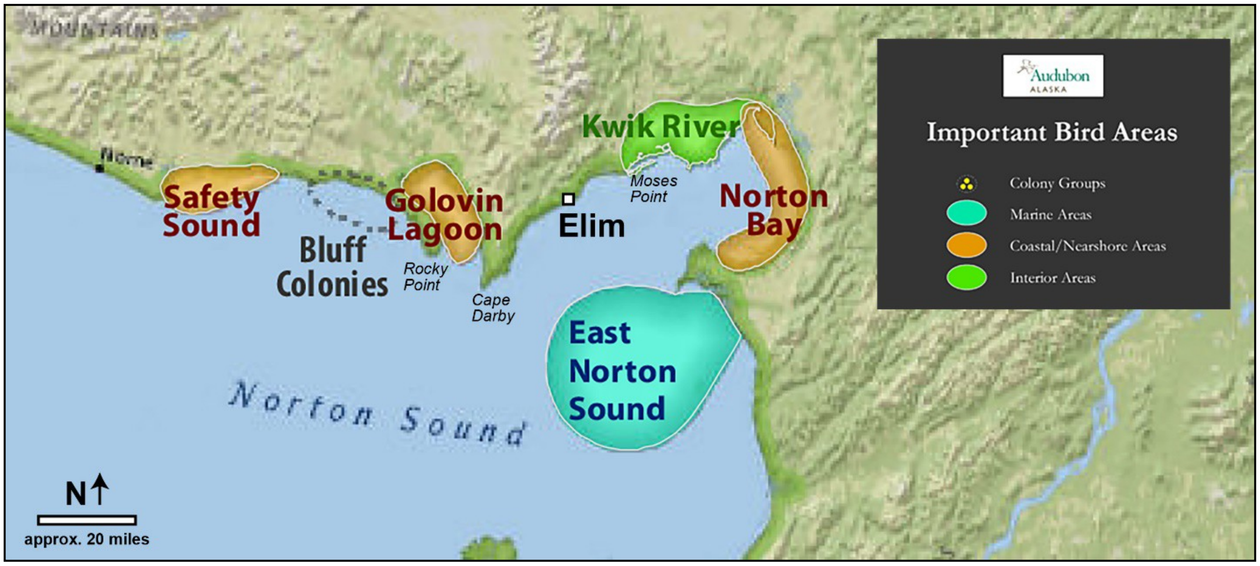

Figure 15. Important Bird Areas in Norton Sound (excerpted and annotated from Audubon Alaska 2014)

3.2.1.5. Seals, Walrus, and Whales

The following is a general natural history discussion of important marine mammal species and their habitat and distribution near Elim. Several of these species are listed under the Endangered Species Act, and all are managed under the Marine Mammal Protection Act and are discussed further in that regulatory context in Section 3.2.2, “Endangered Species Act and Marine Mammal Protection Act.”

Several species of seals, walrus, and whales make notable use of Norton Sound for at least a portion of the year. Their seasonal distribution is tied to the advance and retreat of sea ice. Ringed, bearded, spotted, and ribbon seals are collectively known as “ice seals” due to their associations with sea ice. Ringed seals are the most widespread and numerous of the ice seals. They are primarily associated with shorefast ice, whereas the other ice seals generally prefer moving ice. Ringed seals can create and maintain breathing holes in thick winter ice and may build a den in the snow. Pupping occurs in late winter or early spring. Many ringed seals are present in Norton Bay during the winter and large numbers of ringed seal pups are reared on the sea ice during the spring. Some ringed seals follow the ice pack north as it retreats but others remain in Norton Sound all summer, feeding on salmon and other fish at the mouths of major rivers. Juvenile seals are often seen resting on beaches (Oceana and Kawerak, Inc. 2014).

Bearded seals prefer moving ice and open water over relatively shallow seafloors. They feed primarily at or near the seabed, on benthic invertebrates and demersal fish. Like the ringed seals, bearded seals congregate at the open water found near Cape Darby and eastern Norton Bay in winter and spring. Juvenile bearded seals may remain in open water during the summer, feeding in lagoons and rivers, but older individuals migrate north with the retreating pack ice. Bearded seals are a particularly important subsistence species (Oceana and Kawerak, Inc. 2014).

Spotted seals prefer the outmost margins of winter sea ice, so their winter range is typically south of Norton Sound. They are generally widespread through the Bering Sea and Norton Sound in summer and early fall and may haul out onto beaches in large groups. Most summer and fall concentrations of Norton Sound spotted seals are in the eastern portion of the Sound, where herring and small cod are more abundant. Spotted seals are reportedly more sensitive to human disturbances than other seals or walruses and have been displaced from some haulout and feeding areas due to such disturbance. Seals and other marine mammals tend to congregate there, especially in the autumn (Kawerak, Inc. 2017).

Ribbon seals are relatively uncommon and seen only occasionally by Elim-area hunters, and only in the fall, far offshore. Like spotted seals, they spend winters along the southern edge of Bering Sea ice. Ribbon seals spend most of their time in open water away from land and rarely haul out on shore (Oceana and Kawerak, Inc. 2014).

Pacific walrus prefer access to open water and concentrate in winter in Bering Sea areas where winds and currents create dependable leads and polynyas. Most walruses follow the springtime retreating ice edge back into the Chukchi Sea, but some adult male walrus remain in the Bering Sea. An area of late lingering ice in eastern Norton Sound is known as a spring concentration area for male walrus, where they feed on mollusks and shrimp along the seafloor. Walruses generally do not enter far into Norton Bay, except under favorable conditions of moving ice, a south wind, and an incoming tide.

Beluga whales concentrating in Norton Sound belong to the eastern Bering Sea stock, one of five stocks found in Alaskan waters. Belugas are small, toothed whales that feed in shallow coastal waters and at the mouths of rivers and are generally found in herds that range in size from a handful of individuals to hundreds. Beluga whales use Norton Sound during the entire open-water season, but not typically in the winter due to the extensive ice cover. During the spring and summer, beluga whales in Norton Sound tend to concentrate in the eastern half of the Sound. In Norton Sound, beluga whales are found along the shorefast ice edge in spring and Elim hunters look for them along the ice edge near the village and in the shallow waters of Norton Bay in the fall (Oceana and Kawerak, Inc. 2014).

Gray whales and Steller sea lions forage in western Norton Sound in the spring and summer but do not appear to enter Norton Bay. Minke whales have been reported far offshore of Elim and humpback whales may venture into Norton Bay. Elim is within the theoretical range of polar bears, but a sighting there would be extremely uncommon.

3.2.1.6. Inland Setting

The beach at Elim is backed by a low eroding bluff near its center, with rocky bluffs of increasing height extending to the east and west (Figure 16). Immediately inland of the bluff are roads, homes, and other development features of the Elim community. Consequently, there is little or no transitional habitat between the beach and upland areas. The intertidal and supratidal beach is sand and gravel with some bedrock outcroppings. The beach is heavily used by Elim residents to launch small fishing boats, land supplies from barges, and as a community gathering and recreational area. Elim Creek cuts through the village, draining freshwater shrub and forest wetlands on the slopes to the north of the village. Undeveloped uplands are dominated by spruce and birch forests at lower elevations, while alpine tundra and barren rocky hilltops appear between 400- and 500-ft above sea level.

Figure 16. August 2019 View of the Beach and Coastal Bluffs at Elim and the Developed Areas Beyond

3.2.1.7. Invasive Species

Alaskan waters have seen few marine invasive species so far. However, a potentially harmful tunicate species has been found near Sitka, and several other potentially invasive species, such as the Chinese mitten crab and the European green crab, are under surveillance (ADFG 2019a, ADFG 2002). A 2017 assessment prepared by the University of Alaska (Reimer et al. 2017) developed a semi-quantitative ranking of the potential risk posed by 46 marine species to the Bering Sea. The top ten non-native species of concern include the European green crab, Pacific oyster, bay barnacle, and several bryozoans and sea squirt species. Two of these species, the Japanese skeleton shrimp and soft-shell clam, are already present in regions of the Bering Sea.

The main terrestrial invasive species threat within Alaska is from rats and mice. Introduced rats have had devastating effects on seabird populations at remote Alaskan locations, especially on islands (Frits 2007). Nome already has an established breeding population of rats within the settled human environment. If Elim does not already have invasive rodents, it is vulnerable to the introduction of rats and mice via cargo transshipped from Nome.

3.2.2. Endangered Species Act and Marine Mammal Protection Act

As is often the case for Alaska coastal navigation projects, most of the species potentially affected by the proposed action *and* listed under the Endangered Species Act (ESA) are marine mammals. Of the 16 ESA-listed species presented in Table 3, all but the first three entries (the eider and albatross species) are also managed under the Marine Mammal Protection Act. An additional 10 marine mammal species potentially affected by the project but *not* listed under the ESA have been identified (Section 3.2.2.2, “Marine Mammal Protection Act”). The potential project impacts, and mitigatory measures for those impacts, are very similar for all marine mammals, ESA-listed or not, and marine mammals will be analyzed collectively in Section 8.3.2, “Endangered Species Act and Marine Mammal Protection Act.”

3.2.2.1. Endangered Species Act and Critical Habitat

Jurisdiction under the ESA of 1973 is divided by species between the United States Fish and Wildlife Service (USFWS) and the NMFS. Through informal consultation with the USFWS and the NMFS, the USACE has identified the ESA-listed species that may be present in the project ROIs or along the presumptive route of project construction-related vessels traveling between Anchorage, Alaska, and Elim (Table 3). Correspondence regarding the informal consultation can be found in Appendix G.

Table 3. ESA-Listed Species Potentially Affected by the Proposed Action

Species	**Listed Population**	**ESA Status**	**Agency Jurisdiction**	**ROI in which species is present**	**Critical Habitat in ROI?**
Spectacled eider, *Somateria fischeri*	All	Threatened	USFWS	Norton Sound	No
Steller's eider, *Polysticta stelleri*	AK breeding population	Threatened	USFWS	Norton Sound	No
Short-tailed albatross, *Phoebastria albatrus*	All	Endangered	USFWS	Transit	No
Polar bear, *Ursus maritimus* (mm)	All	Threatened	USFWS	Norton Sound	Yes
Northern sea otter, *Enhydra lutris kenyoni* (mm)	Southwestern Alaska DPS	Threatened	USFWS	Transit	No
Ringed seal, *Pusa hisipida (mm)*	Arctic DPS	Threatened	NMFS	Norton Sound	Proposed
Bearded seal, *Erignathus barbatus* (mm)	Beringia DPS	Threatened	NMFS	Norton Sound	No
Steller sea lion, *Eumetopias jubatus* (mm)	Western DPS	Endangered	NMFS	Norton Sound & Transit	**Yes**
Bowhead whale, *Balaena mysticetus* (mm)	All	Endangered	NMFS	Norton Sound	No
Humpback whale, *Megaptera novaeangliae* (mm)	W. Pacific DPS	Endangered	NMFS	Norton Sound & Transit	No
	Mexico DPS	Threatened			
N. Pacific right whale, *Eubalaena japonica* (mm)	All	Endangered	NMFS	Norton Sound & Transit	**Yes**
Gray whale, *Eschrichtius robustus* (mm)	Western North Pacific DPS	Endangered	NMFS	Norton Sound & Transit	No

Species	Listed Population	ESA Status	Agency Jurisdiction	ROI in which species is present	Critical Habitat in ROI?
Sperm whale, *Physeter macrocephalus* (mm)	All	Endangered	NMFS	Transit	No
Fin whale, *Balaenoptera physalus* (mm)	All	Endangered	NMFS	Transit	No
Blue whale *Balaenoptera musculus* (mm)	All	Endangered	NMFS	Transit	No
Beluga whale, *Delphinapterus leucas* (mm)	Cook Inlet DPS	Endangered	NMFS	Transit	**Yes**
Note: DPS=Distinct Population Segment mm = marine mammal					

When a species is listed under the ESA, the responsible agency (USFWS or NMFS) is required to determine whether areas are containing physical or biological features that are essential to support the recovery of that species and designate such areas and features as CH. For some listed species, insufficient information or other factors may delay or forestall the designation of CH. A designated CH that is present in the project area is described by species in the section below.

The ADFG is required under state law (AS 16.20.190) to maintain a list of endangered species in Alaska; however, there is no regulatory requirement for a separate endangered species consultation with the ADFG. The State of Alaska endangered species list currently includes:

- Blue whale (*Balaenoptera musculus)*
- Humpback whale (*Megaptera novaeangliae)*
- Right whale (Eubalaena japonica)
- Short-tailed albatross (Phoebastria albatrus)
- Eskimo curlew (*Numenius borealis)*

The three whale species and the short-tailed albatross designated as endangered by the State of Alaska are duplicative of ESA-listed species (Table 3). The Eskimo curlew is quite possibly extinct; the last confirmed sighting was in 1987. This species' former range did not include the Seward Peninsula or the Bering Sea and it will not be discussed further here.

Protected species concerns for this project are dominated by marine mammals, especially pinnipeds (seals, sea lions, and walrus) and cetaceans (porpoises, dolphins, and whales). Eleven of the 16 ESA-listed species in Table 3 are pinnipeds or cetaceans; also, polar bears and sea otters are regarded as marine mammals for regulatory purposes. The marine mammals in Table 3 are flagged (mm) in the “Species” column. Marine mammals not listed under the ESA are identified in Section 3.2.2.2, “Marine Mammal Protection Act.”

Spectacled Eider

Spectacled eiders are large sea ducks that spend most of their life cycle in the arctic environment. They were listed as a threatened species throughout their range in 1993 based on indications of steep declines in the Alaska-breeding populations. From November through March or April, spectacled eiders remain in the open sea, polynyas, or open leads in the sea ice of the northern Bering Sea; the availability of sea ice as a resting platform is believed to be important for energy conservation. As open water becomes available in spring, breeding pairs move to nesting areas on wet coastal tundra along the Arctic Ocean coast or along the Bering Sea coast of the Yukon-Kuskokwim Delta (Figure 17). Males return to the marine environment after incubation begins. Females move to molt areas in July if unsuccessful at nesting, or in August-September if successful. Spectacled eiders molt in several discrete areas of shallow coastal water during late summer and fall. Spectacled eiders generally depart all molting sites in late October to early November, migrating offshore in the Chukchi and Bering Seas to a single wintering area in openings in the pack ice of the central Bering Sea south/southwest of St. Lawrence Island.

Figure 17. Spectacled Eider Use Areas and Migration Patterns (USFWS 2012)

Critical habitat designated for spectacled eiders consists of wintering habitat in the Bering Sea south of St. Lawrence Island, nesting habitat along the coast of the Yukon-Kuskokwim Delta, and molting areas in eastern Norton Sound and Ledyard Bay on the Chukchi Sea coast. The closest CH unit to Elim is the Eastern Norton Sound Unit (also known as “Unit 3”), an autumn molting concentration area (Figure 17). The northern boundary of this CH unit is defined by a line between the mouth of Quiktalik Creek and Point Dexter (Figure 17 and Figure 18), and the western boundary is a line extending south from Cape Darby. The project site lies roughly 1.3 miles outside of this CH unit but project vessels traveling to and from Elim would cross through a portion of the CH unit of spectacled eider distribution within this CH unit. The birds typically concentrate in areas roughly 20 miles or more to the south of Elim and away from likely project vessel transit routes (Figure 18).

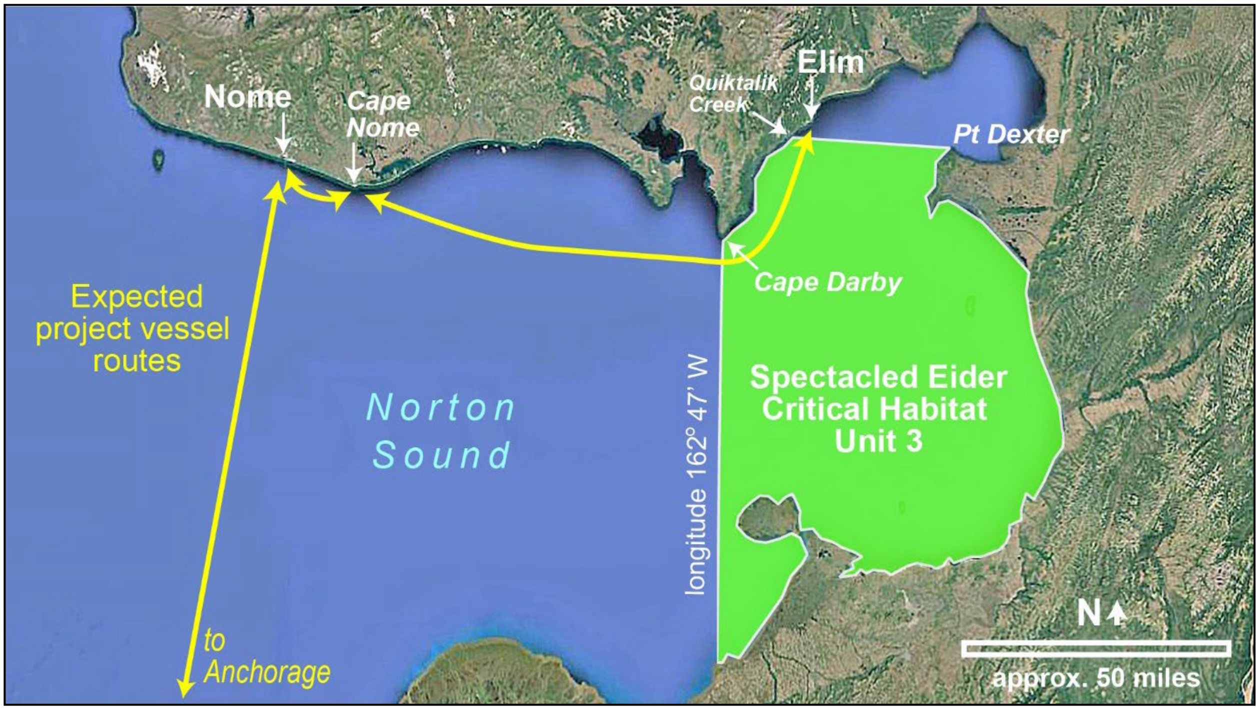

Figure 18. Relationship of Norton Sound Spectacled Eider CH to Expected Project Vessel Routes

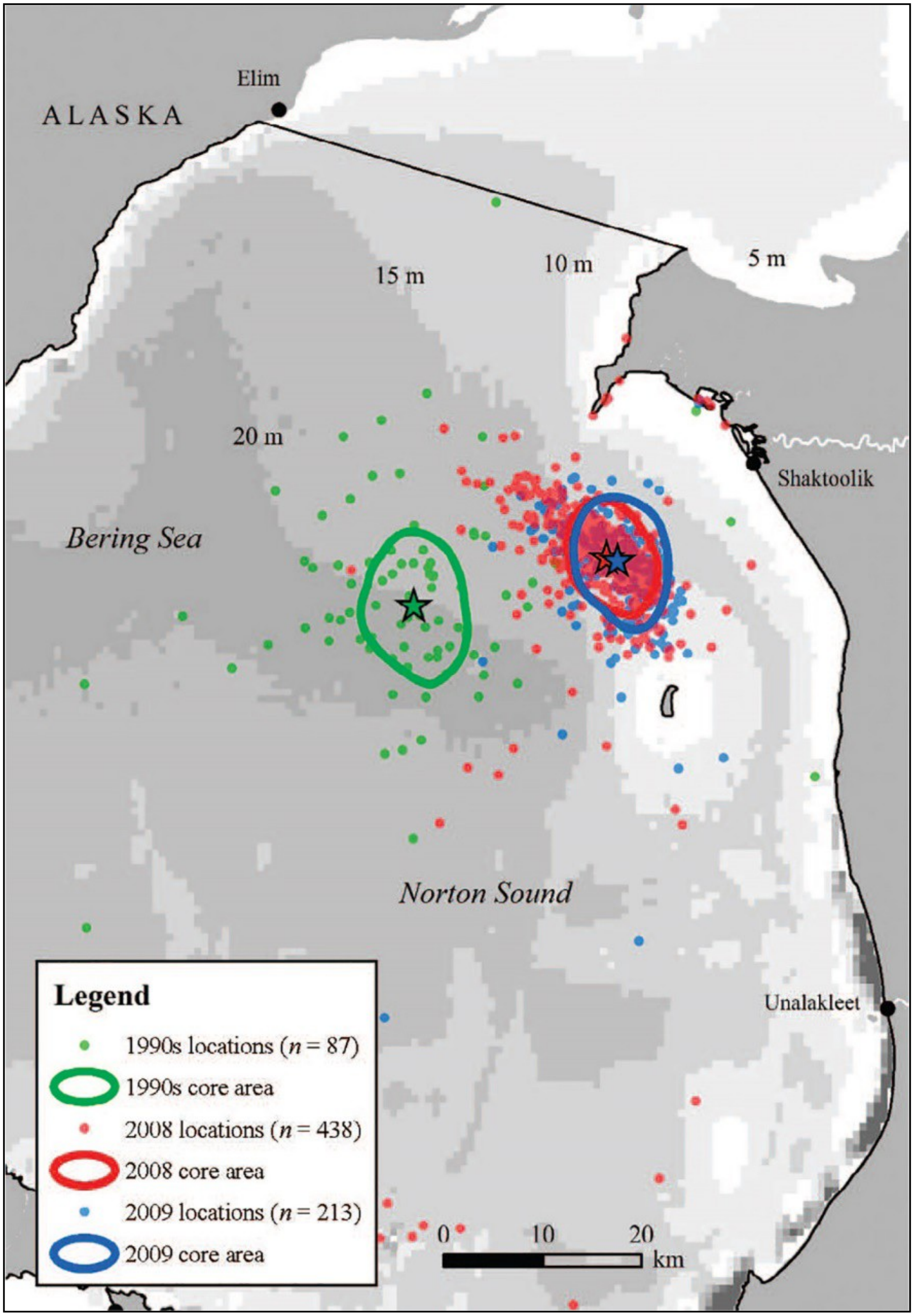

Figure 19. Distribution of Spectacled Eider Sightings within Eastern Norton Sound (from Sexson et al. 2016)

Steller's Eider

The Steller's eider is a sea duck that has both Atlantic and Pacific populations. The Pacific population consists of both a Russia-breeding population (which nests along the Russian eastern arctic coastal plain) and an Alaska-breeding population. The Alaska-breeding population of the Steller's eider was listed as threatened in July 1997 based on a substantial contraction of the species' breeding range in Alaska, overall reduced numbers breeding in Alaska, and vulnerability of the Alaska-breeding population to extinction (USFWS 2011).

Most of the Pacific population winters in the Aleutian Islands and along the Alaska Peninsula, then migrates along the Bristol Bay coast towards arctic nesting grounds in the spring. Steller's eiders arrive in small flocks of breeding pairs on the Alaskan Arctic Coastal Plain (ACP) in early June and similar habitat along the arctic coast of Russia (Figure 20). Nesting on the ACP is concentrated in tundra wetlands near Utqiaġvik and occurs at lower densities elsewhere on the ACP. Hatching occurs from mid-July through early August. After rearing is complete, both the Russia- and Alaska-breeding populations depart for molting areas in southwest Alaska (such as Izembek Lagoon), where they remain for about 3 weeks. Following the molt, the Pacific-wintering Steller's eiders disperse throughout the Aleutian Islands, the Alaska Peninsula, and the western Gulf of Alaska (USFWS 2011). Critical habitat designated for Steller's eiders consists of breeding areas along the Bering Sea coast of the Yukon-Kuskokwim Delta and molting areas along the north coast of the Alaska Peninsula.

There are no identified concentration areas or CH for Steller's eiders in the vicinity of the project area; Steller's eiders may be sighted near Elim (Figure 19), but primarily as transients migrating between breeding, molting, and wintering areas.

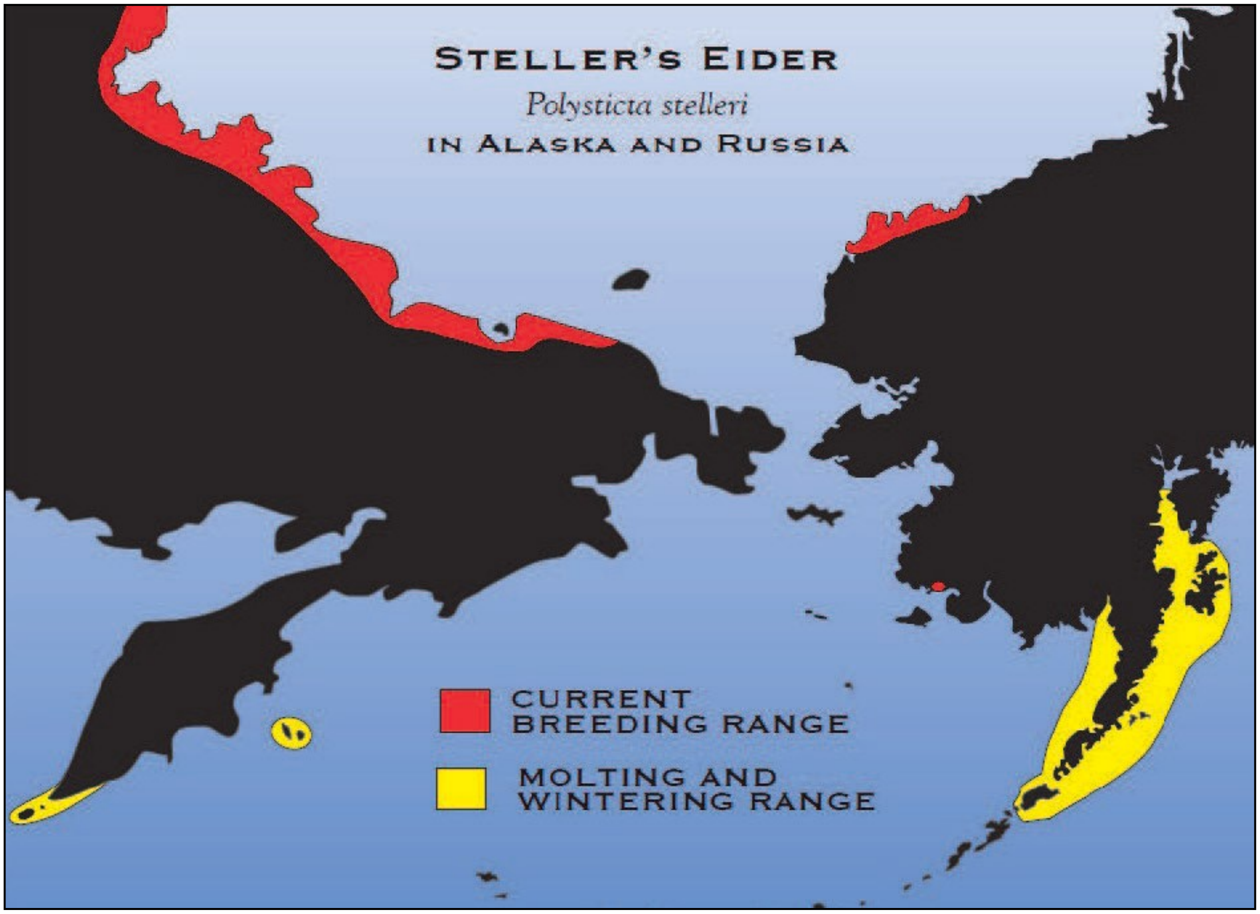

Figure 20. Breeding and Wintering Range of Steller's Eider (USFWS 2011)

Short-tailed Albatross

Short-tailed albatross (*Phoebastria albatrus*) range across much of the North Pacific Ocean as adults and sub-adults. They tend to concentrate along the continental shelf edges of the Gulf of Alaska and Aleutian Basin (USFWS 2008), where upwelling and high primary productivity result in abundant food resources. Their only known breeding range is an isolated group of small islands off the coast of Japan. There is no ESA-designated critical habitat for this species (USFWS 2008). Project-related vessels traveling between Anchorage and Elim could travel close to areas where short-tailed albatross concentrate to feed (Figure 21).

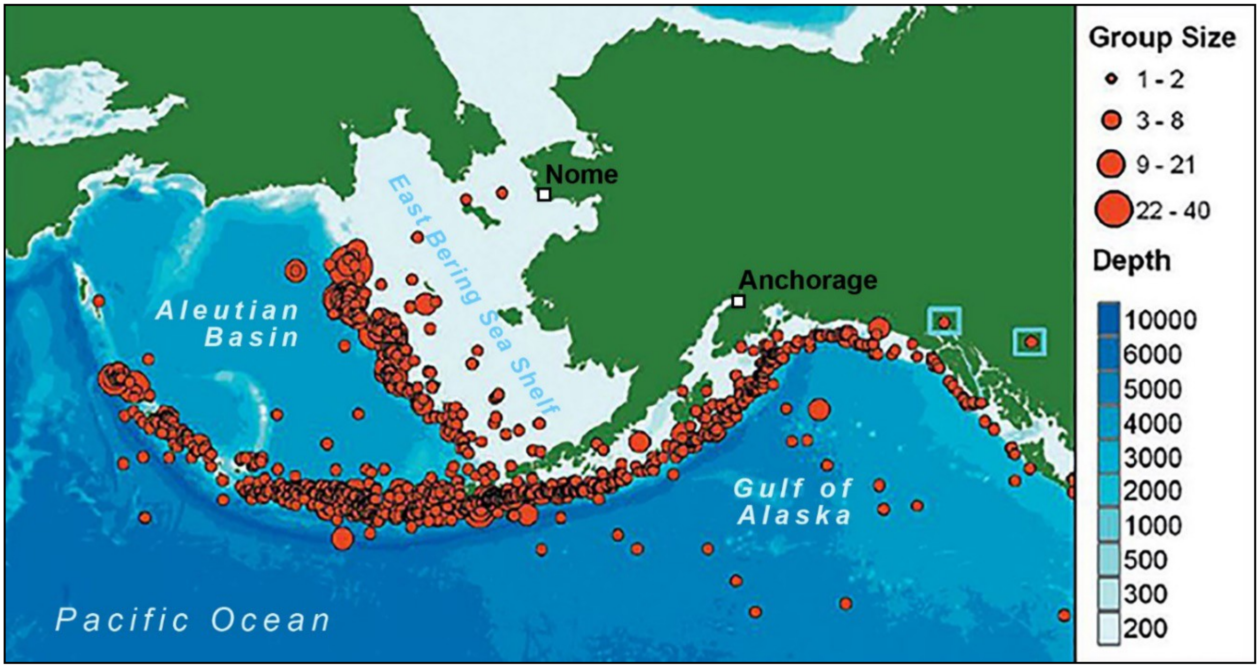

Figure 21. Opportunistic Sightings of Short-Tailed Albatross Compiled 1944-2004 (adapted from USFWS 2008)

Polar Bear

The polar bear is a maritime carnivore dependent on arctic sea ice and the associated assemblage of sea mammals. Polar bears are widely distributed throughout the arctic, with a worldwide population estimated at 20,000–25,000. Sea ice provides polar bears with a platform for hunting and feeding, breeding, and denning. The most productive hunt for ice seals, the polar bear's primary prey, is along ice edges and open leads, so polar bears tend to migrate seasonally with the sea ice edge as it advances in the autumn and retreats in spring (USFWS 2016).

As a result of the observed and anticipated changes to its sea ice habitat in the United States, the polar bear is listed as a threatened species throughout its range (73 FR 28212). The USFWS designated critical habitat for polar bears under the ESA in 2010 (75 FR 76086, USFWS 2010). The designated CH includes three habitat units: barrier islands, sea ice, and terrestrial denning habitat. Coastal barrier islands and spits off the Alaska coast provide areas free from human disturbance and are important for denning, resting, and migration along the coast. Polar bears regularly use barrier islands to move along the Alaska coast as they traverse across the open water, ice, and shallow sand bars between the islands (USFWS 2016). Designated barrier island CH includes a 1-mile buffer zone to minimize disturbances to polar bears.

The only CH unit appearing at Elim is 'sea ice.' The nearest 'barrier island' CH exists within Golovin Bay, roughly 30 miles northwest of Elim, and near Moses Point, about 10 miles northeast of Elim. There is no terrestrial denning habitat identified along the

Norton Sound coast. While Elim is within the theoretical range of polar bears, population studies suggest that typical polar bear winter foraging and denning ranges do not extend far enough into Norton Sound to be found at Elim (Smith et al. 2017). The presence of a polar bear at Elim during a given year would, therefore, be very unusual. The likelihood of a polar bear appearing near Elim would be highest when dense sea ice is present in Norton Sound, roughly November through May, and minimal when sea ice is absent. Rarely, a polar bear may be stranded on the Norton Sound coast when the sea ice retreats in the spring (ADFG 2012).

Northern Sea Otter

Northern sea otters are not found in Norton Sound. Still, Northern sea otters live throughout the Aleutian Islands, along both the Bering Sea and Gulf of Alaska coasts of the Alaska Peninsula, and along much of the Alaska mainland Pacific coast. Project vessels in transit to and from Elim would pass sea otter habitat for a portion of their route along the Alaska Peninsula. Sea otters are primarily near shore animals. The CH description (USFWS 2013) includes as a primary constituent element (PCE) that states: “Nearshore waters that may provide protection or escape from marine predators, which are those within 100 m (328.1 ft) from the mean high tide line.” A project vessel in transit between Anchorage and Elim is unlikely to pass within 100 meters from shore intentionally.

Ringed Seal

The ringed seal is the smallest and most common Arctic seal; they are found in all seasonally ice-covered seas of the Northern Hemisphere. There is one recognized stock of ringed seals, the Arctic stock, found in U.S. waters; the population of this stock is estimated at over 300,000 individuals. The Arctic ringed seal was listed as threatened in 2012 due to the anticipated long-term alteration of their sea ice habitat. The District Court of Alaska vacated this listing. Subsequently, the NMFS appealed that ruling and the species’ ESA status was eventually restored. CH was proposed in December 2014 in conjunction with the listing of arctic ringed seals. The rule has not been finalized and may be revised. The CH description proposed in 2014 encompasses all contiguous marine waters of the Beaufort and Chukchi Seas, and much of the Bering Sea, within the U.S. Exclusive Economic Zone (EEZ), containing these “essential features”:

> *(1) Sea ice habitat suitable for the formation and maintenance of subnivean* (i.e., under the snow) *birth lairs used for sheltering pups during whelping and nursing, which is defined as seasonal landfast (shorefast) ice, except for any bottomfast ice extending seaward from the coastline in waters less than 2 m deep, or dense, stable pack ice, that has undergone deformation and contains snowdrifts at least 54 cm deep.*

(2) Sea ice habitat suitable as a platform for basking and molting, which is defined as sea ice of 15 % or more concentration, except for any bottom-fast ice extending seaward from the coastline in waters less than 2 m deep.

(3) Primary prey resources to support Arctic ringed seals, which are defined to be Arctic cod, saffron cod, shrimps, and amphipods (NOAA 2019a).

Bearded Seal

The Beringia and Okhotsk Distinct Population Segments (DPS)s of bearded seals were listed as threatened in 2012. Only the Beringia DPS is present in Alaskan waters. Bearded seals are generally found in moving ice and areas of open water. They can be found in the Bering Strait region all year, although a large portion of the population migrates north into the Arctic Ocean during the summer and early fall. Many juveniles remain in the Bering Sea during summer, feeding in bays and estuaries. No CH has yet been proposed for this species (NOAA 2019b).

Steller Sea Lion

The Steller sea lion was listed as a threatened species under the ESA in November 1990 (55 FR 49204). In 1997, NMFS reclassified Steller sea lions into two DPSs based on genetic studies and other information (62 FR 24345). At that time, the eastern DPS was listed as threatened and the western DPS was listed as endangered (NMFS 2008).

Steller sea lions prefer the colder temperate to subarctic waters of the North Pacific Ocean. Haul outs and rookeries usually consist of beaches (gravel, rocky, or sand), ledges, and rocky reefs. In the Bering Sea and Okhotsk Sea, sea lions may also haul out on sea ice, but this is considered atypical behavior. CH for Steller sea lions was designated in 1993 and is described in 50 Code of Federal Regulations (CFR) § 226.202. CH in Alaska west of 144°W longitude consists of:

a. Aquatic zones that extend 20 nautical miles (nm), or 37 kilometers (km), seaward of each major haul out, and major rookery (as listed in Table 1 and
b. Table 2 of 50 CFR § 226).
c. Terrestrial zones that extend 3,000 ft (0.9 km) landward from each major haul out and major rookery.
d. Air zones that extend 3,000 ft (0.9 km) above the terrestrial zone of each major haul out and major rookery in Alaska.

Three aquatic foraging areas: the Shelikof Strait area, the Bogoslof area, and the Seguam Pass area, as specified at 50 CFR § 226.202(c).

The vast majority of designated CH sites for the Western DPS are along the Aleutian Islands and the Alaska Peninsula. A project-related barge traveling from Anchorage to Elim would pass through the 20-nm aquatic zones of numerous CH Bogoslof special aquatic foraging areas. The nearest Steller sea lion CH to Elim is on the east shore of St. Lawrence Island, about 200 miles to the southwest. However, Steller sea lions, especially juveniles and non-breeding males, can range through waters far beyond their primary use areas. Observations suggest that Steller sea lions are becoming common in the northern Bering Sea. Their change in range is attributed to climate change-driven movement of pelagic fish prey species, such as Pacific cod, northward (Gay Sheffield, personal communication 2018).

Bowhead Whale

Four distinct populations of bowheads are recognized worldwide; the only population found in U.S. waters is the Western Arctic stock, also known as the Bering-Chukchi-Beaufort stock. The United States listed all bowhead whales as endangered under the ESA in 1973 (NOAA 2018c).

Western Arctic bowheads’ winter in the Bering Sea along the southern edge of pack ice or within polynyas. In March and April, most bowheads are thought to migrate along leads in the ice through the Chukchi Sea to summering areas in the Beaufort Sea. From August to October, they migrate back west to Point Barrow and pass through the Bering Strait by November (ADFG 2008c). Norton Sound is at the outer limit of their typical range (Oceana & Kawerak, Inc. 2014; Smith et al. 2017). A bowhead whale would most likely be found in the vicinity of Elim during the winter, as sea ice extends into Norton Sound. No CH has been established for this species.

Humpback Whale

Humpback whales were listed on the ESA in 1973. Guidance from the NMFS on humpback whales occurring in Alaskan waters (NMFS 2016a) discusses three DPSs:

- Western North Pacific DPS (ESA endangered);
- Mexico DPS (ESA threatened); and
- Hawaii DPS (not listed under the ESA).

Whales from the Western North Pacific, Mexico, and Hawaii DPSs overlap to some extent in feeding grounds off Alaska. An individual humpback whale encountered in the Bering Sea has an 86.5% probability of being from the unlisted Hawaii DPS, an 11.3% chance of being from the threatened Mexico DPS, and a 4.4% chance of being from the endangered Western North Pacific DPS (Table 4).

Table 4. Humpback Whale DPS Distribution in Alaskan Waters

Summer Feeding Areas	Hawaii DPS (not listed)	Mexico DPS (threatened)	Western North Pacific DPS (endangered)
Aleutian Islands, Bering, Chukchi, and Beaufort Seas	86.5%	11.3%	4.4%
Gulf of Alaska	89.0%	10.5%	0.5%

The humpback whale is seasonally migratory, mating and calving in tropical and subtropical waters in winter but spending summers feeding in temperate and subpolar seas. In Alaskan waters humpbacks concentrate in southeast Alaska, Prince William Sound, lower Cook Inlet, and along the Aleutian Islands in summer. Some humpback whales' summer in the Bering Sea, even venturing into the Chukchi Sea. In 2007, humpbacks were spotted in the Beaufort Sea east of Utqiaġvik, suggesting a northward expansion of their summer feeding range (ADFG 2018a). Humpback whales are most likely to be in the vicinity of Elim during the summer and fall.

North Pacific Right Whale

The North Pacific right whale was listed on the former Endangered Species Conservation Act and continued to be listed as endangered following the passage of the ESA in 1973. The listing was later divided into two separate endangered species: North Pacific right whales and North Atlantic right whales, then divided into two distinct endangered species: North Pacific right whales and North Atlantic right whales. Two areas of CHs designated in 2008 (73 FR 19000; Figure 22) occur in areas that could encounter project-related shipping. Barges are more likely to travel the more direct route through the relatively sheltered waters of Shelikof Strait rather than run south of Kodiak Island.

North Pacific right whales are found from Baja California to the Bering Sea with the highest concentrations in the Bering Sea, Gulf of Alaska, Okhotsk Sea, Kuril Islands, and Kamchatka area. They are primarily found in coastal or shelf waters. The seasonal distribution of this species is poorly understood (NMFS 2013). However, recent studies of long-term acoustic monitoring suggest they may venture farther into the northern Bering Sea than previously thought (Wright et al. 2019). In the spring through the fall, their movements are believed to follow the distribution of prey, primarily high densities of zooplankton. In the winter, pregnant females move to shallow waters in low latitudes to calve. The winter habitat of the rest of the population is unknown (ADFG 2018b). This species would most likely be present in the vicinity of Elim in the summer.

Western North Pacific Gray Whale

Gray whales occur in two isolated geographic distributions within the North Pacific Ocean: the eastern North Pacific stock, found along the west coast of North America, and the western North Pacific “Korean" stock, found along the coast of eastern Asia. Most of the eastern North Pacific stock spend the summer feeding in the northern Bering and Chukchi Seas. Still, some have been reported feeding in waters between southeast Alaska and northern California. In the fall, gray whales migrate from their summer feeding grounds, heading south along the coast of North America to spend the winter in their wintering and calving areas off the coast of Baja California, Mexico.

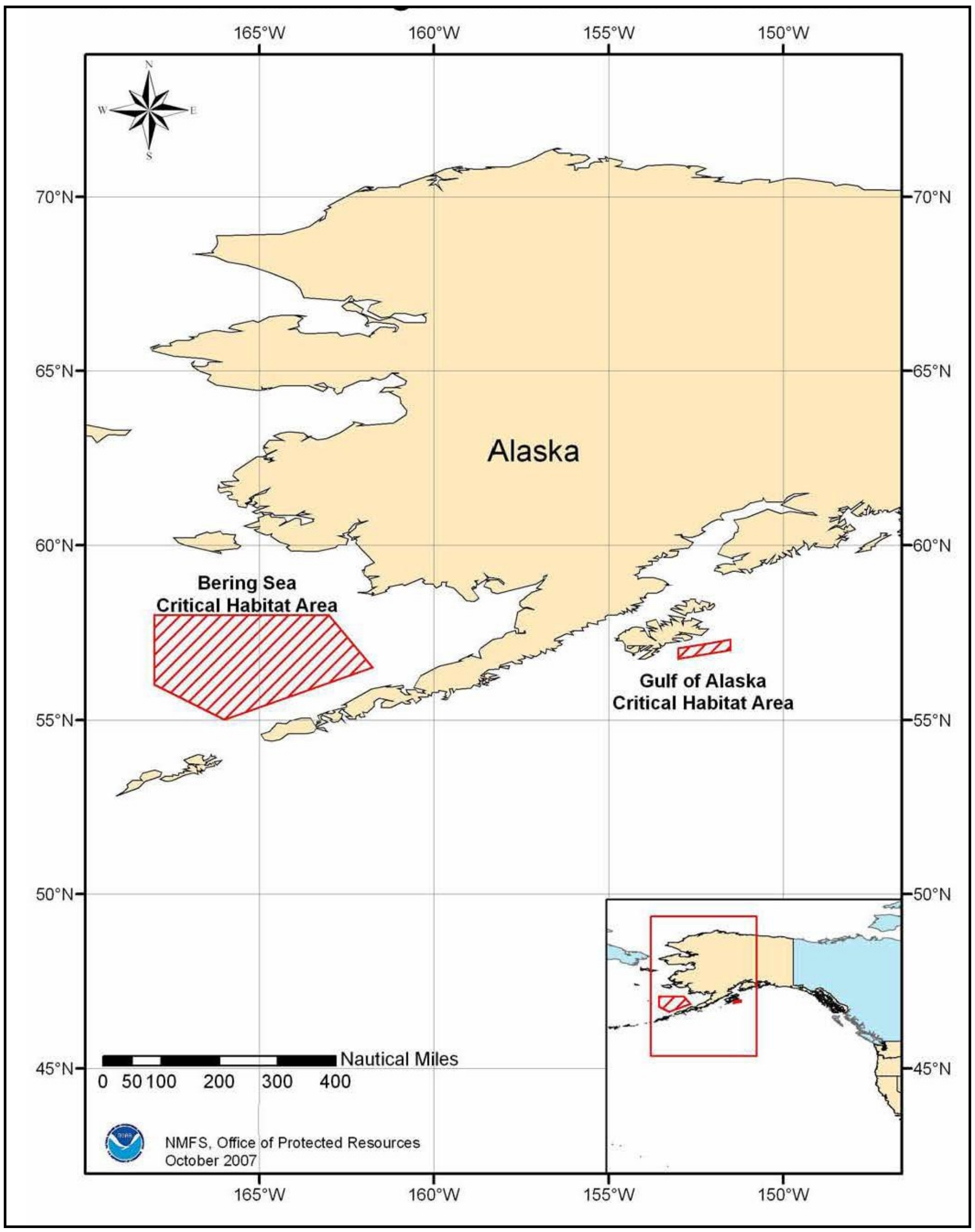

Figure 22. North Pacific Right Whale Critical Habitat

A small number of endangered Western North Pacific DPS of gray whales make their way to the coastal waters of North America during the summer and autumn feeding season, mixing with the unlisted Eastern Pacific population (Moore et al. 2018). The probability of encountering a western north Pacific gray whale in the Bering Sea is unknown. No CH is designated for this species.

Fin, Sperm, and Blue Whale

These great whales are deep water oceanic species that range throughout the North Pacific Ocean and would be encountered only incidentally by project-related vessels. Fin whales are migratory, generally spending the spring and early summer in cold high latitude feeding waters. Populations tend to return to low latitudes for the winter breeding season, though they may remain in residence in their high latitude ranges if food resources remain plentiful. In the eastern Pacific, fin whales typically spend the winter off the central California coast and into the Gulf of Alaska. In summer, they migrate as far north as the Chukchi Sea (ADFG 2008).

Sperm whales generally venture no further north into the Bering Sea than about 62°N latitude, preferring to feed in the Gulf of Alaska south of St. Lawrence Island and along the Aleutian Islands. There is no well-defined north-south migration of North Pacific sperm whales. The females and young remain in tropical and temperate waters year-round, with males joining them in the breeding season but ranging into higher latitudes to feed at other times (ADFG 2018c).

Blue whales in Alaskan waters are most likely to be found in the Gulf of Alaska and along the Aleutian Islands. They are thought to move into high-latitude waters in the spring and spend winters in temperate or tropical areas, but little is known about population-wide movements (ADFG 2018d).

No CH has been designated for fin, sperm, or blue whales.

3.2.2.2. Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 protects all whales, dolphins, porpoises, seals, sea lions, polar bears, and sea otters, regardless of a species' listing under the ESA. Except for the three bird species (Steller's eider, spectacled eider, and short-tailed albatross), all of the ESA species listed in Table 3 are also protected under the MMPA. Marine mammals not currently listed under the ESA, but protected under the MMPA that may be present in the project area include:

- Pacific walrus (*Odobenus rosmarus*)
- Spotted seal (*Phoca larga*)
- Ribbon seal (*Histriophoca fasciata)*
- Harbor porpoise (*Phocoena phocoena*)

- Killer whale (*Orca orca*)
- Beluga whale, other than Cook Inlet DPS (*Delphinapterus leucas*)
- Stejneger's beaked whale (*Mesoplodon stejnegeri*)
- Sei whale (*Balaenoptera borealis*)
- Minke whale (*Balaenoptera acutorostrata*)
- Gray whale, other than Western North Pacific DPS (*Eschrichtius robustus*)

Several of these species, such as spotted seal, beluga whale, and walrus, are relatively common in Norton Sound and important for subsistence. These species are discussed in more detail in Section 3.2.1.5, "Seals, Walrus, and Whales" and 3.5, "Subsistence Use." The Pacific walrus is under the jurisdiction of the USFWS; the NMFS manages all the rest of the MMPA species listed above.

3.2.3. Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 implements the United States commitment to four international treaties for the protection of a shared migratory bird resource. The list of migratory bird species protected by the MBTA appears in 50 CFR §10.13. In Alaska, all native birds except grouse and ptarmigan are protected under the MBTA; grouse and ptarmigan are protected and managed under the State of Alaska regulations.

Bird species expected in the project ROI are discussed above in Section 3.2.1.4, "Coastal Birds."

3.2.4. Essential Fish Habitat and Anadromous Streams

Essential Fish Habitat (EFH) is defined by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. The MSA requires Federal action agencies to consult with the NMFS on proposed actions that may adversely affect EFH. Essential Fish Habitat in Alaskan waters is designated in several fishery management plans prepared by the North Pacific Fisheries Management Commission (NPFMC 2018).

An EFH Assessment has been prepared for this project and is provided in Appendix H: Essential Fish Habitat. The nearshore marine waters near Elim contain EFH for all five species of Pacific salmon at the following life-stages:

- Pink salmon (*Oncorhynchus gorbuscha*) – juvenile and mature.
- Chum salmon *(Oncorhynchus keta)* – juvenile, immature, and mature.
- Sockeye salmon (*Oncorhynchus nerka*) – juvenile, immature, and mature.
- Coho salmon (*Oncorhynchus kisutch*) – juvenile and mature.

- Chinook salmon (*Oncorhynchus tshawytscha*) – immature.

Habitat areas of particular concern (HAPCs) are specific sites within marine EFH that are of particular ecological importance to the long-term sustainability of managed species, are of a rare type, or are especially susceptible to degradation or development. The NPFMC may designate specific sites as HAPCs and may develop management measures to protect habitat features within HAPCs. There are no HAPCs designated within Norton Sound or near the project area.

EFH for Pacific salmon includes freshwater habitat and extends to all streams, lakes, wetlands, and other water bodies currently, or historically accessible to salmon. The State of Alaska manages these waters and their salmon fisheries. The location of many freshwater water bodies used by salmon are contained in documents organized and maintained by the Alaska Department of Fish and Game (ADFG). ADFG is required to specify the various streams that are important for spawning, rearing, or migration of anadromous fishes. Determining the multiple streams is accomplished through the Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes and the Atlas to the Catalog of Waters Important for Spawning, Returning or Migration of Anadromous Fishes (NPFMC 2018). An annotated screenshot from the ADFG's Anadromous Waters Catalog interactive mapping website (ADFG 2020) is shown in Figure 23. Numerous major salmon streams discharge into Norton Bay and eastern Norton Sound, but mostly well to the east or south of Elim. Elim Creek is not currently cataloged by the ADFG as an anadromous stream, although pink salmon are known to enter it.

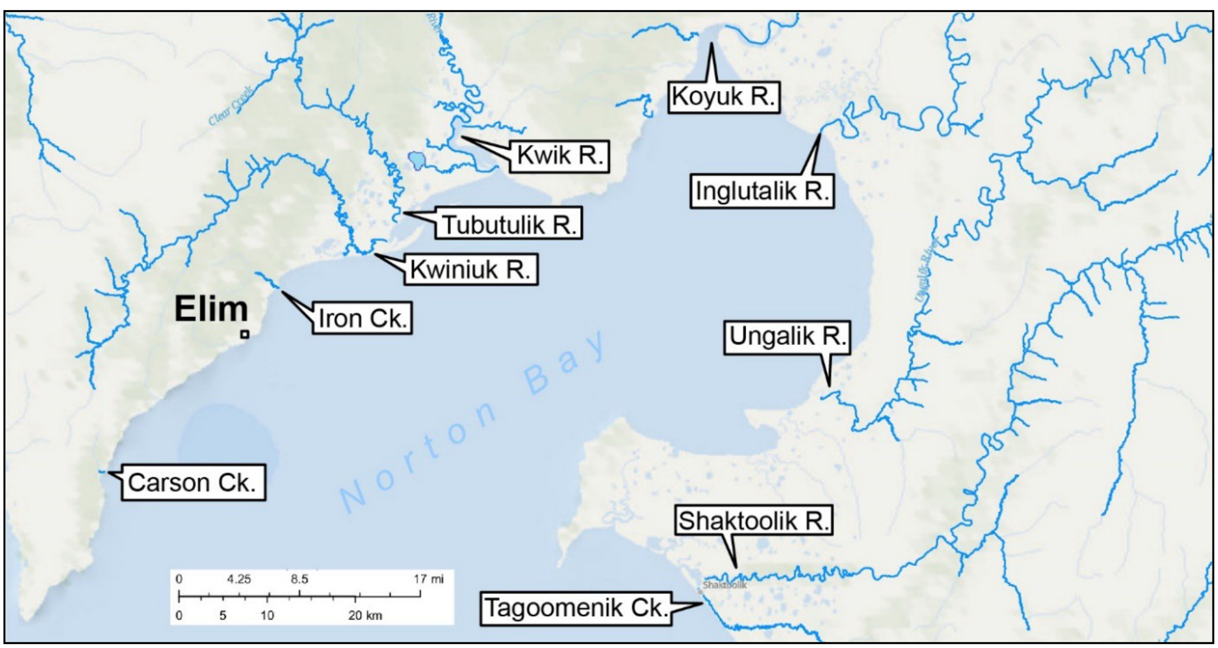

Figure 23. ADFG-Cataloged Anadromous Streams (in Bright Blue) Discharging into Norton Bay (ADFG 2019a)

Typically, mature king and chum salmon enter Norton Sound rivers in mid- to late June, followed by pink salmon shortly after that. Coho salmon usually begin to enter freshwater in late July and run through August (ADFG 2019b).

3.2.5. Special Aquatic Sites

Special aquatic sites, identified as part of the Clean Water Act, are waters of the U.S. possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. The following ecosystems are identified as special aquatic sites:

- Wetlands
- Coral reefs
- Sanctuaries and refuges
- Mudflats
- Vegetated shallows
- Riffle and pool complexes

The USFWS has identified several areas of terrestrial freshwater wetlands inland of the coast (Figure 24) but no special aquatic sites exist within the project ROI.

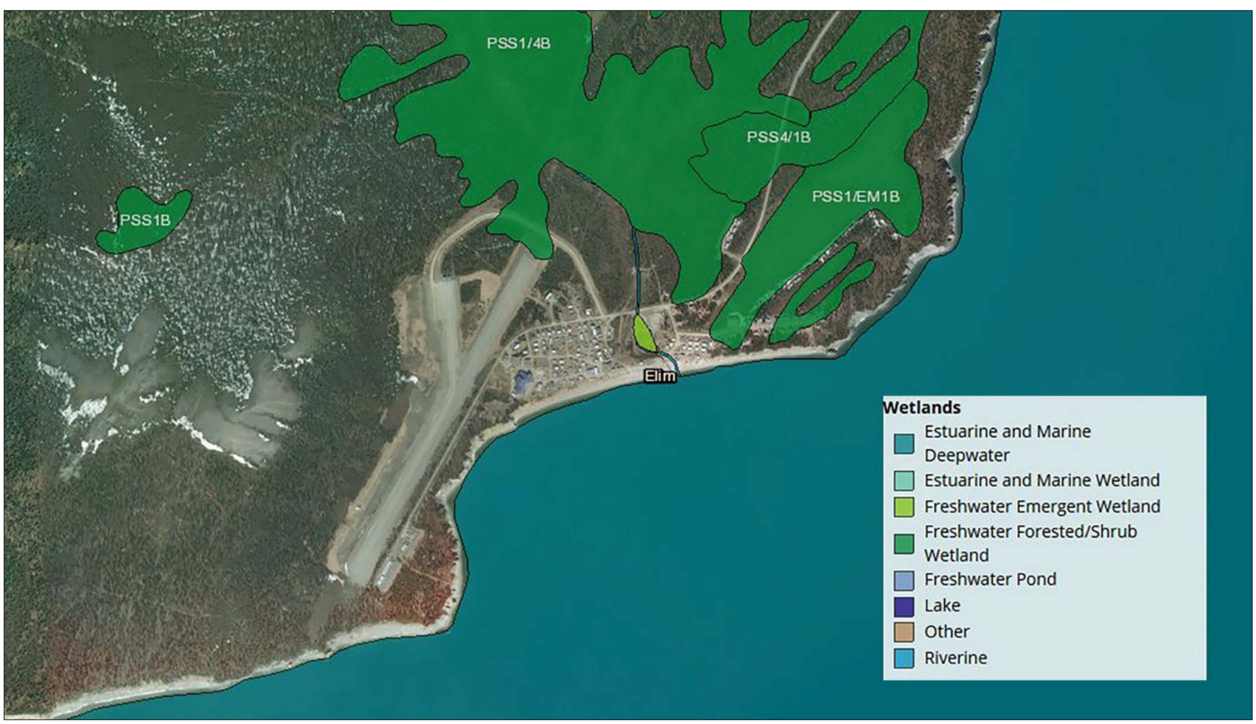

Figure 24. USFWS-Identified Wetlands in the Elim Area

3.3. Socio-Economic Conditions

3.3.1. Population

Although outmigration persists as a threat to most rural Alaska communities, the population of Elim has remained relatively stable. Between 2010 and 2019, population estimates in Elim fluctuated between 330 and 370 but showed an overall increasing trend over the 9-year period. The American Community Survey (ACS) 2017 estimates that 98% of the population of Elim are Alaska Native. Elim's population is 60% male and 40% female. The median age of Elim residents is relatively young at 25 years. Approximately 26% of residents live below the poverty line. Detailed population information can be found in Appendix D: Economics.

3.3.2. Employment

Compared to the regional hub of Nome, where there are more year-round jobs, employment opportunities in rural Elim are limited and often dependent on the industries present and the extent of that presence. For example, some residents are employed in the oil and gas industry, which are dependent on resource and industry movements. The Alaska Department of Labor & Workforce Development (ADLWD) reports worker characteristics for Elim for 2012–2016 (ADLWD 2016). In the 5-year period, the percentage of residents employed shows some fluctuation with a decrease in the percent of employed residents in the last 2 years, from 72 to 65%. The local government sector accounts for more than 60% of total resident employment for the 5-year period. The private sector employs 30%, and the state government employs about 2% of employed residents.

The oil and gas industry drive several employment opportunities in Elim. These positions include Freight, Stock and Material Movers and Laborers; Construction Laborers; and Water and Wastewater Treatment Plant and System Operators. In 2012 and 2013, Fish Cutters and Trimmers were ranked second in Elim's top occupation list, but this occupation has since dropped off the list. The loss of Fish Cutters and Trimmers suggests that the commercial fishing operations in Elim were previously a major employer for residents and downsized in recent years. This occupation category is discussed further in subsequent sections of Appendix D: Economics.

Commercial fishing is a key basic income earning practice in Elim during the commercial salmon fishing season; however, it is not reported by the Alaska Department of Labor & Workforce Development (ADWLD) in its worker characteristics (USACE Public Meeting 2018). The number of commercially-harvested fish is tracked by Norton Sound Economic Development Corporation (NSEDC) via commercial fishing permits owned by Elim fishermen, but this does not show the number of crew members employed by each commercial vessel. Appendix D: Economics describes the characteristics of the commercial fisheries' resources and attributes in Elim. While not captured as a top occupation by ADWLD, community members in Elim who own vessels dedicate labor and resources in maintaining their boats and dedicate labor fishing during the commercial fishing seasons. Some community members have a formal full-time or part-time job and work in commercial fisheries intermittently.

3.3.3. Income and Cost of Living

Income and the cost of living influence the community's livelihood and viability. Almost half of the employed residents in Elim earned less than $10,000 in wages in 2016. Data from remote Alaska is limited to the latest available data from 2016. More than 20% of the working residents in Elim earned less than $5,000 in 2016. Wages for Elim residents ranged from under $5,000 to over $50,000. As the wage ranges increase in dollar value the percent of Elim residents earning those wages decreases. At the statewide level, the opposite is observed; fewer residents earned the low wage ranges, and more workers earned higher wage ranges. About 33% of statewide residents earned $50,000 or more, while only 10% of Elim residents earned this wage range. About 21% of residents statewide earned less than $10,000, but in Elim, this percent is doubled at 44%. About 33% of statewide residents earned $50,000 or more, while only 10% of Elim residents earned this wage range. The household income in Elim is just under $40,000, but Elim residents pay at least 2.5 times the U.S. average for basic goods.

These income and cost of living conditions mean that households in Elim are more exposed to systemic problems such as interruptions to the transportation system. While a set of factors and thresholds come into play when defining poverty, these comparisons aid in understanding some of the challenges faced by the 26% of Elim residents who are considered low income (Census Bureau 2017). Additional Employment, Income, and Cost of Living information can be found in Appendix D: Economics.

3.3.4. Marine Infrastructure & Facilities

Elim is not connected to any other communities by road and must be accessed by airplane or seasonally by boat or snowmachine.

3.3.4.1. Marine Facilities

Elim has no dock or barge ramp infrastructure. A barge brings freight from Nome to the beach in front of the community. Supplies must be lightered to shore due to a complete lack of marine facilities.

The fuel barges anchor offshore near the fuel header location at the southwest end of the community and freight barges land east of a small stream outfall along the beach where cargo is offloaded. Fuel barge operators report that the shoreline area at the landing on the west side of town is rocky, so they anchor offshore and float a hose to the marine header on shore. Freight barges utilize the shore at Elim Beach as a makeshift barge landing (Figure 25). Note in the figure how the subsistence vessel in the foreground is pulled up on the beach while the heavy machinery on the beach is used for offloading. No infrastructure is present, and tugs must push barges up against the shore and/or the barge will tie off to heavy equipment on shore to maintain position during the offloading of cargo. Freight landing craft operators also report that the rocky coastline on the east side of the community is a hazard, as is a sewer outfall pipe near the middle of the community. Also, the steep bank in some areas of the beach makes offloading cargo difficult, and barge operators report that the bridge in town is too small for large trucks to transit.

Figure 25. Barge Preparing to Unload at Elim

3.3.4.2. Airport

Elim's isolated location has led to a reliance on air transportation. Until the outbreak pandemic of Coronavirus, two local airlines, flying bush planes (e.g., Cessna Caravan), served Elim daily. One of the airlines filed for bankruptcy in April 2020, ceasing flights to Elim and other communities. This same airline company reports that it plans to re-launch as a new company (Ravn Alaska, August 2020). There is an unattended, lighted 3,401-ft long by 60-ft wide state-owned gravel runway. Elim Native Corporation also owns a private, unattended, and unlighted 3,000-ft long by 60-ft wide airstrip at Moses Point.

3.3.5. Navigation Conditions

Harbor accessibility and days with safe moorage are limited for all vessel classes. Freight and fuel delivery costs are relatively high due in part to inadequate barge landing conditions coupled with other factors, which can result in the high costs for freight and fuel delivery. Damages to vessels occur regularly at Elim Beach and Moses Point as a result of weather events.

Under current conditions, adverse wave conditions limit vessel access to the area of safe moorage within the mouth of the Kwiniuk River at Moses Point. Wind and wave data from the ongoing Wave Information Study for Alaska, published by the Engineering Research and Development Center's Coastal Hydraulics Laboratory, indicate that waves produce inaccessible conditions across all vessel classes at Moses Point 31.6% of the time and unmoorable conditions 19% of the time during the harvest season. Other constraints include weather, such as times of high wind or heavy seas, that force vessels to try and seek refuge at Moses Point, which, itself, can be inaccessible from Elim by land due to flooding of the access road. Fuel and cargo barges delivering to Elim incur higher costs due to anticipated delays and increased operating costs associated with delivering to the community. Barges often wait offshore until conditions at Elim are safe to deliver cargo.

All these conditions limit the community's ability to develop a stable and sustainable local marine resource economy sufficient to support their mixed subsistence-cash economy. Further discussion on links between vessel access and community viability is found in Section 4.3, "Proposed Golovin Improvements".

3.4. Cultural Resources

3.4.1. Historic Context

The earliest-known archaeological site in the vicinity of Elim is Iyatayet (NOB-00002), located on Cape Denbigh, approximately 25 miles east of Elim across Norton Bay. The oldest occupations at this multicomponent site date to about 4,000 years ago; however, the site was periodically occupied until about 500 years ago (Tremayne et al. 2018). Multiple archaeological sites in the region demonstrate that the shores of Norton Sound have been continuously occupied for at least the past 2,000 years.

European explorers first visited the region in 1778, when James Cook sailed into Norton Sound. Joseph Billings followed this in 1791, and Otto von Kotzebue in 1816 (Bockstoce 1979). In 1822, the Russian-American Company established a trading post at Saint Michael, approximately 80 miles south of Elim across Norton Sound. Encroachment of outsiders into the region impacted local communities in multiple ways, including encouraging the migration of individuals from further north into the area to take advantage of trade opportunities and a decrease in local indigenous populations due to multiple epidemics. The 1867 Treaty of Cession transferred Russian possession of the Alaska Territory to the United States. The late 1800s saw a further influx of outsiders into Norton Sound, with the establishment of Christian missions in the area and the discovery of gold near Nome (Ray 1964; Ganley 1995; Phillips-Chan 2019; Raymond-Yakoubian 2019).

In 1914, the Golovin Evangelical Covenant mission was relocated to what is now the City of Elim. The Covenant mission and children's home was established at the former location of *Nuviakchak*, a Malemiut Inupiat village that had been abandoned sometime before 1910. Reverend Ludwig Evald Ost and his wife Ruth Ost led the relocation and called it the "Elim Mission Roadhouse." Reverend Ost chose the name "Elim" for its biblical associations. In 1917, 350,000 acres of land around Elim were set aside in an Executive Order and designated the Norton Bay Reservation for use by the U.S. Bureau of Education and the inhabitants of Elim (BIA 1975; Raymond-Yakoubian 2019). In 1929, under pressure from mining lobbyists, 50,000 acres were removed from the reserve via another Executive Order. The City of Elim was incorporated in 1970. When ANCSA was passed in 1971, Elim chose the "opt-out" option through Section 19b of ANCSA. Instead of other ANCSA benefits, Elim gained title to 298,000 acres of the former reserve (Case and Voluck 2012; Raymond-Yakoubian 2019).

3.4.2. Known Cultural Resources

The Alaska Heritage Resources Survey (AHRS) database documents twelve known cultural resources within the vicinity of Elim (Table 5). The AHRS identifies Elim itself as the historic village of *Nuviakchak* (SOL-00038). A search of both the Bureau of Ocean and Energy Management's (BOEM) database and the National Oceanic and Atmospheric Admiration's (NOAA) Wrecks and Obstructions database identified no known shipwrecks or other obstructions within the project vicinity (BOEM 2011; NOAA 2018b). No underwater archaeological surveys were conducted for this study, as the annual development of shorefast ice and grounded pressure ridges, as well as the impacts of ice scouring, reduce the likelihood that any *in situ* underwater cultural resources exist.

Table 5. Known Cultural Resources within the General Vicinity of the Proposed Project (AHRS 2020)

AHRS No.	Site Name	NRHP Status	In APE
SOL-00038	Nuviakchak (Elim)	Unevaluated	YES
SOL-00127	Unalakleet–Nome Trail	Eligible	No
SOL-00177	Cabin 1	Unevaluated	No
SOL-00178	Cabin 2	Unevaluated	No
SOL-00179	Outbuilding 1	Unevaluated	No
SOL-00180	Cabin 3	Unevaluated	No
SOL-00181	Old High School	Unevaluated	No
SOL-00182	Dog House	Unevaluated	No
SOL-00183	Cabin 4	Unevaluated	No
SOL-00184	U.S. Post Office	Unevaluated	No
SOL-00185	Cabin 5	Unevaluated	No
SOL-00186	Meeting House	Unevaluated	No
Note: NRHP = National Register of Historic Places			

There have been at least six cultural resources surveys conducted in the Elim area. In 2002, the Army National Guard (ARNG) conducted a study on the Elim ARNG Armory in preparation for potential future undertakings at the facility (Morris et al. 2002). No historic properties were identified during the survey. In 2004, the Alaska Native Tribal Health Consortium (ANTHC) coordinated service line replacements to ten homes in Elim. The 2004 undertaking received concurrence from the State Historic Preservation Officer (SHPO) that the project would not affect historic properties due to the lack of ground disturbance (ANTHC 2004). In 2006, the ANTHC coordinated service connection replacements for 30 homes in Elim. The undertaking, which entailed replacing existing subsurface service connections, also received concurrence from the SHPO that the project would not affect any historic properties (ANTHC 2006). In 2014, Walking Dog Archaeology conducted a survey of Elim in preparation for a Kawerak Transportation Project to rehabilitate the major roads and parking in the community. All major roadways and the beach were surveyed. Pipkin (2014) reported negative findings on all walked roadways and along the beach.

In 2016, GCI Communications Corporation (GCI) conducted an archaeological and architectural survey of Elim as a part of the TERRA Terrestrial Backbone Telecommunications System Project. Results of the inventory and survey included recommendations of eligibility for listing the village of *Nuviakchak* and ten buildings in Elim in the National Register of Historic Places (GCI 2016). However, the status of these structures is listed as pending on the associated AHRS Cards. The SHPO did not concur with the eligibility of SOL-00038 due to insufficient documentation of eligibility under Criteria A or C. In 2018, a USACE archaeologist conducted a pedestrian survey on the upland areas of four potential boat harbor locations: Moses Point, Iron Creek, Elim Beach, and Airport Point. No cultural resources were identified during the survey.

3.5. Subsistence Use

Subsistence activities are an integral aspect of daily life for the people of Norton Sound. As noted in Berger (1985):

> *Anthropologists and lawyers have made many attempts to define subsistence, for them a technical term. For Alaska Natives, however, subsistence is a way of life. The traditional economy is based on subsistence activities that require special skills and a complex understanding of the local environment that enables the people to live directly from the land. It also involves cultural values and attitudes: mutual respect, sharing, resourcefulness, and an understanding that is both conscious and mystical of the intricate interrelationships that link humans, animals, and the environment. To this array of activities and deeply embedded values, we attached the word 'subsistence,' recognizing that no one word can adequately encompass all these related concepts. (51)*

Subsistence provides food security (Fall and Kostick 2018), nutrition, health and wellness, food sovereignty and self-determination, and a unique connection to cultural heritage and the environment. Communities in Norton Sound have been practicing subsistence for thousands of years; they are well-suited to the land they live on and subsistence permeates all aspects of life. Subsistence is a fundamental part of the daily life of most Elim community members who harvest, prepare, and share wild foods throughout the year. Subsistence activities include hunting of marine mammals, land mammals, and birds; gathering bird eggs, greens, roots, berries, mollusks, and seaweed; as well as crabbing and fishing (Raymond-Yakoubian 2019).

Elim can be described as having a mixed cash-subsistence economy where equipment requiring cash inputs have become important harvest tools for subsistence activities. Examples of this include skiffs, boat motors, set and drift nets made of nylon-based materials, all-terrain vehicles (ATVs), snowmachines, and firearms. All of these are essential to the modern subsistence practice and almost all the equipment required to participate in a subsistence-based economy must be purchased with cash (Howe and Martin 2009). Associated with much of this equipment is the need for fuel. As Raymond-Yakoubian (2019) describes in her study on Elim subsistence:

> *…the cost of fuel can be limiting or prohibitive for some residents who want to travel beyond the village limits to hunt, fish, or gather subsistence foods. Some hunters will pool financial resources to buy fuel. Non-hunters may also contribute funds to a hunting or fishing party and receive a share of the harvest in return. (126)*

For Elim's community, subsistence activities are facilitated by the use of skiffs, which are referenced as small subsistence vessels in the literature. Currently, these skiffs, as well as larger vessels, are primarily hauled out on or tied up to the beaches along the mouth of Kwiniuk River at Moses Point, about a 10-mile drive northeast of Elim. Skiffs are also occasionally hauled out at Elim Beach, and beaches at both Elim and Moses Point are used as a staging area for many subsistence-related events (Raymond-Yakoubian 2019).

3.5.1. Documented Subsistence Harvests

The community of Elim harvests all kinds of animal and plant species. Between 2005 and 2006, Elim harvested more than an estimated 185,000 pounds (lbs) of wild foods (Table 6). Marine mammals provided the most food by meat weight, with an estimated 50.5 beluga, 40.6 bearded seals, 19.7 spotted seal, 14.8 walrus, and 12.3 ringed seal harvested (Ahmasuk et al. 2008:182).

Table 6. Wild Foods (estimated lbs) Harvested in Elim from 2005–2006

Salmon	Non-Salmon Fishes	Caribou	Moose	Other Land Mammals	Marine Mammals	Birds & Eggs	Plants & Berries
38,926.0	28,355.5	20,420.9	13,292.3	348.9	68,850.5	1,851.9	13,452.0
(Source: Ahmasuk et al. 2008:289).							

Marine Mammals

The importance of marine mammals as subsistence resources is documented in the history of Elim. One of the reasons that the ancestors of the current residents chose to establish their village at Elim was because of the abundance of ringed, bearded, and spotted seals in Norton Bay (Raymond-Yakoubian 2019:141). In addition to seals, residents hunt beluga whales and Pacific walrus (Ahmasuk et al. 2008:182).

Elim hunters harvest walruses in the springtime and between Cape Darby and Stuart Island, southwest of the community. Bearded seals are also harvested in the winter and spring, on floating sea ice near Cape Darby or further out into Norton Sound. Ringed seals are harvested in the winter and spring on shorefast ice in Norton Bay. In the fall, ringed and bearded seals are hunted in Norton Bay close to the shoreline and near river mouths. Spotted seals are harvested near Elim in the late spring during ice-out (Kawerak 2013:34). Beluga whales are primarily harvested during the spring and fall. In the spring, beluga whales congregate along the shorefast ice edge in Norton Bay; in the fall, they are found in open water in Norton Bay (Oceana and Kawerak 2014).

Land Mammals

Although land mammals only constitute approximately half of the meat weight of marine mammals harvested annually, they are still significant subsistence resources. Annual caribou harvests depend on multiple factors, including herd range and migration routes, availability of other subsistence species, and cost of gasoline prices, among other things. Between 2010 and 2011, Elim hunters harvested an estimated 83 caribou; the majority were harvested in the spring (Braem and Kostick 2014); over half the number harvested in 2006, and almost one-third of the number harvested in 1999 (Table 7).

Table 7. Approximate Harvest Data for Land Mammals in Elim for 1999, 2006, and 2010

Species	# Harvested 1999	# Harvested 2006	# Harvested 2010
Brown Bear	0	0	3
Caribou	**227**	**150**	**83**
Moose	**14**	**25**	**11**
Muskox	0	0	1
(Source: Braem and Kostick 2014: 8, 22, 40, 59).			

Between 2010 and 2011, Elim hunters harvested an estimated 11 moose. Moose are hunted in the summer and fall and are taken in successively higher numbers ending in September. Brown bear and muskoxen were also harvested in 2010–2011, although no harvests were reported in 1999 or 2006 (Table 7). Elim community members also harvest small land mammals. In 2006, Elim harvested about 25 hares (Mikow et al. 2020), as well as an estimated 13 beavers, two lynx, 11 martens, seven wolverines, three otter, six red fox, and two wolves (Ahmasuk et al. 2008:144). Between 2010 and 2011, Elim reported harvests of six beavers, three lynx, five martens, and one wolverine (Braem and Kostick 2014:23).

Fishes and Invertebrates

Fishes and invertebrates are taken during all seasons of the year, from both marine and freshwater. Fishing is commonly accomplished by using nets, hand-lines, rod and reel, and by setting pots (Oceana and Kawerak 2014). A wide variety of fishes and invertebrates are used for subsistence, including salmon, whitefish, smelt, grayling, burbot, Dolly Varden, herring, tomcod, crab, clams, and mussels. High cultural value is placed on fishing and other subsistence related activities. Residents of Elim generally fish northeast towards Moses Point (Ahmasuk et al. 2008; Oceana and Kawerak 2014; Raymond-Yakoubian 2019). All five salmon species are especially important; Elim residents harvest approximately 146 lbs of salmon annually per capita (Raymond-Yakoubian 2019:4). In 2016, 55 subsistence salmon permits were issued for the Elim Subdistrict; a total of 8,934 salmon, the majority of which were pink salmon, were reported harvested (Menard et al. 2017:69).

Birds

Birds are harvested primarily in the spring and summer, although some species are harvested year-round, and others, like ptarmigan, are hunted mainly during the winter. Between 2005 and 2006, Elim harvested approximately 652 birds (Table 8). The Lesser Canada Goose and Sandhill Crane contributed the most by meat weight, with an estimated 1.4 lbs and 1.1 lbs per capita, respectively (Ahmasuk et al. 2008: 214). Approximately 1,809 bird eggs were also harvested between 2005–2006 (Table 9). Glaucous gull eggs were the most commonly collected (Ahmasuk et al. 2008:246).

Table 8. Estimated Number of Birds Harvested in 2005–2006

Species	# Harvested
Black Brant (*Branta bernicla*)	50
Cackling Goose (*Branta hutchinsii*)	6
Canvasback (*Aythya valisineria*)	2
Emperor Goose (*Chen canagica*)	1
Green-winged Teal *(Anas crecca)*	21
Lesser Canada Goose *(Branta canadensis parvipes)*	92
Lesser Snow Goose (*Chen caerulescens*)	1
Mallard (*Anas platyrhynchos*)	27
Northern Pintail *(Anas acuta)*	114
Northern Shoveler (*Anas clypeata)*	6
Ptarmagin (*Lagopus* spp.*)*	156
Sandhill Crane (*Grus canadensis*)	42
Spruce Grouse (*Falcipennis canadensis*)	61
Tundra Swan (*Cygnus columbianus*)	4
White-Fronted Goose (*Anser albifrons)*	60
Wigeon (*Anas americana*)	6
(Source: Ahmasuk et al. 2008:214)	

Table 9. Estimated Number of Bird Eggs Harvested in 2005–2006

Species	# Eggs Harvested
Arctic Tern	23
Common Eider (Somateria mollissima)	505
Common Loon (Gavia immer)	25
Glaucous Gull (Larus hyperboreus)	609
King Eider (Somateria spectabilis)	82
Black-Legged Kittiwake (Rissa tridactyla)	281
Lesser Canadian Goose (Branta canadensis parvipes)	44
Mallard (Anas platyrhynchos)	16
Mew Gull (Larus canus)	37
Murre (Uria spp.)	40
Northern Pintail (Anas acuta)	129
Red-Throated Loon (Gavia stellata)	2
Sandhill Crane (Grus canadensis)	4
Tundra Swan (Cygnus columbianus)	12
(Source: Ahmasuk et al. 2008:246)	

Plants and Berries

Plants and berries are important subsistence resources (Sobelman 1985; Ahmasuk et al. 2008). Elim residents collect numerous plant and berry species; between 2005 and 2006, Elim collected an estimated 13,452 lbs of plants and berries (Table 10). Berries, especially blackberries, also known as crowberries (Empetrum nigrum), salmonberries, also known as cloudberries (Rubus chamaemorus), blueberries (Vaccinium uliginosum), and lowbush cranberries (Vaccinium Vitis-idaea), composed the majority of the total weight collected. Of the non-berry species, wild rhubarb (Polygonum alaskanum) was the most-often collected.

Table 10. Estimated Amount of Plants and Berries Harvested in 2005–2006

Species	Pounds Harvested
Beach Grass (Elymus arenarius)	9.5
Beach Peas (Lathyrus maritimus)	1.5
Blackberry (Vaccinium uliginosum)	5,041.2
Blueberry (Vaccinium ovalifolium)	2,126.8
Chunucks (Ribes spp.)	4.3
Cranberry (Vaccinium vitis-idaea)	1,501.5
Currants (Ribes triste)	4.3
Eskimo Potato (Hedysarum alpinum)	38.2
Fireweed (Epilobium angustifolium)	1.5
Labrador Tea (Ledum palustre)	6.2
Raspberry (Rubus arcticus)	36.9
Rhubarb (Polygonum alaskanum)	124.0
Salmonberry (Rubus spectabilis)	4,347.1
Seaweed (Palmaria mollis)	12.3
Sourdock (Rumex archius)	84.0
Stinkweed (Artemisia tilesii)	15.7
Wild Celery (Angelica lucida)	3.1
Wild Chives (Allium schoenoprasum)	34.2
Willow Leaf (Salix alaxensis)	59.7
(Source: Ahmasuk et al. 2008:260)	

4. FUTURE WITHOUT PROJECT CONDITION (FWOP)

This section provides forecasting of conditions that are expected to persist at Elim, Alaska, in the absence of navigation improvements. The Future Without Project Condition (FWOP) forms the basis from which alternative plans are formulated and impacts are accessed. The period of the analysis is 50 years, beginning with the base year of 2027, the year of expected construction completion and the start of accrual of project benefits.

4.1. Physical Environment

Under FWOP, there are no anticipated changes expected to the geology/topography, seismicity, bathymetry or tides, and currents in the project area. Changing sea ice conditions and potential sea level rise (Section 1.8.2, “Climate Change”) could result in unknown changes to the storm conditions and increased wave height at Moses Point and Elim Beach. These non-stationarities could result in increased overtopping and erosion of the road to Moses Point and flooding and erosion along Elim Beach. Changing storm conditions and RSLC could also change the dynamics of the mouth of Kwiniuk River, which would affect boat access. See Appendix C: Hydraulics and Hydrology for a more detailed discussion of the potential climate change impacts on the proposed project location. The Norton Sound is fed by many sub-Arctic streams, rivers, and estuarine lagoons meeting the Bering Sea. These hydrogeographically complex systems support subsistence and commercial fisheries for salmon. The Norton Sound region stretches from Cape Douglas, northwest of the mouth of the Sinuk River to Point Romanof, south of Stebbins (Menard et al. 2017). Elim is surrounded by the Kwiniuk River that drains out at Moses Point, which lies approximately 10 miles northeast along Moses Point road. The Tubutulik River also drains out at Moses Point, which is where the community fishes for salmon.

Due to the depth constraints and shoaling/migrating mouth of Kwiniuk River at Moses Point, where commercial fishing vessels deliver their catch, Elim’s commercial fishermen forego some commercial harvest. The disruption to commercial fishing operations due to flooding events or shallow water depths occurs 8–10 times each season, and operations would continue to be disrupted resulting in lost revenue under the FWOP condition. The resulting cascading effect includes fishers choosing to sit out fishing days if they anticipate the fish buying station (a temporary, seasonal development consisting of a small crane with a brail, ice supply, office, lighting, and equipment for moving fish totes for the purpose of accepting commercially caught fish and maintaining the fish at the appropriate temperature until delivered to a tender going to a fish processing station) will not be accessible.

The Norton Sound Economic Development Corporation (NSEDC) estimates 10% of Elim’s commercial harvest overall is foregone due to these inefficiencies. The corporation further estimates that 25% of coho salmon harvest is foregone due to fishing closures when the Unalakleet plant exceeds its processing capacity and shuts down. In the FWOP conditions, NSEDC plans to install a pre-processing plant in Elim to reduce the excessive influx of fish at the Unalakleet plant. However, even if this smaller scale plant opens, without improving navigational access for commercial and tender vessels, 10% of the overall salmon harvest and 15% of coho are still foregone. The present value of commercial harvest foregone is $1.9 million(m) using the Federal discount rate of 2.75% over a 50-year period of analysis. The average annual cost of commercial harvest foregone is $70,000. In addition to commercial harvests foregone, there are transportation inefficiencies borne by the commercial fishery between Elim Beach and Moses Point, and skiff delivery trips from shore to tenders moored offshore as described in Section 4.5, “Marine Resource Assessment.” These are transportation costs that will continue to be incurred by the nation. In addition, residents would continue to utilize Moses Point opportunistically depending on the vessel size and flooding conditions.

4.2. Port of Nome Navigational Improvements

Proposed navigational improvements at the Port of Nome would not resolve the challenges faced by the community of Elim. The lack of moorage, harbor, or a boat landing infrastructure at Elim results in vessel damages, unmet subsistence, and foregone commercial harvests borne by the residents. The proposed harbor modification project at Nome has the potential to reduce marine transportation costs for fuel and goods, including construction materials coming into the region. However, the barge delays at Elim diminish the potential for such cost reductions. The threats to the community’s long-term viability are associated with the specific navigational inefficiencies at Elim. The social and cultural value of safe access to subsistence resources in a changing climate is key to Elim’s viability. Given the cultural and social ties of subsistence activities to specific locations, a harbor project at the Port of Nome would not support Elim’s ability to access and participate in subsistence activities.

4.3. Proposed Golovin Improvements

Though Golovin is closer to Elim than Nome, no roads connect the two villages, and the terrain between the two villages is rugged. The proposed improvements to the village roads in Golovin, along with improvements to their boat launch and barge landing area, would present no additional benefits to Elim. Golovin, like Elim, practices a cash-subsistence economy with the vast majority of goods coming into Golovin harbor being used within the community to maintain their viability. Improvements at Golovin would not resolve the challenges faced by the community of Elim. The lack of moorage, harbor, or a boat landing infrastructure at Elim results in vessel damages, unmet subsistence, and foregone commercial harvests borne by the residents of Elim. Safe access to Elim would still be limited, and barge delays would still occur, thus providing no perceptible benefits for Elim.

4.4. Biological Resources

Under FWOP conditions, the Alaska District would not undertake navigation improvements at Elim so no new impacts would be expected to the biological resources in the Elim area.

Habitats in Norton Sound are exhibiting effects from climate change, effects that are expected to expand and intensify in the future. Warming temperatures in the arctic and subarctic are expected to bring about changes in sea ice cover. The timing, distribution, and even thickness of sea ice has a significant effect on primary productivity. Under warm conditions, the sea ice may melt before there is sufficient sunlight to support the massive phytoplankton bloom typically associated with the melting of sea ice and its release of nutrients and entrained microorganisms. The bloom then happens later in the spring and is more heavily exploited by zooplankton and fish, with less of the bloom's biomass descending to the benthic environment. This shift of energy from benthic-centered to pelagic-centered food webs directly affects benthic and benthic-feeding organisms such as crab, walrus, eiders, and several whale species (Smith et al. 2017). This trophic change could be especially profound in the highly benthic-centered Norton Sound.

4.4.1. Protected Species

ESA and MMPA Species

Polar bears, bearded seals, and ringed seals received their listings under the ESA largely in anticipation of adverse effects on these species from changes in sea ice distribution. Ice seals and walrus depend on sea ice at certain times of the year for migration, pupping, and other important life events (Smith et al. 2017). Diminishing sea ice cover would likely alter the timing of these events and the overall distribution of the effected species as the ice recedes to deeper waters.

Migratory Birds

Diminishing sea ice cover may initially benefit some surface-feeding birds, but, as suggested above, benthic-feeding birds are likely to be negatively affected by lowered benthic biomass. Warmer oceans and the resulting complex trophic changes have been linked to massive die-offs of murres, puffins, and other seabirds reported in recent years (*e.g.*, Van Hemert et al. 2020).

Essential Fish Habitat

Local observation and marine research suggest that the composition and distribution of Bering Sea fish species are changing. Reduction of sea ice cover may drive benthic-centered ecosystems like Norton Sound's to become more pelagic-centered (Kedra et al. 2015; Gay Sheffield, personal communication). A study of 40 fish and invertebrate species found that the center-of-distribution of those species, including Arctic cod, Pacific halibut, and snow crab, have shifted northward an average of 21 miles in response to changing temperature regimens (Smith et al. 2017). Such shifts in species distribution will have far-reaching effects on other species and ecosystems (Smith et al. 2017; Oceana & Kawerak, Inc. 2014).

4.5. Marine Resource Assessment

Marine resources play a critical role in the economies and cultural practices of remote and rural communities in western Alaska, such as Elim. Subsistence activities and commercial fisheries depend on the access to these marine resources and the viability of fisheries and resources in the region. Elim residents rely on marine resources such as fishery, marine mammals, and terrestrial game. A detailed marine resource assessment (MRA) can be found in Appendix D: Economics.

4.6. Subsistence Analysis

Under the FWOP condition, residents of Elim would continue subsistence practices using current methods as detailed in Section 3.5, “Subsistence Use” above. Elim residents rely upon the harvest of subsistence resources for food, clothing, tools, and other usable items. The community’s reliance on these resources is especially significant, given Elim’s relative isolation and limited connections to other communities. Airfreight and cargo barges are the only methods to deliver goods to Elim. Weather conditions and lack of a protected landing area mean that barges are sometimes delayed, and residents may have to go without supplies. At Elim, subsistence goods are harvested for personal use and shared or bartered with other residents, which is known as a mixed cash and subsistence economy. The areas surrounding Elim are used for subsistence and generally reached by vehicle, ATV, boat, plane, or snowmachine depending on the season.

Adverse wave conditions limit vessel access to the area of safe moorage within the mouth of the Kwiniuk River at Moses Point. These conditions would likely increase under the FWOP condition due to the reduction in sea ice, forming a longer open water period.

4.7. Vessel Operations and Community Viability

This section describes the threats to community viability that Elim would face in the future without a functional harbor. The descriptions are by vessel class and highlight linkages between threats to viability in the FWOP and the planning objectives (Section 2.5). To provide safe and reliable access for waterborne transportation systems for commerce and subsistence in Elim is one of the planning objectives. As such, this section describes how the lack of safe access for each vessel in the FWOP condition would impede community viability. Also, the qualitative discussion on community viability aspects is organized under the measurable CE/ICA metric used in this study:

Opportunity Days (further discussed in Section 6.6, “Cost-Effectiveness and Incremental Cost Analysis”).

4.7.1. Opportunity Days of Access for Subsistence and Commercial Vessels

Subsistence is a fundamental component of Elim’s mixed cash-subsistence economy. Employment opportunities are limited and often seasonal. The cost of living is relatively high. The weekly cost of food for a household of four is estimated to be approximately 2.5 times the national average. Elim residents rely upon the harvest of subsistence resources for food, clothing, tools, and medicinal uses. The community’s reliance on subsistence is especially significant, given Elim’s relative isolation and limited connections to other communities. These factors further emphasize the interdependency of the subsistence and cash sectors in Elim’s economy. Different subsistence activities occur at different times of the year and are interconnected to one another. Crucial to subsistence activities is the equipment used to acquire subsistence resources. When the vessels used for these activities are damaged, the ramifications include disruption to acquiring these resources that are vital to Elim’s welfare.

Subsistence activities are intricately tied to cultural values, historical knowledge, and specific places. The continued participation and transfer of these values and knowledge are important to the viability of the community. Subsistence activities bring the community together, cultivating a sense of identity. As access to subsistence resources becomes more difficult, participation in these activities decline, and the fostering of cultural values and identity is threatened. Lack of safe navigational access impedes participation in subsistence activities and continues to threaten community viability.

4.7.2. Opportunity Days of Access for Tenders

Navigational inefficiencies cause disruptions to commercial fishing operations 8–10 times per season on average. The existing and FWOP conditions are such that skiffs shuttle fish totes from the fish buying station to the tender offshore. These deliveries are dictated by the tides and become complex and unsafe during rough wave activity. Moreover, Elim’s commercial harvest in recent years indicates a steady increase, but the Unalakleet processing plant occasionally shuts down because it cannot take any more fish. Periodic plant closures impact commercial fishermen through fishing days forgone, and some harvest is lost. The pre-processing plant in Elim is expected to improve the efficiency of the Unalakleet plant and reduce fishing day closures due to plant shutdowns. However, without access and moorage for fish tenders and commercial vessels to deliver the catch to the head and guts facility in Elim, inefficiencies would still lead to plant closures and fishing days foregone.

The commercial fishery plays a key role in Elim’s mixed cash-subsistence economy. Commercial fishing is a means to earn cash, which can be used for basic goods and to repair or upgrade equipment used in subsistence activities. Other means of cash-earning are limited in Elim, and access to the cash economy often requires individuals to leave their community and culture for extended periods. Moreover, Elim is a fishing community where the skills and practice are passed down by generation. The transfer of these skills is important to the community's ability to survive and thrive. In the FWOP conditions, Elim's commercial fishery would continue to experience disruptions resulting in loss of commercial harvests and residents who leave for better-paying opportunities. Without navigational improvements, the transfer of fishing skills necessary for the continuity of commercial fishing is hampered and may pose risks to the safety of fishermen.

4.7.3. Opportunity Days of Access for Freight and Fuel Barge

In the FWOP conditions, freight barge deliveries would continue to experience delays and operate in less than optimal conditions. An example of such conditions is when the barge surfs the wave to shore and risks rough landing on the gravel beach with a heavy load. This practice poses risks to the safety of barge operators and crew. Navigational inefficiencies would continue to hamper the delivery of critical infrastructure materials and impact Elim's capability to replace aging or threatened infrastructure. Almost 50% of housing units in Elim were built before 1980. Improving the efficiency of delivery can lead to improved housing and combat social and health issues associated with housing conditions such as overcrowding and poor air quality. Without addressing these foundational needs, the viability of a community will continue to be threatened.

Without improved access and moorage for fuel delivery, the fuel barge would continue to anchor offshore and float the hose to shore. Under FWOP conditions, this practice would continue to pose a risk of fuel spills during offloading from the barge to the fuel header. The community relies on the marine environment for subsistence that fuel spills can impact.

4.8. Economic Conditions

An economic analysis of FWOP conditions evaluates the adverse impacts on subsistence and commercial harvests, the opportunity cost of time, transportation costs, barge delays, and vessel damages that could potentially be avoided with navigation improvements at Elim. Vessel damages are assigned monetary values, and if not possible, the damages are discussed in qualitative terms. The FWOP condition provides a benchmark for comparison of the proposed alternative plans. This analysis uses the Federal fiscal year 2021 (FY21) discount rate of 2.50% and a 50-year period of analysis. Descriptions of the analyses and assumptions of the adverse impacts noted above are found in Appendix D: Economics.

Absent Federal action to provide navigation improvements at Elim, transportation inefficiencies, vessel delays and damages, and foregone subsistence and commercial harvest opportunities are expected to continue throughout the period of analysis. The estimated average annual values for each potential benefit category are summarized in Table 11.

Beyond the quantified transportation inefficiencies, vessel delays, damages, and foregone harvests are other social conditions that are expected to continue in the future without navigation improvements. Social conditions affected by the lack of an adequate harbor include public health and safety of the local community and social and cultural values that are tied to subsistence activities. These are elaborated upon in Appendix D; Economics, Section 9.

Table 11. Summary of FWOP Conditions

Potential Benefit Categories	Present Value	Average Annual
Total Subsistence	$6,300,000	$222,000
Commercial Harvest	$1,990,000	$70,000
Transportation Cost Savings Commercial Fishery Operations	$837,000	$30,000
Opportunity Cost of Time	$4,637,000	$164,000
Barge Delays	$635,000	$22,000
Vessel Damages	$16,862,000	$595,000
Total	**$31,262,000**	**$1,103,000**

NSEDC currently has plans to construct a pre-processing plant in Elim to support the NSEDC Unalakleet processing plant. The plant is being planned separately from the project. It would be constructed within the village of Elim, not within the project area. Costs for such a facility are not included in the project.

4.9. Summary of the FWOP Condition

There are no anticipated changes expected to the geology/topography, seismicity, bathymetry or tides, and currents in the project area.

Due to the depth constraints and shoaling/migrating mouth of Kwiniuk River at Moses Point, where commercial fishing vessels deliver their catch, Elim’s commercial fishermen forego some commercial harvest. The disruption to commercial fishing operations due to flooding events or shallow water depths occurs 8–10 times each season, and operations would continue to be disrupted and lose revenue under the FWOP condition.

Under FWOP Conditions, the Alaska District would not undertake navigation improvements at Elim so that no new impacts would be presented to the biological resources in the Elim area. Local observation and marine research suggest that the composition and distribution of Bering Sea fish species are changing and would continue to change with changing climate conditions.

Residents of Elim would continue subsistence practices using current methods as detailed in Section 3.5, "Subsistence Use" above. However, adverse wave conditions limit vessel access to the area of safe moorage within the mouth of the Kwiniuk River at Moses Point. These conditions would likely increase under the FWOP condition due to the reduction in sea ice, forming a longer open-water period.

Under the FWOP condition, there would be no change in the future of the fleet. Without Federal action, no improvements to the waterway are expected. Navigational inefficiencies would continue with barges unable to land at Elim except during high tide and only with tugs or heavy machinery to hold them in place on the beach. Fuel barges would continue to have to float fuel hoses on the water surface to offload fuel, which carries a higher risk for spillage and environmental consequences. Lower quality and loss of commercial fish would continue due to the inefficiencies associated with fish buying stations and tender operations. Vessels would continue to sustain damage from storms and inefficient storage.

5. FORMULATION & EVALUATION OF ALTERNATIVE PLANS*

5.1. Plan Formulation Rationale

Plan formulation is the process of building alternative plans that meet planning objectives and avoid planning constraints. Alternatives are a set of one or more management measures functioning together to address the study objectives. A management measure (measures) can be an activity or structural feature or element that can be implemented at a specific geographic location to address one or more planning objectives. An activity is defined as a non-structural action such as proposed operational changes to improve navigation efficiency. A structural activity requires construction or assembly, typically within the project area or site.

5.2. Management Measures

During the planning charette, August 14–16, 2018, sixteen measures were identified. Using the criteria discussed in Section 2.7, "National Evaluation Criteria," the project delivery team (PDT) evaluated the following structural and non-structural measures. These measures were combined to form the alternatives outlined in Section 5.4, "Preliminary Alternatives Considered."

5.2.1. Criteria and Metrics

Alternative plans were formulated to address study objectives and adhere to study constraints. As part of Federal guidelines for water resources projects, there are general feasibility criteria that must be met. According to ER 1105-2-100 for planning, the USACE projects must be analyzed concerning the four national evaluation criteria (Section 2.7, “National Evaluation Criteria”).

The team used specific screening criteria, which included evaluating the number of Opportunity Days available to vessels under each alternative. Each measure was evaluated against the problems, objectives, and the general metric of whether the measure’s design would address the major mechanisms causing the navigational issues and vessel delays within the Elim area. Specific engineering design criteria used to develop the measures are presented in Appendix C: Hydraulics and Hydrology.

5.2.2. Non-Structural Measures

Non-structural measures are those measures that reduce the consequences of navigational inefficiencies and utilize currently available resources. These measures could include revising procedural control mechanisms, relocation of utilities to open up transport/speed up ability to offload barges and installing a remote hydraulic lift. The non-structural measures discussed during the charette are listed in Table 12.

Table 12. Non-Structural Measures

Ice mitigation	Navigational aid
Emergency response alarm	Light loading
Lightering	Revising procedural control mechanisms (i.e., times harbor is open, number of vessels in the harbor at one time, etc.)
Relocate fish buying station and/or second buying station	Relocation of utilities to open up transport/speed up ability to offload barges
Smaller barges and fishing vessels (already in use)	Hire boat operator to move subsistence vessels
Improve/elevate road	

During the charette, all of the non-structural measures were considered for addressing the problem. During further screening conducted during feasibility, the measures were compared against the study objectives (Table 13).

Table 13. Screening of Non-Structural Measures

	Study Objectives	
	Provide safe, reliable, and efficient waterborne transportation systems for the movement of commerce (including commercial fishing), and subsistence in Elim	Support the long-term viability of Elim
Measure Name	Do the following non-structural considerations meet the study objectives? (Yes/No)	
Ice mitigation	No	No
Emergency response alarm	No	No
Lightering	Yes	No
Relocate fish buying station and/or second buying station	Yes	Yes
Smaller barges and fishing vessels	Yes, but already in use	Yes, but already in use
Improve/elevate road	No	No
Navigational aid	Yes	No
Light loading	No	No
Revising procedural control mechanisms (i.e., times harbor is open, number of vessels in the harbor at one time, etc.)	No	No
Relocation of utilities to open up transport/speed up ability to offload barges	Yes	No
Hire boat operator to move subsistence vessels	No	No

Only one of the non-structural measures met both objectives and was deemed suitable for being carried forward into alternatives development: relocating the fish buying station from Moses Point to the project location. Some of these measures are already implemented to various degrees (i.e., smaller vessels and lightering). Others (i.e., procedural control mechanisms and boat operators to move vessels) would be impractical or impossible to implement efficiently. Improve/elevate road was developed as a measure for Moses Point and Iron Creek sites, which were eliminated from consideration. The community has plans to raise utility lines to enhance the ability to offload barges, so this measure is captured as an existing condition.

Ice mitigation is both unnecessary and detrimental to community viability. The community uses sea ice as a foundation and mode of transport during the cold portion of the year to carry out subsistence activities. In addition, ice formation occurs throughout Norton Sound and conveys impacts on the ecological system of the region.

An emergency alarm system would be moot for the harbor. Residents are constantly vigilant of weather conditions that guide the activities of the fleet.

In such a small and open harbor as the natural harbor at Elim, navigational aids would provide little, if any, benefits to operations. Navigational aids may be revisited if an alternative is selected that requires navigational aid(s) to be fully functional.

Light loading would present additional inefficiencies and expenses for the shipment of goods to Elim. It could also result in shortages of goods due to the infrequency of cargo shipments.

5.2.3. Structural Measures

Structural measures are generally those measures that improve access to Elim, require construction and new materials. The structural measures discussed during the charette are shown in Table 14. All the structural measures, except revetment to protect access road, were carried forward and incorporated into the various alternatives. Revetment to protect the access road was specifically developed for Moses Point, and due to the elimination of this site, this measure was necessarily eliminated.

Table 14. Structural Measures

Entrance Channel	Breakwater/Jetty
Boat Launch	Moorage Basin
Upland Boat Storage	Revetment to protect access road (Moses Point)
Barge Landing/Tender Dock (Elim Beach and Airport Point)	

It was determined during the charette that all of the structural measures addressed the identified problems. During the plan formulation process, the PDT further screened the structural measures to see if they addressed the study objectives (Table 15).

Table 15. Screening of Structural Measures

	Study Objectives	
	Provide safe, reliable, and efficient waterborne transportation systems for the movement of commerce (including commercial fishing), and subsistence in Elim	Support the long-term viability of Elim
Measure Name	Do the following non-structural considerations meet the study objectives? (Yes/No)	
Entrance Channel	Yes	Yes
Boat Launch	Yes	Yes
Upland Boat Storage	Yes	No
Barge Landing/Tender Dock (Elim Beach and Airport Point)	Yes	Yes
Breakwater/Jetty	Yes	Yes
Moorage Basin	Yes	Yes
Revetment to protect access road (Moses Point)	No	No

All the structural measures, except revetment to protect the access road, addressed at least one of the study objectives and were carried forward to develop alternative plans. Revetment to protect the access road was developed specifically for Moses Point, and due to the elimination of this site during the site selection process (Section 5.3, “Site Selection”) this measure was removed from further consideration.

5.3. Site Selection

At the charette, four sites were initially identified as probable locations for the project: Elim Beach, Airport Point, Iron Creek, and Moses Point (Figure 26).

Elim Beach is located in front of the community. The site has ready access to utilities and is currently the point for barge deliveries to the community. Some subsistence and commercial vessels are currently based at Elim Beach but must be pulled onto the shore when not in use, which leads to vessel damages. The fuel header for fuel deliveries is located at Elim Beach. The site would be accessible to all residents, not only those with vehicles. No known contamination concerns exist at Elim Beach.

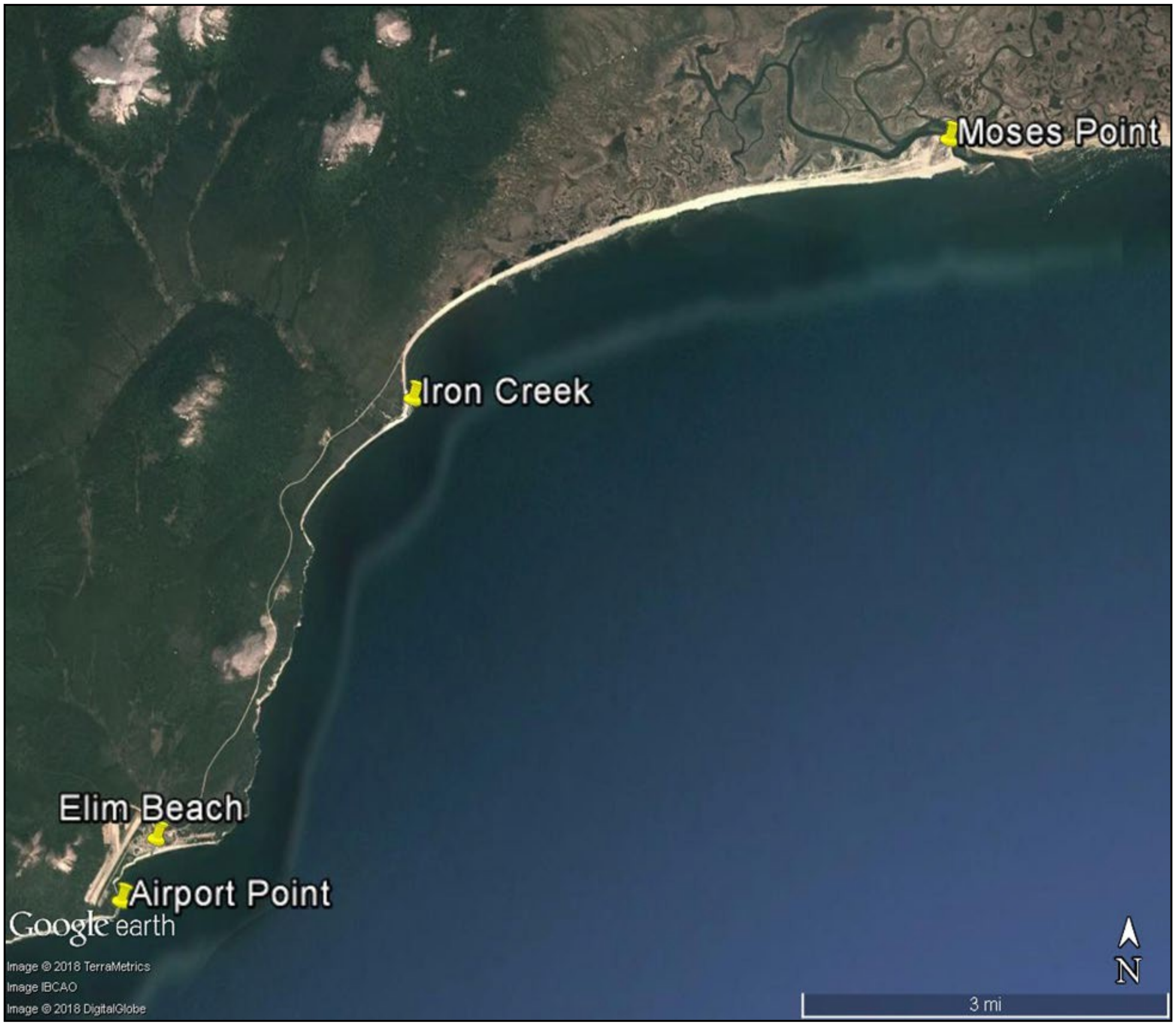

Figure 26. Four Sites Initially Identified for the Potential Project

Airport Point is located to the west of Elim, close to the airport. Currently, the proposed site consists of a rock cliff approximately 115 ft high with no subsistence or commercial activities based on the area. The fuel tank farm is located at the top of the cliff next to the airport. Currently, there is no road to the site, and no uplands exist at the site. There is more bedrock at this site than Elim Beach, which would require more blasting. The fuel header would need to be relocated from Elim Beach to the site.

Iron Creek is located approximately halfway between Elim and Moses Point (about 5 miles from Elim). The site is not as heavily used as either Moses Point or Elim Beach and offers less protection to vessels. The sediment transport at the site is very dynamic, and there tends to a lot of ice, which thins too early in the season for subsistence activities. There are no utilities at the site. Iron Creek would not accommodate barge deliveries and has a potential to impact cultural resources. There is also public concern regarding the history of contamination from prior military activities.

Moses Point is located approximately 10 miles northeast of Elim along a road that would need additional repairs to keep it passable. The site is only readily accessible to residents with vehicles. Currently, commercial fishing activities are based at Moses Point, with the fish buying station being located at the site. Ice must be transported from Elim to the fish buying station. Some subsistence vessels are also based at Moses Point, which provides the most shelter for boats in the area. There are no utilities at the site, and although natural resources are plentiful in the area, the mouth of the river is very dynamic, which could lead to much higher Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) costs. The site also could not accommodate barges. There is also a potential for contamination at Moses Point.

Subsequent screening led to the elimination of the sites: Moses Point and Iron Creek. Moses Point was eliminated because of possible contamination concerns with several active cleanup sites in the area and distance from Elim, which would require the use of vehicles and would require improvements to the road between Elim and Moses Point. The cost to build at Iron Creek would be similar or more costly than the sites closer to Elim and would provide fewer benefits as barges cannot access the site and there is little suitable area for uplands development. Iron Creek is the worst site evaluated for subsistence activities due to long-lasting sea ice in the spring, which becomes thin and soft; this makes it virtually impassible and very dangerous to traverse. In addition to needing vehicles to access the site, there are also potential cultural resources near the site and a history of contamination issues with prior military sites in the vicinity.

5.4. Preliminary Alternatives Considered

The following measures that were carried forward to address the study objectives were combined to develop the preliminary array of alternatives below (Table 16).

Table 16. Measures Carried Forward into Alternative Plan Development

Non-Structural Measures	Structural Measures
Relocate Fish Buying Station	Breakwaters/Jetties
	Moorage Basin
	Entrance Channel
	Barge Landing/Tender Dock
	Boat Launch
	Upland Boat Storage (incorporated into the uplands area of alternatives)

Six alternatives were developed using the above measures carried forward along with the FWOP condition (No Action). The six preliminary alternative plans developed for this study are shown in Table 17.

The fleet size was determined by on the ground survey during a site visit to Elim in September 2011, there were about 50 vessels in the community, and the community members reconfirmed this number at public meetings held in Elim in August 2018. The local fleet includes small skiffs (18–24 ft length overall) and larger seine vessels (20–32 ft length overall) used for subsistence and commercial fishing. NSEDC reports that 23–25 Elim fishermen hold permits and participate in commercial fisheries. This analysis, therefore, assumes that 25 vessels participate in both commercial and subsistence fishing, and the other 25 vessels participate in subsistence harvesting. The assessment of moorage demand in Elim is based on personal interviews or phone calls with fuel and freight barge operators, the Norton Sound Seafood Products (NSSP) fish processing plant manager, and community members who participate in both subsistence and commercial fishing activities. Information gathered during these meetings was compared with the moorage demand analysis from the previous CAP Section 107 study for Elim. The existing demand for moorage is similar to the demand detailed in the 2013 CAP study. Further discussion of moorage demands is discussed in Appendix D: Economics. Basin design was based on these factors, as well as the need to protect the harbor from both the west and east side. Local Service Facilities (LSF) features were included that would maximize benefits and with community input.

Table 17. Preliminary Alternatives Considered

Alternative	Description
1	No Action
2	Elim Beach: Commercial and Subsistence Fleet
3	Elim Beach: Commercial and Subsistence Fleet with 1 Tender
4	Elim Beach: Commercial and Subsistence Fleet with 2 Tenders
5	Elim Beach: Commercial and Subsistence Fleet with 2 Tenders and Fuel and Freight Barge Access
6	Airport Point: Commercial and Subsistence Fleet
7	Airport Point: Commercial and Subsistence Fleet with 2 Tenders and Fuel and Freight Barge Access

5.5. Descriptions of Alternative Plans

5.5.1. Alternative 1: No Action

Existing conditions in Elim will remain the same without the development of navigation improvements. Fishermen would continue to incur losses due to boat damages and missed opportunities for subsistence and commercial fishing. Delays in offloading cargo and fuel will continue to result in high costs and pose the danger of a fuel spill that could cause environmental consequences. Response times to boats in distress will still be hampered by the need to travel to Moses Point before launching response vessels. Vessels would also continue to experience damages during large storm surges due inaccessible of Moses Point in short notice, causing some vessels to get swamped.

5.5.2. Alternative 2: Elim Beach Commercial and Subsistence Fleet

A harbor is located at the beach in front of the school in Elim. The harbor would be sized to accommodate 50 vessels varying in size from 18 ft to 32 ft. Two rubble-mound breakwaters would provide a combined turning and mooring basin of approximately 3.9 acres with a dredging depth of -8.0 ft MLLW with 2 ft of allowable over-dredge. The west breakwater would be approximately 985 ft long and the east breakwater approximately 457 ft long. The entrance channel and turning basin would also have a dredging depth of -8.0 ft MLLW with 2 ft of allowable over-dredge. Local service facilities required would include a single boat launch, uplands with an area of approximately 3.2 acres for parking and turn-around at the boat launch, and a road connecting Front St. to the harbor uplands. The road would be approximately 800 ft long and relatively flat (Figure 27). The fish buying station would be relocated from Moses Point to Elim.

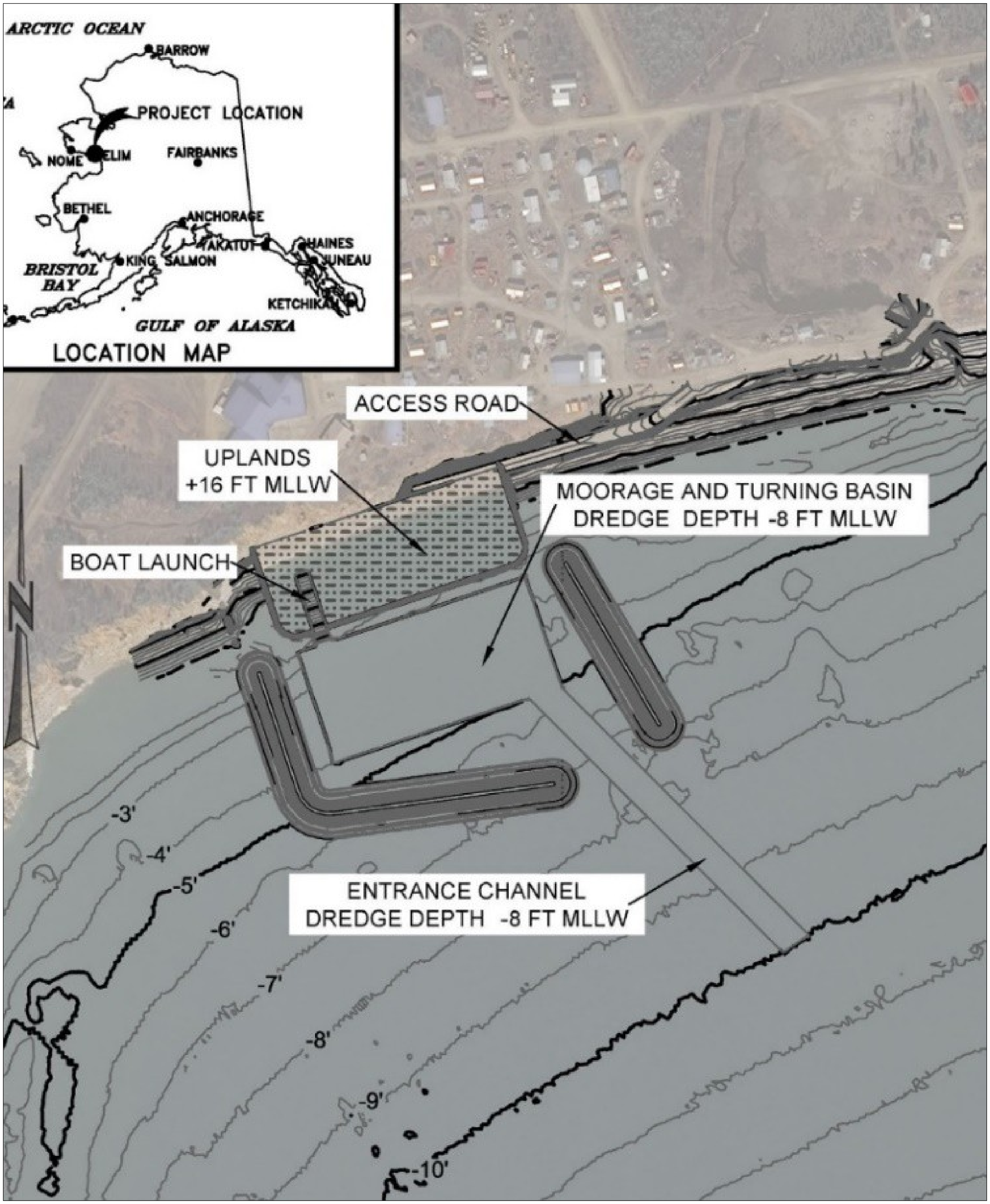

Figure 27. Alternative 2: Elim Beach Commercial and Subsistence Fleet

5.5.3. Alternative 3: Elim Beach Commercial and Subsistence Fleet with One Tender

A harbor located in the same location as Alternative 2, but sized to accommodate a 66-ft tender and 50 vessels varying in size from 18 ft to 32 ft. The plan would include a tender dock with a length of 87 ft. Two rubble-mound breakwaters would provide a turning basin and a mooring basin with a combined area of approximately 4.6 acres with a turning basin dredge depth of -9.0 ft MLLW with 2 ft of allowable over dredge and the mooring basin dredge depth of -8.0 ft MLLW with 2 ft of allowable over dredge. The west breakwater would be approximately 1,068 ft long and the east breakwater approximately 463 ft long. The entrance channel, tender dock access, and turning basin would also have a dredging depth of -9.0 ft MLLW with 2 ft of allowable over-dredge. Local service facilities required would include a single boat launch, uplands with an area of approximately 3.9 acres for parking and turn-around at the boat launch, a tender dock, and a road connecting Front St. to the harbor uplands. The road would be approximately 800 ft long and relatively flat (Figure 28). The fish buying station would be relocated from Moses Point to Elim.

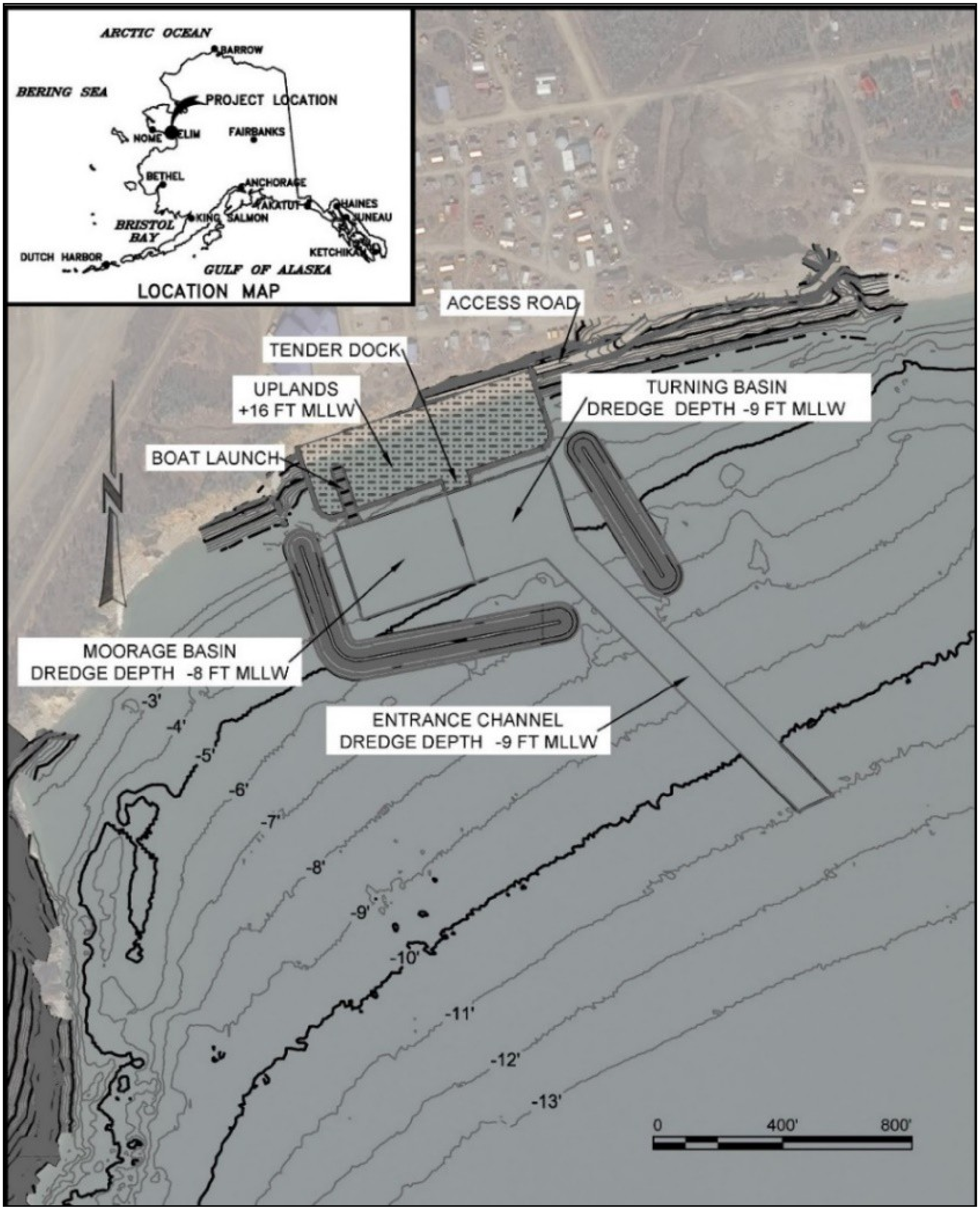

Figure 28. Alternative 3: Elim Beach Commercial and Subsistence Fleet with One Tender

5.5.4. Alternative 4: Elim Beach Commercial and Subsistence Fleet with Two Tenders

The same as Alternative 3 but could accommodate 2 tenders by increasing the moorage basin depth. The plan would include a tender dock with a length of 87 ft. Two rubble-mound breakwaters would provide a combined turning and mooring basin of approximately 5.1 acres with a dredging depth of -9.0 ft MLLW with 2 ft of allowable over-dredge. The west breakwater would be approximately 1,099 ft long and the east breakwater approximately 463 ft long. The entrance channel, tender dock access, and turning basin would also have a dredging depth of -9.0 ft MLLW with 2 ft of allowable over-dredge. Local service facilities required would include a single boat launch, uplands with an area of approximately 3.9 acres for parking and turn-around at the boat launch, a tender dock, and a road connecting Front St. to the harbor uplands. The road would be approximately 800 ft long and relatively flat (Figure 29). The fish buying station would be relocated from Moses Point to Elim.

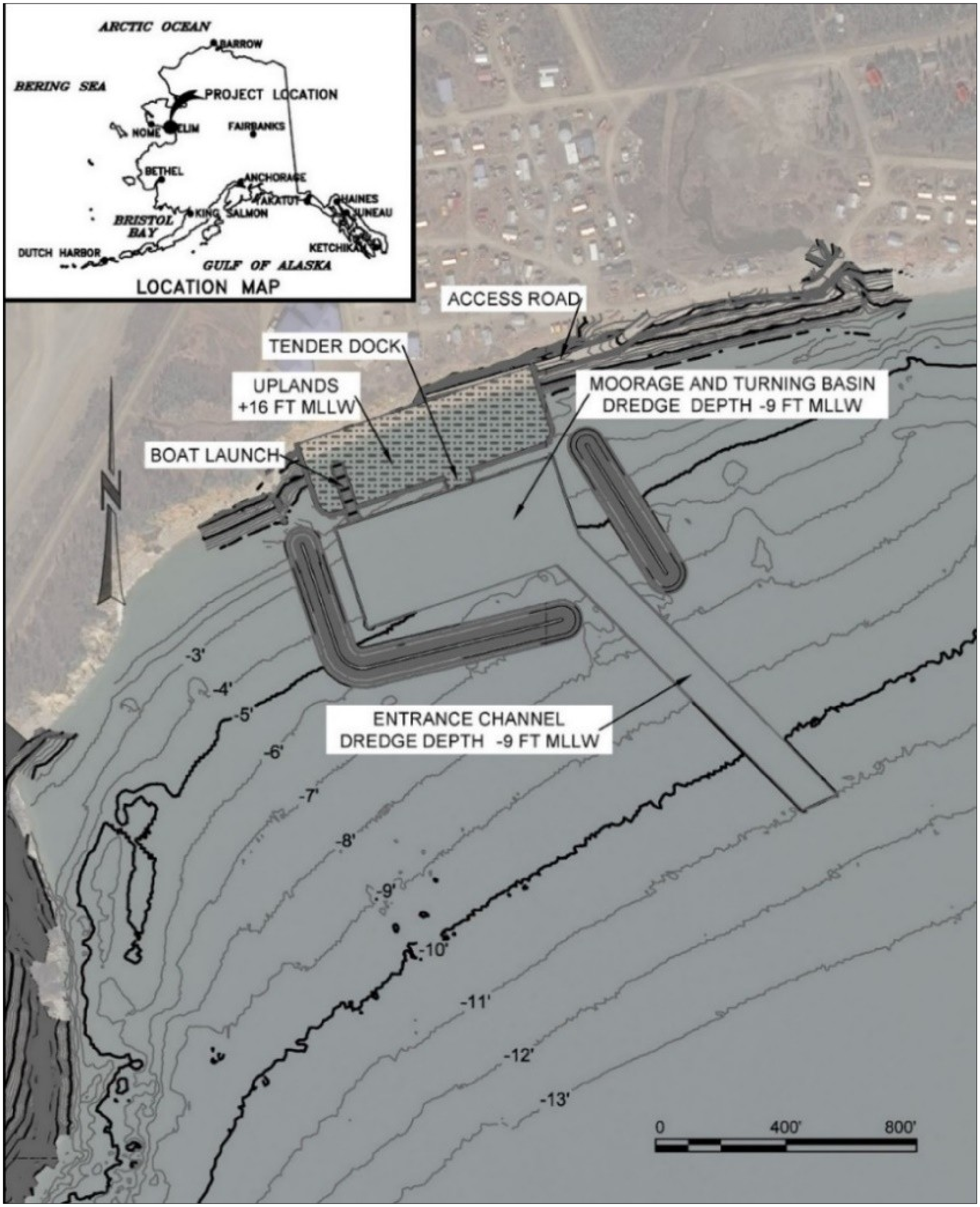

Figure 29. Alternative 4: Elim Beach Commercial and Subsistence Fleet with Two Tenders

5.5.5. Alternative 5: Elim Beach Commercial and Subsistence Fleet with Two Tenders and Fuel and Freight Barge Access

For Alternative 5, a harbor would be located in the same location as Alternative 2. The harbor would be sized to accommodate one 160 ft barge and associated 86 ft tug, two tenders, and 50 vessels varying in size from 18 ft to 32 ft. The plan would include a tender dock with a length of 87 ft. Two rubble-mound breakwaters would provide a turning basin and a mooring basin with a combined area of approximately 6.2 acres with a turning basin dredge depth of -12.0 ft MLLW with 2 ft of allowable over dredge and the mooring basin dredge depth of -9.0 ft MLLW with 2 ft of allowable over dredge. The west breakwater would be approximately 1,082 ft long and the east breakwater approximately 468 ft long. The entrance channel, tender dock access, barge landing access, and turning basin would have a dredging depth of -12.0 ft MLLW with 2 ft of allowable over-dredge. Local service facilities required would include an extension to the fuel header currently located on the bluff above Elim Beach, a single boat launch, uplands with an area of approximately 4 acres for parking and turn-around at the boat launch, a tender dock, a barge landing, two mooring points, and a road connecting Front St. to the harbor uplands. The road would be approximately 800 ft long and relatively flat (Figure 30). The fish buying station would be relocated from Moses Point to Elim.

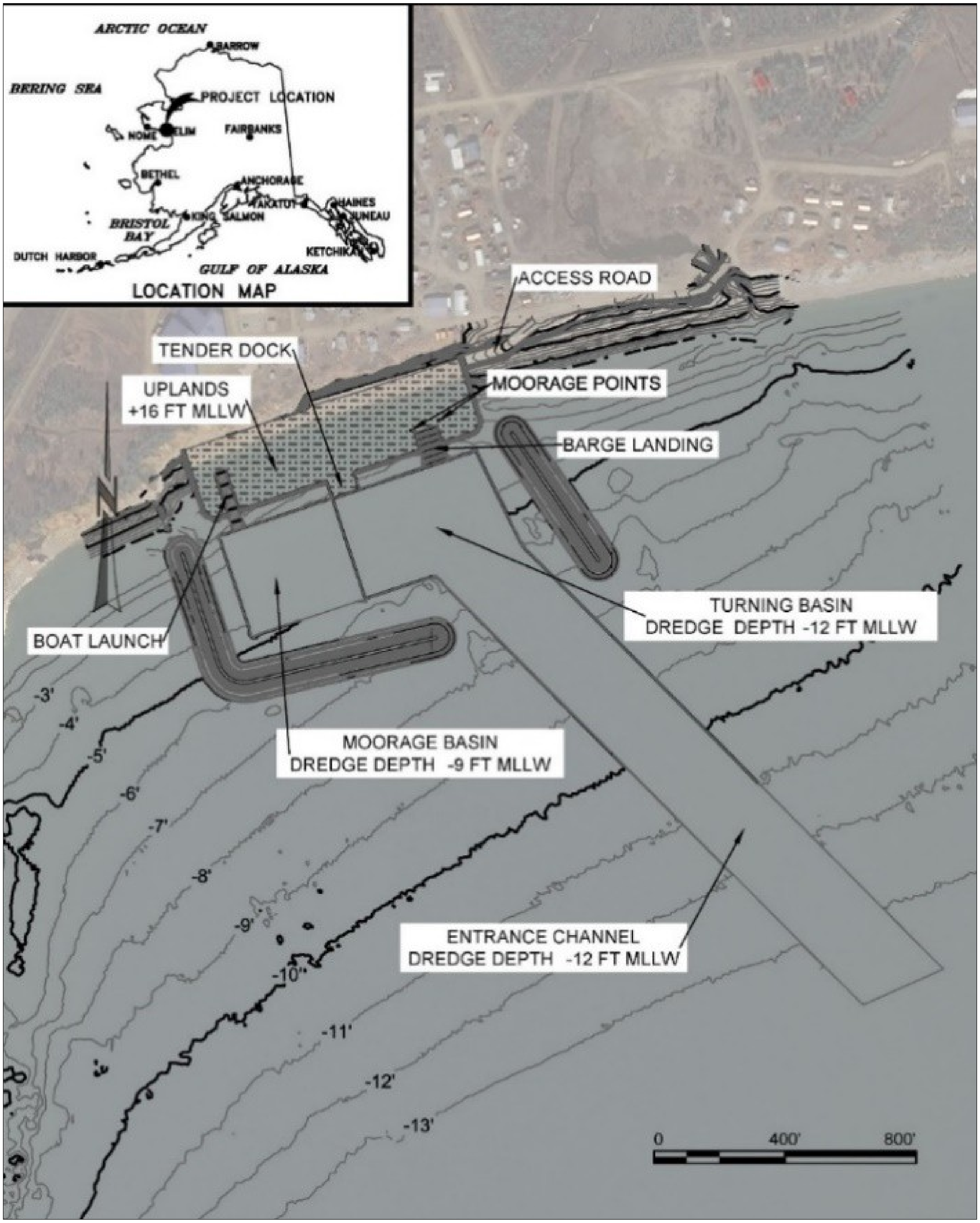

Figure 30. Alternative 5: Commercial and Subsistence Fleet with Two Tenders and Fuel and Freight Barge Access

5.5.6. Alternative 6: Airport Point Commercial and Subsistence Fleet

Alternative 6 would consist of a harbor located at the headland west of Elim Beach, below Elim Airport (Airport Point). The harbor would be sized to accommodate 50 vessels varying in size from 18 ft to 32 ft. Two rubble-mound breakwaters would provide a combined turning and mooring basin of approximately 3.0 acres with a dredging depth of -8.0 ft MLLW with 2 ft of allowable over-dredge. The west breakwater would be approximately 819 ft long and the east breakwater approximately 418 ft long.

The entrance channel and turning basin would also have a dredging depth of -8.0 ft MLLW with 2 ft of allowable over-dredge Local service facilities required would include a single boat launch, uplands with an area of approximately 3.3 acres for parking, and turn-around at the boat launch, and a road connecting the tank farm south of Elim Airport to the harbor uplands. The road would be approximately 0.6 miles long and traverse 115 vertical feet (Figure 31). The fish buying station would be relocated from Moses Point to Airport Point.

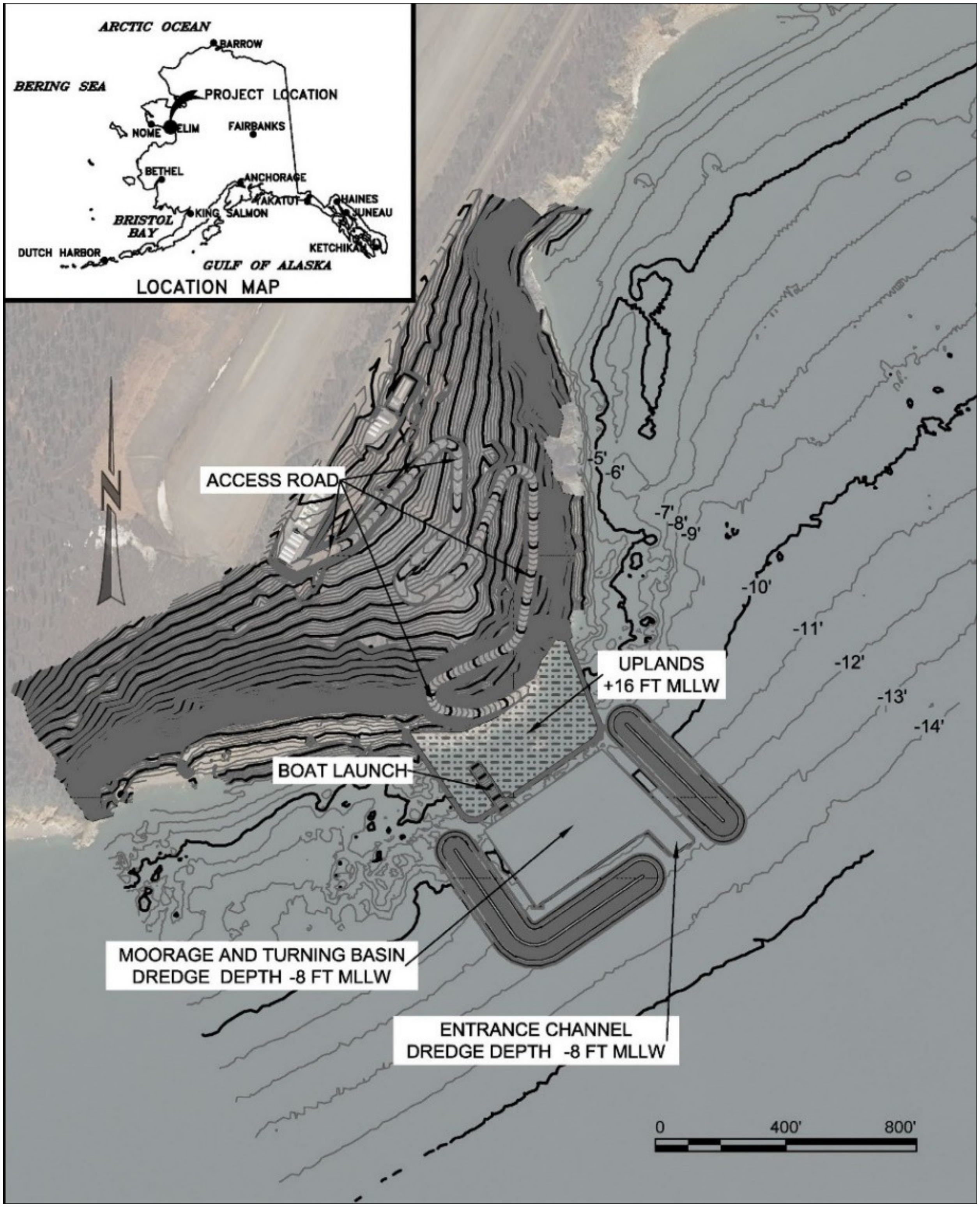

Figure 31. Alternative 6: Airport Point Commercial and Subsistence Fleet

Dredge at Airport Point would be required to ensure the access channel, moorage basin, and entrance channel meets the design draft requirements for navigation. Based on underwater imagery, there appear to be pinnacles that would cause dangerous navigation conditions if construction dredging did not ensure the design depth was achieved throughout the entrance channel and basin. Based on the geophysical survey (Golder 2019) conducted in Summer 2019, a hard bottom may be encountered while dredging. When hard bottoms are encountered during dredging, 2 ft of over-dredge is allowed to ensure design depth is maintained across the dredge prism.

5.5.7. Alternative 7: Airport Point Commercial and Subsistence Fleet with Two Tenders and Fuel and Freight Barge Access

Alternative 7 includes a harbor is located in the same location as Alternative 6. The harbor would be sized to accommodate one 160 ft barge and associated 86 ft tug, two tenders, and 50 vessels varying in size from 18 ft to 32 ft. The plan would include a tender dock with a length of 87 ft. Two rubble-mound breakwaters would provide a turning basin and a mooring basin with a combined area of approximately 6.0 acres with a turning basin dredge depth of -12.0 ft MLLW with 2 ft of allowable over dredge and the mooring basin dredge depth of -9.0 ft MLLW with 2 ft of allowable over dredge. The west breakwaters would be approximately 1,137 ft long and the east breakwater 594 ft long.

The entrance channel, tender dock access, barge landing access, and turning basin would have a dredging depth of -12.0 ft MLLW with 2 ft of allowable over-dredge Local service facilities required would include the relocation of fuel header currently located on Elim Beach, a single boat launch, uplands with an area of approximately 6.2 acres for parking and turn-around at the boat launch, a tender dock, a barge landing, two mooring points, and a road connecting the tank farm south of Elim Airport to the harbor uplands. The road would be approximately 0.6 miles, traverse 115 vertical feet (Figure 32). The fish buying station would be relocated from Moses Point to Airport Point.

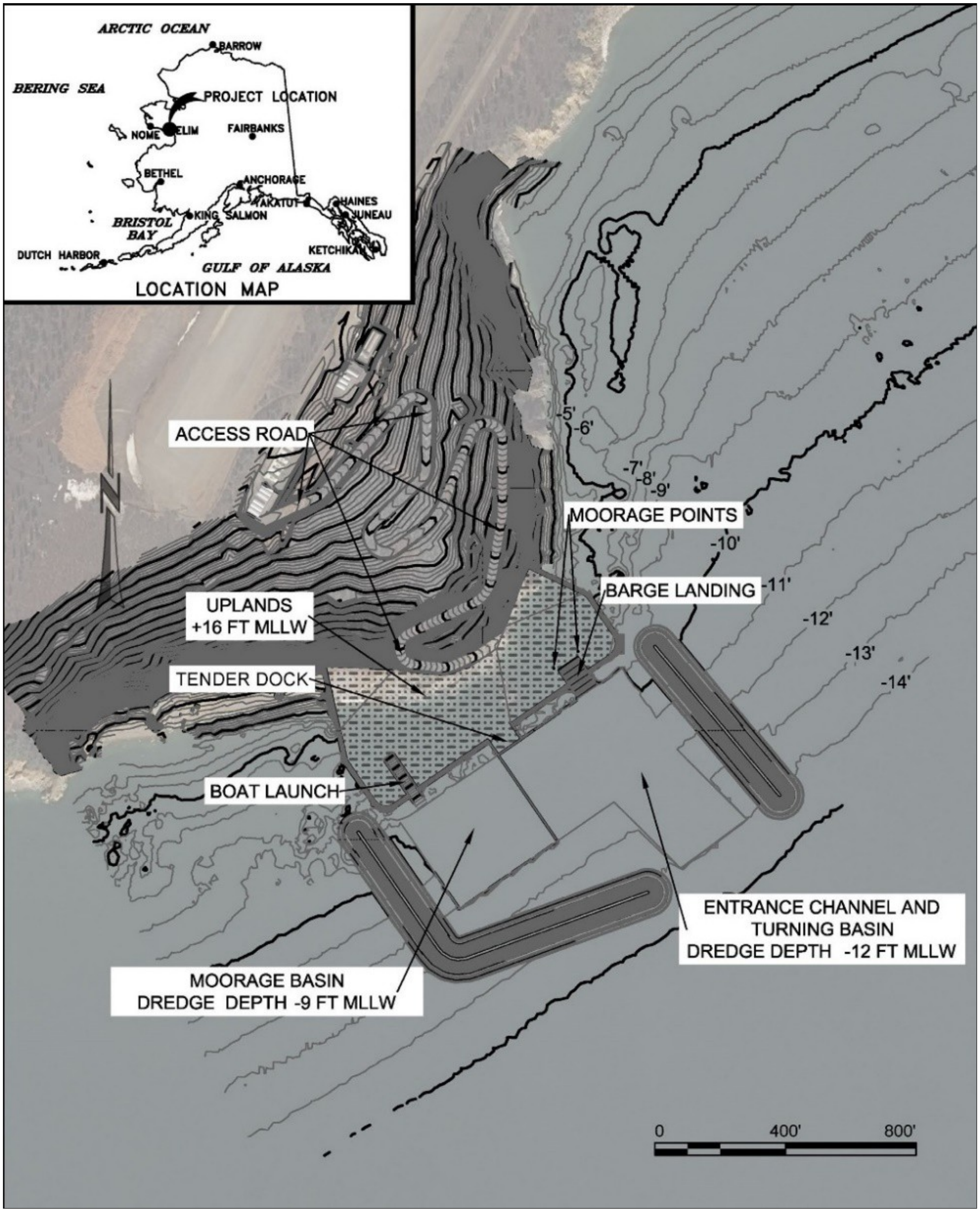

Figure 32. Alternative 7: Airport Point Commercial and Subsistence Fleet with Two Tenders and Fuel and Freight Barge Access

Dredge at Airport Point would be required to ensure the access channel, moorage basin, and entrance channel meets the design draft requirements for navigation. Based on underwater imagery, there appear to be pinnacles that would cause dangerous navigation conditions if construction dredging did not ensure the design depth was achieved throughout the entrance channel and basin. Based on the geophysical survey (reference) conducted in Summer 2019, a hard bottom may be encountered while dredging. When hard bottoms are encountered during dredging, 2 ft of over-dredge is allowed to ensure design depth is maintained across the dredge prism.

5.6. Alternatives Screened from Detailed Analysis

Airport Point was eliminated as a possible project site, thus eliminating Alternatives 6 and 7. The reasons for eliminating these alternatives revolve around the increase in cost with little or no additional benefits added to the project. LSF would also be greater than at the Elim Beach site. A larger area needed for parking and turn-around would be needed at Airport Point (6.2 acres for Alternative 7 as opposed to 3.9 acres for Alternative 5) as well as a more extended road along a precarious embankment compared to the short and relatively flat road needed at Elim Beach. The road for Alternatives 6 and 7 would be approximately 0.6 miles and would raise approximately 115 vertical feet, whereas the road for Alternatives 2, 3, 4, and 5 would be approximately 800 ft and relatively flat. To prepare for the construction of the road, Airport Point would require a substantial amount of blasting and disposal of blasted material as compared to no blasting for the road at Elim Beach. Also, for Alternative 7, the fuel header, which is now located on Elim Beach, would need to be relocated to Airport Point as compared to just having to extend it 150 ft for Alternative 5. The relocation of the two fuel lines to Airport Point would involve laying approximately 6,000-7,000 ft of welded pipe.

In contrast, the extension of the fuel header at Elim Beach would only require laying approximately 200-300 ft of new welded pipe. These components would lead to a much higher project cost if the project were placed at Airport Point with no additional benefits over the Elim Beach location. Details regarding the costs and benefits are addressed in detail in Sections 9 and 10 of Appendix D: Economics. The remaining five alternatives were screened using the national evaluation criteria discussed in Section 2.7 (Table 18).

Table 18. Screening of Alternative Plans

	National Evaluation Criteria[1]			
Alternatives	**Acceptability**	**Completeness**	**Effectiveness**	**Efficiency**
Alternative 1	N/A	N/A	N/A	N/A
Alternative 2	high	low	low	high
Alternative 3	high	low	low	medium
Alternative 4	high	low	low	medium
Alternative 5	high	high	medium	High

[1] Scaled as high, medium, or low to meet the criteria.

The remaining four action alternatives (Alternatives 2-5) address acceptability and efficiency on an average scale of medium to high and will be carried forward along with Alternative 1: No Action. As seen in Table 18, all alternatives provide high acceptability in that they all would comply with applicable laws, regulations, and public policies. These three alternatives also rank low in completeness as they do not provide all necessary features to ensure realization of the project benefits. The effectiveness of Alternatives 2, 3, and 4 would be low. Although Alternatives 3 and 4 do provide a tender dock alleviating some commercial inefficiencies, major hardships would still be encountered regarding long-term viability. Alternative 5 has a higher ranking in all categories because, along with the benefits realized for the subsistence and commercial fleet and tenders, it provides for barge access, which has vast impacts on the community's long-term viability and stemming from effects benefits as discussed in Section 2.9. The effectiveness of Alternative 5 ranks as medium rather than high due to the fact that although it does well at alleviating the specified problems and realizing the specified opportunities, the nature of the area and isolation would prevent all elimination of problems and the cost of any improvements in such a remote location will remain rather high compared to other areas nationally. The efficiency of the alternatives relates to the cost effectiveness which is shown in the CE/ICA in which Alternatives 2 and 5 both resulted in best buy plans, while Alternative 3 and 4 showed only cost-effective plans.

5.7. Alternatives Carried Forward

Alternatives 1-5 are carried forward into detailed analysis. These alternatives were further analyzed to establish their benefits across the four accounts (Section 6.4).

6. COMPARISON & SELECTION OF PLANS*

Each alternative was evaluated to determine how well it met the project objectives of providing safe, reliable, and efficient waterborne transportation and supported the long-term viability of Elim. The alternatives also met the four P&G evaluation criteria outlined in Section 2.7 and evaluated in Section 5.6. Current laws, regulations, policy, and guidance were incorporated into the development of the alternatives to ensure acceptability, completeness, effectiveness, and efficiency.

6.1. With-Project Condition

The following section describes anticipated conditions at Elim, assuming that a project would be constructed. The anticipated benefits of increased safe operations at the harbor are the basis for the economic analysis. All alternatives would transition subsistence and commercial fishing activities from Moses Point (approximately 10 miles northeast of Elim) to Elim Beach. A small boat harbor project at Elim would enhance access to subsistence resources, commercial fisheries and improve efficiencies of fuel and freight deliveries. The NED benefits of a small boat harbor project at Elim are expected to result from reduced vessel damages, increased subsistence, and commercial harvests. In addition, transportation cost savings are expected to accrue to the local commercial fisheries operations. Efficiencies to freight barge deliveries are also expected to reduce delays and, consequently, operating costs. The period of the analysis is 50 years, beginning with the base year of 2027. The FY21 Federal discount rate of 2.5% is used to discount benefits and costs.

6.2. Alternative Plan Costs

Rough Order of Magnitude (ROM) costs were developed for the alternatives, including those to construct and maintain facilities. Appendix E: Cost Engineering details the procedures and assumptions used to calculate these estimates. Cost risk contingencies of 32% were included to account for uncertain items such as sediment characterization and dredge type. Project costs were developed without escalation and are in 2020 dollars. The ROM costs for each alternative are displayed in Table 19.

Table 19: Alternative Plan Costs

Cost Description	Alt 2	Alt 3	Alt 4	Alt 5
Lands, Easements, Rights-of-Way, and Relocations (LERR)	$32,000	$32,000	$32,000	$32,000
Mobilization and Demobilization General Navigation Feature (GNF)	$7,680,000	$7,680,000	$7,680,000	$7,680,000
Breakwater (East & West Walls)	$39,068,000	$41,409,000	$42,310,000	$42,000,000
Dredge and Dispose	$2,242,000	$2,670,000	$3,543,000	$6,890,000
Upland	$7,581,000	$30,280,000	$30,408,000	$31,551,000
Access Road	$1,753,000	$1,753,000	$1,753,000	$1,753,000
Floating Dock, Moorage Points, Gangway	$298,000	$298,000	$298,000	$466,540
Preconstruction, Engineering and Design (PED)	$5,120,000	$5,120,000	$5,120,000	$5,120,000
Supervision, Inspection, and Overhead (SIOH)	$6,400,000	$6,400,000	$6,400,000	$6,400,000
Project First Costs	**$70,175,000**	**$95,643,000**	**$97,545,000**	**$101,892,000**

The PED costs will be similar to the majority of costs for data gathering, design, and permitting required for all alternatives. Supervision, Inspection, and Overhead (SIOH) costs are primarily driven by the schedule of construction, which, due to sequencing and construction windows anticipated, will be three seasons for each alternative. As a result of unsecured facilities in the community, annual mobilization and demobilization will be required for each season of construction. Since the project requires three seasons, and the equipment load is similar for each alternative, the mob-demob costs stay the same for each alternative.

As with benefit flows, costs are discounted to a base year and amortized for comparison against average annual benefits. As such, the project first costs shown below and detailed in Appendix D: Economics differ slightly from those presented in Appendix E: Cost Engineering. Costs used in the benefit-cost analysis include the project's first cost compounded to the base year using the FY21 discount rate, interest during construction (IDC), and Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) costs greater than the without-project condition. The economic cost components used in the benefit-cost analysis are summarized in Table 20.

Table 20. Project Costs for Benefit-Cost Analysis

Cost Description	Alt 2	Alt 3	Alt 4	Alt 5
Project First Cost	$70,175,000	$95,643,000	$97,545,000	$101,892,000
IDC	$874,000	$1,191,000	$1,214,000	$1,268,000
OMRR&R	$2,970,000	$3,004,000	$2,739,000	$2,846,000
Total Economic Cost	**$74,020,000**	**$99,840,000**	**$101,500,000**	**$106,010,000**
AAEQ Economic Cost	**$2,610,000**	**$3,520,000**	**$3,580,000**	**$3,740,000**

Due to climate characteristics and the remoteness of communities in Alaska, construction periods are limited to ice-free seasons. Construction is expected to be phased over 3 years in 4-month construction seasons for all alternatives. Therefore, the interest during construction is calculated by a total of 12 months spread out over the 3 years. The Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) consists of maintenance dredging and armor rock replacement of varying volume and quantities, respectively. Maintenance dredging is assumed to occur in 25 years from completion of project construction for Alternatives 2 and 3. Maintenance dredging for Alternatives 4 and 5 are assumed to occur in 27 and 20 years, respectively, of project completion. Armor rock replacement for all alternatives is assumed to occur every 25 years for analysis.

6.3. Project Benefits

Each alternative provides a certain amount of relief from existing and expected future inefficiencies. From a NED perspective, the differences between the FWOP conditions and those that will occur under the various With Project Conditions are benefits that accrue to the project and together with cost data inform the identification of the Tentatively Selected Plan (TSP). As mentioned at the outset, the Remote and Subsistence Harbors Authority that this study is pursued under allows for plan justification under a Non-NED Framework: Other Social Effects (OSE).

Benefits manifest from the project in many different forms. Subsistence harvest has an estimated mean value of $13.95 per pound across various resources, and increased accessibility would increase harvest 5-10%. The estimated increase in total pounds for Elim is approximately 15,900 lbs. The estimated value of increased subsistence harvest value is $222,000 annually. The addition of a tender dock would eliminate delivery trips to the offshore tenders and create a transportation cost savings of approximately $30,000 annually per vessel when combined with vehicle trip savings to access vessels at Moses Point. Operational inefficiencies during fuel offloading relating to the intensive labor required for the current procedure of floating the hose from offshore creates time delays and prime opportunities for costly mistakes and accidents at Elim; with 2–3 fuel barge deliveries per year, the proposed project could result in a savings average of approximately $22,000 per year. Vessel damages would be reduced by the protection afforded by the harbor. Vessel damages account for over half of the project benefits, representing avoided damages of $595,000 annually. In addition, the value of time that would otherwise be used to perform additional work or leisure (opportunity cost of time) savings would present an estimated benefit of $164,000 per year. The project benefits are summarized below in Table 21 and Table 22. Details regarding these benefits can be found in Appendix D: Economics.

Table 21. Present Value of Benefits by Alternative

Category	Alt 2	Alt 3	Alt 4	Alt 5
Increased Subsistence Harvest	$6,296,000	$6,296,000	$6,296,000	$6,296,000
Increased Commercial Harvest	$842,000	$1,994,000	$1,994,000	$1,994,000
Transportation Cost Savings	$735,000	$837,000	$837,000	$837,000
Opportunity Cost of Time	$4,637,000	$4,637,000	$4,637,000	$4,637,000
Vessel Damages	$16,862,000	$16,862,000	$16,862,000	$16,862,000
Reduced Barge Delays				$635,000
Total	**$29,370,000**	**$30,630,000**	**$30,630,000**	**$31,261,000**

Table 22. Average Annual Benefits by Alternative

Category	Alt 2	Alt 3	Alt 4	Alt 5
Subsistence Harvest	$222,000	$222,000	$222,000	$222,000
Commercial Harvest	$30,000	$70,000	$70,000	$70,000
Transportation Cost Savings	$26,000	$30,000	$30,000	$30,000
Opportunity Cost of Time	$164,000	$164,000	$164,000	$164,000
Vessel Damages	$595,000	$595,000	$595,000	$595,000
Reduced Barge Delays				$22,000
Total	$1,037,000	$1,081,000	$1,081,000	$1,103,000

6.4. Four Accounts

The USACE planning guidance establishes four accounts to facilitate and display the effects of alternative plans. The following four accounts facilitate the evaluation and presentation of the effects of alternative plans. The first is the NED account, which displays changes in the economic value of the national output of goods and services. Next, the Regional Economic Development (RED) account displays changes in the economic value of the regional output of goods and services. The third account is Environmental Quality (EQ), which displays non-monetary effects on ecological and aesthetic resources, including the positive and adverse effects of plans. The last account is the OSE account, which displays plan effects on social aspects such as community impacts, health, and safety, displacement, and energy conservation. A full discussion of the four accounts can be found in Appendix D: Economics.

6.4.1. National Economic Development

The NED account shows changes in the economic value of the national output of goods and services. All of the alternatives show a benefit-cost ratio of less than 1.0. Based on project costs, average annual benefits would have to increase five times to achieve a Benefit-Cost Ratio (BCR) greater than 1.0.

6.4.2. Regional Economic Development

The RED account measures changes in the distribution of regional economic activity that would result from each alternative. Evaluations of regional effects are measured using a nationally consistent projection of income, employment, output, and population.

The USACE Online Regional Economic System (RECONS) is a system designed to provide estimates of regional, state, and national contributions of Federal spending associated with Civil Works and American Recovery and Reinvestment Act (ARRA) Projects. It also provides a means for estimating the forward linked benefits (stemming from effects) associated with non-Federal expenditures sustained, enabled, or generated by USACE projects. Contributions are measured in terms of economic output, jobs, earnings, and/or value-added.

Construction of a new harbor would also create jobs and regional economic opportunities (for purposes of the RECONS analysis, the region was defined as the Nome Census Area). Most of the work would be contracted to firms operating or based out of Alaska. Some work could benefit national firms, and a smaller portion would benefit companies based in the Nome Census Area. Appendix D: Economics presents a detailed analysis performed on RECONS.

6.4.3. Environmental Quality

EQ displays the non-monetary effects of the alternatives on natural resources and is described more fully in Sections 8.2–8.6 of this IFR/EA. A reduction in the fleet’s fossil fuel usage and emissions resulting from reduced delays and idling time with improved access and moorage is expected. Still, improved efficiencies would also grow operations and may lead to more fossil fuel usage.

Enhancements to the environment as a result of constructing Alternative 5 include a reduction in the need for cargo barges to self-lighter, and this, in turn, reduces oil leakages into the sea from construction equipment offloading into the water and ‘walked to shore.’ Alternative 5 would relocate the fuel header from the top of the bluffs to the barge landing on the beach and would eliminate the need to float the hose from offshore and reduce chances for small fuel spills during offloading from the barge to the fuel header.

6.4.4. Other Social Effects

OSE benefits include (1) public health and safety of the local community and communities in the region; (2) access to natural resources for subsistence purposes; (3) welfare of the regional population to be served by the project; and (4) social and cultural value to the local community and communities in the region. The OSE account displays the effects of a proposed intervention, such as a navigation project, on social aspects such as well-being that are integral to personal and community definitions of satisfaction and happiness (IWR 2009). The USACE Planning Guidance Notebook further clarifies that these OSE also include: effects on educational, cultural, and recreational opportunities; effects on security of life, health, and safety; long-term productivity effects including the maintenance and enhancement of the productivity of resources for use by future generations; and effects on emergency preparedness.

These social effects reflect a highly complex set of relationships between the social and cultural setting and the proposed plan (USACE 2000, Appendix D). The OSE account describes the above social effects (benefits) under a framework of “social well-being factors,” as described by IWR (2009, p. 6). Social well-being factors are based in part on Maslow’s hierarchy of human needs theory, which states that people must have a number of essentials to survive and thrive (Maslow 1943). As such, these social well-being factors are important to the long-term viability of a community. The framework of social well-being factors discusses the effects that the proposed project would likely have on the social and cultural landscape in Elim and the region. The proposed project is a harbor of varied scales that would provide safe access and moorage for subsistence and commercial vessels, fish tenders, and a freight/fuel barge. Safe access is the non-monetary metric by which the alternatives are compared. The following social well-being factors expand on the effects of safe navigational access on the social and cultural landscape in Elim and the long-term viability of the community and region.

6.4.4.1. Health and Safety

An important basic human need is for personal and group safety (Maslow 1943). When conditions are unsafe or unhealthy, it can cause stress and dissatisfaction among those affected. Subsistence provides for traditional, healthy foods, and are especially important for food security in remote communities like Elim. Subsistence opportunities are identified as a community strength in the Kawerak-served communities (McDowell Group 2019). Flint et al. (2011) observed that health challenges are increasingly experienced among Alaska Native communities as traditional subsistence foods are replaced with Western, packaged foods. They also suggest a correlation between the reduction in subsistence harvesting and decreases in physical activity as well as increases in drug and alcohol problems. Improved access to subsistence resources supports the physical health of Elders and communities (Flint et al. 2011).

For commercial vessels, improved access and moorage effects include reduced risk of boat accidents at Moses Point during open fishing seasons. In addition, a protected boat launch could also support the timely mobilization of vessels responding to a vessel in distress. Navigation improvements and moorage would promote health and safety during barge operations. A barge landing and protected harbor would reduce risks associated with wave conditions to both crew members and community members in the vicinity. Additionally, the relocation of the fuel header from the top of the bluffs to the beach near the barge landing is expected to eliminate the need to float the fuel hose to shore and then manually drag it across the beach and up the bluffs improving safety and efficiency in fuel delivery overall. Additional discussion on health and safety can be found in Appendix D: Economics.

6.4.4.2. Social Connectedness

Improved access and moorage for subsistence activities support social connectedness among Elim community members. Subsistence activities consist of hunting, fishing, gathering, and the meticulous processing of those harvests; subsistence often requires a collective effort from extended family, friends, and neighbors. By having safe navigational access to these subsistence resources, the collective participation of community members in the subsistence civic infrastructures can be enhanced, strengthening an individual’s ties within and to the community. Appendix D: Economics noted the prominent presence of students aged 4–11 years old in Elim. This age group encompasses the crucial formative years for instilling cultural values and social connectedness through participation in subsistence activities. In Elim, community events centering on subsistence are often organized to involve both the young and the old.

In addition to serving as a crucial vehicle for subsistence harvests, small vessels also serve as a marine highway connecting remote villages. In this sense, the proposed navigation improvements would also support social connectedness with neighboring communities (e.g., Golovin, Koyuk, Shaktoolik). For example, when there is a funeral in Elim, family, and friends from neighboring communities visit by vessel, often with wild foods. This type of inter-village event further promotes reciprocity, which is a significant aspect of Yup’ik and Inupiaq cultural traditions. Additional discussion on social connectedness can be found in Appendix D: Economics.

6.4.4.3. Social Vulnerability and Resiliency

Without a functional harbor, Elim residents will continue to launch their vessels from Moses Point, 10 miles out of town, where the mouth of Kwiniuk River is subject to shoaling and shifting, and boat access from the ocean during most tides is difficult and hazardous. In addition to this ever-changing navigation hazard, the potential difficulty in promptly landing their vessels can impact their ability to process subsistence harvests safely. The proposed protected harbor would create stability in commercial and subsistence activities through safe access and moorage for vessels. By providing this stability, the fishermen are less vulnerable to hazards, such as changing navigable bathymetry, and impacts to their ability to bring their subsistence harvest onto land to process promptly. They would be more able to secure cash from commercial fishing that can be used for equipment repairs, which translates to improved resiliency when they are more able to cope with and recover from hazardous events or unexpected impacts. Additional discussion on social vulnerability and resiliency can be found in Appendix D: Economics.

6.4.4.4. Identity

The cultural identity of Alaska Native Tribes is highly dependent upon subsistence activities tied to specific locations and in-depth historical knowledge of the land and marine subsistence resources. As a social effect of the proposed project, identity must first be considered in the context of its pivotal role in some of the solutions to health challenges, specifically the behavioral health challenges widely experienced by remote Alaska Native communities. The Bering Strait Community Needs Assessment identified the top ten community challenges in the Kawerak Service Area (McDowell Group 2019). Substance abuse and a lack of cultural-based activities are among these community challenges, which are complex and interlinked. Substance abuse is a well-documented problem in the Native American and Alaska Native communities (Dickerson et al. 2010). While the scope of this evaluation does not investigate the complex causes of substance abuse, it does not overlook the links between cultural identity conflicts and these multifaceted problems (Segal et al. 1999; Rasmus et al. 2019). Rasmus identify the externally imposed changes to the indigenous way of life that took place dramatically and quickly in Alaska Native communities as one of the causes of these behavioral health problems (2014).

Elim and the communities in the region are not immune to the challenges of substance abuse and its associated effects. The degree of these challenges may vary from community to community but remain equally a threat to community viability. During focus groups, residents echoed the importance of continued subsistence practices and indigenous knowledge to cultural identity. A harbor that provides safe access can facilitate the subsistence practices important to strengthening identity, which is part of the solutions to address substance abuse and the lack of cultural activities. The proposed project would support behavioral health interventions that are at the core "focus on restoring of order to daily living in conformity with ancient and enduring values that affirm life" (IWR 2009). It is important to recognize the role of indigenous knowledge in cultural identity beyond abstract observations. A protected harbor for the community to launch their vessels and collectively participate in the various subsistence activities can provide stable, meaningful connectedness and indigenous knowledge sharing that support resiliency to the behavioral health problems. Additional discussion on identity can be found in Appendix D: Economics.

6.5. National Economic Development (NED) Analysis

Net benefits and the benefit-cost ratio (BCR) are determined using the average annual benefits and average annual costs for each alternative. Net benefits are determined by subtracting the average annual equivalent costs from the average annual benefits for each alternative; the BCR is determined by dividing average annual benefits by average annual costs. The project costs, benefits, and the benefit-cost ratio by alternative is summarized in Table 23.

Table 23. NED Analysis Summary

Description	Alt 2	Alt 3	Alt 4	Alt 5
Present Value NED Benefits	$27,960,000	$29,150,000	$29,150,000	$29,756,000
Present Value NED Costs	$76,090,000	$102,750,000	$104,500,000	$109,140,000
Average Annual Cost	$2,610,000	$3,520,000	$3,580,000	$3,740,000
Average Annual Benefits	$1,040,000	$1,080,000	$1,080,000	$1,100,000
Average Annual Net Benefits	-$1,570,000	-$2,440,000	-$2,500,000	-$2,640,000
BCR	0.40	0.31	0.30	0.29

6.6. Cost-Effectiveness and Incremental Cost Analysis

The NED analysis did not identify a NED Plan, with all plans having negative average annual net benefits. Alternative 2 had the least negative average annual net benefits. The Section 2006 Authority allows an analysis based on other than NED benefits. In accordance with the Section 2006 Authority, a CE/ICA was conducted to evaluate the effects of the proposed alternatives beyond the NED perspective. These effects are non-monetary outputs. The CE/ICA is utilized to inform decisions on sound investments by identifying options that yield maximum desired outputs for the least acceptable cost. These outputs are measured in opportunity days for access and moorage of the Elim vessel fleet served by the project. It is important to recall the planning objectives developed to address the water resource problem at Elim to understand the basis of the outputs used in this CE/ICA:

1. Provide safe, reliable, and efficient waterborne transportation systems for the movement of commerce (including commercial fishing) and subsistence in Elim
2. Support the long-term viability of Elim

Opportunity days for safe access and moorage conditions directly impact waterborne transportations for the movement of commerce and subsistence in Elim. Given the integral significance of commercial fishing and subsistence practices to livelihoods, these support the community's long-term viability. The CE/ICA metric compares the accessibility and moorage conditions between the proposed alternative plans and the No Action plan. The Alaska District's Hydraulics & Hydrology staff collaborated with Economics staff on the model development of the metric. Vessels operate in and out of Elim from May to November. Accessibility and moorage conditions are evaluated during the season. The model was subsequently submitted to the Deep Draft Navigation Center of Expertise (DDN-PCX) for review and approval. The wave analysis accounts for both low water events and storm events, which restrict access and moorage in the existing conditions. The analysis assumes that two General Navigation Feature (GNF) elements accrue opportunity days. First, is that dredging accrues access days during low water events. Second, is that wave protection (breakwater) accrues access days during higher wave or storm events.

Opportunity days do not represent calendar days. Opportunity days represent the days in a given year for safe access for each vessel class after accounting for wind and surge conditions that exceed safe access requirements for each alternative. Moorage represents the Opportunity Days for safe moorage after accounting for wave conditions that exceed safe tender and barge moorage requirements at each alternative. While assessed separately, access and moorage Opportunity Days are combined as a single metric for the CE/ICA. The access and moorage days gained by each vessel class for each alternative are displayed in Table 24.

Table 24. Opportunity Days by Vessel

Alternatives	Subsistence	Commercial	Tender	Barge	Total Average Annual
Alt 2	2,219	2,219			4,438
Alt 3	2,219	2,219	629		5,067
Alt 4	2,219	2,219	805		5,243
Alt 5	2,219	2,219	805	301	5,544

The cost-effectiveness analysis evaluates a plan's level of output against its cost. The subsequent incremental cost analysis evaluates a variety of alternatives of different scales to arrive at a "best buy" option. Best buy plans are considered the most efficient plans because they provide the greatest increase in output for the least increase in cost. The costs variable for a CE/ICA refer to the average annual economic costs of each alternative. These costs include project first costs, interest during construction, and operation and maintenance costs and are amortized using the FY20 discount rate over the period of analysis. The annual average equivalent costs used in the CE/ICA are summarized in Table 25.

Table 25. Average Annual Costs for CE/ICA by Alternative

Cost Description	Alt 2	Alt 3	Alt 4	Alt 5
Total Economic Cost	$74,018,000	$99,837,000	$101,498,000	$106,007,000
Annual Average Cost	$2,610,000	$3,520,000	$3,579,000	$3,738,000

6.6.1. CE/ICA Results

The cost-effective analysis results identified Alternatives 2, 3, 4 and 5 as cost-effective. The incremental cost analysis identified Alternatives 2 and 5 as best buy plans in addition to the No Action plan. The CE/ICA variables and the results of the cost-effectiveness analysis are summarized in Table 26. The incremental cost analysis showed Alternative 5 would provide many more Opportunity Days than those provided with Alternative 2, including Opportunity Days for two fish tenders and barge access for a minor cost increase per increment. A graph representation of the CE/ICA is presented in Figure 33.

Table 26. Cost-Effectiveness and Incremental Cost Analysis (CE/ICA) Summary

Alternative	Opportunity Days Gained	Average Annual NED Cost	Annual Cost Per Unit of Output (Opportunity Days)	CE/ICA Result
No Action	0	0	0	Best Buy
Alt 2	4,438	$2,610,000	$588	Best Buy
Alt 3	5,067	$3,520,000	$695	Cost Effective
Alt 4	5,243	$3,579,000	$683	Cost Effective
Alt 5	5,544	$3,738,000	$675	Best Buy

The Incremental Cost Analysis is performed by determining the incremental cost per unit between successively larger plans. Best buy plans are those which minimize the incremental cost per unit output at each level of total output. The Incremental Cost Analysis identifies No Action, Alternative 2, and Alternative 5 as the best buy plans (Figure 33). The alternatives differentiated by cost effectiveness are shown in Figure 34.

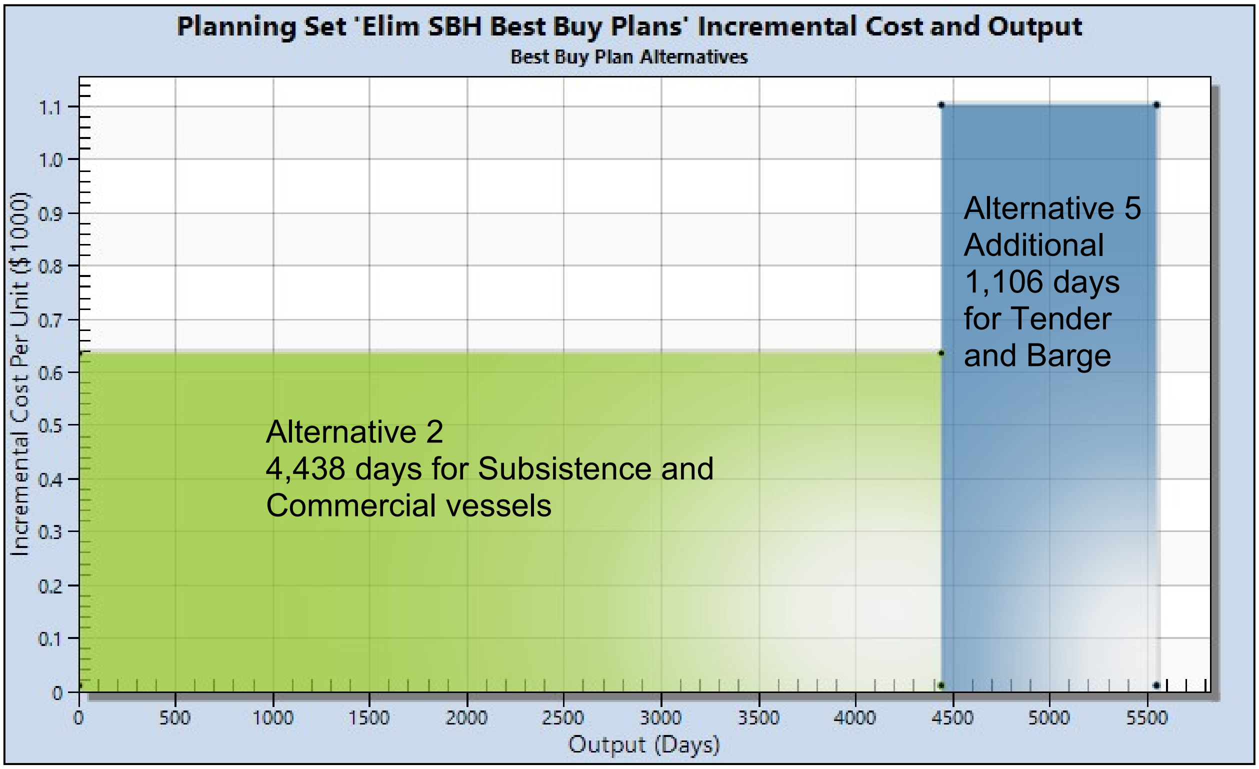

Figure 33. CE/ICA, Incremental Cost, and Output

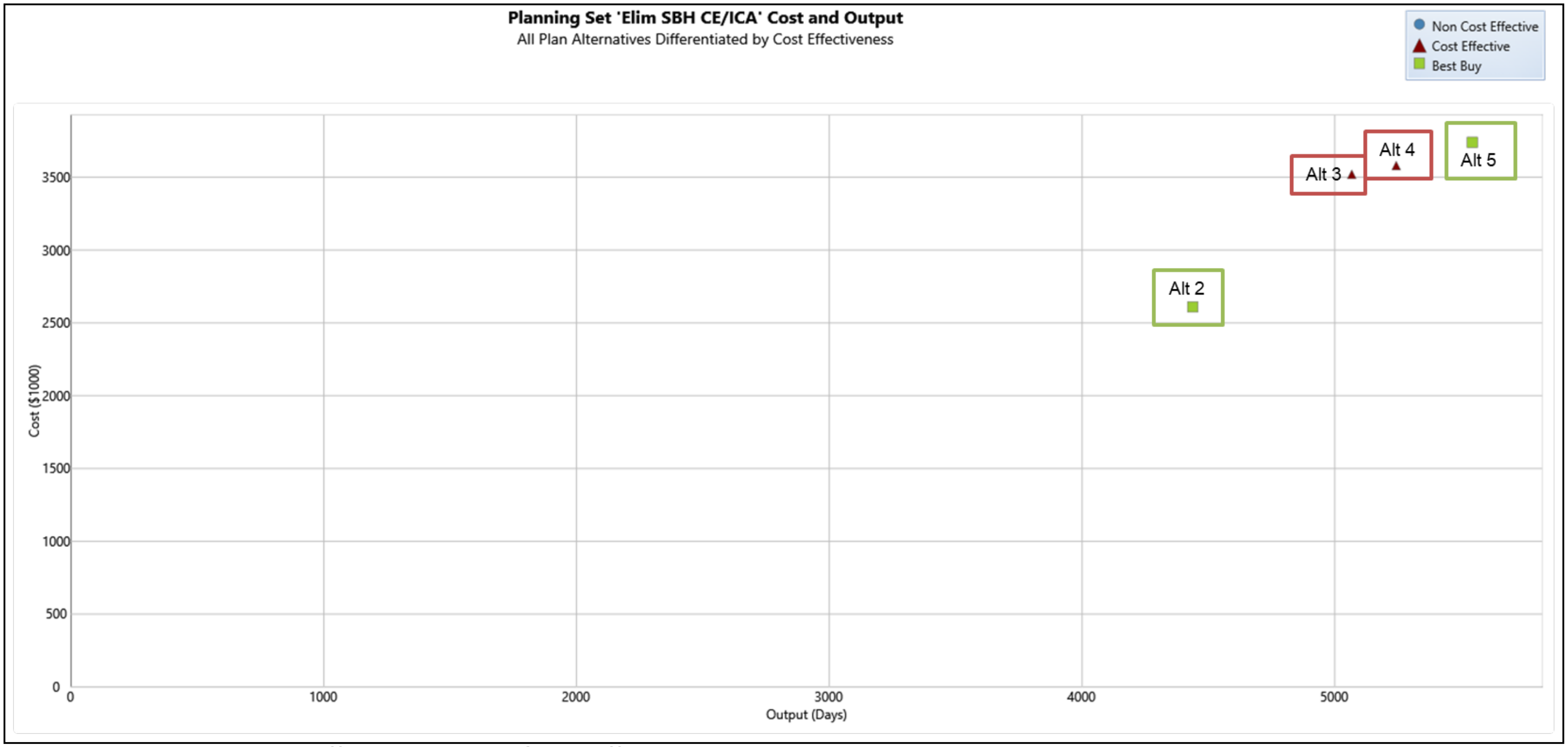

Figure 34. Alternatives Differentiated by Cost-Effectiveness

Through representing other social effects, CE/ICA reflects the cascading, or stemming from, effects of benefits that could be gained with project alternatives compared to their cost. A summary of the beneficial effects and their contributions to community viability is provided in Table 27. Appendix D: Economics contains a detailed discussion of community viability and improved vessel access with Section 9 of the Economic Appendix discussing how community viability is supported by improved access of each vessel class. Efficient barge deliveries are essential in providing increased cash, food supply, health and wellness; as well as reduced costs and outmigration. In addition to the barge-related benefits, the benefits realized for the commercial and subsistence fleet would provide increased time for commercial and subsistence activities and increased food supply. Transit times and emergency reaction times would also be significantly reduced with navigation improvements.

Table 27. Summary of Stemming from Effects Benefits

Impact in Future With Project (FWP)	Effect	Relevance to Viability	Section 2006 Considerations
-Improved efficiency of fuel delivery	-Available cash to pursue subsistence. Reduce the cost of subsistence -Reduced cost of medical-related travel -Reduce the cost of heating houses	-Outmigration (primary subsistence gatherers) -Cultural values (sharing) -Health & wellness (traditional foods). -Professional retention -Training of youth.	-Health & safety -Welfare of population -Regional economy -Access to subsistence resources -Social & cultural value
-Improved efficiency for delivery of critical infrastructure/ components -New construction -Replace aging or threatened infrastructure.	-Available cash to rebuild critical infrastructure -Reduced cost to maintain/replace public health/community facilities -Lower cost of supplies used to combat the effects of climate change	-Sanitary facilities/washeteria -Fuel & water storage -Schools/teacher housing -Health clinics -Repair or relocate infrastructure -Outmigration (primary subsistence gatherers) -Professional retention -Employment	-Local economic opportunities -Health & safety -Welfare of population -Access to subsistence resources -Social & cultural value
-Improved efficiency for delivery of durable goods (vehicles, boats, snow machines, ATVs, building materials, heaters, stoves, washing machines)	-Available cash to pursue subsistence -Increased subsistence food supply -Lower cost bar to start the pursuit of subsistence	-Outmigration (primary subsistence gatherers) -Cultural values (sharing) -Health & wellness (traditional foods) -Training of youth -Professional retention	-Welfare of population -Public safety -Social & cultural value
-Improved safety for moored vessels	-Available time to fish/subsist -Vessel prep time reduced -Production time increased -Increased subsistence food supply -Decreased transit time to vessel -Reduced reaction time for emergencies	-Increased safety and response success -More time available for training -Increased food security -Prepares community for longer open water season -Provides for shore-based facilities	-Local economic opportunities -Welfare of population -Access to subsistence resources -Public health & safety -Social & cultural value

6.6.2. Demand for Access

Vessel operations in the fishing communities of Elim are tied to the maintenance and sustenance of livelihoods. Vessel operations at Elim vary by use and season. It is important to understand that the demand for Opportunity Days also varies. The Opportunity Days are computed from the accessibility conditions by the month of times forecast for harvest or vessel operations. The 'benefits' of the Opportunity Day also vary by vessel type. The various benefits or value a day of access would support by vessel type is summarized in Table 28.

Table 28. Opportunity Days by Vessel Class

Vessel	A day of Access would support	Maximum Opportunity Days
Subsistence	Subsistence harvest	2,229
Commercial	Commercial harvest	2,229
Tender	Improve commercial salmon fishery	805
Barge	• Deliver the fuel supply for half of the year for the community (which is used by subsistence and commercial fleet) • Deliver materials for construction	301

6.7. Multi-Criterion Decision Analysis (MCDA)

While Opportunity Days provide a metric that represents the benefits of safe access and moorage of vessels for each alternative plan, the metric alone inadvertently assumes all vessel operations provide a consistent level of benefits. Therefore, the nuances of benefits accrued by each vessel operation, the demand for access, and the specific contributions to community viability by vessel operation are not fully captured. The Multiple Criteria Decision Analysis (MCDA) is used to account for these benefits intricacies in the framework of CE/ICA to inform decision making and plan recommendation.

The MCDA is a decision aiding tool and allows for an analysis of multiple criteria. MCDA further unpacks the complexities within the single CE/ICA metric and what benefits each vessel provides with increased access. The selection of criteria for the MCDA is based on key benefits that are non-monetary but support community viability and meet the planning objectives. The criteria discussed in Table 29 are comprised of elements from two accounts: OSE and EQ. The following criteria were selected as effects or benefits of navigation measures and subsequently ranked by vessel class to clarify the differences in Opportunity Days. The selection and ranking was conducted by the PDT.

Table 29. Criteria Selected for MCDA

Criteria	Designated Account	Ranking Values
Health and Safety	OSE	**LOW-3 MEDIUM-5 HIGH-7**
Delivery of Essential Goods and Fuel	OSE	
Delivery of Materials for Critical Infrastructure	OSE	
Cultural Identity	OSE	
Reduction in Potential Fuel Spillage	EQ	**LOW-1 MEDIUM-2 HIGH-3**
Reduction in Fuel Consumption during Vessel Idling	EQ	
Reduction in Noise Pollution	EQ	

6.7.1. Criteria Definitions

The criteria in the MCDA are defined in this subsection. The first four are key OSE followed by three effects under the EQ account.

6.7.1.1. Health and Safety

The Health and Safety criterion refers to the effects of safe access by vessel category operation on the health and safety of the vessel operators. It also refers to how the outcomes/activities of the vessel support the health and safety of the community members. For example, this criterion is ranked high for subsistence and commercial vessels but medium for tenders.

6.7.1.2. Delivery of Essential Goods and Fuel

This criterion is discussed in Section 6.6.1 and is the key to sustaining community viability and vitality. Subsistence and commercial fishing activities are crucial to Elim, but access to equipment and fuel to participate in these activities is dependent on the delivery of essential goods and fuel. This criterion is ranked by the vessel type’s operational capacity to maintain the delivery of essential goods and fuel in the future.

6.7.1.3. Delivery of Materials for Critical Infrastructure

The ability of the community to replace and upgrade critical infrastructure is impacted by the ability to deliver construction materials into Elim. This criterion is ranked by the vessel type’s operational capacity to deliver construction materials and support Elim’s capability to upgrade or replace critical infrastructure.

6.7.1.4. Cultural Identity

Cultural identity is elaborated on in various sections of this report as a critical component of community viability. The ability of the community in Elim to continue to practice subsistence activities and transmit knowledge and practice to future generations is captured under this criterion. Subsistence and commercial vessels rank high while barge and tender vessels rank medium and low.

6.7.1.5. Potential Reduction of Fuel Spills

This criterion refers to the ability of improved access for each vessel category to reduce potential fuel spills from the transfer of fuel delivery or fuel spillage from vessel activities.

6.7.1.6. Potential Reduction in Vessel Idling

The Opportunity Days allow for improved efficiencies in vessel operations by reducing vessel idling as a result of a harbor. This criterion assesses the extent to which this benefit is accrued by improved access to each vessel category.

6.7.1.7. Reduction in Noise Pollution to Marine Resources

In the existing conditions, vessel idling generates noise pollution in the marine environment. A reduction in noise pollution as a result of reduced vessel idling is assessed under this criterion.

It should be noted that although it may appear that some criteria are duplicative, differences can be noted between all the criteria. Criterion 2, which addresses the delivery of essential goods and fuel to provide for the more individual needs of everyday living and subsistence activities, is not duplicated by Criterion 3, which addresses the delivery of materials needed for construction and infrastructure projects, which are more community-based. For Criterion 6, reduced idling inefficiencies are addressed from a perspective of reduced time and fuel usage while idling. Criterion 7, however, addresses the environmental aspects of benefits from reduced idling such as reduced noise pollution. The seven criteria address significantly different categories of benefits.

6.7.2. MCDA Results

The MCDA rankings by alternatives are displayed in Figure 35. The MCDA results show that Alternative 5 not only provides higher rankings than Alternative 2 but also performs better than all other alternatives. In OSE criteria, all vessels except the 2 tenders rated high in health and safety, while only the barge class rated high in delivery of goods and materials. All other vessels were rated low for criteria on delivery of fuel and essential goods and delivery construction materials for critical infrastructure. The only criteria in which the barge class was outranked by any other vessel was in cultural identity, with subsistence vessels topping that category. The EQ criteria all revealed barges ranking as high and all other vessels ranking low, except for tenders ranking medium in the reduction of vessel idling. Further discussion and the summary tables of the MCDA is found in Appendix D: Economics.

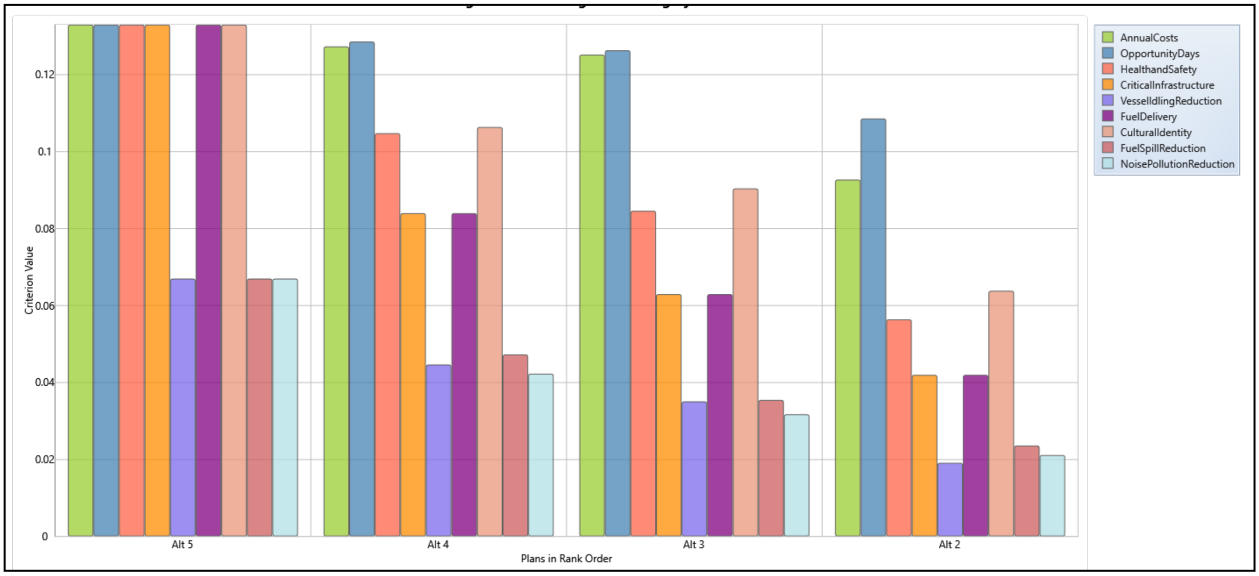

Figure 35. MCDA by Alternative

6.8. Four Accounts Evaluation Summary

Based on this analysis of the four accounts (Section 6.4), each alternative has positive effects for the EQ, RED, and OSE accounts; while having negative net benefits for the NED account. A summary of the four accounts for the alternatives is shown in Table 30.

Table 30. Four Accounts Evaluation Summary

Alternative	Net Annual Benefits & BCR	EQ Positive Effects	RED Impact of Employment and Income in the Region	OSE
2	-$1,570,000 0.40	Low	$35M	Beneficial
3	-$2,440,000 0.31	Low	$47M	Beneficial
4	-$2,500,000 0.30	Middle	$48M	Beneficial
5	-$2,640,000 0.29	High	$50M	Beneficial

Note: RECONS analyzed RED benefits: the impact of employment and income generated in the region by the construction of the project.
EQ effects are based on three environmental effects as a result of the alternative ranked under the MCDA.

6.9. Economic Risk, Uncertainty, and Sensitivity Analysis

The risks in the NED analysis lie in the uncertainties of the NED benefit categories. The benefit estimates are derived from the best available information. For Alaska, data is typically unavailable or limited to small-time periods. Additionally, the economic analysis builds on the 2013 CAP 107 study. Following a review of the CAP 107 study model and literature, assumptions and extrapolations were necessarily developed to reflect current conditions at Elim. However, remaining data gaps trigger uncertainties and, in turn, give rise to the risk of benefits the project would realize. Economic risk, uncertainty, and sensitivity are discussed in Appendix D: Economics Section 15.

6.10. Plan Recommendation Rationale

The NED analysis did not identify a positive NED Plan, and all alternatives had a BCR less than 1.0 (Table 23). Alternative 5 is supported based on the results of a CE/ICA. Alternative 5 had the second lowest Annual Cost of an Increased Opportunity Day, producing one of the best buy alternatives other than the No Action plan for the project, and the sole alternative to address the needs of the entire fleet (Table 24 and Table 26). In addition to being a best buy plan, Alternative 5 also provides the most Opportunity Days of any alternative, providing for almost 800 more Opportunity Days than Alternative 2, 500 more Opportunity Days than Alternative 3, and over 200 more Opportunity Days than Alternative 4.

Alternative 2 would only provide opportunities and benefits for subsistence and commercial fleet with little benefits supporting the RED account. Although there would be a small increase in fish harvests, these would be minimal due to the lack of tender facilities to improve the efficiency of operations. Commercial fish operations would still require vehicle trips to Moses Point on a road that is eroding, and skiffs are lightering fish totes offshore to the tenders. OSE benefits from subsistence activities only would be realized under Alternative 2. OSE benefits associated with the delivery of essential goods, improved efficiency and reliability in the delivery of vehicles, improved reliability in the delivery of fuel that would stem from a barge landing would not be realized under this plan.

Alternatives 3 and 4 would provide more Opportunity Days than Alternative 2 to tender operations and lead to increased fish harvests. Alternatives 3 and 4 also provide potential RED benefits associated with seasonal fish processing job creation. However, without the barge landing, the delivery of materials to replace or upgrade critical infrastructure such as housing would continue to be hindered and stem into OSE that impact the viability of the community.

For example, aging housing structures have poor air quality, which negatively impacts the health of the community. Alternative 5, alone, includes the barge landing, leading to the realization of a compounding effect of the OSE benefits associated with the project across the fleet (Table 27). The barge landing would eliminate time delays associated with waiting for favorable conditions to land as well as reduce operation inefficiencies associated with fuel and freight deliveries. The benefits from increased access and efficiency would spill over into the community bringing the reduced cost in goods and building supplies, which in turn reduces construction costs for critical infrastructure, which in turn provides for increased cash in the local economy. In addition, the elimination of time delays and improved efficiency in the delivery of durable goods could present more opportunities for the pursuit of subsistence activities and participation in events vital to the native culture. Safety would also be improved by having the barge securely moored at the mooring points. Barge landing benefits weigh heavily into the long-term viability of the community.

To provide further support in the decision-making process, the PDT utilized an MCDA analysis to further evaluate the complexity of the benefits associated with the single CE/ICA metric and provide an analysis of these benefits by each vessel class and for each alternative (Sections 6.7.1 and 6.7.2). This analysis shows a breakdown of OSE and EQ benefits associated with the opportunity days. Figure 35 in Section 6.7.2 provides a more conclusive view of the additional, incremental benefits provided by Alternative 5. When comparing the alternatives with MCDA rankings, the performance of Alternative 5 can clearly be seen to have higher rankings to that of Alternative 2 as well as the other alternatives. For the reasons outlined in this section, Alternative 5 is being carried forward as the Recommended Plan.

7. RECOMMENDED PLAN

After initial screening of the alternatives, the team developed preliminary designs for the remaining alternatives as described in Section 5.5. These preliminary designs formed the basis for the NED and CE/ICA analyses to inform the selection of the TSP. With the TSP identified, the team incorporated modifications with input from the sponsor to present the recommended plan at the Agency Decision Milestone (ADM). Input from the ADM and sponsor led the team to perform optimization of the recommended plan. It was determined that all design criteria updates identified during optimization would have impacted harbor effectiveness and quantities for the full suite of alternatives to a similar extent. Because the design modifications to the Recommended Plan would also be applicable to all the alternatives analyzed (other than the no action plan) it was determined that the changes would not disproportionately affect the benefit and cost analysis or change plan selection. The optimized recommended plan is presented in this section.

7.1. Description of Recommended Plan

Alternative 5 was presented as the Tentatively Selected Plan at the ADM on 09 July 2020 and received an endorsement from the HQUSACE Chief of Planning and Policy Division to be carried forward as the Recommended Plan. Alternative 5 serves the full vessel fleet, 25 subsistence vessels, 25 commercial vessels, two tenders, and one barge and tug at Elim Beach.

Comments provided during the policy and legal review suggested that based on review of plan formulation, the required benefits could be achieved with a smaller or lower cost harbor. Through coordination with the community, it was determined that smaller uplands would be able to achieve the same level of benefits for a lower cost to the community (USACE 2020). With these two goals in mind, the optimization of the Recommended Plan was performed.

The modifications to the Recommended Plan would not impact the fleet that would be served or change the benefits realized with project construction. The design modifications to the Recommended Plan would also be applicable to all the alternatives analyzed (other than the no action plan) and, thus, would not disproportionately affect the benefit and cost analysis. Design modifications were made based on district design quality control, agency technical review, policy and legal review comments received, and coordination between the design team and reviewers. All design criteria updates would impact harbor effectiveness and quantities for the full suite of alternatives to a similar extent.

The following alterations were made during optimization:

- The east breakwater was straightened and attached to shore for ease of construction and to limit circulation impacts within the harbor resulting in a design that consists of the east rubble-mound breakwater 820 ft long and the west rubble-mound breakwater 986 ft long. That would provide a 1.4-acre moorage basin for 50 boats ranging in length from 18 ft to 32 ft, an interior channel to provide access to the boat launch, and a 2.5-acre turning and maneuvering basin for the tenders and tug and barge. This plan would provide shelter from waves propagating out of the west through southwest and from the east.
- The entrance channel width was widened from 250 ft to 300 ft to meet recommendations in EM 1110-2-1615 (USACE 1984).
- The required safety clearance for channels with a hard bottom was adjusted from 2 ft to be 3 ft (USACE 1984).
- An armored toe was added to the oceanside of the breakwater to provide greater resiliency from the movements of shorefast ice.
- The uplands were reduced, while providing the same level of benefits, to 1 acre for temporary uplands boat moorage and vehicle and trailer parking. The uplands would need to be armored to withstand the force of the largest waves expected within the harbor.

- The access road layout was modified to tie into a planned laydown pad towards the west end of Front Street, shortening the length of the road to 250 ft running along the base of the bluff.
- The elevation of the boat launch was altered from +16 ft MLLW to +10 ft MLLW while maintaining a lower elevation of -5 ft MLLW and a 13% slope.
- The barge landing was widened from 70 ft to 100 ft with a 1:4 slope from -8 ft MLLW up to +16 ft MLLW to allow for barge loading and unloading.

In addition to design feature alterations, during meetings with the local sponsor, it was determined that project costs could be lowered by utilizing a local source of rock from a quarry located approximately 3.5 miles from Elim (Figure 36). Local sponsors noted this quarry would produce ample material for the project though it would need to be ripped and screened.

Figure 36. Local Source for Rock

The team investigated feature layout adjustments to determine if features could be moved or removed without impacting harbor effectiveness. One such adjustment was to remove the east breakwater. The fetch limited wave analysis indicates that the waves out of Norton Bay could be as large as 7.5 ft. Calculated fetch limited wave heights would exceed the design conditions at the tender dock over 20% of the time and at the boat launch over 50% of the time that waves are approaching the navigation features out of Norton Bay. This is significantly higher than the less than 5% of the time for the tender dock and 20% of the time for the boat launch with the east breakwater in place. Based on the lack of wave information, limited wind data for a fetch analysis, assumptions made during the fetch limited wave analysis, and limited information on local observations indicating otherwise, it was determined that removal of the east breakwater would be an unacceptable risk.

The Recommended Plan as optimized includes a harbor at Elim Beach sized to accommodate one 160-ft barge and associated 86-ft tug, two tenders, and 50 vessels varying in size from 18 ft to 32 ft. The plan consists of a 300-ft wide entrance channel with a dredging depth of -13.0 ft MLLW. These two rubble-mound breakwaters encompass a 1.4 acres moorage basin to accommodate the 50 vessels and an interior channel to provide access to the boat launch with a dredging depth of -9.0 ft MLLW and a 2.5-acre turning and maneuvering basin for the tender and barge and tug with a dredging depth of -13.0 ft MLLW. The west breakwater would be approximately 986 ft long and the east breakwater approximately 820 ft long. The eastern breakwater would be attached to the land. Also included in the project are approximately 1 acre of uplands for upland boat moorage, vehicle and trailer parking, and temporary Connex storage. The uplands would include an 87-ft long tender dock and a 100-ft wide barge landing with two moorage points. A road approximately 250 ft in length would connect the uplands to the boat launch. The fuel head would be extended from the existing fuel header currently located on the bluffs above Elim Beach (Figure 37). The fish buying station would also be relocated from Moses Point to Elim.

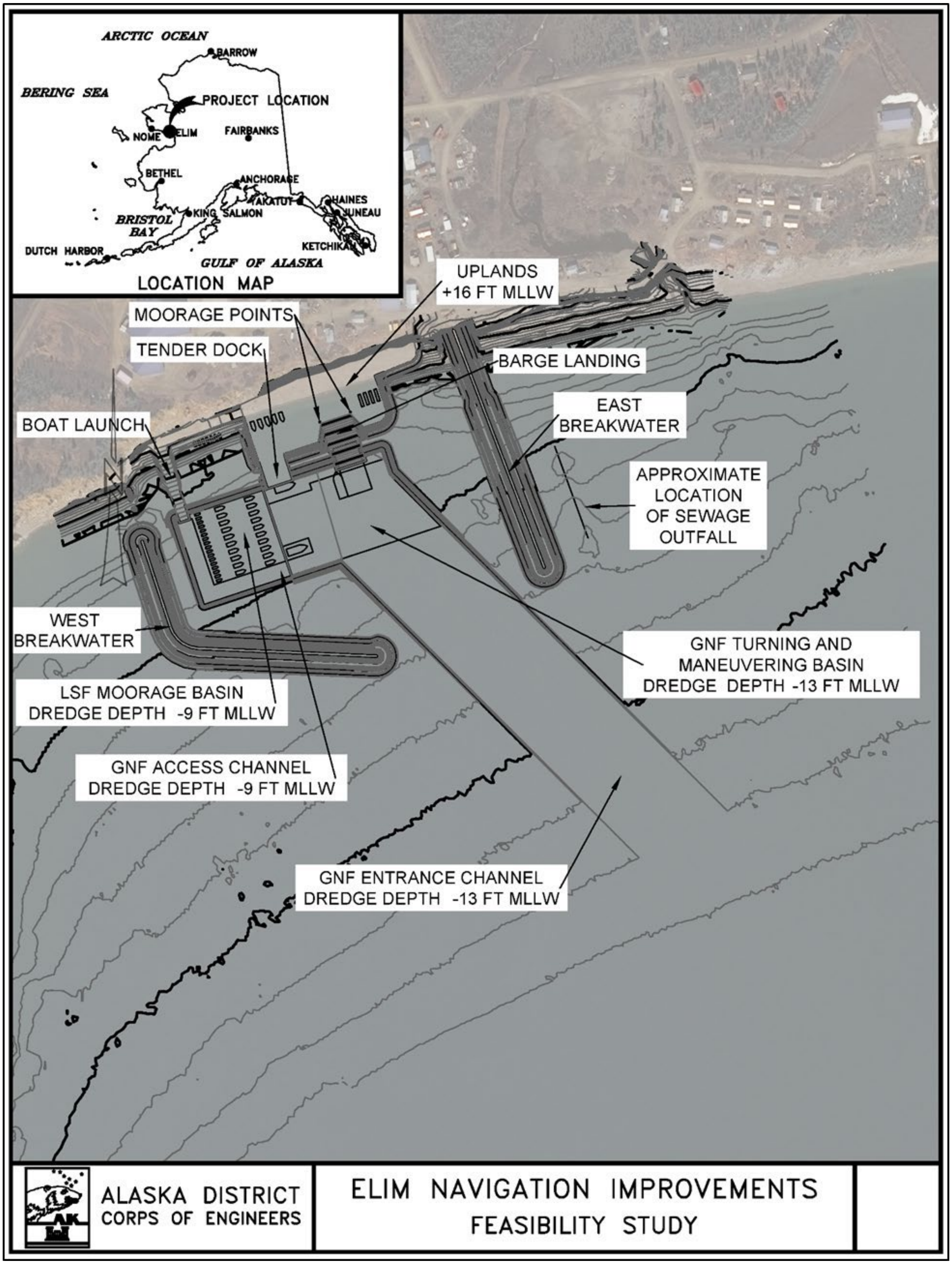

Figure 37. Recommended Plan

The team considered the effects of climate change on the proposed project. The potential impacts of increased overtopping of breakwaters, flooding of local features, erosion of the shoreline, and decrease of maintenance dredging due to sea level change are anticipated to impact any design at Elim Beach. The proposed navigation improvements could cause sheltering to the east of the breakwater and an increase in wave loading on the bluffs to the west. Per a comment received during the public review period, it is anticipated that there will be a decrease in erosion east of proposed navigation improvements. Changes in shoreline would be limited to the pocket beach in front of Elim between Airport Point and headlands east of the community. In addition, an increase in winter temperatures in the region could decrease the period of shorefast and sea ice formation in Norton Sound. The site could be impacted by waves and storm surge in later parts of the year than the season of analysis used for this study. Changing sea ice conditions and potential sea level rise at the project site could result in unknown changes to the storm conditions and increased depth limited wave height, resulting in increased overtopping of the breakwaters during high water events. The breakwater cross-section is designed for moderate overtopping. Detailed information regarding climate change consideration for the project can be found in Appendix C: Hydraulics and Hydrology.

7.2. Plan Components

Plan components are typically categorized into General Navigation Features (GNF) and Local Service Facilities (LSF). The GNF and LSF are important to identify during the study because design and construction costs for GNF are cost-shared between the Federal Government and non-Federal sponsors. Still, the LSF is the sole responsibility of the non-Federal sponsor for construction, operation, and maintenance costs. All of the LSF proposed supports the project benefits at Elim. In addition, construction costs are generally higher in remote Alaskan regions. Other than the breakwaters, the GNF area will be limited to the harbor entrance channel, the interior channel that connects the harbor entrance with local facility areas, and areas for vessel maneuvering, turning, and passing (Figure 37).

The design vessels used for the entrance channel and turning basins are the barge and tug. The entrance channel would be dredged to -13 ft MLLW with 2 ft of allowable over-dredge. The design vessel used for the mooring basin is the commercial vessel. The moorage basin would be dredged to -9 ft MLLW with 2 ft of allowable over-dredge. The dredge quantities for the Recommended Plan are displayed in Table 31.

Table 31. Recommended Plan Dredge Quantities

Material	Quantities [cy]
West Breakwater	
Armor Rock	26,576
B Rock	18,872
Core Rock	17,128
East Breakwater	
Armor Rock	20,501
B Rock	14,705
Core Rock	11,423
Dredging of General Navigation Features	
Mechanical Dredging	46,654
“Ripping”	107,751
Blasting	6,713
Dredging of Local Service Features	
Mechanical Dredging	5,752
“Ripping”	17,621
Blasting	1,154
Uplands	
Fill	50,149
Armor Rock for Revetment	1,558
B Rock for Revetment	1,371

The west breakwater crest width was set to 14.0 ft for overtopping conditions, based on the combined width of three armor stones. The crest height determined by total water level and run-up would be set at +26.7 ft MLLW. The final design crest elevation was set to +20 ft MLLW with the cross-section designed for moderate overtopping conditions. The armor stone being sized for ice impacts also creates a more resilient design that could dissipate more energy during events that have both large waves and high water. Each breakwater would have an armored toe on the ocean side as well. A typical cross-section is shown in Figure 38.

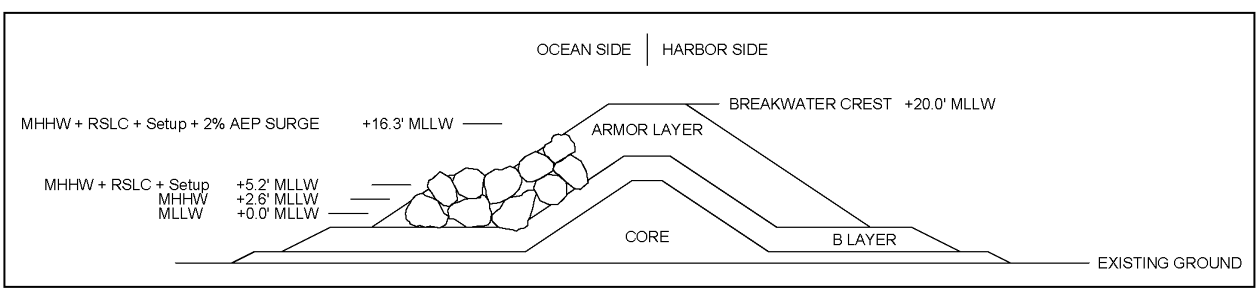

Figure 38. Typical Breakwater Section with Water Level Components.

For this study, the LSF is divided into two categories, upland, and in-water LSF. The upland LSF includes the plan components constructed on the land. The in-water LSF are the components (excluding the GNF) that are constructed in or over water and the intertidal zone. The reason for the two LSF categories is that it became apparent during plan formulation that the GNF costs were relatively stable, while LSF costs varied between the alternatives. The majority of this cost variance was encompassed in the in-water LSF. There were also variances in the upland LSF costs, which assisted in differentiating between alternatives when considering plan selection.

In-water LSF for the project consists of the berthing, mooring, and anchorage area and suggested offsets from local facilities areas as follows:

- Boat Launch – one commercial vessel length (32 ft)
- Tender Dock – two beam widths of tender (48 ft)
- Barge Landing – half the length of the barge during high tide (80 ft)

The Uplands LSF includes the following features:

- 1 acre for upland boat moorage, vehicle and trailer parking, and temporary Connex storage at +16 ft MLLW
- 87-ft tender dock at +16 ft MLLW
- Road approximately 250 ft in length connecting the uplands to the boat launch
- Boat launch
- Barge Landing
- Two moorage points
- Extension of the fuel header currently located on Elim Beach

One-acre of upland features is required to provide upland boat moorage, vehicle and trailer parking, and temporary Conex storage. It was assumed for feasibility level design that the elevation of the uplands would be +16 ft MLLW and include armored slopes.

A 250-ft long gravel access road would be required from the uplands to the boat launch. The seaward edge of the road would be armored to reduce the risk of erosion during high water events and due to shoreline retreat associated with RSLC.

A single boat launch would be required to allow for the launching and retrieving of vessels. It would also enable boat owners to pull their boats on shore if the storm surge and wave conditions are anticipated to be greater than the harbor design conditions. For the feasibility level design, it was assumed that the boat launch would have a 13% slope from the +10 ft MLLW of the uplands to -5 ft MLLW enabling use during most tide conditions.

A barge landing that is 100 ft wide with a 1:4 slope from -8 ft MLLW up to +16 ft MLLW would be required to allow for barge loading and unloading. It is assumed that the style of barge and the method of offloading and loading, driving a loader and/or telescopic handler from the barge onto land via the barge ramp (Figure 39), would not change due to the existence of a harbor. Two moorage points would be required for the barge to moor to while offloading or loading.

Figure 39. Unloading of a Materials Barge on Elim Beach (August 2018).

The Recommended Plan includes the following In-water LSF:

- Tender dock
- Moorage area dredging

A single tender dock would be required to allow for the loading of fish totes onto an NSEDC tender from the fish buying station. The tender dock would be an 87 ft long sheetpile dock at an elevation of +16 ft MLLW with the sheetpile driven to bedrock, approximately 12 ft below existing ground.

7.2.1. Dredged Material Disposal Site

7.2.1.1. Dredged Material Placement and Disposal Alternatives Considered

Up to 185,645 cubic yards of material would be dredged from the seafloor during construction. The USACE has considered several alternatives for the placement or disposal of the dredged material. The following options were considered for dredge material disposal.

Nearshore Placement – Moses Point Access Road. Roughly 3.5 miles of the Moses Point Access Road runs along low ground immediately adjacent to the shoreline (Figure

40) and is subject to damage from storm surge. Placement of the dredged material for beach nourishment could be beneficial in this area. Placement would occur in the very shallow waters east of the mouth of Iron Creek, near the location of erosion along Moses Point. This location is approximately 5 nautical miles from the proposed navigation features. In order to place material in the nearshore, a landing craft would be used and would require light loading to transport material into the shallow water, assumed to be -4 ft MLLW. An excavator would be operated from the landing craft to dump material into the nearshore environment.

This placement option has potential to be environmentally acceptable with further analysis. Dredged material placed along this exposed shoreline would be quickly redistributed, and the dredged material will likely be similar in character to the coarse sediments observed along this beach. However, no environmental survey has been conducted in this area. No current bathymetric data exist for this area, either, so it is unknown how safely and effectively material could be placed on the shoreline.

Offshore Placement/Disposal – Moses Point Access Road. Placement of the dredged material in deeper waters offshore of Moses Point Access Road (Figure 40) may also provide a beneficial beach nourishment, while avoiding the risk of operating in the very shallow nearshore waters. This site is roughly 4.25 miles by vessel from the proposed navigation features at Elim. How close to shore the material would need to be placed for it to enter the local littoral cell would need to be determined. No environmental survey has been conducted in these offshore waters; it is known that the nearby Iron Creek supports salmon spawning habitat and is an important subsistence location. Further study would be required to ensure that dredged material could be placed near the mouth of Iron Creek without adverse effects to the salmon fishery or subsistence practices.

Upland Placement/Disposal. The estimated 185,645 cubic yards would require over 11 acres to accommodate and would cover the area 10 ft deep. Due to lack of road access, areas of steep terrain, and various ponds and streams, no suitable 11-acre location could be found within the community. Suitable sites may be available 1–2 miles out of town. The cost for upland disposal would include transporting material to shore utilizing smaller craft, building containment dikes to drain the material, then trucking the material to a suitable location. These multiple handling steps makes on shore disposal more costly (Table 32). If this option were selected, an assessment of the road system would be needed to ensure truck movement could be accommodated.

Offshore Disposal – Norton Bay. This site is in water greater than 30 ft in depth starting about 2 nautical miles southeast of Elim (Figure 40). This site was determined to be the most cost effective and, as described in the next section, was found to be environmentally acceptable, thus making meet the Federal standard and the preferred option for dredged disposal. This option would be considered the Least Environmentally Damaging Practicable Alternative (LEDPA).

Table 32. Alternative Dredge Material Disposal Methods and Costs

Disposal Method	Cost
Offshore Disposal – Norton Bay	$10,993,000
Offshore Placement/Disposal – Moses Point Access Road	$11,029,000
Nearshore Placement – Moses Point Access Road	$11,992,000
Upland disposal at Elim	$12,460,000

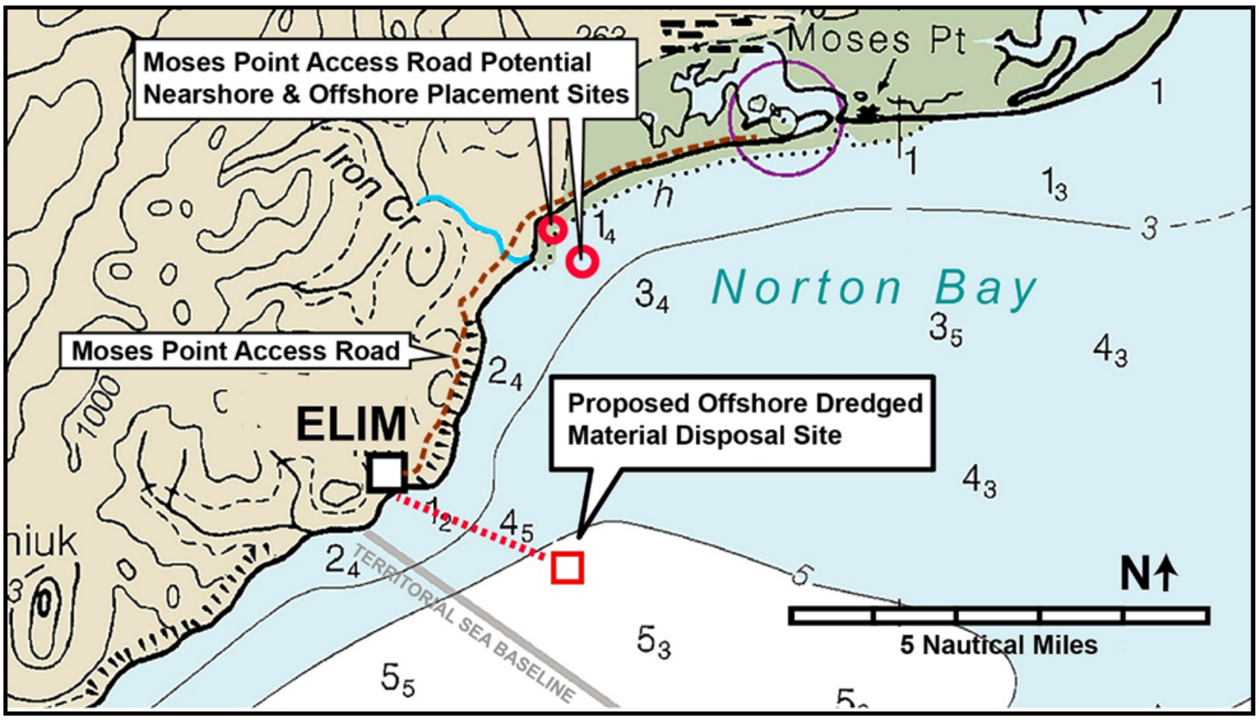

Figure 40. Dredged Material Disposal/Placement Sites Considered (Base image is excerpted from NOAA Chart 16200; soundings are in fathoms/ft).

7.2.1.2. LEDPA Dredged Material Disposal Site Analysis

Location. Dredged material not used as fill in project construction would be discharged at an open-water disposal site in Norton Bay. The proposed disposal site is a square, 2,000 ft on a side (for an area of 92 acres), located 2 nautical miles east-southeast of the project site, in the relatively deep water of 5 fathoms (30 ft; Figure 40).

The vertices of the proposed disposal site are:

a. 64.6065 °N, 162.1856 °W (northwest)
b. 64.6065 °N, 162.1729 °W (northeast)

c. 64.6011 °N, 162.1729 °W (southeast)
d. 64.6011 °N, 162.1856 °W (southwest)

Jurisdiction. This site is inland of the Norton Bay "closing line" (i.e., within the territorial sea baseline; Figure 40) and, therefore, within U.S. "inland waters." Consequently, discharge of the dredged material at the proposed site would be regulated under Section 404 of the Clean Water Act and not Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA).

Preliminary Assessment of Capacity. USACE Planning Guidance ER 1105-2-100 (Appendix E, Section E-15) states that all Federally maintained navigation projects must demonstrate that there is sufficient dredged material disposal capacity for a minimum of 20 years. The proposed disposal site is sized to accommodate the entire 185,645-cubic yard volume of construction dredged material deposited at an average thickness of 1.25 ft. The estimated 40,000 cubic yards of maintenance dredging required within 20 years would add an additional 3.5 inches of dredged material if evenly distributed over the disposal area. Observations by Elim residents suggest that sandy benthic sediments in Norton Bay are highly mobile and frequently displaced by storm surge. Therefore, it is expected that dredged material discharged in the disposal area would likely be redistributed fairly quickly by natural forces. The dispersive nature of the disposal site is discussed further in Section 8.2.1. The proposed disposal site can receive all construction dredging volumes plus estimated future maintenance dredging volumes.

Rationale for Not Preparing a Dredged Material Management Plan. The USACE has determined that preparation of a stand-alone Dredge Material Management Plan (DMMP) is not warranted for this project because:

1. The USACE Planning Guidance Notebook, ER 1105-2-100 (Appendix E, Section E-15) states,

   > *A preliminary assessment is required for all Federal navigation projects to document the continued viability of the project and the availability of dredged material disposal capacity sufficient to accommodate 20 years of maintenance dredging. If the preliminary assessment determines that there is not sufficient capacity to accommodate maintenance dredging for the next 20 years, then a dredged material management study must be performed.*

   As is demonstrated in the passage "Preliminary Assessment of Capacity" above, it is expected that the proposed disposal site will easily accommodate the estimated construction dredging volume. Within 20 years, a single maintenance dredging event would be expected at Elim. The estimated 40,000 cubic yards of maintenance dredging material would add a calculated 3.5 inches to the disposal site, and that material will likely be quickly dispersed by storm surge.

2. The proposed disposal site is very unlikely to be used for any other project besides the navigation improvements at Elim.

3. The proposed disposal site is in a remote location, and its use is unlikely to interfere with local navigation or any other regional activities.

7.2.2. Construction Considerations

Construction is expected to be phased over 3 years in 4-month construction seasons for all alternatives. It is recommended the project be advertised early in the year to maximize the number of contractors to bid on this project.

7.2.3. Dredging Options

Mechanical dredging in combination with heavy ripping and/or drilling and blasting will be required to remove material from the proposed Elim Harbor entrance channel and mooring basin.

Anticipated dredging conditions consist of loose alluvium at the surface, varying in thickness from nonexistent to about 3 ft thick. It is assumed this material can be mechanically dredged by clamshell or long-reach excavator. The thickness of loose sediment and depth to dense alluvium or bedrock varies within the proposed harbor entrance channel and basins. Dense alluvium deposits, weathered bedrock, or bedrock would likely be encountered within 1–3 ft of the seafloor surface. The use of an excavator-mounted pneumatic or hydraulic rock breaker, jackhammer, rock ripper, eccentric ripper, or rock ripping bucket is recommended to remove dense alluvium deposits or weathered bedrock. After dense alluvium or weathered bedrock is loosened or ripped, it can be mechanically dredged by clamshell or long-reach excavator. Bedrock encountered below dense alluvium deposits, or weathered bedrock will require drilling and controlled blasting before it can be mechanically dredged.

Dredge cut slopes in the surface sediment, dense alluvium deposits, and weathered rock can be assumed to be stable at slopes of 1.5 horizontal to 1 vertical within the entrance channel and turning and mooring basins. Dredge cut slopes in bedrock may be cut at slopes of 0.25 horizontal to 1 vertical.

7.2.4. Operation, Maintenance, Repair, Replacement, and Rehabilitation

Sediment transport modeling was used to evaluate the volume and frequency of maintenance dredging required to keep the project at operating depths. The estimated maintenance dredging recurrence interval and quantity is based on the best available information and engineering judgment. There are uncertainties associated with the estimated longshore sediment transport rate based on the surface material at Elim Beach and the gradation of the material is larger than the sediment size used to develop the longshore sediment transport rate empirical equation. There are uncertainties on the entrance channel infill pattern and how the channel may narrow, ultimately dictating the requirement and frequency of maintenance dredging. It is anticipated that approximately 40,000 cubic yards of maintenance dredging will be required every 20 years (Appendix C: Hydraulics and Hydrology). There may be minor stone movement along the outside of the breakwaters due to ice ride up. It is anticipated that approximately 1,177 cy of the armor stone will need to be replaced every 25 years. LSF OMRR&R would consist of regrading 127,116 square ft of the barge landing, uplands and access road annually, replacing 78 cy of upland armor stone every 25 years and replacement of the boat launch and 276 linear ft of sheet pile every 50 years. The OMRR&R costs for the project are estimated at $6,075,000 or $214,000 annually, of which $131,000 annually is GNF OMRR&R and $83,000 annually is LSF OMRR&R.

7.3. Design Vessel

It was assumed that the existing Elim fleet plus two transient tenders and one barge and tug operation could use the harbor at Elim. The characteristics of the fleet proposed to occupy the Recommended Plan are shown in Table 33.

Table 33. Fleet Characteristics

Vessel Class	Vessel Length [ft]	Design Beam [ft]	Design Draft [ft]
Barge	159	52	7
Tug	86	28.5	8
Tender	66	24	6
Commercial	32	12	5
Subsistence	18	7	2

7.4. Aids to Navigation

Initial coordination with the US Coast Guard has indicated that the final breakwater plan must include 10-ft by 10-ft poured concrete pads at the offshore nose. The US Coast Guard would install Federal Aids to Navigation (ATONS) on the concrete pads. An email received by the Coast Guard on 03 June 2020 estimated the ATONS at $50k (Appendix G: Correspondence). Coordination with the US Coast Guard would continue during the preparation of the plans and specifications and construction.

7.5. Integration of Environmental Operating Principles

The following environmental operating principles have been integrated into the planning process:

Foster sustainability as a way of life throughout the organization. This project would increase access and moorage days, fostering a sustainable subsistence-cash economy utilizing marine resources in the Bering Sea. The future without-project condition sees continued vessel delays and damages with the dangerous physical conditions in the existing harbor at Elim. By constructing the Recommended Plan, these negative impacts on the fishing fleet and Elim's economy could be reduced.

Proactively consider environmental consequences of all USACE activities and act accordingly. Environmental consequences were considered throughout the planning process, and every effort has been made to avoid, minimize, or mitigate all anticipated impacts.

Create mutually supporting economic and environmentally sustainable solutions. No NED plan was identified for this project, but the Section 2006 authority affords the PDT the flexibility to use CE/ICA in the absence of a NED plan. Alternative 5 is one of the best buy plans other than the No Action plan based on the CE/ICA. This project was formulated in a way that makes it last, requiring limited maintenance and avoiding long term environmental impacts wherever possible. The sediments removed from the mooring basin and navigation channel would be placed in ocean waters southwest of the project area. The District has identified a suitable dredged material placement location approximately 2 nautical miles offshore.

Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may impact human and natural environments. An environmental assessment (EA) has been conducted, as required by the National Environmental Policy Act, and is integrated into this IFR/EA. In addition, the principles of avoidance, minimization, and mitigation have been and will be enacted to the extent possible. A policy exception for MMPA/ESA has been approved by HQUSACE on 05 October 2020 since a Letter of Authorization (LOA) cannot be obtained during feasibility.

Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs. For this study, extensive coordination has taken place to determine the impacts and subsequent mitigations actions regarding environmental impacts.

Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner. USACE worked closely with the City of Elim throughout this study. The City and other agencies that work at Elim are very knowledgeable about the environment surrounding the Elim Beach site. Coordination with agencies is on-going and may be completed in PED. As noted above, a policy exception for MMPA/ESA coordination was approved by HQUSACE on 05 October 2020 since a LOA cannot be obtained during feasibility.

Employ an open, transparent process that respects the views of individuals and groups interested in USACE activities. USACE made every effort to be responsive to stakeholder concerns. Public input was solicited and used for both environmental and economic analysis purposes. A meeting was held before this study started to obtain input and feedback from commercial fishermen, the City, and stakeholders on what problems the community faces and the impacts on marine activities with the existing conditions in the Elim area. The group defined objectives, opportunities, and constraints for this study and discussed alternative ideas. After a re-scoping effort and the removal of Moses Point, Iron Creek, and Airport Point as a viable harbor improvement location, the team analyzed four alternatives at Elim Beach. It used these as the final array to determine the Recommended Plan (Section 5.7).

7.6. Real Estate Considerations

One permanent easement and one temporary easement (one channel improvement easement and one work area easement) may be needed for the LSF portion of this project. Acquiring these easements is the responsibility of the Non-Federal Sponsor (NFS). There is limited information on erosion or accretion trends along the shoreline at the project site. The limited observations indicate there is a low risk of erosion (Section 3.1.1) and the risk will be managed through monitoring. No land acquisition is needed due to erosion. The proposed project does not cut off public access to the beach and if accretion does occur, the new beach area will be accessible to the public The Government's dominant right of navigation servitude would be exercised for project tidelands below the Mean High Water (MHW) line for the GNF portion of the project. There are no other Federal Projects that would be affected by the project footprint. Further information about real estate requirements for the project is available in Appendix F: Real Estate Plan.

7.6.1. Project Staging Areas

The breakwater and staging areas are owned or leased by the Native Corporation of Elim (Table 34). Additional information on staging areas can be found in Appendix F: Real Estate Plan.

7.6.2. Land Acquisition

The Lands, Easements, Rights of Way, and Relocations, (LERR) that are necessary to implement this project are lands owned by the Native Corporation of Elim (Table 34). The Government's dominant right of navigation servitude would be exercised for project tidelands below the MHW line for the GNF.

Table 34. LERR Required for Project Implementation

Project Tract ID	Features	Owners	Acres	Recommended Estate	Estimated Value
1	East Breakwater	Native Corporation	0.24	Estate # 8: Channel Improvement	$20,000
7	Staging Area	Native Corporation	0.85	Estate #15 4-Year Temporary Work Area Easement	$60,000

7.7. Risk and Uncertainty

In any planning decision, it is important to consider the risk and uncertainty that is invariably present. For this study, there are a few risk and uncertainty categories that were identified and evaluated during the planning process. The risk and uncertainty of items remaining for this project are summarized in Table 35.

Table 35. Risk and Uncertainty Summary

Assumption or Estimate	Risk Comment
Blasting assumptions	Geotechnical data was collected in summer 2019, and the resulting report was presented with data gaps (Appendix B: Geotechnical). Data can be extrapolated to provide reasonable estimates of blasting needed in the project.
Weather Delays	The project area is prone to extreme weather conditions that could impact data collections and construction.
Unanticipated cultural resources	There is very little risk of encountering unanticipated cultural resources
Dredge material disposal	There is very little risk of encountering HTRW. There is no known contamination within the project area.
Increased shoreline erosion	Low risk of increased erosion to the west of the project area. Short- and long-term monitoring is anticipated.
OMRR&R dredging interval	With the low sediment transportation rates, it is unlikely that a shorter interval for OMRR&R dredging than the current 20 years will be needed.
Impacts of sewage outfall	The sewage outfall lies outside of the project footprint, and there is little risk of impacts.
Sedimentation in front of the boat launch area	Low risk of sedimentation in front of boat launch based on limited sediment source, the beach material and top layer of the geophysics survey showing gravel/cobble material, and the relatively mild wave climate that impacts the beach. A risk management strategy of connecting the west breakwater to shore will be investigated during PED.
Landownership and Access	Low risk. The road to access the project is public property. The Elim Native Corporation owns the land of the access, while the City of Elim holds an easement to the access. The Native Village of Elim will own the project. The Local Service Facilities will abut a public road.
Eminent Domain	Low risk. Elim does not have eminent domain capability; however, the need for this capability is not anticipated. Elim is a close-knit community with strong family ties throughout, and the community is in strong support of the project. Tribal government, Native Corporation and City government coordination is well documented, with all three entities supporting the development of harbor infrastructure.

Should the project proceed to implementation, that PED activities will be scoped to address the risk factors listed in Table 35. The following actions are anticipated to manage risks during PED and construction. Further geotechnical investigations are planned in PED to manage the blast assumption risk. Construction is planned for seasonal windows to reduce the chances of weather delays. If cultural resources or HTRW are encountered, work will be stopped immediately, and the cultural resources or materials will be handled according to the appropriate regulations. Short and long-term monitoring will be performed to manage the risk of erosion. OMRR&R intervals have been decreased from 30 to 20 years to account for estimated sedimentation rates. The risk of impacts to the sewage outfall will be tolerated as proper monitoring during construction should prevent any such impacts.

7.8. Project Cost

Cost analyses indicate that the Recommended Plan would have an average annual equivalent cost of $3,451,000. The maximum annual benefits for the Recommended Plan are estimated at $1,107,000. The total project first cost is $74,538,000.

7.8.1. Cost Apportionment

Construction of the project would be apportioned in accordance with the Water Resources Development Act of 1986, as amended. GNF is cost-shared between the Federal government and the non-Federal sponsors. LSF features are solely the responsibility of the non-Federal sponsor. The cost-share summary is based on the project's first cost with contingency (Table 36). The Tribe does meet the ability to pay criteria, which results in further cost-sharing requirements of the local sponsor, in addition to the initial $511,000 being waived.

Table 36. Cost Share Breakdown

Cost Share Table (October 1, 2020 Price Levels, Program Year (FY) 2021)[1]				
WBS Number	**General Navigation Features**	**Project Cost with Contingency**	**Federal Share**	**Non-Federal Share**
	Mobilization/Demobilization	$4,121,000	$3,709,000	$412,000
10	Breakwaters	$46,924,000	$42,232,000	$4,692,000
12	Navigation Ports and Harbors	$11,327,000	$10,194,000	$1,133,000
30	Preconstruction, Engineering & Design (PED)[2]	$5,360,000	$4,824,000	$536,000
31	Construction Management (S&I)[2]	$6,692,000	$6,023,000	$669,000
1	Lands, Easements, Rights-of Way, Relocations (LERR) Reviews	$7,000	$6,000	$1,000
	Subtotal Construction of GNF	**$74,430,000**	**$66,987,000**	**$7,443,000**
1	Lands, Easements, Right-of-Ways, Relocations (LERR)[3]	$108,000		$108,000
	Section 1156 Waiver[4]		$511,000	($511,000)
	Ability to Pay reduction to 25% of normal share[5]		$5,199,000	($5,199,000)
	Total Project First Costs	**$74,538,000**	**$72,697,000**	**$1,841,000**
12	Aids to Navigation[6]	$94,000	$94,000	
	10% Payback		($7,443,000)	$7,443,000
	Credit for LERR[7]		$108,000	($108,000)
	Reduction of Post-Construction 2.5% Payback (25% of 10% IAW Ability to Pay rule)[5, 8]		$5,501,250	($5,501,250)
	Mobilization/Demobilization-LSF	$726,000		$726,000
8	Roads and Docks-LSF	$13,605,000		$13,605,000
12	Navigation Ports and Harbors- LSF	$1,706,000		$1,706,000
30	Preconstruction, Engineering & Design (PED)- LSF	$1,373,000		$1,373,000
31	Construction Management (S&I)-LSF	$1,718,000		$1,718,000
	Total Cost Apportionment	**$93,760,000**	**$70,957,250**	**$22,802,750**

1. Cost is based on Project First Cost (constant dollar basis) on the Total Project Cost Summary Spreadsheet, at an effective price level 1 Oct 2020 (Cost Appendix). Aids to Navigation broken out and shown as a separate cost. Reported costs are rounded and the reported sum is greater or less than the sum of the line items because of rounding errors.
2. PED and Construction cost-sharing totals are reflected as 90% Federal/10% non-Federal.
3. These include LERR and Real Estate administrative costs with escalation from the TPCS.
4. In accordance with Section 1156 of WRDA 1986, as amended, the Federal Government will waive up to the first $511,000 $511,000 of Design and Construction local cost-share (before the Ability to Pay provision is employed.)
5. Section 203 of WRDA 2000, as amended, provided that cost-share agreements for such studies are subject to the ability of a Tribe to pay, as determined by the Secretary of the Army in accordance with procedures to be established by the Secretary.
6. Aids to Navigation are reflected as a Federal cost but are coordinated and paid for by the U.S. Coast Guard.
7. Credit is given for the incidental costs borne by the non-Federal sponsor for lands, easements, rights of way and relocations (LERR) per Section 101 of WRDA 86, not to exceed 10% of the GNF.
8. The non-Federal sponsor shall pay an additional 10% of the costs of GNF of the NED plan, pursuant to Section 101 of WRDA 86. The value of LERR shall be credited toward the additional 10% payment except in the case of LERR for LSF.

7.9. Project Schedule

The total estimated performance period for the construction of the project is a minimum of 3 years. The duration of each summer construction season is estimated to be 4 months. Winter construction is not anticipated. Construction scheduling would be required to avoid conflict between fuel and barge deliveries.

Major construction features for Alternative 5 include entrance channel dredging, turning basin dredging, breakwaters, 1.0 acre for parking and turn around area. Also, the road will be approximately 800-ft in length, connecting Front Street with the project uplands, boat launch, barge landing, two moorage points, and extension of the fuel header currently located on Elim Beach. Extension of fuel header as well as the construction of the road and parking and turn around the area would likely take place after the construction of barge landing. Project specifications would detail time restrictions for the contractor to conduct certain activities during specified time periods.

- Construction sequencing would likely be similar to the following:
- Stone production in the quarry and basin and entrance channel footprint dredging
- New material placement
- Tender dock construction boat landing, barge landing, and moorage points could begin following completion of dredging

For cost estimation purposes, the construction sequencing summarized directly above was developed utilizing the best construction sequencing scenario for cost-effective project implementation. The basis for the construction sequencing scenario is the USACE's experience with previous projects constructed in arctic conditions, including port construction projects in the region. However, there is inherent risk and uncertainty in project authorization and appropriation of funds by Congress, which can influence the Recommended Plan construction schedule and sequencing scenario developed during the feasibility study phase. Project authorization could delay schedule and/or appropriations that could influence construction schedule and sequence. Construction sequencing developed during the feasibility study may have to be revisited to inform appropriation decisions that may potentially be based on what project components or feature(s) have priority considering the associated benefits.

Priorities for Recommended Plan components are influenced by engineering and hydrology considerations, operation and management needs, as well as the benefits associated with the project components, and the priorities expressed by the non-Federal sponsors. There is also a cost risk if construction sequencing for the entire Recommended Plan cannot be optimized due to inadequate funding.

Total project costs could increase due to, but not limited to:

- More contractor mobilizations could be required to complete the Recommended Plan.
- Potential efficiencies associated with optimized construction sequencing may not be realized if appropriations prevent scheduling and construction of the entire Recommended Plan under one contract.

Environmental mitigatory measures developed for this project are summarized in Section 8.6.6. Environmental restrictions on construction timing and sequencing center on the production of underwater noise, especially during pile driving. There are no explicit “no work” windows established for environmental protection, but certain seasonal events may lead to preferential timing or curtailment of high-noise activities. Qualified marine mammal observers would be required during all pile driving, dredging, and other in-water work. These observers would have the authority to enforce marine mammal exclusion zones (i.e., work shut-down radii). Some marine mammal species, such as the beluga whale and spotted seal, are known to concentrate within Norton Sound. Depending on the numbers of marine mammals, frequent work stoppages in response to marine mammal sightings may lead to a significant curtailment of some construction activities towards the end of the construction season. The USACE will develop more information on the extent and timing of the marine mammal concentration in planned pre-construction marine mammal surveys.

8. ENVIRONMENTAL CONSEQUENCES*

8.1. Introduction

This section discusses the potential impacts of the alternatives (discussed in Sections 5–7) upon the environmental resource categories described in Section 3, including the agency’s preferred alternative (Alternative 5/TSP) and the no-action alternative.

Regulations on NEPA analyses state that the document should, “based on the information and analysis presented in the sections on the Affected Environment and the Environmental Consequences…” present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public” (40 CFR § 1502.14). However, as will be shown in the following sections, the four structural alternatives brought forward for analysis are, from an environmental perspective, quite similar to one another. The alternatives would each impact the same environmental location and resources in the same manner, differing incrementally in the magnitude, extent, and duration of those impacts.

Within each resource category, the magnitude of the effects upon that resource are evaluated using these criteria (where relevant) and best professional judgment, and tiered as follows (Doub 2014):

- **Minor:** effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.
- **Moderate:** effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
- **Major:** Environmental effects are noticeable and are sufficient to destabilize important attributes of the resource.

The greatest direct impacts from project construction on most resource categories would be caused by:

- Placement of rock for rubble-mound breakwaters;
- Deepening of the seafloor by dredging, to include potential blasting;
- Placement of dredged material;
- Driving of sheet pile.

A comparison of the magnitude of these direct impacts between the structural alternatives carried forward is provided in Table 37.

Table 37. Comparison of Direct Impacts by Alternatives

Alt #	Area of Rock Placement (acres)	Area of Construction Dredging (acres)	Volume of Construction Dredging (cubic yards)	Sheet Pile Dock	Likelihood of Blasting	Volume of Maintenance Dredging (cubic yards)
2	4.5	5.4	46,760	No	Not Likely	18,000 (every 25 years)
3	4.7	7.3	52,889	Yes	Not Likely	23,000 (every 25 years)
4	4.8	7.7	72,062	Yes	Not Likely	25,000 (every 27 years)
5*	4.8	15.8	185,645	Yes	More Likely	40,000 (every 20 years)
* Reflects refinement of Alt 5 as discussed in Section 7 Recommended Plan						

The four structural alternatives differ only marginally in the number of boats each is designed to accommodate when completed. The differences in footprints of alternatives is a function of the quantity and size of vessels accommodated by design:

- Alternative 2: 50 vessels, 18–32 ft in length
- Alternative 3: 51 vessels, 18–66 ft in length
- Alternative 4: 52 vessels, 18–66 ft in length
- Alternative 5: 53 vessels, 18–160 ft in length

Dredging to create the basin and entrance channel is likely to require a combination of traditional mechanical dredging with a clamshell dredge or excavator and hydraulic “ripping” of weathered bedrock or other dense material. Alternative 5, with its deeper and longer entrance channel, is more likely to require blasting to break up bedrock that cannot be removed by ripping; however, the extent of potential blasting has not yet been evaluated.

8.2. Physical Environment

8.2.1. Soils and Sediments

The construction of navigation improvements would include uplands, dredging, and breakwaters. The uplands would bury the existing beach sediment ranging in size from sands to boulders with material from the local quarry. Dredging would remove some to all of the nearshore sediments down to weathered bedrock within the dredge prism, and the breakwaters would cover nearshore sediment with armor rock from a quarry. The uplands would limit shoreline erosion, and breakwaters would limit longshore sediment transport. The proposed navigation improvements could cause sheltering to the east of the breakwater and an increase in wave loading on the bluffs to the west. Per a comment received during the public review period, it is anticipated that there will be a decrease in erosion east of proposed navigation improvements. The combination of potential changes to the wave conditions due to climate change and diffraction and reflection to the west of proposed navigation improvements could result in an increase in wave loading on the bluffs to the west of Elim Beach.

The proposed in-water dredged material disposal site is assumed to be dispersive and that the dredged material placed there will be quickly redistributed. There is little direct information on the benthic energetics in Norton Bay, as opposed to Norton Sound. Jewett discusses storm-induced benthic disruption offshore of Nome and describes a regularly-monitored site at a depth of 18.6 meters (61 ft) that changed substrate types several times during his studies, which he attributes to storms (Jewett 2013). Nelson describes the significant periodic mobilization of sand in southern Norton Sound (1982). He states, "The major storms increase the average 10-m water depth in southern

Norton Sound as much as 5m and cause fluctuations in pore pressure from wave cyclic loading that may liquefy the upper 2 to 3 m of sediment" (Nelson 1982).

Elim and Norton Bay, in general, are probably not exposed to the magnitude of storm surges as observed near Nome. On the other hand, the seabed depths in question are much shallower and more vulnerable to disruption. The proposed dredged material disposal site is in only 30 ft of water, at 2 nautical miles offshore. Elim is hit periodically with severe storm surges (Appendix C: Hydraulics and Hydrology), as are Moses Point, Koyuk, Shaktoolik, and Unalakleet at the head of Norton Bay. The sediments of Norton Bay are known to be predominantly silt and sand discharged by the Koyuk and several other large rivers at the head of the bay. It is reasonable to assume that benthic sediments at the proposed disposal site experience periodic disturbance from storm surge.

The dredged material is likely to consist of crushed rock, gravel, and sand, and therefore be more coarse than existing benthic sediments. Discharge of the dredged material may change the particle size distribution of benthic sediments at the disposal site. However, it is also likely that the natural dispersion of sediment will eventually cover the coarser discharged material with a layer of silt and sand.

Comparison of Alternatives. The four structural alternatives would not vary significantly in the area of uplands that bury existing soils and sediments, 3.2 acres (Alternative 2) up to 4.0 acres (Alternative 5), or for breakwaters that cover existing nearshore sediment, 4.5 acres (Alternative 2) to 4.8 acres (Alternative 5). The largest difference is the amount of soft sediment removed from the dredge prism, 5.4 acres (Alternative 2) up to 15.8 acres (Alternative 5). Each alternative would have the same magnitude of impact on the shoreline east and west of the navigation improvements. Under the No Action Alternative, the existing soils and sediment would not change along Elim Beach.

Mitigatory Measures. Monitoring of the beach and bluff east and west of the proposed navigation improvements should be included during PED, Construction, and as part or routine operation and maintenance procedures. Short term monitoring would include taking photos of the beach and bluff areas pre- and post-construction. Long-term monitoring should be conducted as part of Operations and Maintenance Project Conditions Surveys performed under the Asset Management Program including photos of the beach and bluff.

Magnitude of Effects: Moderate. The longshore sediment transport would be interrupted, but the estimated longshore sediment transport rate is relatively low, 5,205 cy/yr. The alternatives would noticeably alter the exposed sediment within the project footprint but are not anticipated to destabilize the area surrounding the project. The area to the west may experience some erosion and the area to the east may experience some accretion of sediment.

8.2.1.1. Hazardous, Toxic, and Radiological Waste (HTRW) Issues for Sediment

The project site is an unimproved beach and adjacent offshore area with no history of significant contaminant releases. Section 3.1.1.1 discusses several small areas of contaminated soil reported within Elim. For the identified upland contaminated sites to be relevant to the proposed project, the contaminants would not only have to migrate to the shoreline and beyond but also become entrained and persist in the seafloor materials proposed to be dredged. The area to be dredged begins roughly 200 ft offshore; the intervening area will be covered with fill rather than dredged (Figure 41).

The Clean Water Act Section 404(b)(1) guidelines state:

> "*Dredged or fill material is most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material. Dredged material so composed is generally found in areas of high current or wave energy*…" (40 CFR 230.60).

As described in previous sections, the material to be dredged consists of a few feet of wave-driven coarse sand and gravel, on top of much denser formations of weathered bedrock. The USACE determines that the material to be dredged meets the above description from 40 CFR 230.60 and is highly unlikely to have received and retained contaminants.

Chemical characterization of the dredged material is not planned at this time. The predominance of weathered bedrock expected within the dredging prism would make a collection of representative samples of the *in situ* dredged material problematic. The locations of reported contaminated sites in relation to the footprint of the preferred alternative are shown in Figure 41.

The marine sediments at Elim are unlikely to show the high levels of naturally occurring mineralized arsenic or other metals such as observed within Snake River and its discharge into Nome Harbor. The Snake River watershed encompasses over 86 square miles and has been profoundly disturbed by surface mining for more than a century. Elim Creek is a minor stream draining roughly 5 square miles of mostly undisturbed forest and shrub wetlands.

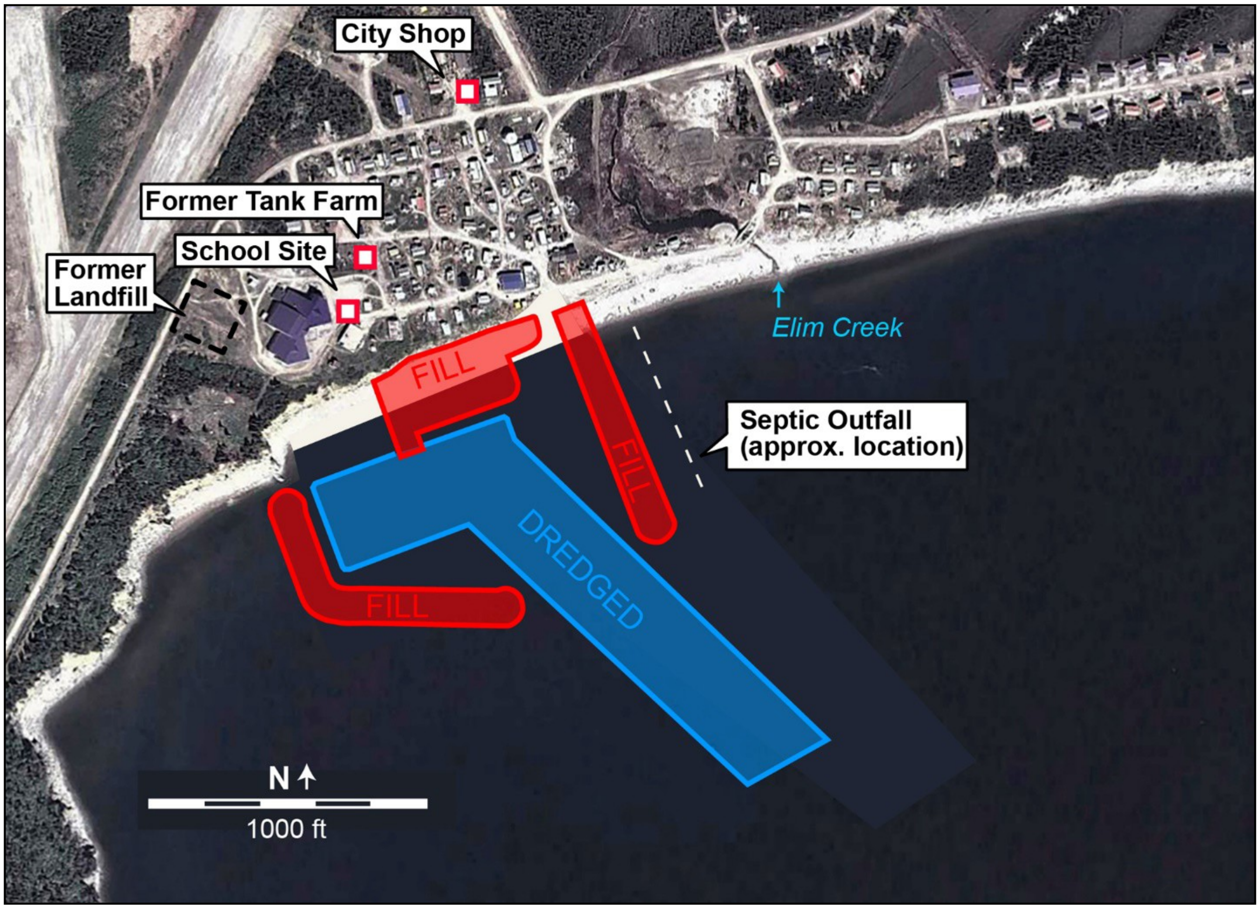

Figure 41. Locations of Reported Contaminated Sites in Relation to the Footprint of the Preferred Alternative

8.2.2. Bathymetry

Based on the qualitative data available, it is assumed that longshore sediment transport dominates sediment transport along Elim Beach over inter-annual or longer time scales and, therefore, likely obscures any signal of cross-shore sediment transport. This analysis suggests that the nearshore benthic environment is routinely disturbed, and therefore, the proposed construction activities could have short-term impacts on water quality and increased turbidity. However, the natural sediment transport at Elim Beach could disburse this material and return the disturbed area to a more natural state over a shortened period of time.

8.2.3. Water Quality

The proposed activities may directly impact water quality in the project area, primarily as a result of:

- Dredging and the placement of dredged material;
- Accidental discharges of dredged material during transport;

- Accidental spills of fuel or other contaminants from project vessels and other machinery.

Dredging and dredged material placement would affect water quality primarily through the temporary suspension of seabed material into the water column, i.e., increased turbidity. Solids suspended in water have the potential to block light entering the water column, distribute contaminants from sediment into the water, deplete oxygen, and release ammonia and sulfide from seafloor sediments. The placement of rock for rubble-mound structures, and driving of piles into the seafloor, would also suspend sediment into the water column, but at a much lesser degree than the direct manipulation of dredged material.

Turbidity. The dredging is expected to be performed with a mechanical clamshell dredge, operated from a crane stationed on a barge, and depositing the dredged material into an adjacent scow. The USACE expects a hydraulic ripping device (and perhaps limited confined subsurface blasting) to be necessary to break up weathered bedrock and highly consolidated sediments.

In mechanical dredging, the sediment becomes suspended into the water by:

- the impact of the dredge with the seafloor,
- the fallback of sediment as the dredge is raised to the surface,
- dewatering of the sediment as it is stockpiled on the scow, and
- discharge of the sediment from the scow at the placement site.

The dredged material is expected to consist of coarse sand, gravel, and crushed rock, with low levels of fines, such as silt. Silt is more easily suspended in water than sand or gravel and tends to stay suspended in the water column longer and be transported farther by currents. Sand, gravel, and other large particles contribute little to turbidity.

If properly sized and stemmed, subsurface blasts would result in minimal dislocation of surface or subsurface material into the water column and contribute minimally to turbidity.

The most relevant State of Alaska turbidity criteria (ADEC 2018b) for marine water uses at Elim are:

- Secondary Recreation (includes boating and recreational fishing): “May not exceed 25 NTU.”
- Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife: “May not reduce the depth of the compensation point for photosynthetic activity by more than 10 %. May not reduce the maximum Secchi disk depth by more than 10 %.”

None of these turbidity criteria are readily applicable to the nearshore environment near Elim. As discussed in Section 8.2.2, natural processes frequently cause turbid conditions in Norton Sound. Ambient turbidity frequently exceeds 25 Nephelometric Turbidity Unit (NTU) in Norton Bay, and the dense marine algae noted growing on rocky substrates in the project area are presumably adapted to tolerate the elevated background turbidity. Turbidity impacts from dredging and material placement are expected to be highly localized and short in duration. Likewise, with proper placement and stemming of explosive charges, any blasting would create minimal and short-term additional turbidity.

Oxygen Depletion, Ammonia, and Sulfide. Oxygen depletion within a body of water generally occurs when an excess amount of organic matter becomes available to microorganisms within the water column and surface sediment. The microorganisms proliferate and consume dissolved oxygen in the process of breaking down the organic matter, and this is most likely to be a problem in enclosed bodies of water with poor circulation. The shallow, exposed, current-swept marine environment at Elim is unlikely to suffer from oxygen depletion of this sort. Ammonia and sulfide accumulate in sediment as anaerobic bacteria break down organic matter; these toxic chemicals can be released into the water column when that sediment is disturbed. The coarse sand, gravel, and weathered rock that would be disturbed by project dredging are unlikely to contain sufficient organic material to cause oxygen depletion or to have generated significant ammonia or sulfide.

Spills of Fuel or Other Contaminants. Project tugboats, survey vessels, dredges, and construction machinery may directly impact water quality through accidental spills of fuel, lubricants, or other contaminants. The contractors would be required to keep their equipment in good repair and to prepare and abide by spill prevention plans to ensure a rapid and effective response to any spills.

The new navigation improvements at Elim may indirectly increase the potential for marine spills along the Elim waterfront, as more boats are concentrated in one area. Alternative 5 provides a protected barge landing, intended to allow the safer transfer of fuel and cargo, which may reduce the risk of a significant contaminant release.

Contaminated Sediment. Construction dredging would disturb a seabed of coarse sand, gravel, and weathered bedrock; this material is very unlikely to contain contaminants or deleterious substances. Chemical analysis of the dredged material is not planned at this time.

Maintenance dredging would remove accumulations of sand that has been transported a considerable distance by currents and that is similar to the sand layer present at the project site at present.

Comparison of Alternatives. The four structural alternatives would have very similar direct effects on water quality; differing primarily on the extent of dredging being performed and the duration of the impacts. The four structural alternatives accommodate roughly the same number of boats, so the risk of fuel spills would be similar. The fishing tenders accommodated by Alternatives 3, 4, and 5, and the tug/barge accommodated by Alternative 5, would be transient vessels, visiting the completed project only briefly a limited number of times a year.

Under the No Action Alternative, no short-term changes to water quality are expected. However, the opportunities offered by the barge landing in Alternative 5 to reduce the risk of contaminant spills would not be realized.

Mitigatory Measures.

1. Dredging would be conducted in a manner that seeks to minimize the amount of suspended sediment generated. Best management practices for dredging unconsolidated sediment may include:

   - Avoiding multiple bites while the bucket is on the seafloor.
   - No stockpiling of dredged material on the seafloor.
   - No leveling of the seafloor with the dredge bucket.
   - Slowing the velocity (i.e., increasing the cycle time) of the ascending loaded clamshell bucket through the water column.
   - Pausing the dredge bucket near the bottom while descending and near the waterline while ascending.
   - Placing filter material over the holding-scow scuppers to remove sediment from the return water.

   These measures would be followed to the greatest extent feasible, but some may be impractical when dredging or ripping consolidated and/or rocky material. For example, when dredging dense sediment, it may be necessary for the bucket to strike the seafloor with as much velocity as possible to ensure penetration of the sediment.

2. The contractor would be required to prepare an Oil Spill Prevention and Control Plan. Reasonable precautions and controls would be used to prevent incidental and accidental discharge of petroleum products or other hazardous substances. Fuel storage and handling activities for equipment would be sited and conducted, so there is no petroleum contamination of the ground, surface runoff, or water bodies. Equipment would be inspected daily for leaks. If leaks are found, the equipment would not be used and pulled from service until the leak is repaired. During construction, spill response equipment and supplies such as sorbent pads shall be available and used immediately to contain and clean up oil, fuel, hydraulic fluid,

antifreeze, or other pollutant spills. Any spill amount must be reported in accordance with Discharge Notification and Reporting Requirements (AS 46.03.755 and 18 Alaska Administrative Code [AAC] 75 Article 3).

Magnitude of Effects: Minor. The proposed activities would cause minor temporary, localized increases in turbidity in a marine environment where naturally high levels of suspended sediments are commonplace. The risk of releasing harmful substances into the water column during dredging is very low. The risk of project-related spills would be controlled through best management practices.

8.2.4. Air Quality

The operation of construction equipment and vessels during project construction would, in the short term, add incrementally to the air pollutant emissions ordinarily generated by vessels and machinery at Elim. Direct, short term project-related impacts to air quality at Elim would be highly variable and transitory, where noticeable at all. The Elim area and surrounding region are designated as “unclassified” under Environmental Protection Agency (EPA) air quality regulations, as insufficient information exists to designate it as an “attainment” (i.e., compliant with ambient air quality standards) or “nonattainment” area (18 AAC 50.015). Without an air quality baseline, it is impossible to determine whether direct, construction-related emissions would cause exceedances of air quality standards within the greater Elim area.

The project would not create any new stationary sources of air emissions. Indirect, long term effects of the project on ambient air quality would be dependent on the number and type of mobile sources (i.e., vessels) that use the new harbor. These would be primarily gasoline-powered small watercraft. Alternatives 3, 4, and 5 provide a dock for occasional use by larger fishing tenders, presumably diesel-powered.

Comparison of Alternatives. The four structural alternatives would have similar direct effects on air quality; differing primarily in the duration of the effects, rather than the intensity or nature of the effects. The alternatives would likely employ the same number and types of mobile emission sources during construction. Still, the alternatives requiring more extensive rock work and dredging may require more construction seasons to complete.

The construction alternatives differ only marginally in the number of boats each can accommodate, ranging from 50 (Alternative 2) to 53 (Alternative 5).

Under the No Action Alternative, air emissions would not change along the Elim waterfront.

Mitigatory Measures. The contractors would be required to use equipment that is in good repair and meets applicable emission standards. Best management practices such as wetting work surfaces would be applied if visible lofted dust is noted. Increased air emissions from increased post-construction activity at the port may be managed through port administrative controls and the upgrading of work surfaces; measures that lie beyond the scope of this Federal study.

Magnitude of Effects: Minor. Both direct and indirect effects on air quality would be highly seasonal, variable, and transient. No new stationary sources of air pollutants would be installed as part of the project. The proposed project site is not in a Clean Air Act (CAA) non-attainment area, and the conformity determination requirements of the CAA do not apply to the proposed action at this time. None of the alternatives would noticeably alter or lead to the alteration of any important attribute of air quality in the Elim area.

8.2.5. Noise

This section addresses airborne noise and effects primarily on the human environment. The effects of underwater noise on marine mammals and fish are addressed in Section 8.3.2.

The operation of equipment and vessels during project construction would, in the short term, add considerably to the noise ordinarily generated by vessels and machinery at the Elim. Most project-related noise would be low-frequency, such as the low-amplitude sound generated by diesel machinery and the movement of rock and other materials. The installation of sheet pile would be a source of higher-frequency, high-energy sound during its construction and is likely to generate the most conspicuous noise of the project. Any offshore subsurface blasting would be done in a manner that contains the blast effects to the highest extent possible. Air-transmitted noise generated during blasting would be minimal, but its amplitude would be highly dependent on the size of the charge and the depth of its placement.

Sound is usually measured in decibels (dB) on a relative scale. Airborne noise weighted for human hearing is measured on an “A-weighted scale,” with units of dBA. The A-weighted decibel scale begins at zero, which represents the faintest sound level that humans with normal hearing can detect. Decibels are measured on a logarithmic scale, so each 10 dB increase doubles the sound; therefore, a noise level of 50 dBA is twice as loud to the listener as a noise of 40 dBA. Typical dBA sound levels for a range of noise situations (Washington State Department of Transportation (WSDOT) 2020) are presented in Table 38.

Table 38. Comparison of dBA Sound Levels (WSDOT 2020).

Representative Sounds	dBA	Human Reaction
Rocket launching pad	180	Irreversible hearing loss
Carrier deck jet operation Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet takeoff (200 ft) Auto horn (3 ft)	120	Maximum vocal effort to communicate
Pile driver Rock concert	110	Extremely loud
Garbage truck Firecrackers	100	Very loud
Heavy truck (50 ft) City traffic	90	Very annoying Hearing damage over time
Alarm clock (2 ft) Hairdryer	80	Annoying
Noisy restaurant Business office	70	Conversation difficult
Air conditioning unit Conversational speech	60	Intrusive
Light auto traffic (100 ft)	50	Quiet
Library Whisper (15 ft)	30	Very quiet
--	10	Barely audible

The position of the proposed sheet pile dock in Alternatives 3, 4, and 5 is roughly 300 ft horizontal distance from the nearest occupied building in Elim (Figure 42). Using a standard noise-attenuation formula (WSDOT 2020), the noise from a pile-driver generating 110 dBA (measured at 50 ft away) would be expected to diminish over distance in the following manner:

- 50 ft .... 110 dBA
- 100 ft .... 103 dBA
- 300 ft .... 90 dBA
- 500 ft ....85 dBA
- 700 ft ....81 dBA

However, the coastal bluff runs in between the sheet pile dock location and structures within Elim. The surface of the constructed uplands is designed to be +16 ft MLLW, whereas the top of the bluff immediately behind the uplands is roughly +30 to +50 ft MLLW. The difference in elevation between the constructed uplands and the Elim townsite would attenuate to some extent the level of noise reaching occupied areas of the village.

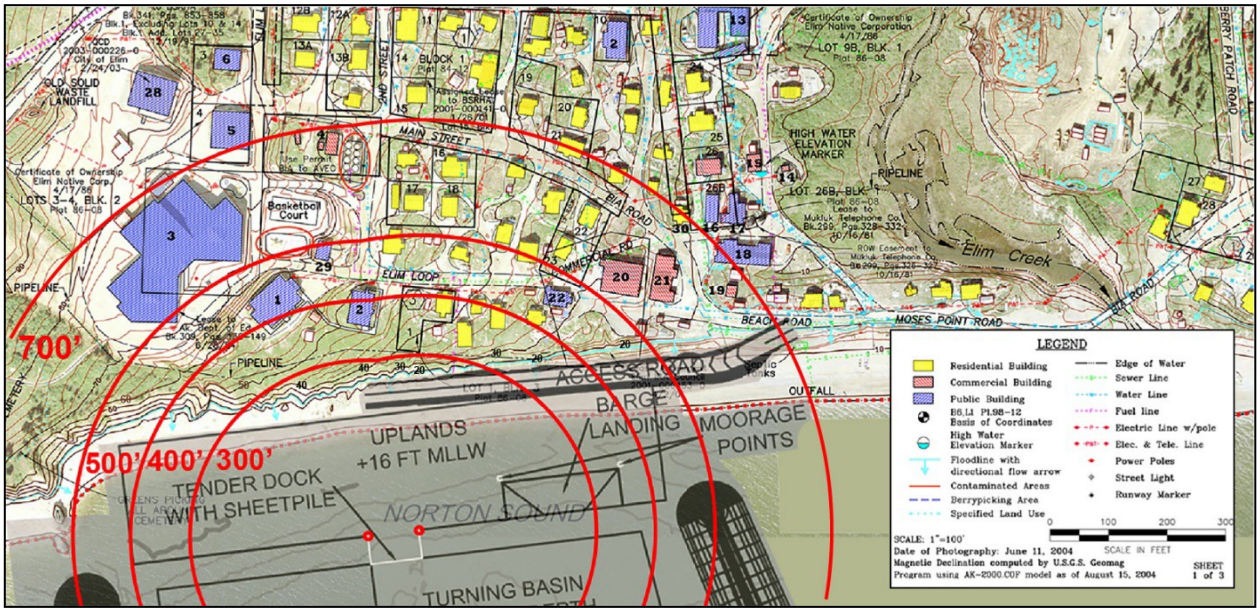

Figure 42. Sound Propagation Distance Radii Centered on Sheet Pile Locations to Elim

The results of an online sound propagation model (MAS Environmental 2020) that takes into account air absorption of sound, temperature, humidity, and changes in elevation are shown in Figure 43. The online model suggests that a person standing on the bluff 300 ft away from pile driving activity may be subjected to less than 60 dBA, rather than the 90 dBA predicted by a simple distance calculation.

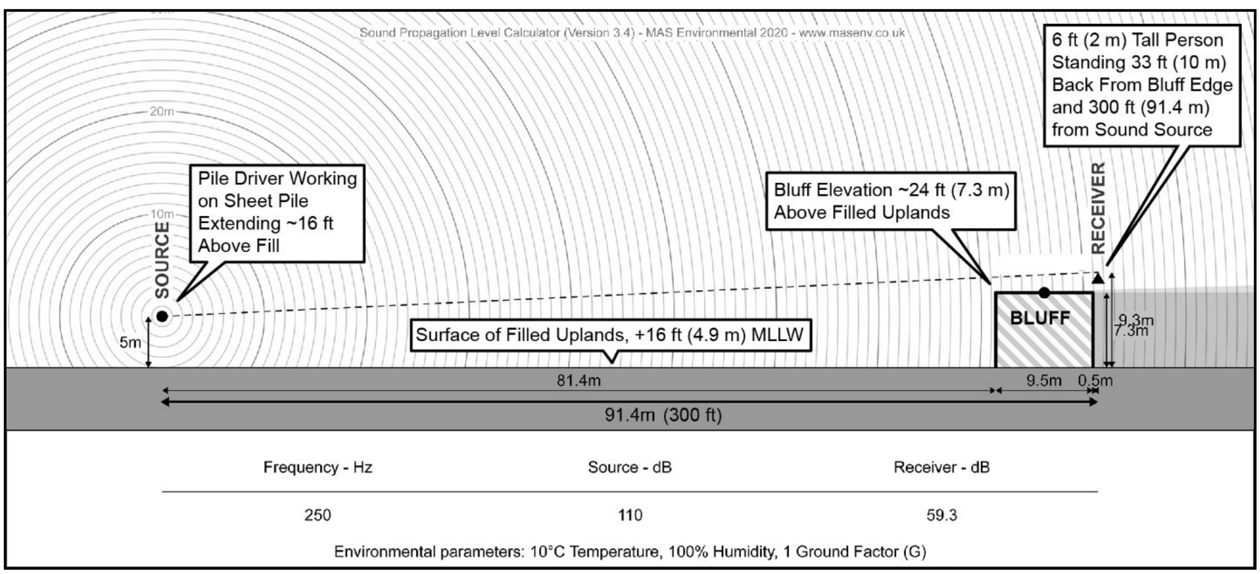

Figure 43. Annotated Print of Sound Propagation Model (MAS Environmental 2020) of Sheet Pile Driving at Elim

Subsurface blasting several hundred ft offshore may generate air-transmitted sound perceivable on shore as a brief, low-frequency “thump” and/or a low-level ground-transmitted vibration. This sound is unlikely to be injurious to people on shore, but it may be startling. The community would be alerted in advance of any use of explosives. The USACE expects subsurface rock ripping and hammering to generate underwater noise of an amplitude similar to that of mechanical dredging. Documented reference sound levels for hydraulic ripping are sparse in the literature. However, in general, noise generated under the water’s surface does not propagate efficiently into the air (Zhang 2002), and these activities should contribute only minimally to the air-transmitted noise perceived within the village.

Comparison of Alternatives. Injurious or intrusive noise from pile driving during construction is the greatest potential adverse effect of air-transmitted noise on the human environment. Alternatives 3, 4, and 5 all incorporate the same size sheet pile dock; Alternative 2 does not include a sheet pile dock or pile driving.

The primary long-term effect for all alternatives would be an increased level of noise and activity associated with the expected increase of small watercraft operating out of Elim (as opposed to Moses Point). Alternatives 3, 4, and 5 would also bring larger fishing tenders to dock at Elim. Alternative 5 provides a barge landing, which would relocate barge operations from the east end of the beach where they are currently handled. As noted earlier, the high bluff inland of the project site would attenuate air-transmitted noise to the community of Elim. With the No Action Alternative, the general noise levels along the Elim waterfront would not be expected to increase.

Mitigatory Measures. High-noise activities, such as pile-driving, would be timed to minimize impacts on residential areas. Pile driving equipment varies in terms of power (and therefore noise generation); the minimum power equipment necessary to perform the required work would be used. Sound baffles may be used to attenuate air-transmitted noise further.

Magnitude of Effects: Alternatives 3, 4, 5 – Moderate. Both direct and indirect effects on air-transmitted noise would be highly seasonal, variable, and transient. Conspicuous and/or potentially harmful levels of noise from specific activities (i.e., pile driving) would be mitigated through timing and worksite safety practices.

Alternative 2 – Minor. Alternative 2 does not include a tender dock or barge landing. Therefore Alternative 2 would not involve pile driving and no larger vessels such as a fish tender or tugboat would use the harbor.

8.2.6. Aesthetics

The proposed activities would create an artificial structure where one does not exist now. The completed project would be most visible from the beach east of the project site and homes and other structures on higher land on the east side of Elim. The high coastal bluff immediately north of the project footprint will likely block the view of the completed project from most vantage points on the west side of Elim.

Comparison of Alternatives. The structural alternatives would not differ visually from one another to any significant degree. The size differences between the larger or smaller alternatives may not be readily apparent to a viewer on the shore, especially since the breakwaters in each alternative are comparable in size and extend about the same distance from shore. The No Action Alternative would have no effect on visual resources at Elim.

Mitigatory Measures. None proposed.

Magnitude of Effects: Minor. The structural alternatives would not differ visually from one another to any significant degree; the size differences between the larger or smaller alternatives (or the No Action alternative) would not be readily apparent to a viewer on the shore. In meetings with Elim residents, the visual impact of the project was not mentioned as a concern.

8.3. Biological Resources

8.3.1. Habitat and Wildlife

The proposed project would have highly localized direct and indirect effects on the habitat and wildlife resources discussed in Section 3.2.1. The USACE anticipates no discernable changes to regional oceanographic systems or trends as a result of the completed project.

The new rubble-mound breakwaters would permanently replace a portion of the existing sandy benthic habitat with a rocky high-relief substrate. This habitat type appears to be common along rocky shores in the project area. The USACE expects the new high-relief rocky habitat created by the rubble-mound structures to rapidly recruit a diverse community of marine algae and invertebrates similar to that observed on natural boulders and pinnacles in the area. However, the replacement of habitat is unlikely to alter the overall composition of species in the long term as the existing sandy benthic habitat type would remain abundant in the immediate vicinity. Dredging would also disrupt benthic habitat in the short term. However, the areas to be dredged would very quickly be resurfaced in the highly-mobile sand that characterizes surface sediment in the area.

The proposed 1 acre constructed uplands would occupy what is now sandy intertidal beach and shallow subtidal waters. The existing beach is frequently disrupted by wave action and human activity and is not known to provide useful habitat for wildlife.

Fishes in the immediate nearshore area may be displaced in the short term by construction-related disturbances. Birds using the Elim waterfront area may be displaced in the short term by construction activities but would benefit in the long term from expanded roosting and foraging structures. No known nesting habitat would be affected by the proposed project.

If subsurface blasting is necessary, it would occur within the dredging prism (i.e., a benthic habitat that must be removed), so no additional loss of habitat would be expected due to the use of blasting. Properly sized and stemmed explosive charges would result in brief, low-frequency air-transmitted sound that may cause minor, short-term disruptions to seabird behavior in the project area. The effects of underwater noise from subsurface blasting on fish and marine mammals are discussed in the following subsections.

8.3.1.1. Invasive Species

Marine invasive species may become a threat in the Bering Strait region as climatic and oceanographic changes become more apparent. Larger ships traveling into the region from northern Asian and European ports may transport, via bilge water and hull biofouling, new species able to survive in the Elim area (Conservation of Arctic Flora and Fauna [CAFF] and Protection of the Arctic Marine Environment [PAME] 2017; Reimer et al. 2017). Iceland, at much the same latitude as the Seward Peninsula, has seen an influx of numerous invasive tunicates, crustaceans, and fish from the eastern Atlantic coast (Fernandez et al. 2014).

The risk of project tugs, barges, and other project vessels introducing invasive species to the Elim area during the 3 or 4 years of construction is low, especially as the project vessels are likely to be coming to Elim from more southerly waters in Alaska or the Pacific Northwest. The project contractor will be required to include measures (suitable to the type of vessels used for the project) to prevent the introduction and spread of marine and terrestrial invasive species as part of an overall Environmental Protection Plan. Such measures would include rodent exclusion and interdiction steps, such as recommended by the ADFG (Frits 2007; Johnson 2008). As suggested above, the greatest long-term risk of introducing marine invasive species to the Norton Sound area would come via vessels visiting from distant but climatically similar locations, such as northeast Asia and northern Europe. Such vessels are very unlikely to travel directly to Elim. Still, any invasive species that become established near the Port of Nome could then be carried by transshipments from Nome to Elim.

Worldwide, current efforts to reduce the spread of marine invasive species focus on ballast water management. Exchanging ballast water in mid-ocean greatly reduces the risk of transporting invasive species from one port to another. Coastal species in ballast water taken onboard a port are unlikely to survive in the open ocean. Likewise, any pelagic species taken onboard a mid-ocean ballast exchange are not likely to thrive in shallow coastal waters at the next port. Enforcement of invasive species control measures are beyond the authority of the USACE and beyond the scope of this study.

Comparison of Alternatives. As described in Section 8.1, the five structural alternatives would each impact the same environmental location and resources in the same manner, differing incrementally in the magnitude, extent, and duration of those impacts. The direct impacts caused by dredging and placement of a stone for the breakwaters are compared in Table 37. As discussed in Sections 8.2.4, 8.3.2, and 8.3.4, the pile driving required under Alternatives 3, 4, and 5, and the potential for blasting under Alternative 5, increase the short term impacts of air-transmitted and underwater noise on the local habitat and wildlife.

Under the No Action Alternative, no changes to habitat are expected. However, the opportunities offered by the barge landing in Alternative 5 to reduce the risk of contaminant spills would not be realized.

Mitigatory Measures. The mitigatory measures described in Section 8 for water quality, air quality, protected species, and essential fish habitat would also serve to reduce project effects on habitat. The project contractor would be required to include measures to prevent the introduction and spread of marine and terrestrial invasive species as part of an overall Environmental Protection Plan. Such measures would include rodent exclusion and interdiction steps, such as recommended by the USFWS.

Magnitude of Effects: Moderate. All five structural alternatives pose potential effects on the overall ecological setting that may be noticeable but would be highly localized to the immediate project area such that they would not destabilize important attributes of the ecological setting. The No Action Alternative would have no effect on habitat or on wildlife.

8.3.2. Endangered Species Act and Marine Mammal Protection Act

As the proposed project may affect most of the species discussed in Section 3.2.2 in similar ways, the evaluation of potential effects is organized here by type of effect rather than individual species. The project may have potential short-term effects associated with construction, as well as long-term effects caused directly or indirectly by the finished project. No ESA-listed or MMPA-protected species are known to congregate at or preferentially use habitat in the project area. Any project effects are likely to be on individual animals that are incidentally in the vicinity of construction activities or project-related vessel traffic. ESA determinations are presented in the "Magnitude of Effects" subsection at the end of each section.

8.3.2.1. Pinnipeds and Cetaceans

Generally speaking, marine mammals face common threats from human activities:

- Noise and disturbance
- Vessel strikes
- Direct impacts from human fishing (e.g., entanglement in fishing gear)
- Indirect impacts from human fishing (e.g., competition for food resources)
- Contaminants and pollutants
- Habitat degradation caused by human activities
- Hunting and illegal killings

Direct Short-Term Effects from Construction-Related Activities. The major in-water construction activities under all alternatives would consist of dredging material from the seabed to create navigation channels and basins (including rock ripping and potential blasting), placing rock for breakwaters, and pile driving (except for Alternative 2). The main potential threats to marine mammals from these activities include noise and disturbance, vessel strikes, and release of pollutants. Virtually all construction work would be performed when ice is absent, roughly late May through mid-October.

The USACE has prepared a draft Biological Assessment (BA) to evaluate in more detail the potential effects on ESA-listed species from pile driving and dredging. Appendix I: Draft Biological Assessment contains further discussion on the sections summarized below.

Noise and Disturbance. The NMFS has developed comprehensive guidance on sound levels likely to cause injury to marine mammals through the onset of permanent and temporary threshold shifts (PTS and TTS; Level A harassment; 81 FR 51693). Under the PTS/TTS Technical Guidance (NMFS 2018), the NMFS uses the following thresholds for underwater sounds that cause injury, referred to as Level A harassment under section 3(18)(A)(i) of the MMPA. These acoustic thresholds are presented using dual metrics of cumulative sound exposure level (LE) and peak sound level (PK) for impulsive sounds and LE for non-impulsive sounds (Table 39).

Table 39. Marine Mammal Hearing Groups and Level A Acoustic Thresholds

Hearing Group	Relevant Species	Generalized Hearing Range	PTS Onset Acoustic Thresholds	
			Impulsive	Non-Impulsive
Low-Frequency Cetaceans (LF)	Humpback whale NP right whale NWP gray whale Blue whale Fin whale	0.007–35 kHz	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
Mid-Frequency Cetaceans (MF)	Sperm whale Beluga whale	0.15–160 kHz	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency Cetaceans (HF)	Harbor Porpoise	0.275–160 kHz	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,MF,24h}$: 198 dB
Phocid Pinnipeds (PW)	Ringed seal Bearded seal Harbor seal Spotted seal	0.05–86 kHz	$L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW)	Steller sea lion	0.06–39 kHz	$L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	$L_{E,OW,24h}$: 219 dB

PTS: Permanent Threshold Shift: a permanent reduction in the ability to hear (i.e., injury).
kHz: kilohertz (sound frequency)
dB: Decibels, unweighted (sound intensity)
L_{pk}: Peak sound level; “flat” = unweighted within the generalized hearing range.
L_E: Cumulative sound level; “24h” = 24-hour cumulative period
LF, MF, HF, PW, OW: defined in “Hearing Group” column
(Adapted from NMFS 2018)

NMFS currently uses the following conservative thresholds of underwater sound pressure levels (measured in micropascals, or µPa), expressed in root mean square (rms), from broadband sounds that cause behavioral disturbance (referred to as Level B harassment under Section 3(18)(A)(ii) of the MMPA):

- impulsive sound: 160 dB re 1 μPa_{rms}
- continuous sound: 120 dB re 1μPa_{rms}

For air-transmitted sound, the NMFS has developed the following Level B thresholds:

- 100 dB re 20μPa_{rms} for non-harbor seal pinnipeds
- 90 dB re 20μPa_{rms} for harbor seals

The major sources of noise and disturbance expected during the construction of this project are:

- project-related vessels (tugboats, barges, and scows);
- dredging;
- placement of rock material;
- driving of sheet pile.

Project Vessel Noise

Tugboats may generate significant underwater noise, especially when maneuvering or holding a barge in position against a dock or the shore. During a 2001 acoustic survey of Cook Inlet (Blackwell and Greene 2002), the highest level underwater broad-frequency noise recorded (149 dB re 1μPa, at a distance of 102 meters) was generated by a tugboat docking a gravel barge. The same tug/barge combination generated a maximum level of 125 dB re 1μPa, at a distance of 190 meters when in transit. The underwater noise level generated by a tugboat can vary greatly with the size/horsepower of the tugboat engine and whether noise-reducing features, such as propeller cowlings, are present. Diesel-powered tugs typically generate underwater noise at relatively low frequencies, roughly in the 0.02–1 kHz range (USACE 1998).

At 0.02–1 kHz, the typical frequency range of underwater noise generated by a tugboat engine (USACE 1998) places it at the lower end of the generalized hearing range of low frequency (LF) cetaceans and below or at the very lower limit of the hearing range of other marine mammals (Table 39). The noise generated by the tugboat engine is assumed to be non-impulsive/continuous; no source of impulsive noise from the tug and barge is anticipated other than brief, incidental sounds from docking or landing. The 125 dB re 1μPa, at a distance of 190 meters, of a tug and barge in transit (Blackwell and Greene 2002) falls well below the Level A harassment (injury) acoustic thresholds for non-impulsive noise shown in Table 39, but slightly exceeds the 120 dB re 1μPa$_{rms}$ default conservative threshold for a Level B disturbance from continuous noise. There is the potential for LF cetaceans within a few hundred meters of proposed action-related vessels in transit to experience a Level B disturbance (behavioral disruption) due to underwater noise. Other marine mammals would likely be insufficiently sensitive to the low-frequency engine noise to experience a disturbance.

Air-transmitted noise levels generated by tugboat diesel engines are comparable to those of large construction equipment, generally 70–100 A-weighted decibels (dBA) within 50 ft of the engine (United States Navy [USN] 1987; Dyer and Bertel 1983). Thornton (1975) measured in-air barge noise at levels between 88 and 93 dBA in the aft deck of two barges. These levels fall below the level B disturbance threshold for pinnipeds (excluding harbor seals, which are not a species of concern for this project).

Dredging Noise

The USACE expects that creating the harbor basin and entrance channel would require a combination of mechanical clamshell dredging, hydraulic rock ripping and perhaps limited confined subsurface blasting. In the BA, the USACE uses sound levels recorded during operation of a large clamshell dredge in Cook Inlet, Alaska (Clarke et al. 2003) as a reference source. The *Viking* is a 1,475 hp clamshell dredge with an 11.5-cubic meter bucket that was recorded mining sand and gravel. The equipment used to dredge at Elim would be similar in scale to the *Viking* and could be assumed to generate noise of similar amplitude. Clarke recorded digging sounds between 113–107 dB at distances of 158–464 meters from the source, respectively. Assuming a transmission loss coefficient of 15 for the practical spreading calculation, a received level of 113 dB at a range of 158 meters indicates an SL of 146 dB. The same calculation using a received level of 107 dB at a range of 464 meters indicates an SL of 147 dB. The dredging noise would be below the PTS threshold at the source, so the dredging noise would not have the potential to seriously injure or kill low-frequency cetaceans or phocid seals, assuming an SL of between 146–147 dB. The sound would attenuate to the 120 dB harassment threshold between 54–63 meters from the source. The USACE would establish a 75-meter exclusion radius around the dredge to monitor for the presence of ESA-listed species.

The USACE expects rock ripping to generate underwater noise of an amplitude similar to that of mechanical dredging. Documented reference sound levels for hydraulic ripping are sparse in the literature. Still, the Level A zone of typical hydraulic rippers is 2–3 meters, whereas the level B zone would be less than the zone for vibratory pile driving (~7 kilometers; see below).

The underwater noise impacts (and, more importantly, the rapid rise and fall of pressure levels) from confined underwater blasting would likely extend to about 7 kilometers from shore. More precise distance estimates will be developed in PED. Since an Incidental Harassment Authorization (IHA) would be obtained for this project, marine mammals would be exposed to Level B (Behavioral) harassment. It would impact the most susceptible marine mammals (low-frequency cetaceans such as humpback whales) out to 7 kilometers. Phocid seals and otariid seals would be subject to Level B Harassment at smaller distances. Level A harassment (mortality or permanent injury) authorization would not be sought as part of this project, and blasting shutdowns would be implemented for Level A zones. Overall, the potential impacts from confined underwater blasting are anticipated to be minor since they occur over a short period (once per day at most for several days) and would likely only expose a small number of marine mammals.

Placement of Rock Material Noise

Placement of rock material for the breakwaters produces low-intensity underwater sound; armor stone is typically maneuvered carefully into place rather than allowed to drop to avoid damaging the armor stone or displacing the core material underneath.

The rock material may be placed by excavators or other heavy equipment working from barges or shore. The intensity of air-transmitted noise from on-land construction equipment is most often expressed in decibels weighted for the human-hearing frequency range (“A-weighted” decibels, or dBA). In contrast, water-transmitted noise intensity is generally expressed in unweighted decibels (dB). The A-weighting convention was developed for human health and safety and emphasizes the frequencies between 1 kHz and 6.3 kHz to simulate the relative response of human hearing. A typical averaged maximum (L_{max}) or time-weighted (L_{eq}) noise intensity levels generated by shore-based heavy construction equipment, expressed as dBA measured at a distance of 50 ft or 10 meters (33 ft; United States Department of Transportation (USDOT) 2006; Department for Environment, Food and Rural Affairs (DEFRA) 2005) is shown in Table 40.

Table 40. Typical Air-Transmitted Noise Levels of Land Construction Equipment

Equipment	**Averaged measured L_{max} @ 50 ft (dBA)[a]**	**Measured L_{eq} @ 33 ft (dBA)[b]**
Bulldozer	82	81–86
Dump Truck	76	79–87
Excavator	81	69–89
Front End Loader	79	68–82
a = USDOT 2006; b = DEFRA 2005		

Studies of the frequency ranges of construction machinery noise tend to measure sound pressure levels in a general range of 0.063–8 kHz (Roberts 2009; DEFRA 2005), but this may again represent an emphasis on human hearing and not the full range of frequencies generated by the equipment.

Driving of Sheet Pile Noise

The driving of sheet pile for the tender dock with a vibratory hammer has the potential to create underwater noise at levels exceeding harassment thresholds over a large area. Appendix I: Draft Biological Assessment calculates that the 120 dB acoustic threshold for harassment may extend 7,356 meters from the source of the sound. However, the tender dock would most likely be constructed after the breakwaters are in place. The rubble-mound breakwaters would largely absorb and refract the sound generated by pile driving, leaving only the entrance gap, which could potentially be sealed with a bubble-curtain or some other sound attenuation technique.

Vessel Strikes. Project vessel activity during and in support of construction would likely consist of tugs, barges, and scows maneuvering around the immediate project area. Also, transporting rock to the project site from the Cape Nome quarry and transporting project equipment and supplies to Elim from a base port (presumably, Anchorage via Nome) would result in vessel traffic.

The effects of proposed project vessels would be an incremental increase over the effects of very similar vessels that work out of Elim or travel between communities on the Gulf of Alaska and the Bering Sea every year. The probability of strike events depends on the frequency, speed, route of marine vessels, as well as the distribution of marine mammals in the area.

An analysis of ship strikes in Alaskan waters (Neilson et al. 2012) found that whale mortalities are more likely when large vessels travel at speeds greater than 12 knots. Another study (Vanderlaan and Taggart 2007) used observations to develop a model of the probability of lethal injury based upon vessel speed, projecting that the chance of lethal injury to a whale struck by a vessel is approximately 80% at vessel speeds over 15 knots, but approximately 20% at 8.6 knots.

The relatively low speed of a typical ocean-going barge and tug (typically no more than 9 knots), together with a barge's blunt prow and shallow draft, make it far less likely to strike and inflict injury upon a marine mammal than larger, faster ocean-going vessels such as cruise ships and cargo ships. The limited maneuverability and long stopping-distance of a barge and tug would make it difficult for the vessels to avoid an observed marine mammal, and in many circumstances, unsafe for them to attempt to do so. Conversely, however, the vessels' low speed and consistent course would enable marine mammals to avoid the path of the barge and tug well before there was a danger of collision.

Project-related vessels en-route between Anchorage and Elim would pass through the critical habitat areas described above for North Pacific right whales and Cook Inlet beluga whales. They would also pass through the 20-nm nautical zone of numerous Steller sea lion rookeries and haul outs in the Gulf of Alaska, and through the Shelikof and Bogoslof Foraging Areas, but would not approach within 3 nm of any rookeries or haul outs.

Release of Contaminants. The increased vessel activity during project construction represents an increased risk of accidental leaks and improper discharges of fuel or other pollutants. Such releases may come from tugboats and survey vessels. On shore discharges from land construction equipment could potentially also contaminate marine waters.

8.3.2.2. Other ESA-Listed Species

Polar Bears. The great majority of project construction or study activities would occur when ice is absent from the Elim area, and therefore when a polar bear is least likely to be present near Elim. Geotechnical studies needed before the start of construction might be conducted in late winter from sea ice beyond the existing causeway. Rock quarrying in support of the project could occur in winter at the Cape Nome quarry site. This established quarry is relatively close to the designated barrier island CH fronting Safety Sound, but outside of the 1-mile no-disturbance zone associated with that CH. A polar bear that found itself near Elim after sea ice has retreated in the spring would be in far more immediate danger from vehicles, hunters, and public safety officers than from construction of the proposed project.

Stellers and Spectacled Eiders. Potential impacts on Steller's eiders would be limited to disturbance of migrating birds that may pass close to Elim while construction is underway. Eiders attempting to settle and rest in nearby wetlands or nearshore waters might be displaced by construction noise and movement. Still, large areas of similar, disturbance-free habitat are readily available near the project site.

Northern Sea Otter and Short-Tailed Albatross. The USACE determines that project activities would have no effect on these species, as they would not be present in the Norton Sound ROI, and project vessels in transit are very unlikely to encounter or affect them.

Comparison of Alternatives. Injurious noise from pile-driving is the greatest potential adverse effect on ESA-listed marine mammals. Alternative 2 would pose the least risk of injurious noise, requiring no pile driving or blasting. Alternative 5 would pose the greatest risk of injurious noise, as it requires both pile driving and the potential for blasting.

Mitigatory Measures

1. Noise and Disturbance. During all pile-driving, dredging, and other in-water work:

- A qualified marine mammal observer(s) would be present. All observers must be able to spot and identify marine mammals and record applicable data during all types of weather during all in-water activity.
- Marine mammal observers would have no other duties during the observation period to ensure that watching for protected species remains the observer's main focus.
- Marine mammal observers would have the authority to stop pile-driving operations immediately and/or lower noise levels to less than 120 dB when marine mammals are visible within the exclusion zones. Estimated exclusion

zones are developed in Appendix I: Draft Biological Assessment and discussed above. The extent of exclusion zones would be refined during formal ESA consultation with the NMFS.

- For dredging, rock-placement, and other in-water activities in which harassment is possible (but not injurious noise), the exclusion zone would be 75 meters.
- Marine mammal observers would watch for marine mammals within the exclusion zone for 30 minutes before pile-driving. If a marine mammal is observed within the exclusion zone during the 30-minute observation period before start-up, the observation period need not start over once the animal moves out of the exclusion zone. Still, work may not commence until the animal is outside the zone.
- Marine mammal observers would have the authority to (1) immediately stop pile-driving activities when a marine mammal is present within or is approaching the exclusion zone, and (2) provide clearance for work to resume after the animal leaves.
- A lead observer would be responsible for implementing the protocols. The lead observer may select and train additional observers but would remain accountable for their performance.
- An observation station(s) would be established to maximize the visibility of the exclusion zone. The observer shall order all pile driving activity to cease whenever the exclusion zone is not fully visible due to weather or low light. Activities would not commence until viewing conditions make it possible to observe the entire exclusion zone.
- Pile driving or any work with the potential to generate noise levels above 120 dB (impact and/or vibratory hammers) shall start at low intensity to allow for marine mammals to evacuate the exclusion zone.

2. Vessel Strikes. The NMFS has recommended the following general measures to minimize the risk and harm to protected marine species (ESA and MMPA) from vessel strikes; these would be followed to the extent practicable:

- Proposed action-related vessels would be limited to a speed of 8 knots or the slowest speed above 8 knots consistent with safe navigation to reduce the risk of collisions with protected species:
  - when within 3 nautical miles of any Steller sea lion haul outs or rookeries;
  - when transiting the North Pacific right whale CH areas; and
  - when transiting the Cook Inlet beluga whale CH areas.

- Vessel operators would strive not to approach within 100 yards of a marine mammal to the extent practicable, given navigational and safety constraints.
- The contractor performing the work would prepare an Oil Spill Prevention and Control Plan describing steps to avoid and mitigate releases of hazardous substances.

a. Cook Inlet Beluga Whales: The NMFS has recommended special conservation measures to minimize the impacts of vessel strikes on Cook Inlet beluga whales within their designated CH. Vessels would exercise special caution in the vicinity of the Susitna Delta to minimize the impacts of vessels within this seasonally vital Cook Inlet beluga whale habitat. The Susitna Delta Exclusion Zone (Figure 44) is defined as the union of the areas defined by:

- A 10-mile (16 km) buffer of the Beluga River thalweg seaward of the mean lower low water (MLLW) line; and
- A 10-mile (16 km) buffer of the Little Susitna River thalweg seaward of the MLLW line; and
- A 10-mile (16 km) seaward buffer of the MLLW line between the Beluga River and Little Susitna River.

The buffer extends landward along the thalweg buffers to include intertidal area up to mean higher high water (MHHW). The seaward boundary has been simplified so that it is defined by lines connecting readily discernible landmarks.

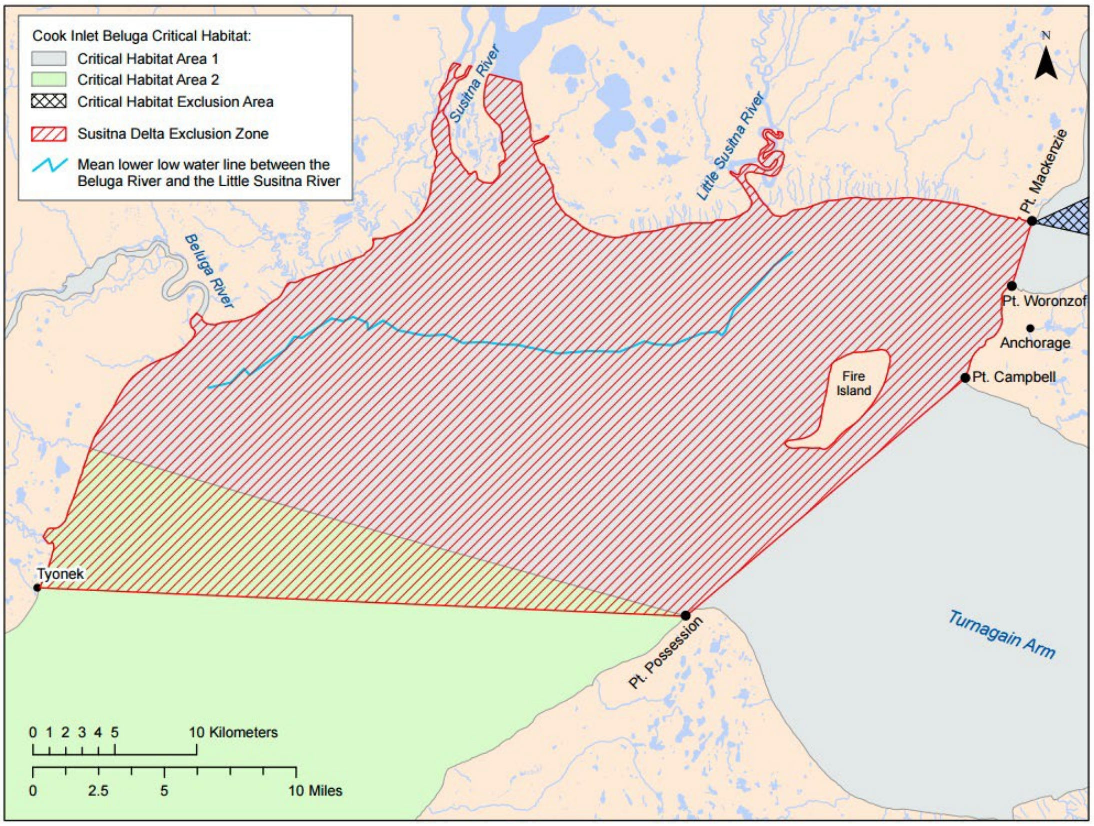

Figure 44. Boundaries of the Susitna Delta Exclusion Zone

For vessels operating in the Susitna Delta Exclusion Zone, the following would be implemented:

- All vessels operating within the designated Susitna Delta area would maintain a speed below 4 knots. Crews must note the numbers, date, time, coordinates, and proximity to vessels of any belugas observed during operations and report these observations to NMFS.
- Protected species observers (PSOs) must be in place to monitor for ESA-listed species before and during all vessel movements when vessels are under power (propellers spinning) within the Susitna Delta Exclusion Zone. PSOs are not required to be observing when vessels are not under power (in gear).
- PSOs must be located in a position that affords views of water within a 100-meter radius of all vessels under power (in gear).
- Exercise special caution in the vicinity of the Susitna Delta to minimize the impacts of vessels within this seasonally vital Cook Inlet beluga whale habitat.
- Vessel operators must avoid moving their vessels when PSOs are unable to adequately observe the 100-meter zone around vessels under power (in gear)

due to darkness, fog, or other conditions, unless necessary for ensuring human safety.

- If any vessels enter the Susitna Delta Exclusion Zone, PSOs must email NMFS: date, time, number, and geographic coordinates of ESA listed marine mammals observed during vessel movements, descriptions of any deferred vessel movements, or vessel re-directions.

b. North Pacific Right Whale: The vessel operator would avoid transits within designated North Pacific right whale CH (Figure 22). If transit with North Pacific right whale CH cannot be avoided, NMFS recommends a route along the western boundary of the CH where historical and contemporary observations indicate that North Pacific right whales are not as concentrated as other areas in the CH. In addition, if transit with North Pacific right whale CH cannot be avoided, NMFS recommends that transit in right whale CH be limited to between September and March, a time of year right whales may be at lower numbers in the Bering Sea.

If transiting in North Pacific right whale CH, vessel operators are requested to exercise extreme caution and observe the 10-knot (18.52 km/h) vessel speed restriction. Operators transiting through North Pacific right whale CH would have trained PSOs actively engaged in sighting marine mammals. PSOs would increase vigilance and allow for reasonable and practicable actions to avoid collisions with North Pacific right whales. Operators would maneuver vessels to keep 800 meters away from any observed North Pacific right whales while within their designated CH and avoid approaching whales head-on consistent with vessel safety. Vessels would take reasonable steps to alert other vessels in the vicinity of whale(s) and report of any dead or injured listed whales or pinnipeds.

3. Release of Contaminants. The contractor would be required to prepare an Oil Spill Prevention and Control Plan. Reasonable precautions and controls would be used to prevent incidental and accidental discharge of petroleum products or other hazardous substances. Fuel storage and handling activities for equipment would be sited and conducted, so there is no petroleum contamination of the ground, surface runoff, or water bodies. Equipment would be inspected daily for leaks. If leaks are found, the equipment would not be used and pulled from service until the leak is repaired. During construction, spill response equipment and supplies such as sorbent pads shall be available and used immediately to contain and clean up oil, fuel, hydraulic fluid, antifreeze, or other pollutant spills. Any spill amount must be reported in accordance with Discharge Notification and Reporting Requirements (AS 46.03.755 and 18 AAC 75 Article 3).

4. Polar Bear Interaction Plan. In the unlikely event that a polar bear is encountered by project personnel, they would follow the standard Polar Bear Interaction Guidelines distributed by the USFWS.

Magnitude of Effects: Moderate. The proposed actions may have effects that are sufficient to alter noticeably but not to destabilize important attributes of the resource. Construction activities such as pile driving, dredging, and vessel operations may have adverse effects on some ESA-listed species. These effects would be limited in duration to the construction period and limited in the extent to, at most, within a few kilometers of the construction area. Appendix I: Draft Biological Assessment finds that project construction is “likely to adversely affect” the following species due to exposure to underwater noise from dredging and pile driving (limited to Level B harassment):

- Ringed seals (Arctic DPS)
- Bearded seals (Beringia DPS)
- Steller sea lions (Western DPS)
- Gray whales (Western North Pacific DPS)
- Humpback whales (Western North Pacific and Mexico DPSs)

The USACE will continue coordination with the NMFS and will initiate formal consultation on the species above when sufficient information on project activities exists to consider impacts on these species in more detail. The ASA(CW) approved a policy exception for this project, allowing ESA consultation to continue into PED, in a memorandum dated 5 October 2020.

The USACE determines that the project activities would have “no effect” on the following species due to the very low probability of these species being in the project area or of being encountered by a project vessel in transit:

- Sperm whale
- North Pacific right whale
- Bowhead whale
- Fin whale
- Blue whale
- Beluga whale (Cook Inlet DPS)

The USFWS concurred in a letter dated 17 Dec 2019 (USFWS 2019) with the USACE’s determinations of “may affect, but not likely to adversely affect” for:

- Polar bears
- Steller’s eiders
- Spectacled eiders

The USACE determines that the project activities would have "no effect" on the following species due to the very low probability of these species being in the project area or of being encountered by a project vessel in transit:

- Short-tailed albatross
- Northern sea otter (Southwest Alaska DPS)

The USACE determines that no Critical Habitat for any species would be adversely affected by the project activities.

8.3.3. Migratory Bird Treaty Act

The project area does not appear to be used as a nesting habitat for birds, perhaps due to the existing human activity on the beach and the unstable coastal bluff. Construction activities are unlikely to disturb nesting birds. The completed rubble-mound breakwaters would provide roosting habitat that may make the near shore marine environment at Elim more attractive to foraging birds such as gulls and cormorants. Still, the breakwaters are not likely to be used for nesting. Likewise, the presence of fishing tenders and fish catches brought into Elim may attract seabirds such as gulls but would not affect nesting success.

Comparison of Alternatives. The structural alternatives and the No Action Alternative are all unlikely to cause a take under the Migratory Bird Treaty Act.

Mitigatory Measures. None proposed.

Magnitude of Effects: Minor. The proposed action is unlikely to result in the killing of a migratory bird or destruction of an active nest, as no birds nesting habitat has been identified in the area likely to be disturbed by the project.

8.3.4. Essential Fish Habitat and Anadromous Streams

The effects on EFH and anadromous streams have been evaluated in detail in Appendix H: Essential Fish Habitat. The USACE has determined that the proposed project will not adversely affect EFH. The construction activities will create temporary disturbances that may modify fish behaviors and movements. Still, the project will not have a significant impact on the waters and substrates identified as necessary to fish for spawning, breeding, feeding, or growth to maturity. No anadromous streams will be affected by the project. The rubble-mound structures will create a minor diversion for migrating salmon away from the shoreline, but into waters only a few feet deeper than the salmon traverse at present. The USACE expects the new high-relief rocky habitat created by the rubble-mound structures to rapidly recruit a diverse community of marine algae and invertebrates similar to that observed on natural boulders and pinnacles in the area.

The USACE provided the EFH Assessment to NMFS, who concluded in a letter dated 5 February 2020 (NMFS 2020) that any impacts to EFH would be avoided or minimized with the application of the conservation recommendations provided in their letter (see Mitigatory Measures below). As described in the EFH Assessment, the potential effects of blasting have not been thoroughly evaluated, as insufficient information exists as to the extent of any needed blasting. The USACE will continue to coordinate with the NMFS as further information on the need for blasting is developed.

The USACE considered including fish passage gaps between the breakwaters and the shoreline, but, based on local observations of the highly mobile beach sediment, concluded that such gaps would require continuous maintenance to keep open. Without the fish passage gaps, fish migrating along the shore will be diverted seaward by the breakwaters a short distance, but into waters only a few feet deeper than they traverse at present. This diversion should have no discernable effect on migrating fish, especially the far-traveling salmon. This evaluation of fish passage was included in the EFH Assessment (Appendix K), which was reviewed by the NMFS.

Comparison of Alternatives. The long-term effects of the four structural alternatives would be very similar, as the alternatives occupy the same location, share most construction features, and differ primarily in scale. The construction of the sheet pile dock included in Alternatives 3, 4, and 5 would add to the short-term impacts from noise and disturbance, as would the potential for subsurface blasting in Alternative 5.

The No Action Alternative would have no effect on EFH.

Mitigatory Measures. The USACE will implement to the extent possible the conservation recommendations provided by the NMFS (NMFS 2020):

1. Piles would be driven with a vibratory hammer to the extent practicable. Pile driving can generate intense underwater sound pressure waves that can disrupt migration and injure or kill fish. Vibratory hammers produce less intense sounds than impact hammers (NMFS 2005). If an impact hammer is required because of substrate type or the need for seismic stability, piles would be driven as deep as possible with a vibratory hammer before the impact hammer is used.

2. In-water blasting would be avoided unless it is the only practical method for setting piles in bedrock. In-water blasting produces intense underwater sound pressure waves that can kill or injure fish. NMFS strongly encourages the use of drilling techniques or other mechanical means for setting piles in bedrock. If underwater blasting must be used, mitigation measures (e.g., stemming) would be employed to contain the explosive energy within the bedrock to the greatest extent possible. Because potentially harmful sound pressure waves are

attenuated more rapidly in shallow water than in deep water (Rogers and Cox 1988), blasts would be conducted during the lowest tide level practical.

3. Include an Oil Spill Prevention and Control Plan and a plan for minimizing the spread of invasive species in the Environmental Protection Plan.
4. Ensure rock for rubble-mound construction will be free of contaminants and invasive species.

Magnitude of Effects: Minor. The proposed action would have minimal short term or long-term effects on EFH.

8.3.5. Special Aquatic Sites

Special aquatic sites, as defined in Section 3.2.5, are not known to be present in the project area except as freshwater forest and scrub wetlands well inland from the project site.

Comparison of Alternatives. Neither the structural alternatives nor the No Action Alternative would affect special aquatic sites.

Mitigatory Measures. None proposed.

Magnitude of Effects: Minor. No detectable impacts are expected to special aquatic sites.

8.4. Cultural Resources

Per 40 CFR § 1508.8, this analysis reviewed the potential effects on aesthetic, historical, and cultural resources both directly and indirectly impacted by the proposed navigation improvements. The proposed navigation improvements have the potential to impact the historic village of Elim (SOL-00038). Consultation with community members did not identify any cultural resources concerns within the proposed undertaking’s Area of Potential Effect (APE). It includes part of the Elim Beach and the in-water footprints for the proposed harbor area and dredged materials disposal area (Figure 45), and no community members identified instances of any artifacts or other cultural resources being found along the Elim Beach. Elim Beach has a history of impacts from storm surges, construction, barge landings, and other activities; it is unlikely that unknown subsurface cultural resources exist. Furthermore, it is unlikely that any unknown underwater cultural resources exist within the APE due to the annual development of shorefast ice and grounded pressure ridges, as well as the impacts of ice scouring on the ocean floor.

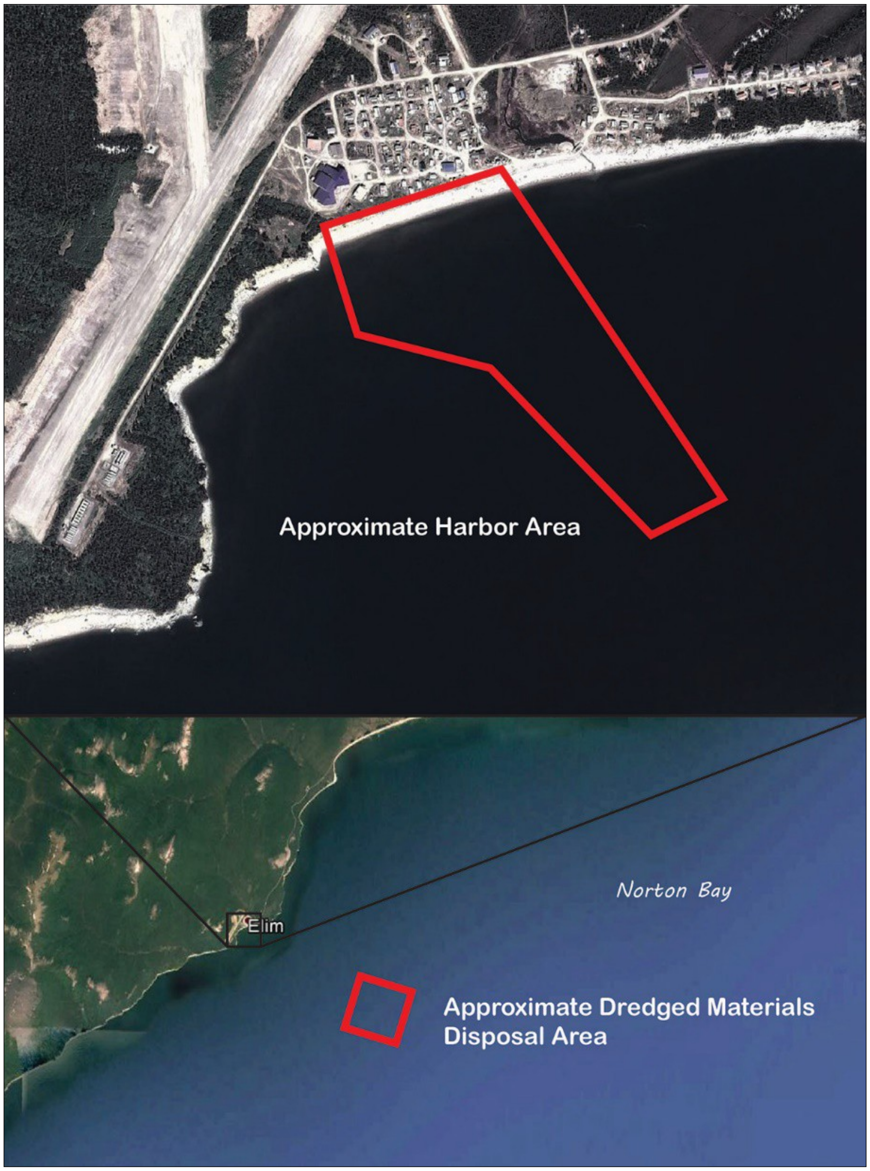

Figure 45. Areas of Potential Effect (APE) in Red

According to the Alaska Historic Resource Survey (AHRS), the eligibility of the historic village of Elim, or *Nuviakchak*, for listing in the National Register of Historic Places (NRHP) is pending. GCI (2016) recommended that *Nuviakchak* and ten contributing buildings were eligible for listing in the NRHP; however, the State Historic Preservation Officer (SHPO) did not concur with their determination due to insufficient documentation. For this undertaking and analysis under Section 106 of the National Historic Preservation Act (NHPA), the USACE is treating *Nuviakchak* as if it were an eligible historic property.

Comparison of Alternatives. Under the No-Action Alternative, cultural resources would not be subjected to any novel impacts. Aesthetic, historical, and cultural resources would continue to be impacted by storm surges, barge landings, and other routine activities. No new permanent or temporary impacts to cultural resources would be realized as a result of the project.

Alternatives 2–5 have the same basic footprint along Elim Beach and into Norton Sound. From a cultural resource perspective, the potential impacts of all structural alternatives are the same. No underwater historical or cultural resources are known or expected to exist in the APE, and no subsurface cultural resources associated with *Nuviakchak* (SOL-00038) are known in the vicinity of Elim Beach.

Mitigatory Measures. None proposed.

Magnitude of Impact: Minor. The USACE has determined that the proposed action would have no adverse effect on historic properties under Section 106 of the NHPA (36 CFR § 800.5(b)). The Alaska State Historic Preservation Officer (SHPO) has concurred with a determination of no historic properties adversely affected (Appendix G: Correspondence). The proposed action would not alter or lead to the alteration of any important attribute of historical or cultural resources.

8.5. Subsistence Use

Section 803 of the Alaska National Interest Lands Conservation Act (ANILCA) defines subsistence use as:

> *…the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption of food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.*

Similarly, the State of Alaska [Alaska Statue 16.05.940(33)] defines subsistence uses as:

> *…the noncommercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling handicraft articles out of non-edible by-products of fish and wildlife resources taken for personal or family consumption.*

Subsistence activities are of vital importance to the community of Elim. This section analyzes whether or not the proposed project would impact access to subsistence opportunities in the Elim area. For analyses on the proposed project's impact on subsistence species in the region (Section 8.3).

The Alaska Land Use Council wrote that a significant restriction of subsistence uses if "a proposed action… can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources" (Alaska Land Use Council [ALUC] 1984). Additionally, the 1983 U.S. District Court Decision of Record in *Kunaknana vs. Watt* stated that:

> *…restrictions for subsistence uses would be significant if there were large reductions in abundance or major redistribution of these resources, substantial interference with harvestable access to active subsistence-use sites, or major increases in non-rural resident hunting.*

These access concerns include not only the physical access to subsistence areas but potential increases to the cost of their use and potential increases in competition for subsistence resources.

A primary purpose of the proposed project is to improve maritime access to subsistence resources. Most of the community currently hauls out their small subsistence vessels at Moses Point, which is approximately 10 miles away from Elim and where changing sandbanks at the mouth of the Kwiniuk River hamper an individual's abilities to navigate safely and reliably access resources. The Elim Beach has been identified as a location to beach and butcher beluga, as well as a place to hold other community activities. The project area itself has not been identified as a subsistence location. No reductions in the opportunity to continue subsistence use of resources are expected in the long-term. There may be a short-term redistribution of subsistence resources away from the Elim Beach during construction; however, this is not expected to be substantial. Potential impacts to the subsistence resources themselves are discussed above in Section 8.3 and the draft Biological Assessment (Appendix I: Draft Biological Assessment).

Comparison of Alternatives. Under the No-Action Alternative, subsistence use would not be impacted by any new construction work associated with the proposed undertaking. Subsistence resources would continue to be impacted by environmental changes, and access to those resources would continue to be hampered by insufficient infrastructure for moorage of small subsistence vessels. Changes to the climate are currently impacting subsistence and are expected to continue to do so in the future. For example, winter hunting seasons are becoming shorter, and shorefast ice has been reported as more unstable and dangerous than it was in the past. Climate-influenced changes in fisheries distributions could make subsistence resources less plentiful and require more time and effort to gather (Oceana and Kawerak 2014). Subsistence resources such as marine mammals are also expected to be impacted in numerous ways as large vessel traffic increases in the Bering Strait in response to decreasing sea-ice coverage (Raymond-Yakoubian 2018).

Under all structural alternatives, subsistence use would be supported by providing moorage for 25 subsistence vessels as well as a single boat launch. Alternatives 3–5 would also provide for space to accommodate commercial vessels, which could indirectly benefit subsistence use by supporting the mixed cash economy and providing additional discretionary funds that could be used to support subsistence activities.

Mitigatory Measures. None proposed.

Magnitude of Impact: Minor. The proposed project is not expected to substantially interfere with harvestable access to subsistence locations, to cause a major redistribution of subsistence resources, or to cause a major increase in non-rural resident use.

8.6. Other Required Analyses

8.6.1. Protected Tribal Resources

The Executive Memorandum on Government-to-Government Relations with Native American Tribal Governments of 1994, the Department of Defense American Indian and Alaska Native Policy of 1998, and the Department of the Army Memorandum on American Indian and Alaska Native Policy of 2012 require that the USACE assess the impacts that Federal projects may have on protected tribal resources. Also, it requires USACE to assure the rights and concerns of Federally-recognized Tribes are considered during the development of such projects. The Department of the Army defines Protected Tribal Resources as those natural resources and properties of traditional or customary religious or cultural importance, either on or off Tribal lands, retained by, or reserved by or for Federally-recognized Tribes through treaties, statutes, judicial decisions, or executive orders. The Federal government's trust responsibility, deriving from the Federal Trust Doctrine and other sources, for these Protected Tribal Resources is independent of their association with Tribal lands.

This trust responsibility is discharged in this report through compliance with multiple statutes affecting Protected Tribal Resources (Table 41). In this report, Protected Tribal Resources are generally understood to include natural resources, cultural resources, and access to subsistence resources; the Native Village of Elim has identified no specific resource(s).

Table 41. Sections that Address Protected Tribal Resources

Topic	Report Section	Statute	Potential Effects
Natural Resources	Section 3.1 Section 3.2 Section 8.2 Section 8.3	Migratory Bird Protection Treaty Act of 1918, National Environmental Policy Act of 1970, Marine Mammal Protection Act of 1972, Clean Water Act of 1972, Endangered Species Act of 1973, Magnusson-Stevens Fisheries Conservation and Management Act of 1976	Insignificant Effects
Cultural Resources	Section 3.4 Section 8.4	National Historic Preservation Act of 1966, National Environmental Policy Act of 1970, American Indian Religious Freedom Act of 1978, Abandoned Shipwreck Act of 1988, E.O. 13007 “Indian Sacred Sites”	Insignificant Effects
Subsistence Use	Section 3.5 Section 8.5	Marine Mammal Protection Act of 1972, Endangered Species Act of 1973, Alaska National Interest Lands Conservation Act of 1980	Insignificant Effects
Environmental Justice	Section 8.6.2	Clean Air Act of 1963, National Environmental Policy Act of 1970 E.O. 12898 “Environmental Justice” E.O. 13045 “Protection of Children”	Insignificant Effects

8.6.2. Environmental Justice and Protection of Children

Executive Order (E.O.) 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” directs Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law. An environmental justice (EJ) analysis typically includes the following elements:

- Identification of any minority and/or low-income status communities in the project area;
- Identification of any adverse environmental or human health impacts anticipated from the project; and
- Determination of whether those impacts would disproportionately affect minority and/or low-income communities.

E.O. 13045, “Protection of Children from Environmental Health Risks and Safety Risks,” directs Federal agencies to identify and address environmental health and safety risks that may disproportionately affect children, to the greatest extent practicable and permitted by law. This analysis typically builds off the EJ analysis. It includes a determination of whether the identified adverse environmental or human health impacts anticipated from the project would disproportionately affect children.

8.6.2.1. Identification of Minority or Low-Income Populations

Based on the 2010 census data, the estimates for the population of Elim was 368 residents. Of that total population, 96% identified as American Indian or Alaskan Native, 2% identified as White, and the final 2% identified as having two or more ethnicities (Division of Community and Regional Affairs [DCRA] 2019). The total combined minority population, as defined in E.O. 12898 in Elim, equates to 96%, which is well above the 50% threshold for minority population size specified in the Federal environmental justice guidelines. Also, roughly one-third of Elim residents live below 125% of the poverty level (Section 2.9.5).

8.6.2.2. Identification of Potential Adverse Impacts

The project site is located primarily just offshore of the community. Potential adverse impacts within the community are most likely to happen during construction and include noise and diminished air quality. As discussed in Section 8.6.2.3 and Section 8.6.2.4, residences and facilities closest to the project site will experience greater impacts than those further inland. The Aniguiin School (K–12 public school), associated teacher housing, Boys and Girls Club building, village store, and several private residences are located along the southern edge of the community closest to the project site.

8.6.2.3. Determination under E.O. 12898

Elim is a small, compact, and rather homogeneous community. While residences located closer to the shoreline, and therefore to the project site, may be more affected by construction activities than those located further inland, there is no indication that any minority or income group would be subject to disproportionate adverse impacts. The USACE has determined that the project will not have disproportionately adverse impacts on minority and low-income populations.

8.6.2.4. Determination under E.O. 13045

The proximity of the school building and several residences to the project site has the potential to subject children disproportionately to adverse effects (particularly noise) during project construction. With careful consideration of construction timing and equipment selection, and equipment movements through the community, the USACE determines that the project activities will not cause disproportionately adverse effects on children.

8.6.3. Cumulative and Long-Term Impacts

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) define cumulative effects as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR § 1508.7).

The community of Elim has included a small boat harbor as part of its long-term infrastructure improvement and economic development goals. The 2012–2017 Elim Local Economic Development Plan (Kawerak 2013) lists a boat harbor as a secondary goal, behind basic infrastructure improvements such as a new water source and replacing a dilapidated bridge over Elim Creek. A regional economic development strategy prepared by Kawerak, Inc., for 2019–2014 (Kawerak 2019) lists a boat harbor as #4 in a list of ten priority projects. Other fishing and coastal-oriented objectives in the development plans include a fish processing plant, an on-shore fishing gear work area, and a seawall to protect shoreline infrastructure from further erosion. Along with a boat harbor, these improvements may effectively turn Elim into a regional fishing center, concentrating at Elim subsistence and commercial fishing vessels that would otherwise operate in other parts of Norton Bay. These improvements would increase noise, air emissions, and the risk of contaminant discharges along the Elim waterfront while reducing them in other areas. In particular, Moses Point may see a reduction over time of commercial fishing operations; this may be a benefit from an environmental perspective, as Moses Point is in a more environmentally sensitive area than is Elim.

8.6.4. Unavoidable Adverse Impacts

The TSP would replace 4.8 acres of sandy near shore benthic habitat with rubble-mound breakwaters. Constructing the navigation improvements at Elim would introduce new, minor sources of air emissions, noise, and potential contamination to Elim, in the form of subsistence and commercial watercraft relocating operations from other parts of the Norton Bay area.

8.6.5. Incomplete or Unavailable Information

Information that would be required before construction of the TSP, but which has been unavailable during the feasibility phase, includes:

- Project-specific geotechnical information.
- Project-specific physical characterization of the material to be dredged.
- Refinement of the location of the proposed dredged material disposal area through soundings and underwater imagery.

- Quantitative surveys of marine mammal presence within the project area.

8.6.6. Summary of Mitigatory Measures

For avoiding and minimizing impacts to water quality:

1. Dredging would be conducted to minimize the amount of suspended sediment generated. Best management practices for dredging unconsolidated sediment may include:

   - Avoiding multiple bites while the bucket is on the seafloor.
   - No stockpiling of dredged material on the seafloor.
   - No leveling of the seafloor with the dredge bucket.
   - Slowing the velocity (i.e., increasing the cycle time) of the ascending loaded clamshell bucket through the water column.
   - Pausing the dredge bucket near the bottom while descending and near the waterline while ascending.
   - Placing filter material over the holding-scow scuppers to remove sediment from the return water.

   These measures would be followed to the greatest extent feasible but may become impractical when dredging or ripping consolidated and/or rocky material.

2. The contractor would be required to prepare an Oil Spill Prevention and Control Plan. Reasonable precautions and controls would be used to prevent incidental and accidental discharge of petroleum products or other hazardous substances. Fuel storage and handling activities for equipment would be sited and conducted so there is no petroleum contamination of the ground, surface runoff, or water bodies. Equipment would be inspected daily for leaks. If leaks are found, the equipment would not be used and pulled from service until the leak is repaired. During construction, spill response equipment and supplies such as sorbent pads shall be available and used immediately to contain and clean up oil, fuel, hydraulic fluid, antifreeze, or other pollutant spills. Any spill amount must be reported in accordance with Discharge Notification and Reporting Requirements (AS 46.03.755 and 18 AAC 75 Article 3).

The U.S. EPA recommends (EPA 2020) that the mound of dredged material created at the open-water disposal site be kept to a height of less than 10% of the pre-discharge water depth, i.e., less than 3 ft high within the 30-ft water depth at the disposal site. The U.S. EPA requests that it be provided with particle size data and other physical characteristics of the dredging prism when such information is generated by the geotechnical investigation planned for PED.

For avoiding and minimizing impacts to air quality: The contractors would be required to use equipment that is in good repair and meets applicable emission standards. Best management practices such as wetting work surfaces would be applied if visible lofted dust is noted.

For minimization of air-transmitted noise: High-noise activities, such as pile-driving, would be timed to minimize impacts on residential areas. Pile driving equipment varies in terms of power (and therefore noise generation); the minimum power equipment necessary to perform the required work would be used. Sound baffles may be used to attenuate air-transmitted noise further.

For avoidance and minimization of impacts to habitat: The project contractor would be required to include measures to prevent the introduction and spread of marine and terrestrial invasive species as part of an overall Environmental Protection Plan. Such measures would include rodent exclusion and interdiction steps, such as recommended by the USFWS.

For avoidance and minimization of impacts to pinnipeds and cetaceans:

1. During all pile-driving, dredging, and other in-water work:

    - A qualified marine mammal observer(s) would be present. All observers must be able to spot and identify marine mammals and record applicable data during all types of weather during all in-water activity.

    - Marine mammal observers would have no other duties during the observation period, to ensure that watching for protected species remains the observer's main focus.

    - Marine mammal observers would have the authority to stop pile-driving operations immediately and/or lower noise levels to less than 120 dB when marine mammals are visible within the exclusion zones. Estimated exclusion zones are developed in Appendix I: Draft Biological Assessment and discussed above; the extent of exclusion zones would be refined during formal ESA consultation with the NMFS.

    - For dredging, rock-placement, and other in-water activities in which harassment is possible (but not injurious noise), the exclusion zone would be 75 meters.

    - Marine mammal observers would watch for marine mammals within the exclusion zone for 30 minutes prior to pile-driving. If a marine mammal is observed within the exclusion zone during the 30-minute observation period before start-up, the observation period need not start over once the animal moves out of the exclusion zone. Still, work may not commence until the animal is outside the zone.

- Marine mammal observers would have the authority to (1) immediately stop pile-driving activities when a marine mammal is present within or is approaching the exclusion zone, and (2) provide clearance for work to resume after the animal leaves.
- A lead observer would be responsible for implementing the protocols. The lead observer may select and train additional observers but would remain accountable for their performance.
- An observation station(s) would be established to maximize the visibility of the exclusion zone. The observer shall order all pile driving activity to cease whenever the exclusion zone is not fully visible due to weather or low light. Activities would not commence until viewing conditions make it possible to observe the entire exclusion zone.
- Pile driving or any work with the potential to generate noise levels above 120 dB (impact and/or vibratory hammers) shall start at low intensity to allow for marine mammals to evacuate the exclusion zone.

2. During project vessel operations:
   - Proposed action-related vessels would be limited to a speed of 8 knots or the slowest speed above 8 knots consistent with safe navigation to reduce the risk of collisions with protected species:
     - when within 3 nautical miles of any Steller sea lion haul outs or rookeries;
     - when transiting the North Pacific right whale CH areas; and
     - when transiting the Cook Inlet beluga whale CH areas.
   - Vessels transiting the Susitna Delta Exclusion Zone (Figure 44) will implement the special conservation measures established by NMFS (described in Section 8.3.2).
   - Vessel operators would not approach within 100 yards of a marine mammal to the extent practicable, given navigational and safety constraints.

For avoidance and minimization of impacts to polar bears: If a polar bear is encountered by project personnel; they would follow the standard Polar Bear Interaction Guidelines distributed by the USFWS.

For avoidance and minimization of impacts to EFH:

1. Piles would be driven with a vibratory hammer to the extent practicable. Pile driving can generate intense underwater sound pressure waves that can disrupt migration and injure or kill fish. Vibratory hammers produce less intense sounds than impact hammers (NMFS 2005). If an impact hammer is required because of substrate type or the need for seismic stability, piles would be driven as deep as possible with a vibratory hammer before the impact hammer is used.

2. In-water blasting would be avoided unless it is the only practical method for setting piles in bedrock. In-water blasting produces intense underwater sound pressure waves that can kill or injure fish. NMFS strongly encourages the use of drilling techniques or other mechanical means for setting piles in bedrock. If underwater blasting must be used, mitigation measures (e.g., stemming) would be employed to contain the explosive energy within the bedrock to the greatest extent possible. Because potentially harmful sound pressure waves are attenuated more rapidly in shallow water than in deep water (Rogers and Cox 1988), blasts would be conducted during the lowest tide level practical.

3. Ensure rock for rubble-mound construction will be free of contaminants and invasive species.

No compensatory mitigation is required for this project.

8.6.7. Comparison of the Effects of the Project Alternatives

The above environmental analyses have demonstrated that none of the proposed alternatives will have a major impact on any resource's categories (Table 42). The only difference in impacts among structural alternatives is that Alternative 2 would be expected to have a minor effect on Noise. In contrast, Alternatives 3–5 would be expected to have a moderate effect.

Table 42. Environmental Effects by Alternative

Resource Category	No Action Alternative	Alt 2	Alt 3	Alt 4	Alt 5
Bathymetry	Minor	Moderate	Moderate	Moderate	Moderate
Soils & Sediments	Minor	Moderate	Moderate	Moderate	Moderate
Water Quality	Minor	Moderate	Moderate	Moderate	Moderate
Air Quality	Minor	Minor	Minor	Minor	Minor
Noise	Minor	Minor	Moderate	Moderate	Moderate
Aesthetics	Minor	Minor	Minor	Minor	Minor
Habitat & Wildlife	Minor	Moderate	Moderate	Moderate	Moderate
ESA-Species	Minor	Moderate	Moderate	Moderate	Moderate
MMPA-Species	Minor	Moderate	Moderate	Moderate	Moderate
Migratory Birds	Minor	Minor	Minor	Minor	Minor
Essential Fish Habitat	Minor	Minor	Minor	Minor	Minor
Special Aquatic Sites	Minor	Minor	Minor	Minor	Minor
Cultural Resources	Minor	Minor	Minor	Minor	Minor
Subsistence Use	Minor	Minor	Minor	Minor	Minor

9. PUBLIC AND AGENCY INVOLVEMENT

The following list of agencies were contacted during the scoping period to solicit input on the scope of the impacts and resources affected by the proposed project. No responses were received regarding the proposed harbor development. All coordination letters can be found in Appendix G: Correspondence:

- Alaska Department of Environmental Conservation, Water Quality Division
- Alaska State Historic Preservation Office
- U.S. Environmental Protection Agency, Region 10 Dredged Material Program
- National Marine Fisheries Service, Habitat Conservation Division
- National Marine Fisheries Service, Protected Resources Division
- U.S. Fish and Wildlife Service, Planning Assistance Unit

The draft IFR/EA was made available for public and agency review beginning on 28 April 2020 and extending for 30 days. One comment from the public was received via email and is provided in Appendix G. Comments on the draft IFR/EA from the NFS, EPA, and USFWS are provided in Appendix G, Section 11.

9.1. Public/Scoping Meetings

August 2018

On the evening of 14 August 2018, the USACE held a public meeting in Elim about the study and potential project locations. From 15–16 August 2018, representatives from the non-Federal sponsor (Native Village of Elim) , City of Elim, Kawerak, Incorporated, Norton Sound Economic Development Corporation (NSEDC), and Brice Marine, as well as Elim community members and USACE personnel from the Alaska District and Seattle District, participated in a Planning Charette in Elim.

April 2019

On 17 April 2019, another public meeting was held in Elim. The purpose of the meeting was to update the community on the progress of the study. Also, to explain the authority under which the study is pursued and the non-monetary benefits that can be considered in the plan selection. Community members present informed USACE Alaska District personnel on the current conditions they operate under in subsistence and commercial fishing. Information regarding the presence of cultural resources in the area was also requested of the community at this meeting. Representatives of the Native Village of Elim, including Tribal Council members, were also in attendance.

On 18 April, the NSEDC held a public meeting that was well-attended by the community members. USACE personnel were invited by NSEDC to attend the two-part meeting as observers. The first part of the meeting provided an overview of the NSEDC’s programs, and the second part was a Fishermen’s Meeting that discussed the effectiveness of commercial fishing administered through the NSEDC. This meeting provided valuable information about community views on fishing opportunities and infrastructure.

9.2. Government to Government

The Native Village of Elim, which is the Federally-recognized Tribe of Elim, is the non-Federal co-sponsor of this study. On 03 December 2020, the Native Village of Elim formally requested Government-to-Government consultation with the USACE Alaska District regarding the Elim Subsistence Harbor Feasibility Study. Consultation between the Native Village of Elim and USACE is ongoing.

9.3. Federal and State Agency Coordination

NMFS Habitat Division

- USACE submits EFH Assessment to NMFS – 7 January 2020.
- NMFS circulates EFH Assessment to USFWS, US EPA, ADEC, ADFG, Kawerak, and others as part of their review – 5 February 2020.

- NMFS provides EFH concurrence/conservation recommendations – received 12 March 2020.
- USACE accepts EFH conservation recommendations – 9 April 2020.

NMFS Protected Resources Division

- USACE submits preliminary ESA and MMPA species lists to NMFS – 20 March 2019.
- NMFS approves species lists – 20 March 2019.

The USACE has determined that ESA formal consultation with the NMFS is required and that consultation will have to occur in PED. The USACE prepared a policy exception request to extend ESA/MMPA consultation with NMFS past the feasibility phase; this request was approved by USACE HQ on 05 October 2020.

USFWS Planning and Consultation Branch

- USACE submits preliminary ESA species list to USFWS – 20 March 2019.
- USFWS approves species list – 21 March 2019.
- USACE submits the ESA determination letter to USFWS – 18 November 2019.
- USFWS provides an ESA concurrence letter – 17 December 2019.

USFWS Conservation Planning Assistance Branch

- USACE emails USFWS to ask if it wishes to coordinate formally under the Fish and Wildlife Coordination Act (FWCA) (following up on previous verbal communication) – 19 November 2019.
- USFWS emails stating that "a full CAR" may not be needed for the project, citing the projects mostly marine impacts – 19 November 2019.
- USACE emails USFWS to prompt it for a definitive answer about FWCA participation – 5 February 2020.
- USFWS provides a letter stating that an FWCA investigation and report is not needed for the project; the letter includes "voluntary recommendations" on migratory birds and invasive species – 19 February 2020.

U.S. EPA and ADEC Division of Water

- USACE emails EPA and ADEC contacts to provide preliminary information and initiate a conversation about project dredged material disposal – 2–3 January 2020.
- ADEC states that it has "no objection" to a "Tier 1" approach to the dredged material – 10 January 2020.
- EPA expresses skepticism over a Tier 1 approach and recommends chemical evaluation of the dredged material – 29 January 2020.

- USACE replies that it will provide its justification for a Tier 1 approach in the project 404(b)(1) evaluation and NEPA document – 30 January 2020.
- EPA reviews the draft IFR-EA upon its release in April 2020. EPA provides comments by email, and EPA and USACE discuss in several emails April-June 2020. EPA's final email requests particle-size-analysis results from the PED geotechnical investigation but does not require chemical analyses at this time – 13 June 2020.

The state of Alaska issues a Section 401 Certificate of Reasonable Assurance for the project – 26 June 2020.

Alaska State Historic Preservation Officer

- USACE submits a letter notifying the SHPO of the initiation of planning for a Federal undertaking – 31 October 2018.
- USACE submits a letter to the SHPO with a determination of "no adverse effect on historic properties" [36 CFR § 800.5(b)] – 18 February 2020
- SHPO responds with a letter concurring on the determination – 20 March 2020

9.4. Status of Environmental Compliance

The compliance status with relevant Federal and State regulations and with relevant Executive Orders is summarized in Table 43.

Table 43. Status of Compliance with Federal and State Regulations, Executive Orders

Federal Statutory Authority	Compliance Status	Compliance Date/Comment
Clean Air Act	FC	Project site not in the non-attainment area; conformity requirements do not pertain.
Clean Water Act	FC	The USACE authorizes its discharges under Section 404 of the Clean Water Act (CWA), applying all applicable substantive legal requirements. The State of Alaska review process for Section 401 is concurrent with the agency review of this IFR/EA and located in Appendix A: 404(b)(1) Clean Water Act Evaluation. The State of Alaska provided a Section 401 certificate in June 2020.
Coastal Zone Management Act	FC	The State of Alaska withdrew from the voluntary National Coastal Zone Management Program on 1 July 2011. Therefore, within the State of Alaska, Federal agencies are not required to ensure their activities are consistent with an approved State coastal management plan.
Endangered Species Act	PC	Section 7 informal consultation with USFWS complete. Section 7 formal consultation with NMFS will continue into PED. Policy exception approved by ASA(CW) on 5 Oct 2020.
Marine Mammal Protection Act	PC	MMPA coordination with NMFS will continue into PED.
Magnuson-Stevens Fishery Conservation and Management Act	FC	NMFS reviewed USACE EFH Assessment, provided a letter with conservation recommendations.
Fish and Wildlife Coordination Act	FC	USFWS provided a letter with conservation recommendations and stating that an FWCA report is not needed.
Marine Protection, Research, and Sanctuaries Act	FC	Project discharges would not be subject to MPRSA.
Migratory Bird Treaty Act	FC	No takings under the MBTA are anticipated.

Federal Statutory Authority	Compliance Status	Compliance Date/Comment
National Historic Preservation Act	FC	No adverse effect on historic properties.
National Environmental Policy Act	PC	NEPA compliance will be complete upon signing of the Finding of No Significant Impact (FONSI) (Appendix J: Finding of No Significant Impact).
Executive Order 11990: Protection of Wetlands	FC	No impacts to wetlands are anticipated.
Executive Order 12898: Environmental Justice	FC	Low-income and minority populations and potential disparate impacts have been evaluated and addressed to the extent practicable.
Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks	FC	No disparate impacts on the health or safety of children are identified.
Executive Order 13112: Invasive Species	FC	The potential of the project to introduce or spread invasive species has been evaluated and addressed to the extent practicable.
Executive Order 13186 Protection of Migratory Birds	FC	No significant direct or indirect effects on migratory birds are anticipated.
Key: Full Compliance (FC), Partial Compliance (PC)		

9.5. Views of the NFS

During the ADM, the Native Village of Elim explained that “without a functioning harbor at Elim, it would be very difficult, if not impossible, to maintain our culture and economy.” Additionally, the Tribe stated, “This project is critical to the long-term survival of our community. After review of the Alternatives, we feel Alternative 5 is the best alternative that will address the needs of our community. We recognize the high costs in this development and that our location and environment add to these high costs. We also recognize the community’s isolation from the road system in our state.”

The Native Village of Elim support the findings of this study and understand the cost-share for the design and construction of Alternative 5, the Recommended Plan. The Self- Certification of Financial Capability has been obtained from the NFS ,and is included in the final report submittal (Appendix G: Correspondence).

10. PREPARERS OF THE ENVIRONMENTAL ASSESSMENT

The Environmental Assessment was prepared by members of the USACE Alaska District Environmental Resources Section (Table 44). The Environmental Resources Section provided the environmental analyses incorporated into this IFR/EA.

Table 44. Preparers of the Environmental Assessment.

Name	Title	Degree	Responsibilities
Kelly Eldridge	Archaeologist	Anthropology (M.A.)	Cultural Resources, Subsistence Use, Protected Tribal Resources
Christopher Floyd	Biologist	Biochemistry & Molecular Biology (M.S.)	Physical Environment, Biological Resources, Environmental Justice & Protection of Children, Cumulative and Long-Term Impacts
Michael Salyer	Chief of Environmental Resources	Biology (M.S.)	Oversight and guidance of EA development, independent review of EA for accuracy and compliance with CEQ regulations

11. CONCLUSIONS & RECOMMENDATIONS

Given the analysis presented throughout this IFR/EA, it was determined that Alternative 5 is the Recommended Plan. There was no NED Plan identified during this study; therefore, a CE/ICA was used to identify the best buy plan. Alternative 5 would provide for 5,544 additional vessel Opportunity Days to support the subsistence fleet, commercial fleet, and the fuel and cargo barge. These additional days would allow for the more efficient delivery of fuel and goods to the community and increase opportunities to harvest subsistence and commercial resources. The resulting reduction in the cost of essential goods coupled with expanded economic opportunities would contribute to the long-term viability of the mixed, subsistence-cash local economy of Elim. Alternative 5 would provide an additional regional benefit with job creation and some economic opportunities in the Nome Census Area. This assessment supports the conclusion that the proposed project does not constitute a major Federal action, significantly affecting the quality of the human environment. Therefore, a draft FONSI has been prepared.

It is recommended that Congressional authorization be requested for the application of the ability to pay provision as put forth in section 203(d)(1) of WRDA 2000, as amended (33 U.S.C. 2269(d)) for the cost-sharing agreement for the project.

Federal implementation of the Recommended Plan would be subject to the NFS agreeing to enter into a written Project Partnership Agreement (PPA), as required by Section 221 of Public Law 91-611, as amended, to provide local cooperation satisfactory to the Secretary of the Army. Entering into the PPA will ensure compliance with Federal laws and policies.

The Alaska District recommends that the selected navigation improvements plan at Elim, Alaska be constructed generally in accordance with the Recommended Plan herein, and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable at a certified project first cost of $74,538,000 with the contingency, provided that prior to construction the NFS agree to enter into a PPA and be jointly and severally responsible for all non-Federal obligations and responsibilities, including the following:

a. Provide, during the period of design and construction, funds necessary to make its total contribution to commercial navigation equal to 10% of the cost of design and construction of the general navigation features (GNFs) attributable to dredging to a depth not in excess of -20 ft mean lower low water (MLLW), as reduced by the waiver amount in accordance with Section 1156 of WRDA 1986, as amended (33 U.S.C. 2310) and by application of the ability to pay factor in accordance with Section 203 of WRDA 2000, as amended (33 U.S.C. 2269);

b. Provide all lands, easements, and rights-of-way (LER), including those necessary for the borrowing of material and placement of dredged or excavated material; and perform or assure the performance of all relocations, including utility relocations, all as determined by the Federal government to be necessary for the construction or operation and maintenance of the GNFs and all in compliance with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (42 U.S.C. 4601-4655), and the regulations contained in 49 C.F.R. Part 24;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs, an additional amount equal to 10% of the total cost of construction of GNFs less the amount of credit afforded by the Federal government for the value of the LER and relocations, including utility relocations, provided by the non-Federal sponsors for the GNFs. If the amount of credit afforded by the Federal government for the value of LER, and relocations, including utility relocations, provided by the non-Federal sponsors equals or exceeds 10% of the total cost of construction of the GNFs, the non-Federal sponsors shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LER and relocations, including utility relocations, in excess of 10% of the total costs of construction of the GNFs;

d. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project;

e. Provide, operate, and maintain, at no cost to the Federal government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal laws and regulations and any specific directions prescribed by the Government;

f. Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsors own or control for access to the project for the purpose of completing, inspecting, operating and maintaining the GNFs;

g. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

h. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses for a minimum of 3 years after the final accounting and assure that such materials are reasonably available for examination, audit, or reproduction by the Federal government;

i. Perform, or ensure performance of, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601–9675, that may exist in, on, or under LER that the Federal government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Federal government determines to be subject to the navigation servitude, only the Federal government shall perform such investigation unless the Federal government provides the non-Federal sponsors with prior specific written direction, in which case the non-Federal sponsors shall perform such investigations in accordance with such written direction;

j. Assume complete financial responsibility, as between the Federal government and the non-Federal sponsors, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under LER that the Federal government determines to be necessary for the construction or operation and maintenance of the project; and

k. Agree, as between the Federal government and the non-Federal sponsors, that the non-Federal sponsors shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA.

______________________________ ______________________________

DAMON A, DELAROSA Date
COL, EN
Commanding

12. REFERENCES

Ahmasuk, A., Trigg, E., Magdanz, J., & Robbins, B. (2008). *Bering Strait Region Local and Traditional Knowledge Pilot Project: A Comprehensive Subsistence Use Study of the Bering Strait Region*. North Pacific Research Board Project Final Report, Project No. 643. Kawerak, Inc.

Alaska Department of Environmental Conservation (ADEC). (2020). *Division of Spill Contaminated Sites Database*. https://dec.alaska.gov/Applications/SPAR/PublicMVC/CSP.

Alaska Department of Environmental Conservation (ADEC). (2013). *Waste Erosion Assessment and Review (WEAR) Trip Report*. Elim, Alaska: Alaska Department of Environmental Conservation.

ADEC. 2018b. Water Quality Standards, 18 AAC 70. Amended as of 6 April 2018.

ADEC. 2008. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. As amended through 12 December 2008.

Alaska Department of Fish and Game (ADFG). (2012). *Alaska's Nome Area Wildlife Viewing Guide, Exploring the Nome Roadways*. Nome, Alaska.

ADFG. 2019a. Invasive Species webpage: http://www.adfg.alaska.gov/index.cfm?adfg=invasive.main

Alaska Department of Fish and Game (ADFG). (2020). Anadromous Waters Catalog website: https://www.adfg.alaska.gov/sf/SARR/AWC/.

Alaska Department of Fish and Game (ADFG). (2019b). *Fishing Info-Northwest Drainage Management Area*. www.adfg.gov/index.cfm?adfg=ByAreaInteriorNorthwest.fishingInfo.

Alaska Department of Fish and Game (ADFG). (2019d). *Subsistence Harvest Information for Community of Elim*. https://www.adfg.alaska.gov/sb/CSIS/index.cfm?ADFG=harvInfo.harvest.

ADFG. 2018a. Species Profile, Humpback Whale (*Megaptera novaeangliae*) webpage: http://www.adfg.alaska.gov/index.cfm?adfg=humpbackwhale.main

ADFG. 2018b. Species Profile, North Pacific Right Whale (Eubalaena japonica) webpage: http://www.adfg.alaska.gov/index.cfm?adfg=rightwhale.main

ADFG. 2018c. Species Profile paper, Sperm Whale.

ADFG. 2008a. Species Profile paper, Fin Whale.

ADFG. 2008b. Species Profile paper, Blue Whale.

ADFG. 2008c. Species Profile paper, Bowhead Whale.

ADFG. 2002. Alaska Aquatic Nuisance Species Management Plan. October 2002.

Alaska Department of Labor and Workforce Development (ADLWD). (2016). *Alaska Local and Regional Information – Elim City*. Research and Analysis Section. http://live.laborstats.alaska.gov/alari/details.cfm?yr=2016.

Alaska Heritage Resources Survey (AHRS). (2020). *Alaska Heritage Resources Survey Database*. Office of History and Archaeology, Alaska Department of Natural Resources. http://dnr.alaska.gov/parks/oha/ahrs/ahrs.htm.

Alaska Land Use Council (ALUC). (1984). *Memorandum: ANILCA Section 810 Evaluation Guidelines*. November.

Alaska Native Tribal Health Consortium (ANTHC). (2004). Letter Report to Alaska State Historic Preservation Officer regarding Service Line Replacement to 10 Homes. AN 04-CE1. ADP File No. 3130-3R ANTHC.

Alaska Native Tribal Health Consortium (ANTHC). (2006). Letter to Alaska State Historic Preservation Officer regarding Service Connections Replacement to 30 Homes. ADP File No. 3130-3R ANTHC.

Alaska Ocean Observing System. (2018). *Waverider Buoy Station 46265: NOAA NDBC.* Nome, Alaska.

American Society of Civil Engineers. (2017). *American Society for Civil Engineers Infrastructure Report Card for Alaska*. https://www.infrastructurereportcard.org/state-item/alaska/

Audubon Alaska, 2014. Important Bird Areas of Alaska, v3. Audubon Alaska, Anchorage, AK. Accessed online at http://databasin.org/datasets/f9e442345fb54ae28cf72f249d2c23a9

Berger, T. R. (1985). *Village Journey: The Report of the Alaska Native Review Commission*. Hill and Wang.

BIA 1940. Constitution and By-Laws of the Native Village of Elim Alaska. U.S. Department of the Interior, Office of Indian Affairs, U.S. Government Printing Office.

BIA 1975. Elim, Alaska, Its Resources and Development Potential. Bureau of Indian Affairs Planning Support Group, Billings.

Blackwell, S. B., & Greene, C. R., Jr. (2002). *Acoustic Measurements in Cook Inlet, Alaska, during August 2001.* Prepared for the National Marine Fisheries Service.

Bockstoce, J. R. (1979). *The Archaeology of Cape Nome, Alaska*, University Museum Monograph 38. University of Pennsylvania Press.

Braem, N. M., & Kostick, M. L. (2014). *Subsistence Wildlife Harvests in Elim, Golovin, Kivalina, Koyuk, Noatak, and Wales, Alaska, 2010–2011*. Alaska Department of Fish and Game, Division of Subsistence.

Bureau of Indian Affairs (BIA). (1940). *Constitution and By-Laws of the Native Village of Elim Alaska*. U.S. Department of the Interior, Office of Indian Affairs. U.S. Government Printing Office.

Bureau of Indian Affairs (BIA). (1975). *Elim, Alaska, Its Resources, and Development Potential*. Bureau of Indian Affairs Planning Support Group, Billings, MT.

Bureau of Indian Affairs (BIA). (2016). *Native Entities in Alaska*. Subset of Indian Lands of Federally Recognized Tribes of the United States Map. U.S. Department of the Interior, Office of Trust Services.

Bureau of Ocean Energy Management (BOEM). (2011). *Shipwrecks Off Alaska's Coast*. https://www.boem.gov/about-boem/shipwrecks-alaskas-coast.

CAFF and PAME. 2017. Arctic Invasive Alien Species: Strategy and Action Plan, Conservation of Arctic Flora and Fauna and Protection of the Arctic Marine Environment Akureyri, Iceland. ISBN: 978-9935-431-65-3

Case, D. S., & Voluck, D. A. (2012). *Alaska Natives and American Laws* (3rd Edition). University of Alaska Press.

Castellano, Marlene Brant (2004). *Ethics of Aboriginal Research*. Journal of Aboriginal Health. January 2004. National Aboriginal Health Organization.

Census Bureau (Census Bureau). (2017). *2013–2017 American Community Survey 5-Year Estimates*. American FactFinder. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

Chapman, R. S., & Mark, D. J. (2014). *Storm Damage and Flooding Evaluation: Western Alaska Storm Surge Modeling Study: the Bering Sea and Bristol Bay Site Calibration and 2005–2011 Extreme Water Level Statistics*. ERDC/CHL.

Clarke, D. G., Dickerson, C., & Reine, K. J. (2004). *Characterization of Underwater Sounds Produced by Dredges*. ASCE, Reston, Virginia.

Davidson-Arnott, R. G. D. (2005). Conceptual Model of the Effects of Sea Level Rise on Sandy Coasts. *Journal of Coastal Research*, *216*, 1166–1172.

Denali Commission Alaska (Denali). (2018). *Distressed Communities Report*. June.

Department for Environment, Food and Rural Affairs - United Kingdom (DEFRA). 2005. Update of Noise Database for Prediction of Noise on Construction and Open Sites.

Dickerson, D. L., Spear, S., Marinelli-Casey, P., Rawson, R., Li, L., & Hser, Y. (2010). American Indians/Alaska Natives and Substance Abuse Treatment Outcomes: Positive Signs and Continuing Challenges. *Journal of Addictive Diseases, 30(1)*, 63–74.

Division of Community and Regional Affairs (DCRA). (2019). Informational Portal: Elim, Alaska. State of Alaska. https://dcced.maps.arcgis.com/apps/MapJournal/index.html?appid=a1672a5dd0194d4ca74e8296756bf018.

Doub, J. P. (2014). *Uses of Tiered Significance Levels in NEPA Documents*. [Unpublished capstone paper]. Duke University.

Dyer, T. R., & Bertel, L. (1983). Noise Control on Diesel Tugs – A Sequel, Marine Technology. *The Society of Naval Architects and Marine Engineers*, *20(4)*, 385–397.

Environmental Protection Agency (EPA). (2018). *Environmental Justice Screening and Mapping Tool.* https://ejscreen.epa.gov/mapper/.

Environmental Protection Agency (EPA). (2020). Email dated 13 June 2020, subject: Draft IFRA/EA for the "Elim Navigation Improvement Project" available.

Fall, James A. & Marylynne L. Kostick. (2018). *Food Security and Wild Resource Harvests in Alaska*. Alaska Department of Fish and Game, Division of Subsistence.

Fernandez, Linda, Kaiser, Brooks A., & Vestergaard, Niels (Eds.). (2014). *Marine Invasive Species in the Arctic*. Nordic Council of Ministers.

Flint, C. G., Robinson, E.S., Kellogg, J., Ferguson, G., BouFajreldin, L., Dolan, M., & Lila, M.A. (2011). Promoting Wellness in Alaskan Villages: Integrating Traditional Knowledge and Science of Wild Berries. *EcoHealth*, *8(2)*, 199–209.

Frits, Ellen I. (2007). *Wildlife and People at Risk – A Plan to Keep Rats Out of Alaska*. Alaska Department of Fish and Game.

Fukuyama, Allan K., and John S. Oliver. (1985). Seastar and walrus predation on bivalves in Norton Sound, Bering Sea, Alaska. *Ophelia, 24(1),* 17–36.

Ganley, Matthew L. (1995). The Malemiut of Northwest Alaska: A Study in Ethnonymy. *Études/Inuit/Studies, 19(11),* 103–118.

GCI Communications Corporation (GCI). (2016). *TERRA Terrestrial Telecommunications Backbone System Project: Class III Inventory of the Village of Elim, Alaska*. Prepared by Environmental Resources Management.

Golder Associates, Inc. (Golder). (2019). *Final Report of Results Geophysical Survey Report Navigation Improvements Study, Elim, Alaska*. Anchorage.

Government Accounting Office (GAO). (2012). *Regional Alaska Native Corporations: Status 40 Years after Establishment, and Future Considerations. Report to Congressional Requestors*. GAO-13-121.

Hamazaki, T., Fair, L., Watson, L., & Brennan, E. (2005). Analyses of Bering Sea bottom-trawl surveys in Norton Sound: absence of regime shift effect on epifauna and demersal fish. *ICES Journal of Marine Science, 62(8),* 1597–1602.

Hood, D.W., and Burrell, D.C. 1974. Environmental Study of the Marine Environment near Nome, Alaska, R-74-3, Inst. Mar. Sci., Univ. of Alaska.

Howe, L. E., & Martin, S. (2009). *Demographic Change, Economic Conditions, and Subsistence Salmon Harvests in Alaska's Arctic-Yukon-Kuskokwim Region*. Department of Economics, and Institute of Social and Economic Research, University of Alaska Anchorage.

Huntington, H. P. (2000). *Traditional Ecological Knowledge of Seals in Norton Bay, Alaska.* Submitted to the Elim-Shaktoolik-Koyuk Marine Mammal Commission and the National Marine Fisheries Service.

Indian Health Service (IHS). (2005). *Elim Sewer Treatment Improvements.* Sanitation Tracking and Reporting System (STARS) Report # AK23784-2005.

Institute of Water Resources (IWR) Report 2009-R-4. (2009). *Handbook on Applying Other Social Effects Factors in the Corps of Engineers Water Resources Planning*. Alexandria, VA: Institute of Water Resources

Intergovernmental Panel on Climate Change (IPCC). (2001). *Climate Change 2001: The Scientific Basis*. Contribution of Working Group I to the Third Assessment Report. Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment. Cambridge University Press.

Jewett, S. C. (2013). Mining- and Storm-Induced Benthic Disturbances in Norton Sound, Alaska. In Lang, M. A., & Sayer, M. D. J. (Eds), *2013 Curaçao AAUS/ESDP Joint International Scientific Diving Symposium* (pp. 125–138).

Johnson, T. (2008). *Rat Control for Alaska Waterfront Facilities*. Alaska Sea Grant College Program, University of Alaska Fairbanks.

Kawerak, Incorporated (Kawerak). (2013). *Seal and Walrus Harvest and Habitat Areas for Nine Bering Strait Region Communities*. Kawerak Social Science Program, Nome.

Kawerak, Incorporated (Kawerak). (2014). *Bering Strait: Marine Life and Subsistence Use Data Synthesis*. Kawerak Social Science Program, Nome.

Kawerak, Incorporated (Kawerak). (2019). *Bering Straits Comprehensive Economic Development Strategy, 2019-2024*.

Kawerak, Incorporated (Kawerak). (2017). Letter to Tom Moran, City Manager, City of Nome, dated 26 October 2017, subject: Impact to Local Marine Mammals and Subsistence Hunting – Mitigation Measures.

Kawerak, Incorporated (Kawerak). (2020a). *Elim*. https://kawerak.org/our-region/elim/.

Kawerak, Incorporated (Kawerak). (2020b). *Who We Are: History*. https://kawerak.org/about-us/who-we-are/.

Kedra, M., C. Moritz, E. Choy, C. David, R. Degen, S. Duerksen, I. Ellingsen, B. Gorska, J. Grebeier, D.2015. Polar Research 34: 23755, doi: 10.3402/polar.v34.23775

Kelly, S., and Ames, L. (2018). Essential Fish Habitat Consideration for Dredge Operations: Mitigation Measures and Case Studies from Alaska. *Proceedings of the Western Dredging Association Dredging Summit and Expo 2018*, Norfolk, VA, USA.

Kirievskaya, D. van Oevelen, K. Piwosz, A. Samuelsen, and J. Weslawski. 2015. Status and Trends in the Structure of Arctic Benthic Food Webs. Polar Research 34: 23755, DOI: 10.3402/polar.v34.23775

Kunaknana v. Watt, No. A83-337 CIV, D. Alaska (December 20, 1983).

Langdon, S. J. (2002). *The Native People of Alaska: Traditional Living in a Northern Land* (4th Edition). Greatland Graphics.

Larsen, P.H., Goldsmith, S., Smith, O., Wilson, M. L., Strzepek, K., Chinowsky, P., & Saylor, B. (2008). Estimating future costs for Alaska public infrastructure at risk from climate change. *Global Environmental Change*, *18(3)*, 442–457.

MAS Environmental. (2020). *Noise Tools: Sound Propagation Calculator*. http://noisetools.net/noisecalculator2.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50(4)*, 370–396.

McDowell Group. (2019). *Bering Strait Community Needs Assessment Data Book*. Anchorage.

McQueen, A.D., Suedel, B.C., Wilkens, J.L., and Fields, M.P. (2018). Evaluating Biological Effects of Dredging-Induced Underwater Sound. *Proceedings of the Western Dredging Association Dredging Summit & Expo '18, Norfolk, VA*, USA, June 25–28, 2018.

Menard, J., Soong, J., Bell, J., and Neff, L. (2017). *2016 Annual Management Report: Norton Sound, Port Clarence, and the Arctic, Kotzebue Areas*. Fishery Management Report No. 17-41. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries.

Mikow, E. H., Runfola, D. M., & Naaktgeboren, L. (2020). Customary and Traditional Use of Hares in Game Management Units 18, 22, 23, and 26A. Special Publication No. BOG 2020-01. Alaska Department of Fish and Game, Division of Subsistence.

Mitchell, Donald Craig. 1997. Sold American: The Story of Alaska Natives and Their Land, 1867-1959. Dartmouth College, Hanover.

Mitchell, Donald Craig. (2001). *Take My Land, Take My Life: The Story of Congress's Historic Settlement of Alaska Native Land Claims, 1960–1971.* University of Alaska Press.

Moore, J. E., & Weller, D. W. (2018). Updated estimates of the probability of striking a western North Pacific gray whale during the proposed Makah hunt. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-605.

Morris, B. E., Raymond-Yakoubian, B. P., & Ream, B. A. (2002). *Final Archaeological and Historical Survey for Federal Scout Readiness Center*. Prepared by Integrated Concepts and Research Corporation and Hart Crowser, Inc. for the Alaska Army National Guard.

National Academy of Sciences. (2014). *Responding to Oil Spills in the U.S. Arctic Marine Environment*. The National Academic Press.

National Marine Fisheries Service (NMFS). (2005). *Final Environmental Impact Statement, Essential Fish Habitat Identification, and Conservation in Alaska*, Vol. 2, Appendix G. Department of Commerce.

National Marine Fisheries Service (NMFS). (2008). *Recovery Plan for the Steller Sea Lion, Eastern and Western Distinct Population Segments* (Eumetopias jubatus), Revised.

National Marine Fisheries Service (NMFS). (2013). *Final Recovery Plan for the North Pacific Right Whale* (Eubalaena japonica). Office of Protected Resources.

National Marine Fisheries Service (NMFS). (2016a). *Occurrence of Endangered Species Act (ESA) Listed Humpback Whales off Alaska*, Revised.

National Marine Fisheries Service (NMFS). (2016b). *Recovery Plan for the Cook Inlet Beluga Whale* (Delphinapterus leucas). Office of Protected Resources.

National Marine Fisheries Service (NMFS). (2016c). *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*. NOAA Technical Memorandum NMFS-OPR-55.

National Marine Fisheries Service (NMFS). (2018). *Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0). Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts*. NOAA Technical Memorandum NMFS-OPR-59.

National Marine Fisheries Service (NMFS). (2020). Letter to U.S. Army Corps of Engineers dated 5 February 2020, Re: Essential Fish Habitat Assessment for Elim Small Boat Harbor.

NOAA. 2019a. Species Directory, Ringed Seal, https://www.fisheries.noaa.gov/species/ringed-seal#overview

NOAA. 2019b. Species Directory, Bearded Seal, https://www.fisheries.noaa.gov/species/bearded-seal#overview

NOAA. 2019c. Species Directory, Beluga Whale, https://www.fisheries.noaa.gov/species/beluga-whale

National Oceanic and Atmospheric Administration (NOAA). (2018a).

National Oceanic and Atmospheric Administration (NOAA). (2018b). *Wrecks and Obstructions Database*. https://nauticalcharts.noaa.gov/data/wrecks-and-obstructions.html.

NOAA. 2018c. Species Directory, Bowhead Whale webpage: https://www.fisheries.noaa.gov/species/bowhead-whale#overview

National Oceanic and Atmospheric Administration (NOAA), NMFS, Northwest Arctic Borough, Bering Straits Coastal Resources Service Area, NANA Regional Corporation, Norton Sound Economic Development Corporation, Alaska CHADUX Oil Spill Cooperative, Oil Spill Recovery Institute, Cominco Mining Company. (2002). *Sensitivity of Coastal Environments and Wildlife to Spilled Oil – Northwest Arctic Alaska*.

Nelson, C. H. (1982). Modern Shallow-Water Graded Sand Layers from Storm Surges, Bering Shelf: A Mimic of Bouma Sequences and Turbidite Systems. *Journal of Sedimentary Petrology, 52(2),* 537–545.

North Pacific Fishery Management Council. (2018). *Fishery Management Plan for the Salmon Fisheries in the EEZ off Alaska*. October.

Norton Sound Economic Development Corporation (NSEDC). (2020). *CDQ Management*. https://www.nsedc.com/fisheries/cdq-management/

National Wetlands Inventory (NWI). (2019). *National Wetlands Inventory Mapper*. USFWS. https://www.fws.gov/wetlands/data/Mapper.html

Oceana and Kawerak, Incorporated (Oceana and Kawerak). (2014). *Bering Strait: Marine Life and Subsistence Use Data Synthesis*. July.

Osborne, E., Richter-Menge, J., & Jeffries, M. (2018). *Arctic Report Card 2018: Effects of persistent Arctic warming continue to mount.* National Oceanic and Atmospheric Administration.

Perovich, D., Meier, W., Tschudi, M., Farrell, S., Hendricks, S., Gerland, S., & Webster, M. (2018). Sea Ice. In E. Osborne, J. Richter-Menge, and M. Jeffries (Eds.), *Arctic Report Card 2018: Effects of persistent Arctic warming continue to mount* (pp. 25–32). National Oceanic and Atmospheric Administration.

Phillips-Chan, A. (2019). *Nome*. Images of America Series. Arcadia Publishing.

Pipkin, M. E. (2014). *Cultural Resources Examination of the Elim Community Streets Project Area*. Prepared for R.P. Kinney and Associates, Inc. Anchorage.

Rasmus, S. M. (2014). *Indigenizing CBPR: Evaluation of a Community-Based and Participatory Research Process Implementation of the Elluam Tungiinun (Towards Wellness) Program in Alaska*. National Institutes of Health.

Rasmus, S.M., Trickett, E., Charles, B., John, S., & Allen, J. (2019). *The Qasgiq Model as an Indigenous Intervention: Using the Cultural Logic of Contexts to Build Protective Factors for Alaska Native Suicide and Alcohol Misuse Prevention*. Alaska Department of Health and Human Services.

Ray, D. J. (1964). Nineteenth-Century Settlements and Subsistence Patterns in Bering Strait. *Arctic Anthropology, 2(2),* 61–94.

Raymond-Yakoubian, J. (2019). Salmon, Cosmology, and Identity in Elim, Alaska. [Unpublished doctoral dissertation]. Department of Anthropology, University of Alaska Fairbanks.

Reimer, J. P., Droghini, A., Fischbach, A., Watson, J. T., B. Bernard, & Poe, A. (2017). *Assessing the Risk of Non-Native Marine Species in the Bering Sea*. NPRB Project 1523. Alaska Center for Conservation Science, University of Alaska Anchorage.

RJW Consulting (RJW). (2013). *Final Report, 2013 Environmental Baseline Studies, Nome Offshore Report*. Document #PMM001-3300-101. December.

Roberts, C. (2009). Construction noise and vibration impact on sensitive premises, Proceedings of ACOUSTICS. 23–25 November 2009.

Rogers, P.H., & Cox, M. (1988). Underwater sound as a biological stimulus. In J. Atema, R.R. Fay, A.N. Popper, and W.N. Tavolga (Eds.), *Sensory Biology of Aquatic Animals* (pp. 131–149). Springer-Verlag.

Segal, B., Burgess, D., Frank, P., Hild, C., & Saylor, B. (1999**).** *Alaska Natives Combating Substance Abuse and Related Violence Through Self-Healing: A Report for the People*. The Center for Alcohol and Addiction Studies, University of Alaska Anchorage.

Sexson, Matthew G., Greg A. Breed, Margaret R. Peterson, & Abby N. Powell. 2016. Shifts in the Distribution of molting Spectacled Eiders (Somateria fischeri) indicate ecosystem change in the Arctic. The Condor 118(3):463-476. August 2016.

Smith, M. A., Goldman, M. S., Knight, E. J., & Warrenchuk, J. J. (2017). *Ecological Atlas of the Bering, Chukchi, and Beaufort Seas* (2nd Edition). Audubon Alaska.

Sobelman, S. S. (1985). *The Economics of Wild Resource Use in Shishmaref, Alaska*. Technical Report No. 112. Alaska Department of Fish and Game, Division of Subsistence.

Thornton, C. (1975). *Noise Pollution Aspects of Barge, Railroad, and Truck Transportation*. DTIC Document.

Transportation Research Board and National Research Council (TRB and NRC). (2014). *Responding to Oil Spills in the U.S. Arctic Marine Environment*. The National Academies Press.

Tremayne, A. H., Darwent, C. M., Darwent, J., Eldridge, K. A., & Rasic, J. T. (2018). Iyatayet Revisited: A Report on Renewed Investigations of a Stratified Middle-to-Late Holocene Coastal Campsite in Norton Sound, Alaska. *Arctic Anthropology, 55(1)*, 1–23.

United States Army Corps of Engineers (USACE). (1984, September 25). Hydraulic Design of Small Boat Harbors. (EM 1110-2-1615). Department of Army

USACE. 1998. Draft Environmental Impact Statement, Beaufort Sea Oil and Gas Development/Northstar Project, Appendix B: Biological Assessment. June 1998.

U.S. Army Corps of Engineers (USACE). (2000). *Engineering Regulation (ER) 1105-2-100 Planning Guidance Notebook*, 20314-1000. Department of the Army.

U.S. Army Corps of Engineers (USACE). (2009). *Alaska Baseline Erosion Assessment.* Alaska District.

U.S. Army Corps of Engineers (USACE). (2012). *Trip Report: Archaeological Survey of The Pinnacle for the proposed Elim Boat Harbor*. Prepared by Erin Laughlin, Environmental Resources, Alaska District.

U.S. Army Corps of Engineers (USACE). (2017). *Implementation Guidance for Section 1105 of the Water Resources and Development Act (WRDA 2016), Remote and Subsistence Harbors*. Department of the Army.

U.S. Army Corps of Engineers (USACE). (2018). *Geotechnical Site Assessment, Elim Navigation Improvements.* Alaska District.

U.S. Army Corps of Engineers (USACE). (2019a). Incorporating Sea Level Change in Civil Works Programs. *(ER 1100-2-8162)*. Department of Army.

U.S. Army Corps of Engineers (USACE). (2019b). Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation. *(EP 1100-2-1)*. Department of Army.

U.S. Army Corps of Engineers (USACE). (2020). Meeting Minutes regarding Elim Webex Meeting with Sponsors (12 May).

U.S. Department of Transportation (USDOT). 2006. Construction Noise Handbook, Final Report. August 2006.

U.S. Fish and Wildlife Service (USFWS). (2008). *Short-tailed Albatross Recovery Plan*. September.

U.S. Fish and Wildlife Service (USFWS). (2010). Final Rule, Designation of Critical Habitat for the Polar Bear (*Ursus maritimus*) in the United States, 75 FR 76086.

U.S. Fish and Wildlife Service (USFWS). (2011). Fact Sheet: Threatened and Endangered Species, Steller's Eider (*Polysticta stelleri*). August.

U.S. Fish and Wildlife Service (USFWS). (2012). Fact Sheet: Threatened and Endangered Species, Spectacled Eider (*Somateria fischeri*). May.

USFWS. 2013. Southwest Alaska Distinct Population Segment of the Northern Sea Otter *(Enhyra lutris kenyonii*) Recovery Plan. July 2013.) Recovery Plan. July 2013.

USFWS. 2016. USFWS. Polar Bear (*Ursus maritimus*) Conservation Management Plan, Final. U.S. Fish and Wildlife, Region 7, Anchorage, Alaska. 20 December 2016.

U.S. Fish and Wildlife Service (USFWS). (2019). Letter to U.S. Army Corps of Engineers dated 17 Dec 2019, re: Section 7 Endangered Species Act determination for the Elim Tribal Partnership Project.

United States Navy (USN). 1987. Draft Environmental Impact Statement for Battleship Battlegroup/Cruiser Destroyer Group Homeporting, San Francisco Bay, San Francisco, California. January.

Van Hemert, C., Schoen, S. K., Litaker, R. W., Smith, M. M., Arimitsu, M. L., Piatt, J. F., Holland, W. C., Hardison, D. R., & Pearce, J. M. (2020). Algal toxins in Alaskan seabirds: Evaluating the role of saxitoxin and domoic acid in a large-scale die-off of Common Murres. *Harmful Algae* 92(101730).

Walters, K. L., Johnson-Jennings, M., Stroud, S., Rasmus, S., Charles B., John, S., & Boulafentis, J. (2018). Growing from our roots: Strategies for Developing Culturally Grounded Health Promotion Interventions in American Indian, Alaska Native, and Native Hawaiian Communities. *Prevention Science*, *21*(S1), 54–64.

Washington State Department of Transportation (WSDOT). (2020). *Chapter 7.0: Construction Noise Impact Assessment*. Biological Assessment Preparation Manual. https://www.wsdot.wa.gov/sites/default/files/2018/01/18/Env-FW-BA_ManualCH07.pdf

Water Resources Council (WRC). (1983). Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies.

Williams, Maria Shaa Tláa. (2009). Alaska and Its People: An Introduction. In M.S.T. Williams (Ed.), *The Alaska Native Reader: History, Culture, Politics* (pp. 1–11). Duke University Press.

Wuebbles, D. J., Fahey, D. W., Hibbard, K. A., Dokken, D. K., Stewart, B. C., & Maycock, T. K. (2019). *Climate Science Special Report: Fourth National Climate Assessment, Volume I.* U.S. Global Change Research Program.

Wright, D. L., Berchok, C. L., Crance, J. L., & Clapham, P. J. (2019). Acoustic detection of the critically endangered North Pacific right whale in the northern Bering Sea. *Marine Mammal Science, 35(1),* 311–326.

Zhang, Z. Y. (2002). Modeling of Sound Transmission from Air into Shallow and Deep Waters. *Phys. Rev. Lett., 97,* 234–243. Conference Proceedings of the Australian Acoustical Society, November 13–15, Adelaide.